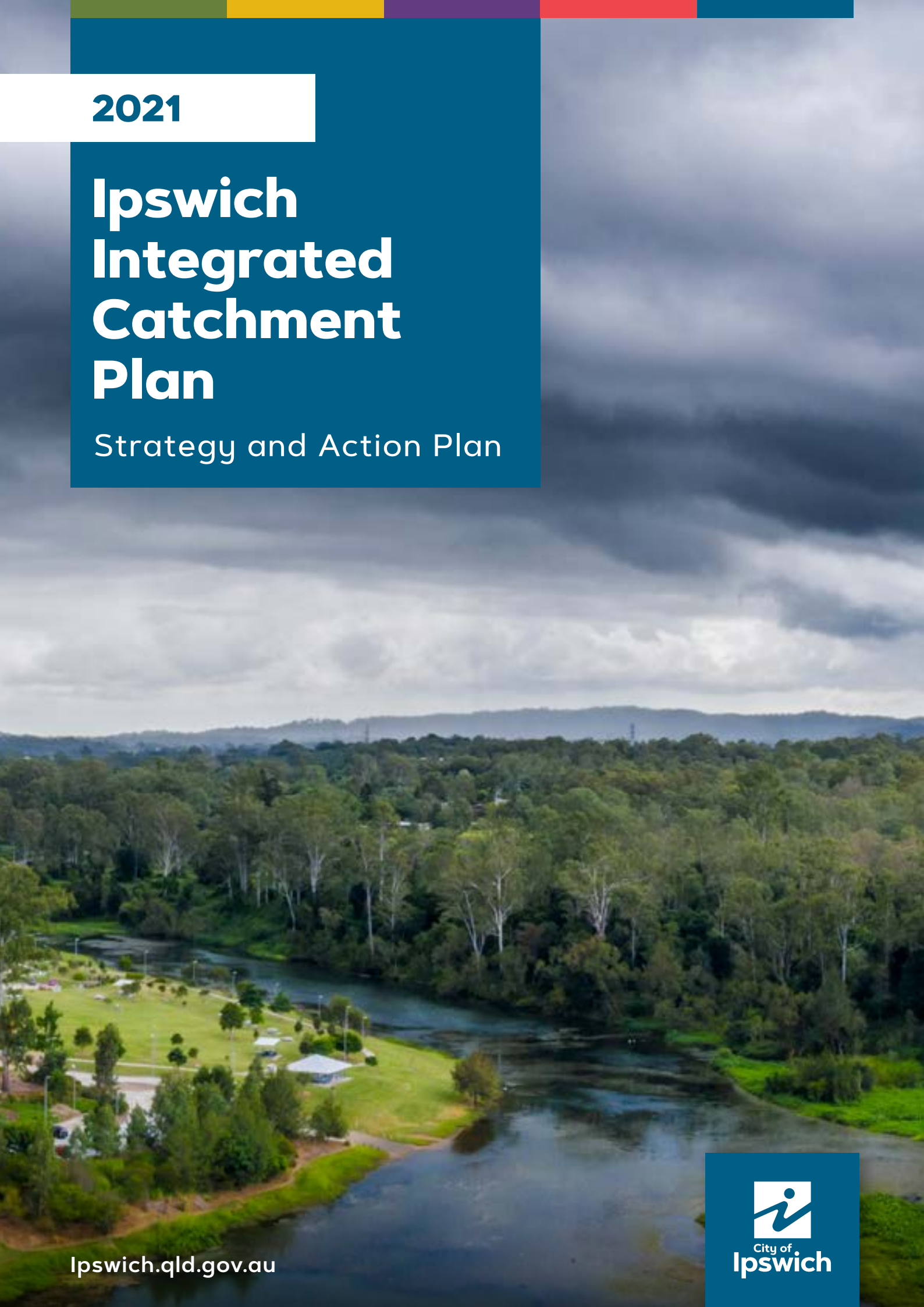
2021

Ipswich Integrated Catchment Plan

Strategy and Action Plan



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City of Ipswich



ACKNOWLEDGEMENTS

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CONTENTS

FOREWORD **4**

CONTEXT **6**

REGIONAL CONSISTENCY AND COLLABORATION 7

ABOUT THE IPSWICH INTEGRATED CATCHMENT PLAN (IICP) 9

INTERACTION BETWEEN PLANS AND STRATEGIES 10

AN OVERVIEW OF THE IPSWICH FLOODPLAIN 11

STRATEGIC DIRECTION **13**

A VISION FOR AND INTEGRATED APPROACH 14

SOURCE – PATHWAY – RECEPTOR MODEL 14

ASSESSING RISK AND MITIGATION 15

SIX OBJECTIVES **18**

OBJECTIVE 1: DEFINE AND REDUCE FLOOD RISK 19

OBJECTIVE 2: ACHIEVE SUSTAINABLE FLOOD MITIGATION THROUGH PHYSICAL INTERVENTION 41

OBJECTIVE 3: PLAN FOR DEVELOPMENT OUTCOMES THAT ARE RISK-INFORMED 48

OBJECTIVE 4: PROMOTE FLOOD-RESILIENT BUILT FORM 55

OBJECTIVE 5: ENABLE OUR COMMUNITY TO ANTICIPATE, RESPOND AND ADAPT TO FLOODS AND FLOODING 60

OBJECTIVE 6: DELIVER EMERGENCY RESPONSE AND RECOVERY DECISIONS THAT ARE INTELLIGENCE BASED 65

GLOSSARY **73**

ACTION PLAN **75**



FOREWORD

Flood is a reality of life in Ipswich.

Past events such as the major floods of 1974 and 2011 are etched into the collective memory of our city. We will never forget.

We also know that flooding will happen again and is a natural part of the lifecycle of a river system. When it does happen, we want a city that is informed, ready and resilient.

There were many lessons learned in the aftermath of the 2011 flood. Councils, the State Government, and other stakeholders have spent the past 10 years developing an understanding of our floodplains and what we can all do to support resilient communities.

The Ipswich Integrated Catchment Plan is part of our ongoing commitment to understanding and preparing for floods. It is the most detailed and comprehensive study ever undertaken in our city and goes above and beyond recommendations from the Queensland Floods Commission of Inquiry.

We know that the human and social costs of flooding can be just as significant as the more tangible costs of building and infrastructure damage.

The Ipswich Integrated Catchment Plan takes a holistic approach, recognising that the most effective way of building flood resilience is to integrate the full spectrum of catchment planning; from community awareness and evacuation routes; to flood resilient home design and city planning and development controls; to large-scale revegetation and climate change modelling.

It is a view that is shared by the community. Throughout the process, the Managing Future Floods community engagement has ensured the people of Ipswich have been involved in the city's plan.

The Ipswich Integrated Catchment Plan will guide council's actions and future investment and chart the way forward for the whole city.

Together we can build Ipswich's readiness and resilience for future floods.



Evening Light on Brisbane River by F Martin
Ipswich Enviroplan Photo Comp



CONTEXT

REGIONAL CONSISTENCY AND COLLABORATION

Flooding in Queensland in the summer of 2010/2011 affected more than 2.5 million people and about 29,000 homes and businesses.

In 2011 the Queensland Floods Commission of Inquiry (QFCoI) was established to enquire into seven matters arising out of the 2010/2011 floods.

This included the preparation and planning for floods by State and local governments, such as land use planning and future development, emergency response procedures, dam operations and structural mitigation. Recommendations for local governments included:

Councils in floodplain areas should, resources allowing, develop comprehensive floodplain management plans that accord as closely as practicable with best practice principles.

(Recommendation 2.12)

Following the QFCoI, the Queensland Government and local governments committed to long-term floodplain management practices to reduce the impact of current and future flood risks. The process of floodplain management in the Brisbane River catchment followed four phases.

PHASE 1 – DATA COLLECTION REPORT (AURECON, 2013)

PHASE 2 – BRISBANE RIVER CATCHMENT FLOOD STUDY (BRCFS)

This study, led by the Queensland Reconstruction Authority was released in May 2017. It was the largest flood study undertaken in Australia to better understand current and future flood risks and identify regionally consistent approaches to strengthen flood resilience across the Brisbane River floodplain.

PHASE 3 – BRISBANE RIVER STRATEGIC FLOODPLAIN MANAGEMENT PLAN (SFMP)

This plan brought together four local councils including Ipswich and key stakeholders to develop the most comprehensive regional approach to managing flood risk in Australia. The methodology of the regional-scale study included a detailed assessment of flood risk, regionally consistent framework for land use planning, disaster management strategies and information for improving community awareness and resilience. The SFMP provided a valuable toolkit for local governments throughout Queensland seeking to implement floodplain management that aligned with best practice principles. One of the priority actions noted to follow the SFMP was to 'complete a sub-regional Bremer River model (including its tributaries) to be consistent with the regional BRCFS outcome and update existing creek models', which the IICP completes.

PHASE 4 – LOCAL FLOODPLAIN MANAGEMENT PLANS (LFMP)

These plans are developed to provide localised flood risk assessments following the regionally consistent approach established in the SFMP. The Ipswich Integrated Catchment Plan (IICP) represents council's fulfilment of this requirement to establish strategies to deliver sustainable management of flood risk for Ipswich.

Together we can build Ipswich's readiness and resilience for future floods.

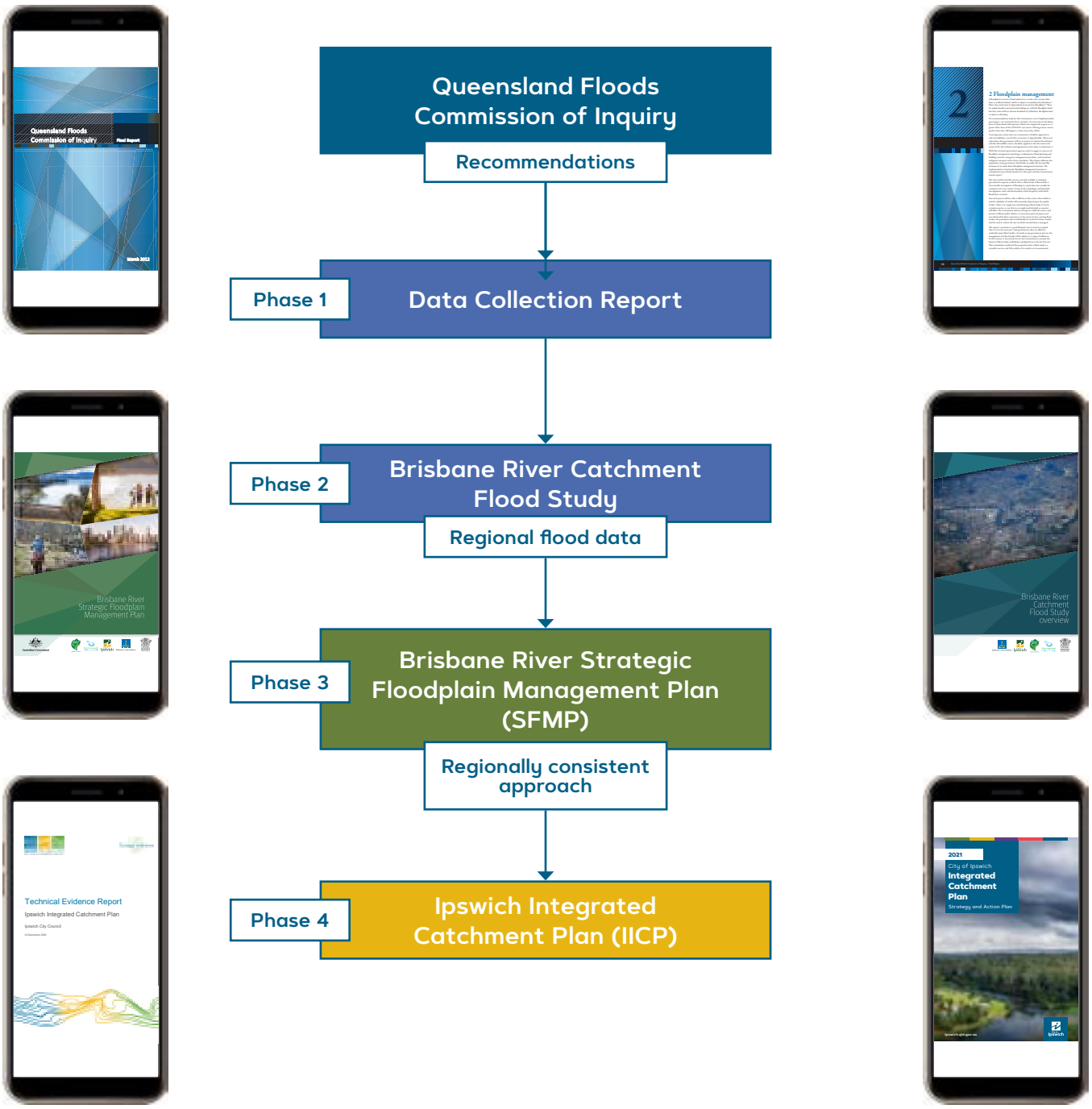


Figure 1 Brisbane River floodplain management process

ABOUT THE IPSWICH INTEGRATED CATCHMENT PLAN (IICP)

This IICP has been prepared following the regionally consistent approach established in the SFMP for catchments of the Brisbane River, Bremer River and the local creeks within the bounds of the Ipswich Local Government Area (LGA).

The IICP is a holistic non-statutory integrated floodplain management document that provides a range of recommendations and actions for council to consider. It aims to achieve effective mitigation of current and future flood risk, build community flood resilience and drive reduction of flood risk to people and property while ensuring the natural functions of the floodplain are preserved, water quality is improved and ecological diversity increased within the catchment.

Using the data and outputs from the BRCFS, SFMP, Ipswich River Flood Studies (which includes the Brisbane and Bremer River systems) and the individual flood studies for the local creek catchments, a full understanding of the flood behaviour has been developed. The IICP has assessed and characterised the nature of flood risk across the City of Ipswich and how to best manage the risk. It has been developed as two documents:

1. **Ipswich Integrated Catchment Plan – Strategy and Action Plan (this document)**
2. **Ipswich Integrated Catchment Plan – Technical Evidence Report (TER).**

The TER presents the detailed analysis that has been undertaken across the multiple defined work packages to provide an integrated flood risk assessment and policy recommendations to inform best practice integrated catchment planning across Ipswich. For further details, specific sections of the TER are referenced throughout this document.

During the development of the technical work, discussion papers on the IICP work packages were released to the community via the Shape Your Ipswich website. These discussion papers presented early findings and encouraged community and stakeholder feedback to help shape the IICP.

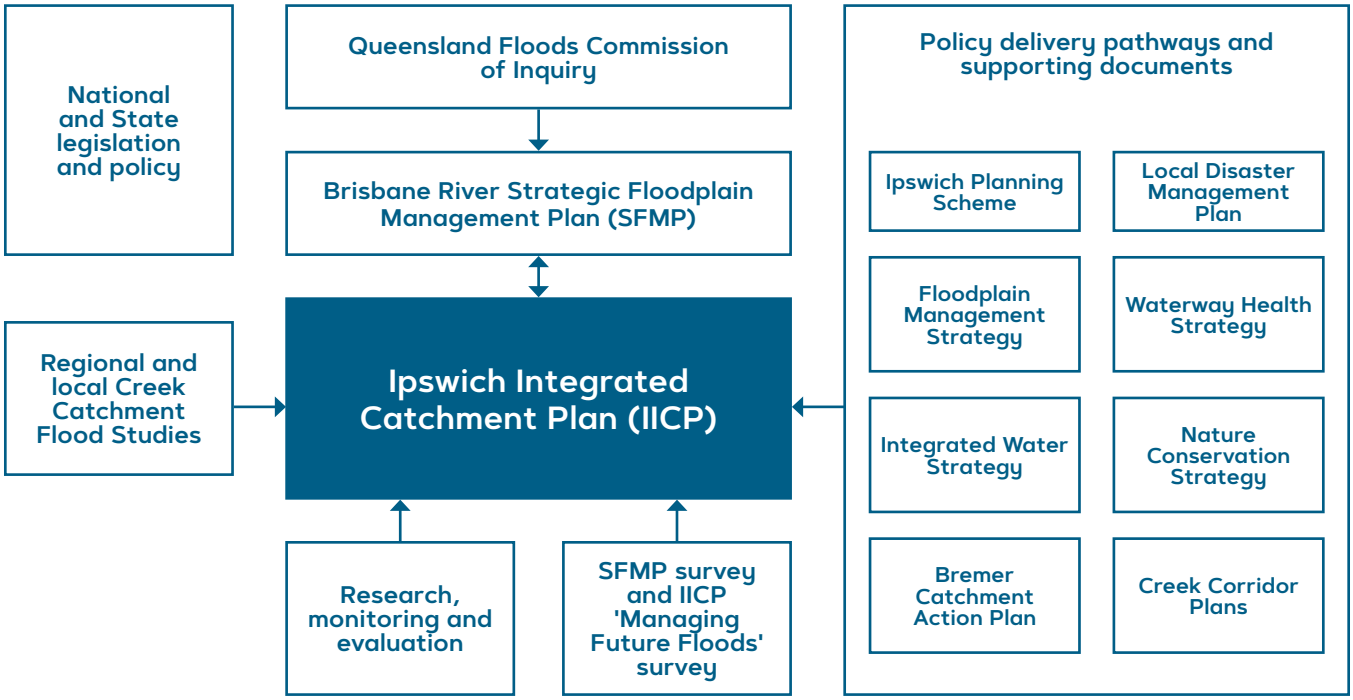
The IICP will ultimately help the overall understanding of the extent and scale of flooding and inform the development of policies and projects across council.



INTERACTION BETWEEN PLANS AND STRATEGIES

The IICP presents a range of actions and recommendations for integrated catchment and flood management across Ipswich. These have been developed having regard to the vision and the objectives and actions of existing plans, strategies and legislation.

This holistic approach to the development of actions was important to identify any conflicts and/or synergies to realise the multiple benefits of an integrated approach and maximise future investment.





AN OVERVIEW OF THE IPSWICH FLOODPLAIN

The Ipswich local government area sits predominately within the Bremer River catchment, and includes headwaters for the Lockyer Creek, Mid Brisbane River and Lower Brisbane River catchments.

Most of these waterways have been significantly modified or altered from their pre-European state yet remain important landscape, ecological and recreational resources.

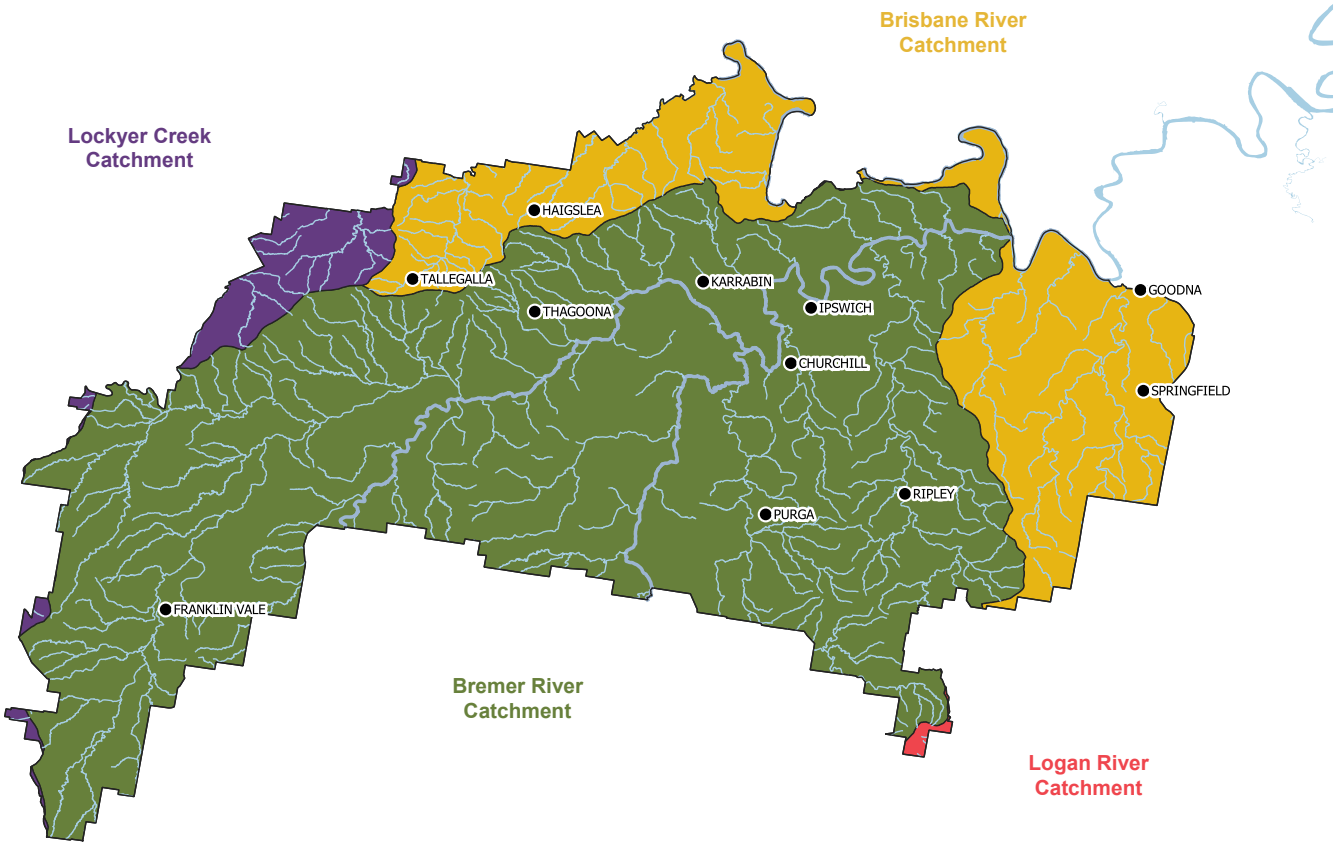


Figure 2 Major catchments within Ipswich LGA

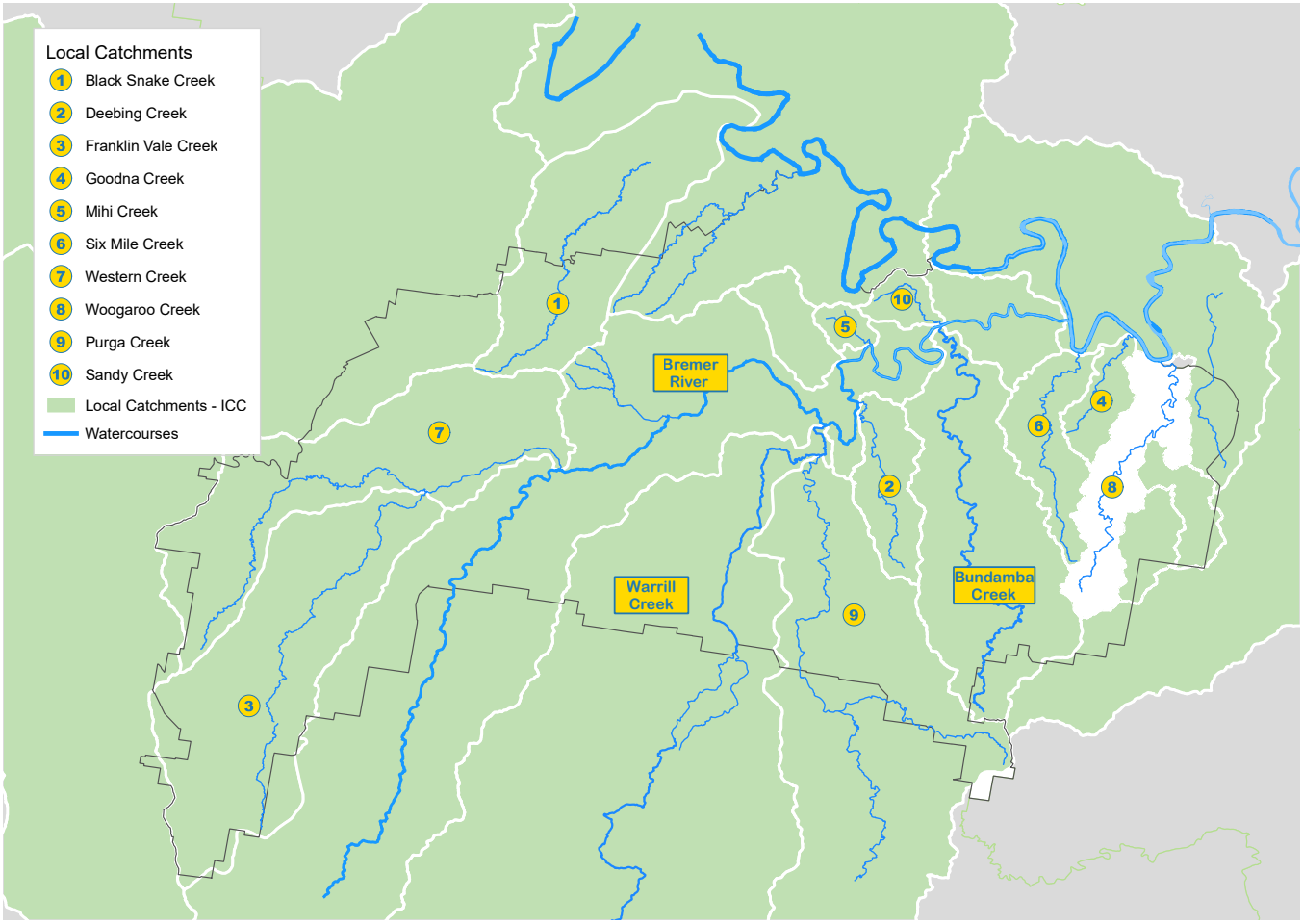


Figure 3 Catchments and sub-catchments within Ipswich LGA

Ipswich has experienced a broad range of historic flood events across multiple catchments.

- The flood of 1893 was the largest flood on record in Ipswich and Brisbane. The record of 24.5m AHD (Australian Height Datum) at the city gauge still stands today.
- The flood of 1974 was the second largest known flood to have occurred in Ipswich and Brisbane when the city gauge reached a level of 20.7m AHD.
- The 2008 localised flood event (approximately a 1 in 100 AEP) occurred in catchments such as Thagoona and Black Snake Creek. During the 2008 flood in Black Snake Creek, collapsed fencing caused blockage upstream of the detention basin outlets, which led to overtopping and flooding.
- The 2011 Bremer/Brisbane River flood event, where flooding in the Ipswich LGA was dominated by high levels of backwater from the Brisbane River. The city gauge reached a level of 19.3m AHD. The event was approximately a 1 in 80 AEP.
- The 2013 Bremer River flood event (approximately a 1 in 20 AEP).

For further flood history of Ipswich and its catchments, the Ipswich City Council Floodplain Management Strategy, the Ipswich Rivers Flood Study, and local catchment assessments provide a wealth of information on historical flood events.



STRATEGIC DIRECTION

A VISION FOR AN INTEGRATED APPROACH

The Ipswich Integrated Catchment Plan will deliver a suite of effective, sustainable floodplain management measures that seek to reduce the risk of flooding to the Ipswich community using a whole-of-catchment approach that is truly integrated across the whole city.

This vision statement identifies the range of values which need to be considered in the rehabilitation and protection of Ipswich waterways and their catchments, including flood conveyance and mitigation for infrastructure and houses, clean and safe water, green and shady places for the community to enjoy, and habitat and connections for native plants and animals.

To achieve this vision, an integrated catchment planning approach has been adopted for the IICP, based on the framework presented in the Brisbane River SFMP. This describes the more holistic planning and strategic development of catchment-wide objectives.

Management of flood risk within a catchment should be cognisant of the broader environmental outcomes that are sought to achieve sustainability, including the benefits that come from flooding and the recharge of floodplain wetlands and groundwater reserves (SFMP, 2019).

While traditional flood mitigation approaches have focused on large scale infrastructure such as dams and levees that have fundamentally modified waterways and their ecosystems, the IICP seeks to locally refine the SFMP approach to engage the floodplain and identify a suite of actions, recommendations and policies across the catchment that mitigate flood risk.

SOURCE – PATHWAY – RECEPTOR MODEL

The IICP applies the Source-Pathway-Receptor model in developing a plan for integrated management of the catchment to understand the floodplain as a holistic system. The model considers the source, pathways and receptors of flooding in sequential order.



1. **The Source: where floodwaters come from;**
2. **The Pathways: how the water travels through the environment; and**
3. **The Receptors: who or what could be affected by the floodwaters.**

It is important to note that the steps do not imply priority, moreover it reflects a logical sequence in which to evaluate actions, starting with the source of flooding. Furthermore, integrated floodplain management cannot be implemented by applying individual treatment measures in isolation. Linkages with other categories of mitigation measures, and an iterative approach to the development of these measures is necessary to develop an optimal integrated plan (Designing Strategies for Integrated Flood management, 2017).

The IICP includes actions from each category of treatment measure in the Source-Pathway-Receptor model.

Additionally, the IICP specifically identifies physical mitigation options that work with natural processes to regain what has been lost on the floodplain, investigating revegetation and reengaging floodplains to improve flood hazard, regenerate soils by retaining sediment on the land, and recharge groundwater tables.

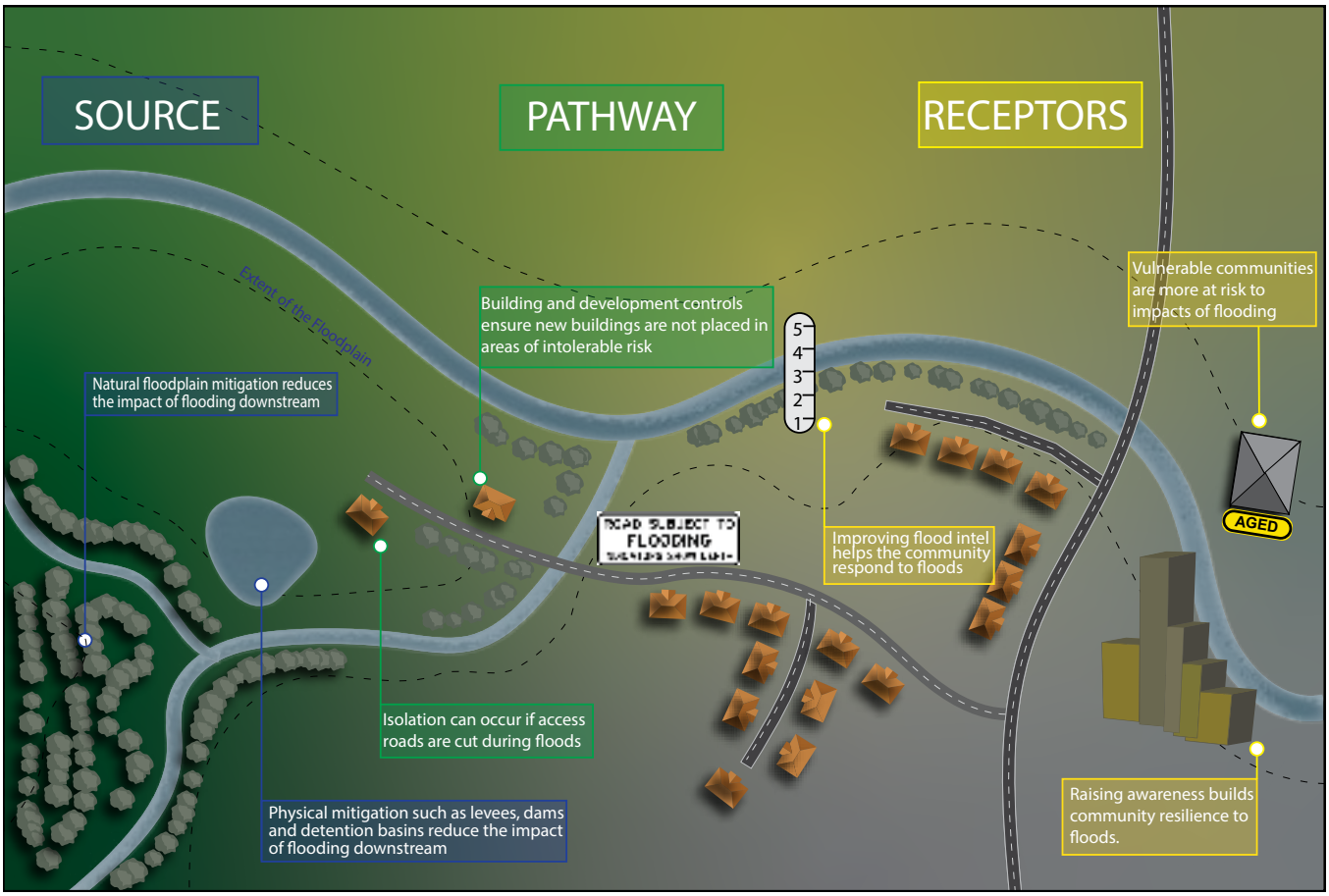


Figure 4 Conceptual integrated catchment planning across the floodplain

ASSESSING RISK AND MITIGATION

The IICP uses a flood risk assessment methodology in accordance with international standards and risk assessment guidelines. The risk assessment follows four steps;

1. **risk identification;**
2. **risk analysis;**
3. **risk evaluation; and**
4. **risk treatment.**

A range of risks have been considered from very low to extreme depending on a combination of different likelihood flood hazard events and impacts to the community. The risk assessment identifies the likely level of risk across the Ipswich LGA collectively, in other words the risk presented does not apply to individual properties or assets.

The primary objective of the IICP is to identify risk treatments or mitigation actions to reduce or maintain the level of risk to a tolerable or acceptable level. This can be illustrated by bringing the 'unmitigated risk' profile down.

A responsive, flexible and long-term action plan considers all possible floodplain mitigation measures along with the effectiveness, acceptability and consequences of any action. The costs of maintaining the current level of risk with just one mitigation measure will likely become inefficient in the face of natural change or prohibitively expensive in the future.

The integrated catchment planning approach across the spectrum of the Source-Pathway-Receptor model identifies a suite of tools and prioritise and stagger investment in floodplain mitigation measures.

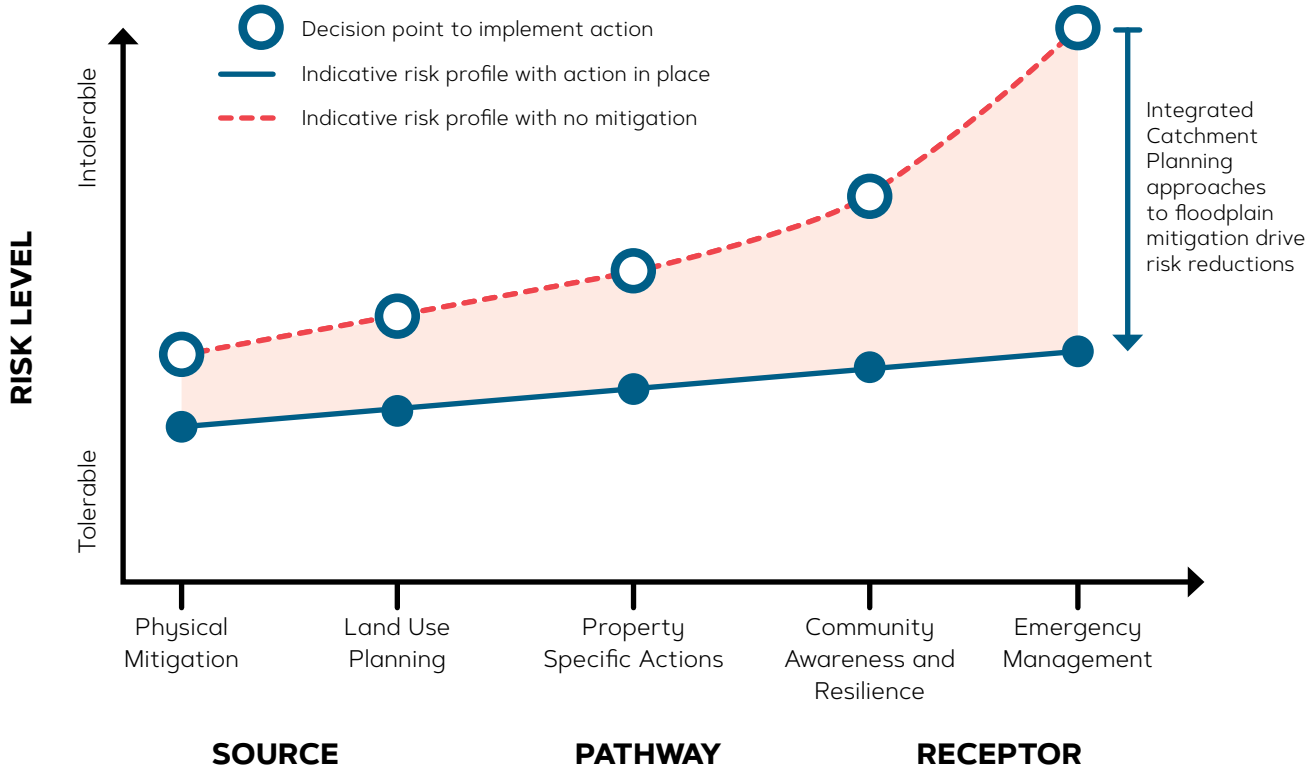


Figure 5 Indicative risk reduction profile

This approach has informed six objectives for integrated catchment and flood risk management. When implemented, these will support the delivery of the IICP vision.

Each objective relates to a work package of the IICP and is detailed within this Strategy and Action Plan, and the Technical Evidence Report.



CURRENT AND FUTURE FLOOD RISK

Objective 1: Define and reduce flood risk



PHYSICAL MITIGATION

Objective 2: Achieve sustainable flood mitigation through physical intervention



LAND USE PLANNING

Objective 3: Plan for development outcomes that are risk-informed



PROPERTY SPECIFIC ACTIONS

Objective 4: Promote flood-resilient built form



COMMUNITY AWARENESS AND RESILIENCE

Objective 5: Enable our community to anticipate, respond and adapt to floods and flooding



EMERGENCY MANAGEMENT

Objective 6: Deliver emergency response and recovery decisions that are intelligence based



SIX OBJECTIVES



OBJECTIVE 1: DEFINE AND REDUCE FLOOD RISK

CURRENT AND FUTURE FLOOD RISK

UNDERSTANDING FLOOD RISK

The identification of flood risk in the Ipswich catchment considers the regional catchments of the Bremer and Brisbane rivers as well as local creek catchments and their major tributaries.

Community vulnerability and flood exposure across Ipswich has been identified and analysed. This information is a prerequisite for determining how weather and climate events contribute to the occurrence of disasters.

Understanding a full picture of flood risk helps to design and implement effective risk management strategies and is therefore important to not only understand how assets, buildings and services may be impacted but also identify the community's vulnerability and exposure to flooding hazards.

This methodology has also been applied to the IICP. While the approach reflects regionally consistent outcomes driven by the SFMP framework, the identification of flood risk in the Ipswich catchment has evolved to suit locally specific conditions associated with creek catchments and major tributaries. Full details of this analysis is found in Section 4 of the IICP TER (Current and Future Flood Risk).

WHAT IS FLOOD RISK?

Risk is defined as a combination of likelihood and consequence.

Likelihood of flood risk has been kept consistent across all flood studies in the IICP and is expressed as the flood events Annual Exceedance Probability (AEP). The AEP represents the probability that a given flood level be exceeded in any one year (BoM, 2020). For example a 1 in 20 AEP represents a five per cent chance of the flood event occurring in any one calendar year.

AEP	AT LEAST ONCE IN 80 YEARS	AT LEAST TWICE IN 80 YEARS	IPSWICH CBD (M AHD)
1 in 10 (10% AEP)	100%	100%	14.8
1 in 20 (5% AEP)	98%	91%	16.1
1 in 50 (2% AEP	80%	48%	18.7
1 in 100 (1% AEP)	55%	19%	20.1
1 in 500 (0.2% AEP)	15%	1%	23.4
1 in 2000 (0.05% AEP)	4%	0.1%	25.7
PMF (Probable Maximum Flood)	0.1%	<0.1%	36.1

Table 1 Probability of floods occurring within an 80-year lifetime and the corresponding flood levels at the Ipswich CBD flood gauge.

Consequence examines the impact to exposed elements because of a flood event. This is the physical impact of the event upon an asset, as well as the economic impacts, social impact including upon of vulnerable communities and environmental impact.

TOLERABILITY

Tolerability in the context of flooding describes whether flood risk requires mitigation or action to reduce the economic, social or environmental impacts.

A risk evaluation of tolerability is required to ensure appropriate mitigation measures can be identified to reduce economic, environmental or social impacts of a flood. The level of risk has been categorised consistent with the State Planning Policies definition: What society would reasonably accept, tolerate, or find intolerable.

The National Emergency Risk Assessment Guidelines (NERAG) describe risk tolerance as the organisation's readiness to bear the risk, after risk treatment, in order to achieve its objectives.

Understanding the community's tolerability to flooding helps to identify the level of mitigation required across the suite of floodplain management approaches assess in the IICP.

COMMUNITY PERSPECTIVES

The Managing Future Floods survey undertaken as part of the IICP community engagement contained a number of questions that help to determine a baseline level of tolerability to unmitigated flood risk in Ipswich.

The majority of respondents would be concerned in a flood event, while a quarter reported they would be calm before a flood event occurs. When asked who is primarily responsible for safety, the majority responded by saying 'yourself'. This suggests the respondents do not feel flooding risk is acceptable but will take action themselves to mitigate intolerable risk.

The risk evaluation categorises the risk ratings into intolerable, tolerable, or acceptable risks based on thresholds in accordance with State Planning Policies.

RISK DESCRIPTION	RATIONALE	RISK PROFILE	HYDRAULIC RISK CATEGORY
Extreme Risk	▪ Frequent flooding ▪ Conveyance area ▪ Buildings vulnerable to failure and unsafe for vehicles and people	Intolerable	HR1c HR1b
High Risk	▪ Unlikely and rare flooding ▪ New flow conveyance paths create dangerous conditions ▪ Buildings vulnerable to failure.	Tolerable	HR2c HR3c
Medium Risk	▪ Generally unsafe for vehicles and people ▪ Areas still effected by frequent and likely flood events	Tolerable	HR2b HR2c
Low Risk	▪ Generally safe infrequent and likely flood events ▪ High hazard associated with unlikely and rare events	Acceptable	HR2a HR3a HR4
Very Low Risk	▪ Balance of floodplain ▪ Area potentially affected by extremely rare flooding that may not require mitigation	Acceptable	HR5

Table 2 Description of risk tolerability

FLOOD RISK FACTORS

Detailed examination was undertaken to understand current flood risk within the Ipswich LGA.

- Hydraulic risk – mapping flood likelihood by AEP and flood hazard category based on depths and velocities of floodwaters;
- Flood islands – identifying issues of isolation caused by flood waters;
- Time to inundation of floodwaters to roads and buildings;
- Duration of inundation of floodwaters over roads and buildings; and
- Economic impacts – direct and indirect damages caused by flooding.

The flood risk assessment methodology used in the IICP is in accordance with international standards and guidelines. The risk assessment follows four key steps; risk identification, risk analysis, risk evaluation and risk treatment.

HYDRAULIC RISK

Hydraulic Risk (HR) has been used in the SFMP to provide a regionally consistent definition of consequence using HR derived from hazard characteristics identified in the Australian Institute of Disaster Resilience (AIDR) Guideline.

The SFMP mapped HR across five categories of relative hydraulic risk. The IICP adopts the SFMP HR categories, but refines the matrix by introducing sub categories based on the hazard level to map across 10 categories of relative HR.

Using different flood hazard categories across the catchment is helpful in designating appropriate flood risk management responses in areas exposed to hazard that is unsafe for children and the elderly, or on the other end of the scale, areas potentially exposed to hazard that threaten the structural integrity of buildings.

HR has been mapped across ten categories of relative hydraulic risk as shown in the HR matrix. Generally, the HR level improves as you move diagonally from the bottom right to top left of the matrix. Higher frequency flood events associated with a 1 in 10 and a 1 in 20 AEP which carry lower hazard are more 'tolerable' than events with higher hazards.

- The (a) subcategories represent areas a low hazard risk (i.e. of lesser consequence other than flood damage);
- The (b) subcategories represent the consequence range where there is risk to vehicles and life; and
- The (c) subcategories represent the consequence range where there is risk to structures.

AEP	LOW HAZARD	MODERATE HAZARD			HIGH HAZARD	
PMF	HR5	HR5	HR5	HR5	HR5	HR5
1 in 2,000	HR5	HR5	HR4	HR4	HR4	HR4
1 in 500	HR5	HR4	HR4	HR3(b)	HR3(c)	HR3(c)
1 in 100	HR4	HR4	HR3(b)	HR2(b)	HR2(c)	HR2(c)
1 in 50	HR4	HR3(b)	HR2(b)	HR2(b)	HR1(c)	HR1(c)
1 in 20	HR3(a)	HR2(b)	HR2(b)	HR1(b)	HR1(c)	HR1(c)
1 in 10	HR2(a)	HR1(b)	HR1(b)	HR1(b)	HR1(c)	HR1(c)

Table 3 Revised HR Matrix for use in the IICP

The relative risks of each of the HR categories have been considered further. For example, on the basis that a low hazard high frequency event poses lower relative risk to people and property, it is considered HR2(a) is of lower relative risk to HR3c and HR3b and has been categorised as such. This provides a relevant graduation of risk profile from high risk conveyance areas associated with high hazard through to lower risk on the peripheral of flood storage.

VALUE	1	2	3	4	5	6	7	8	9	10
HR Category	HR1(c)	HR1(b)	HR2(a)	HR2(b)	HR2(c)	HR3(c)	HR2(b)	HR3(a)	HR4	HR5

Table 4 Relative risk of HR Categories used in the IICP (where 1 is the highest and 10 is lowest hydraulic risk)

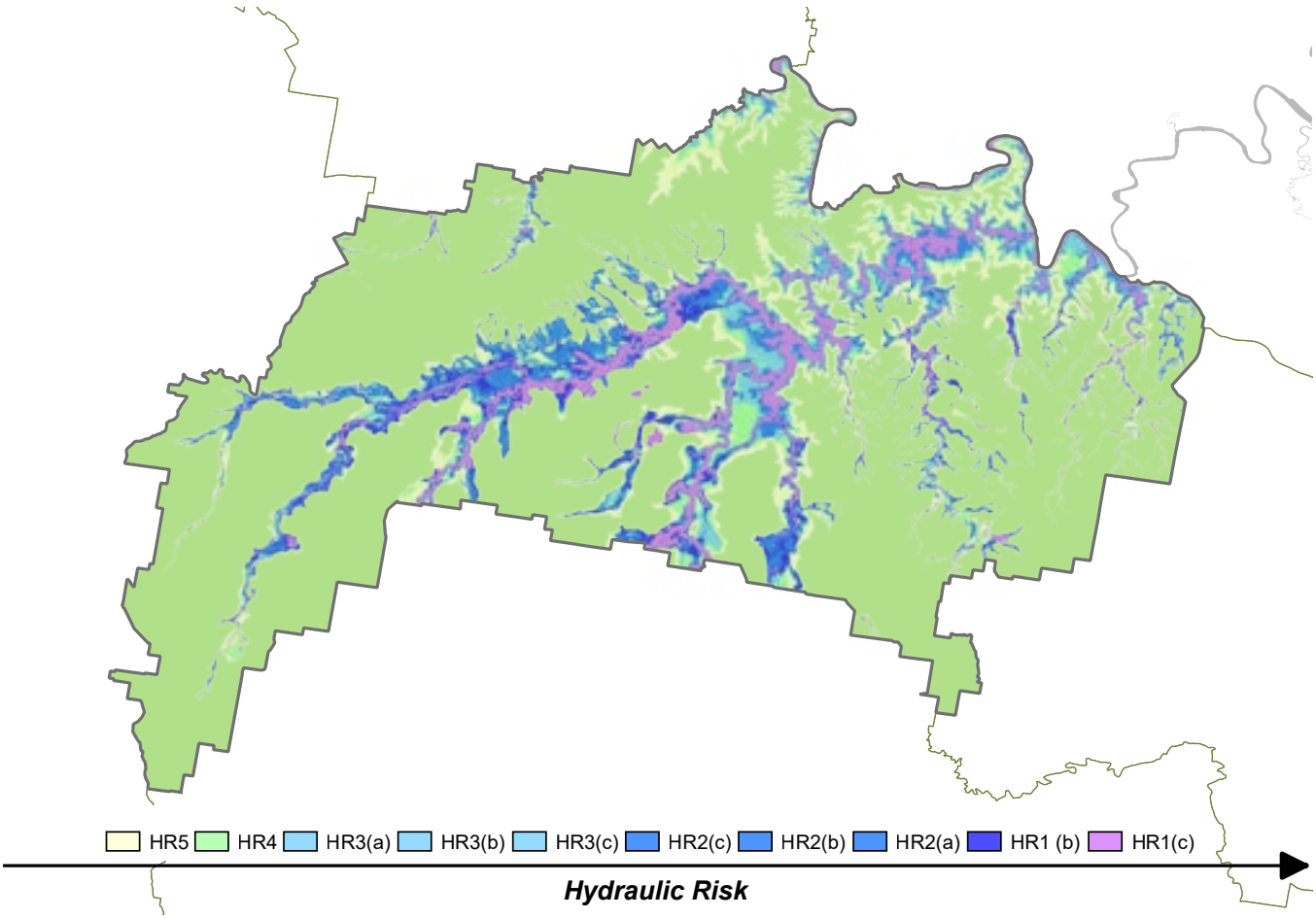


Figure 6 Hydraulic risk in Ipswich

CURRENT FLOOD EXPOSURE

The Ipswich LGA has a significant number of residents, up to 43 per cent, living within the extent of the floodplain. There are an estimated 17,300 residents mapped in the highest five hydraulic risk categories of HR1(c) to HR3(c). The suburbs of Goodna, Bundamba, Ipswich, Brassall, Churchill, Karalee, North Booval, One Mile, West Ipswich and East Ipswich have high numbers of properties exposed to high HR.

Some of the main findings with key considerations for building exposure being:

- There are 36,380 buildings exposed to flooding with 17 per cent exposed to the highest hydraulic risk categories HR1c to HR3c
- The majority of high-risk buildings are residential
- The highest relative increase of buildings impacted across all storm events is seen between the 1 in 100 to 1 in 500 AEP flood events
- There is also a notable increase in building exposure to flood between the 1 in 20 and the 1 in 50 AEP events.



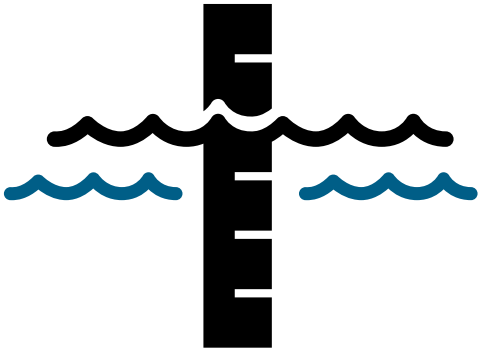
36,860
buildings within the floodplain extent



6,000+
buildings with water over the floor during a 1 in 100 AEP flood event



15,000+
buildings inundated above ground level during a 1 in 100 AEP flood event



6,368
buildings exposed to top 5 hydraulic risk categories (HR1c to HR3c)

BUILDING TYPE	HR1(C)	HR1 (B)	HR2(C)	HR2(B)	HR3(C)	HR3(B)	HR2(A)	HR3(A)	HR4	HR5	TOTAL
Residential	684	558	973	813	664	4,212	2,247	266	3,013	11,501	24,931
Residential Multi-Dwelling	173	131	347	193	197	790	590	52	799	2,461	5,733
Commercial	134	114	115	100	99	189	140	17	218	475	1,601
Industrial	90	26	104	73	54	91	129	3	180	280	1,030
Community and Public Facilities	112	41	107	140	32	147	283	10	167	676	1,715
Agriculture	11	33	13	36	52	127	52	23	201	516	1,064
Other	12	45	41	34	17	101	138	5	90	303	786
TOTAL	**1,216**	**948**	**1,700**	**1,389**	**1,115**	**5,657**	**3,579**	**376**	**4,668**	**16,212**	**36,860**

Table 5: Number of buildings in the floodplain and their relative exposure to Hydraulic Risk (HR)

POPULATION

Almost 84,000 residents are mapped within the extent of the floodplain (up to Probable Maximum Flood) which indicates about 43 per cent of Ipswich residents are exposed to flooding of some nature (2016 Census data). Of these 84,000 residents mapped within the floodplain extent, 21 per cent are exposed to the top 5 HR categories and 2,200 residents are located within the highest risk category.

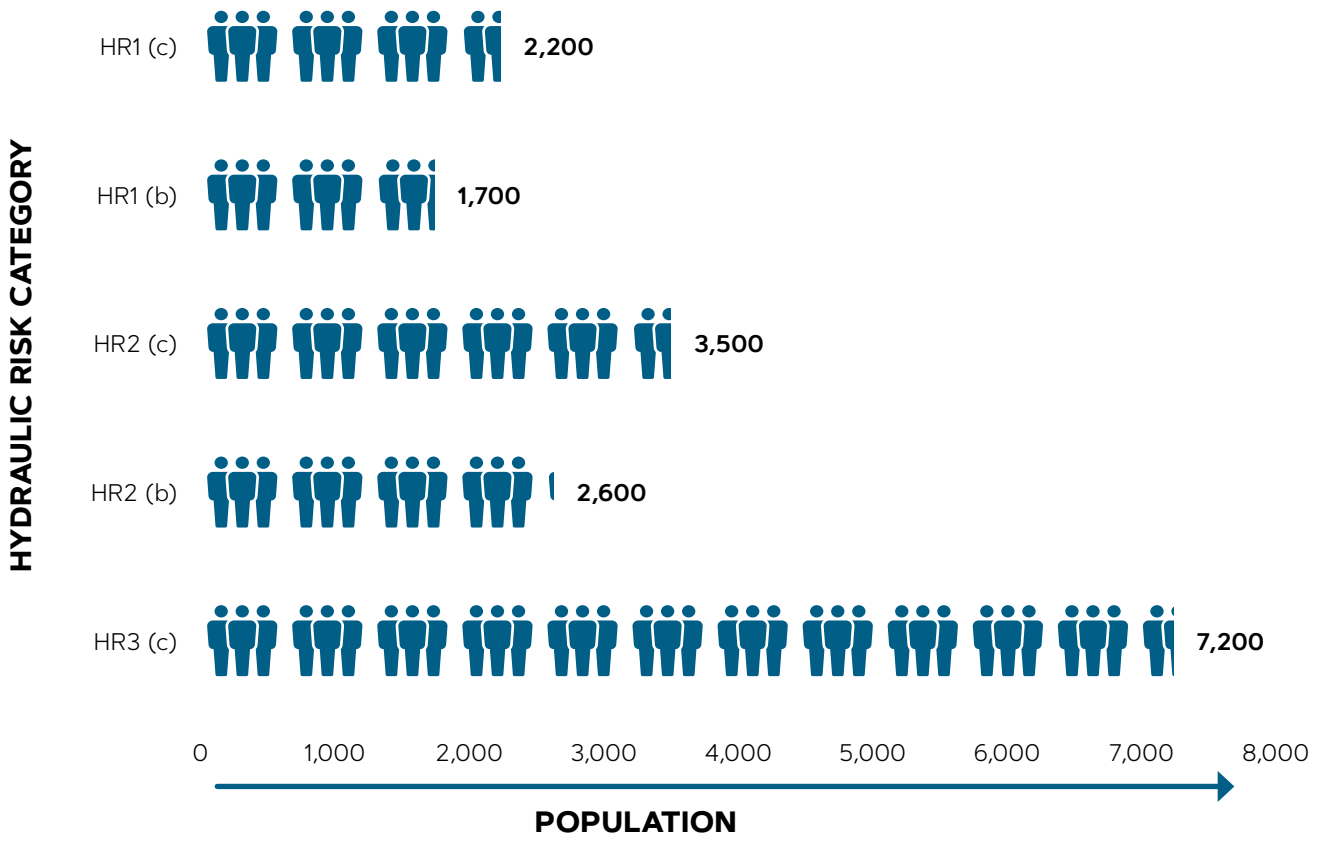


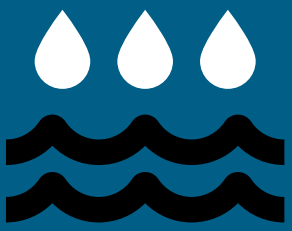
Figure 7 Population exposure to highest hydraulic risk

CRITICAL INFRASTRUCTURE

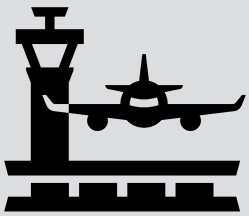
Critical infrastructure is an important component of flood exposure as this infrastructure performs an important life-supporting role in flood events. It is vital to have this infrastructure operational before, during and after flood events. Doing so increases operational preparedness, response, and recovery significantly.

CRITICAL INFRASTRUCTURE	HR1(C)	HR1 (B)	HR2(C)	HR2(B)	HR3(C)	HR3(B)	HR2(A)	HR3(A)	HR4	HR5
Defence Infrastructure	2	0	6	9	19	37	0	0	39	28
Emergency management facilities	0	0	0	0	5	1	0	1	6	7
Pumping stations and wastewater treatment plants.	1	0	7	1	11	0	0	0	3	0
Electricity and telecommunications	1	1	0	0	0	0	0	0	1	11
TOTAL	**4**	**1**	**13**	**10**	**35**	**38**	**0**	**1**	**49**	**46**

Table 6: Critical Infrastructure in the floodplain and relative exposure to Hydraulic Risk (HR)



63 critical infrastructure buildings exposed to high hydraulic risk



36 airport and associated infrastructure buildings



5 emergency management buildings



20 water infrastructure buildings



2 electricity and telecommunications buildings

TIME TO INUNDATION

Time to inundation (TTI) is dependent on the type of flooding. Longer TTIs would be expected for large riverine floods while shorter TTI would be expected for major local creek flooding events.

The process is based on scenario modelling to best estimate TTI, however there are many thousands of different possibilities. In an actual flood event, TTI could be faster or slower on the modelled scenarios depending on the rainfall patterns.

A sample hydrograph of a flood model is represented below, this shows how the flood water level increases over time until a road, building or asset is inundated. The pink shaded area in the graph is the TTI.

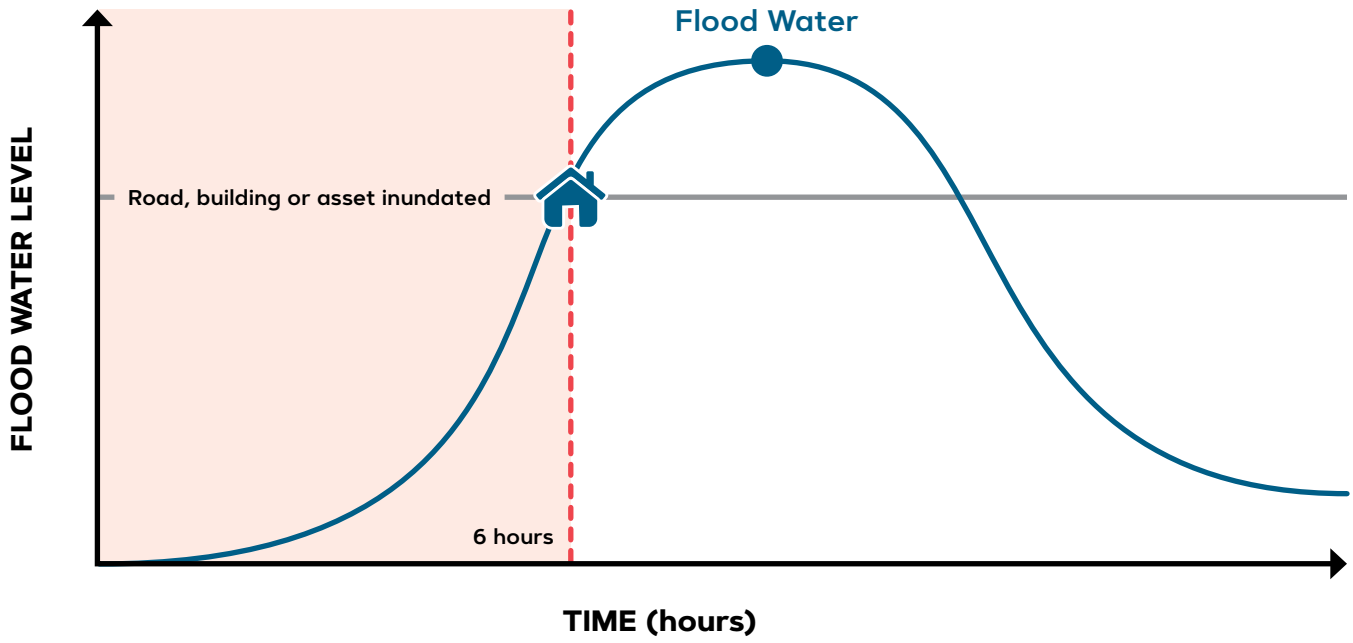


Figure 8 Sample hydrograph showing a TTI of 6 hours

The data informs several outputs that contribute to the picture of flood risk across the Ipswich LGA. TTI data helps to inform prioritisation of areas subjected to isolation by floodwaters, evacuation planning or community awareness and education activities.

TTI information can also help understand exposed roads and the need for earlier action on potential closures and understanding areas subject to flash flooding.

Where TTI is less than 6 hours, residents and businesses only have a short time to react to flood warnings and will need to be aware of their flood risk and potentially self-evacuate. It is important that people in these areas are well prepared.

The 1 in 2000 AEP event has been used as it is an appropriate representation of a very rare flood event for purposes of investigating evacuation throughout the Ipswich LGA. This design event is also defined as a very rare event in the Australian Rainfall & Runoff Guidelines 2019 (AR&R), and is the last design event before the PMF for modelled catchments across Ipswich.

The suburbs of Brassall, Raceview and Bundamba are more susceptible to 'flash flooding'. From this investigation, flash flooding hotspots have been highlighted to inform early evacuation measures as well as possible areas that may require road upgrades on existing evacuation routes.

FLOODED ROAD LOW POINTS

Road immunity and flooded road low points were identified across the city on local, state and federal highways. Using the flood water levels to identify where each section of road is inundated, each section of road that is 'wet' is mapped as a road low point. This information is useful to identify areas in the network with low flood immunity and also used to calculate flood islands, time to inundation and duration of floodwater inundation.



Figure 9 Number of properties by suburb with a time to inundation of less than 6 hours

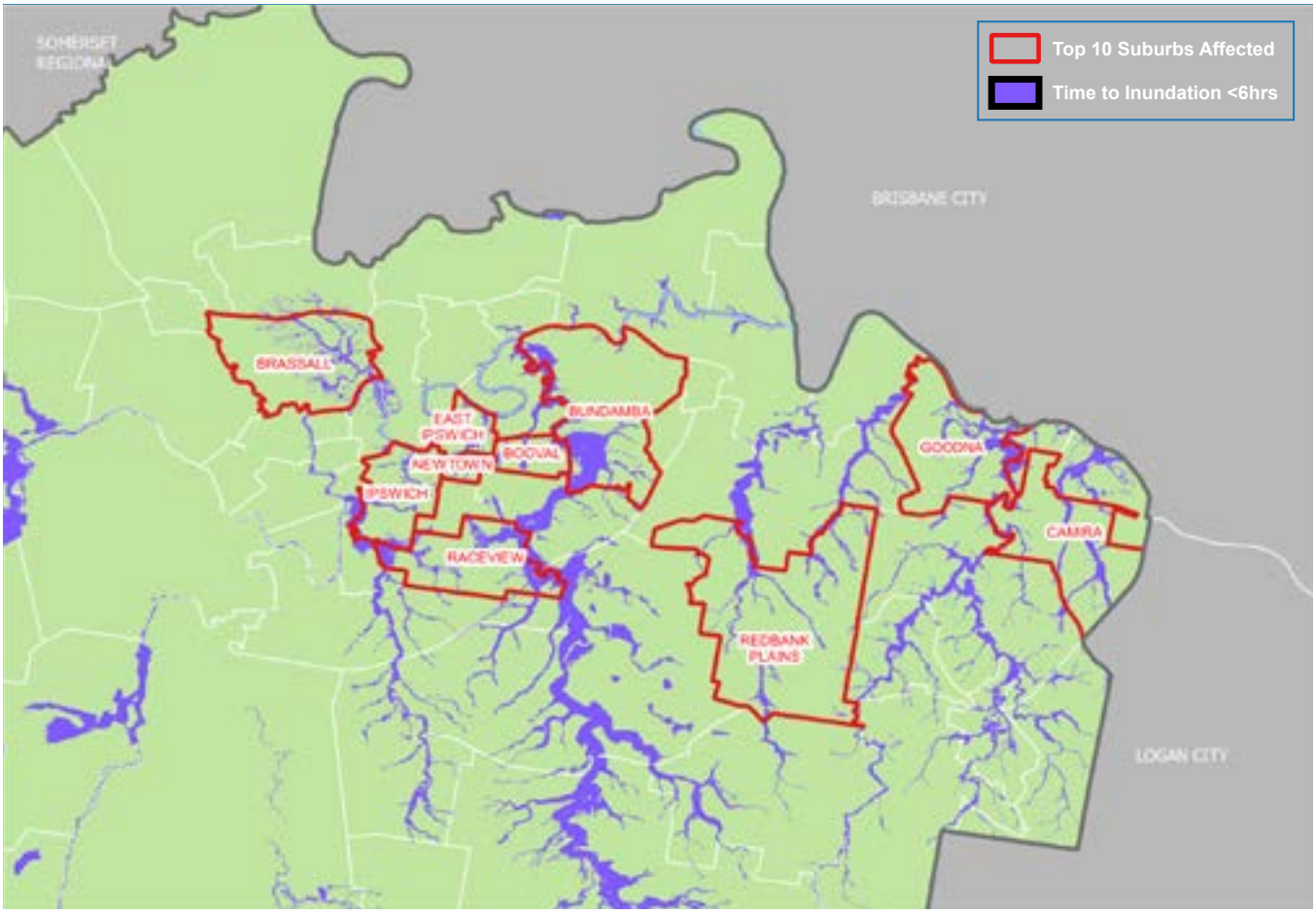


Figure 10 Map of top 10 suburbs affected by TTI of less than 6 hours

DURATION OF INUNDATION

Duration of flood inundation (DFI) has been identified by calculating the total duration of time flood water exceeds a certain level.

Data relating to how long floodwaters inundate an area was extracted from the suite of available council flood models (Brisbane River, Bremer River and local creek catchments).

Time series information within the models has been used to produce worst case scenarios (i.e. longest duration) for all models. For analysis of buildings, DFI is based on the duration of flood waters inundated over floor levels; and for analysis of roads DFI is based on the duration of floodwaters inundated above road low points.

Like TTI, DFI analysis is based on the 1 in 2000 AEP flood event. For the purposes of analysing TTI, the 1 in 2000 AEP is the "worst case" primarily due to flood storages depleted in a relatively shorter time period.

DFI is important information to consider as residents who may shelter in place on the upper levels of buildings will need to be self-sufficient for a certain period. Structural damage to buildings can also increase with longer inundation times, which may decrease the safety of choosing not to evacuate. DFI is also useful in determining which roads will flood the longest and could be considered for approximate information of road closure times and preparation for opening.

Suburbs that are most prone to longer durations of inundation are impacted by flooding from the Brisbane and Bremer rivers. In particular, Goodna and North Booval have the highest number of properties with inundation time greater than 36 hours. The top 10 suburbs are shown below.



Figure 11 Number of properties with DFI of more than 36 hours

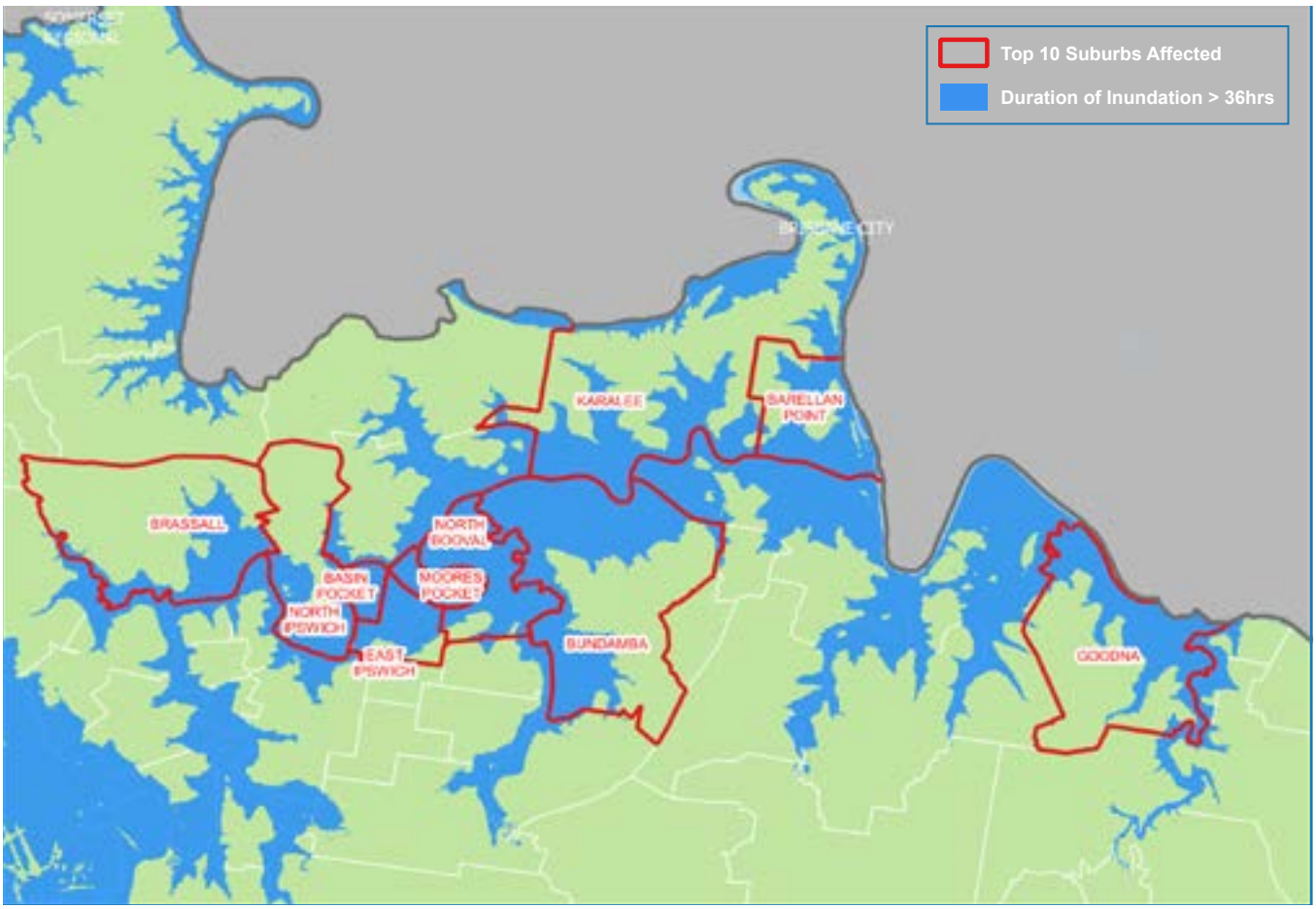


Figure 12 Map of top suburbs with DFI of more than 36 hours

FLOOD ISLANDS

Flood Islands are a unique, complex, and relatively dangerous situation that can develop during flood events.

Flood islands develop when servicing roads to areas are cut (often multiple times) and the area is then physically isolated with no means of vehicle transportation and likely no or reduced pedestrian mobility.

Two types of flood islands can develop during flood events: low and high flood islands. Low flood islands are of most concern, as they can become submerged at any point in time up to the Probable Maximum Flood (PMF) event. It is therefore important to understand low flood islands that become inundated in more frequent flood events.

High flood islands are characterised by:

- Entry and exit roads to the island are flooded,
- As flood waters rise, a section of the flood island remains dry and immune in a PMF event, and
- High flood islands require the community to be aware and prepared, such as having emergency kits, resupply of their own medication and also the need to know the community around them as relocation may be necessary if no formal/informal area is available for relocation.

Low flood islands are characterised by:

- Entry and exit roads to the island are flooded, and,
- As flood waters rise, eventually the entire island will become submerged. Depending on the extent of flooding, this can obviously become a life-threatening situation.

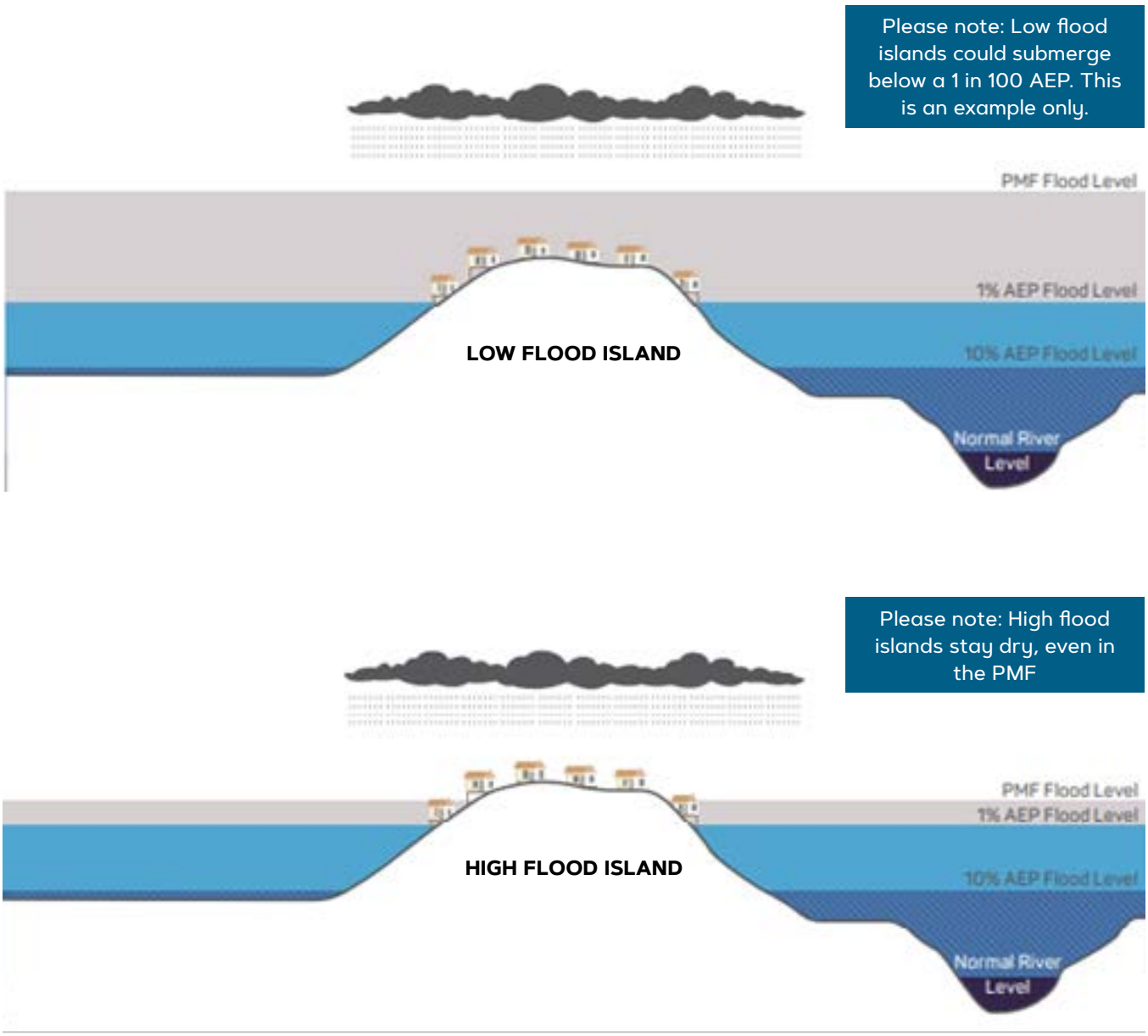


Figure 13 Flood islands (AIDR, 2017)

The suburbs with the most buildings exposed to flood islands include Rosewood, East Ipswich and Brassall. The breakdown of buildings exposed to flood islands are shown in Figures 14 and 15.

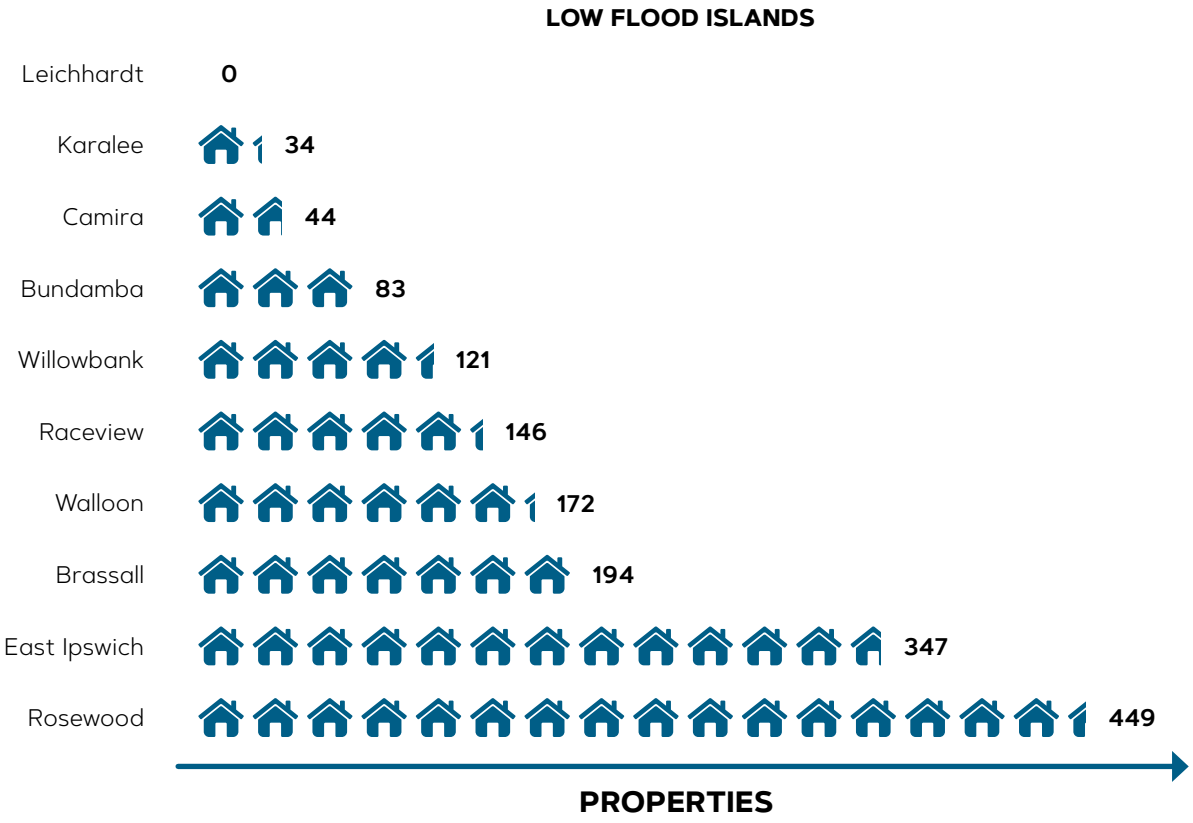


Figure 14 Suburbs with the highest number of buildings on low flood islands

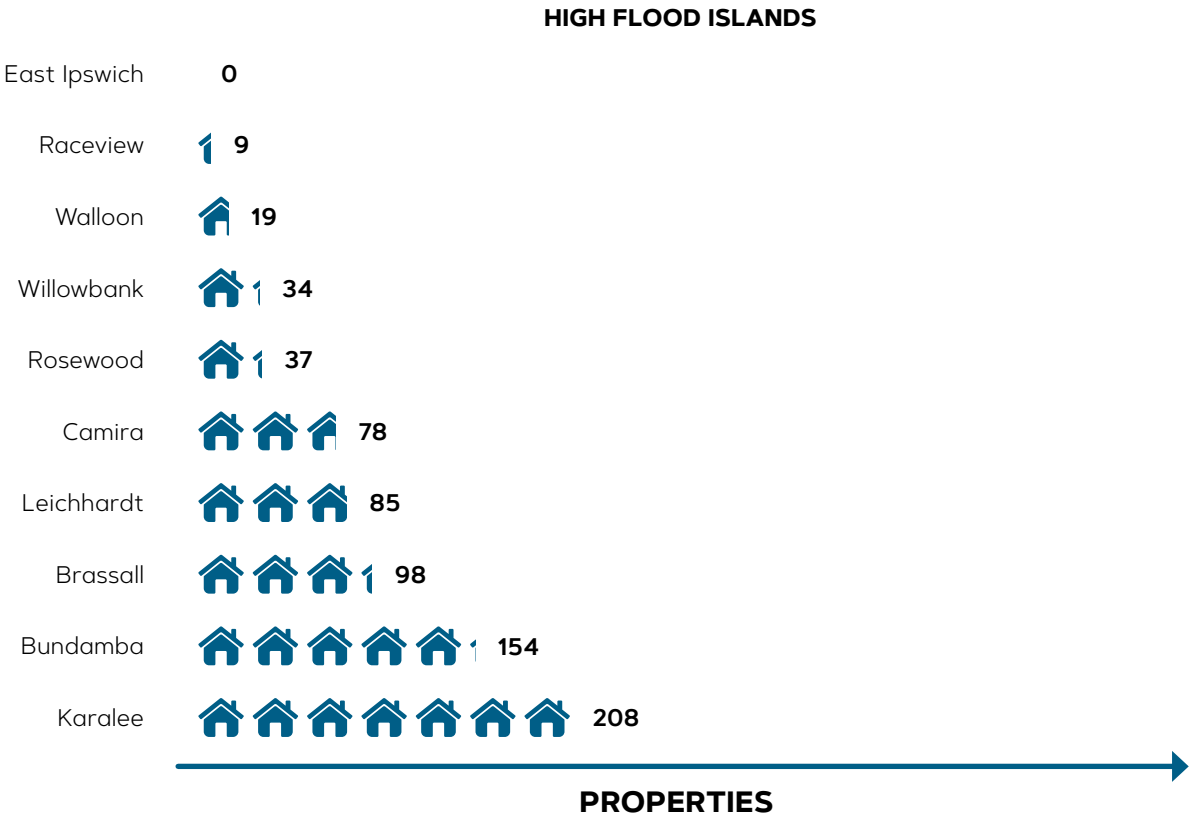


Figure 15 Suburbs with the highest number of buildings on high flood islands

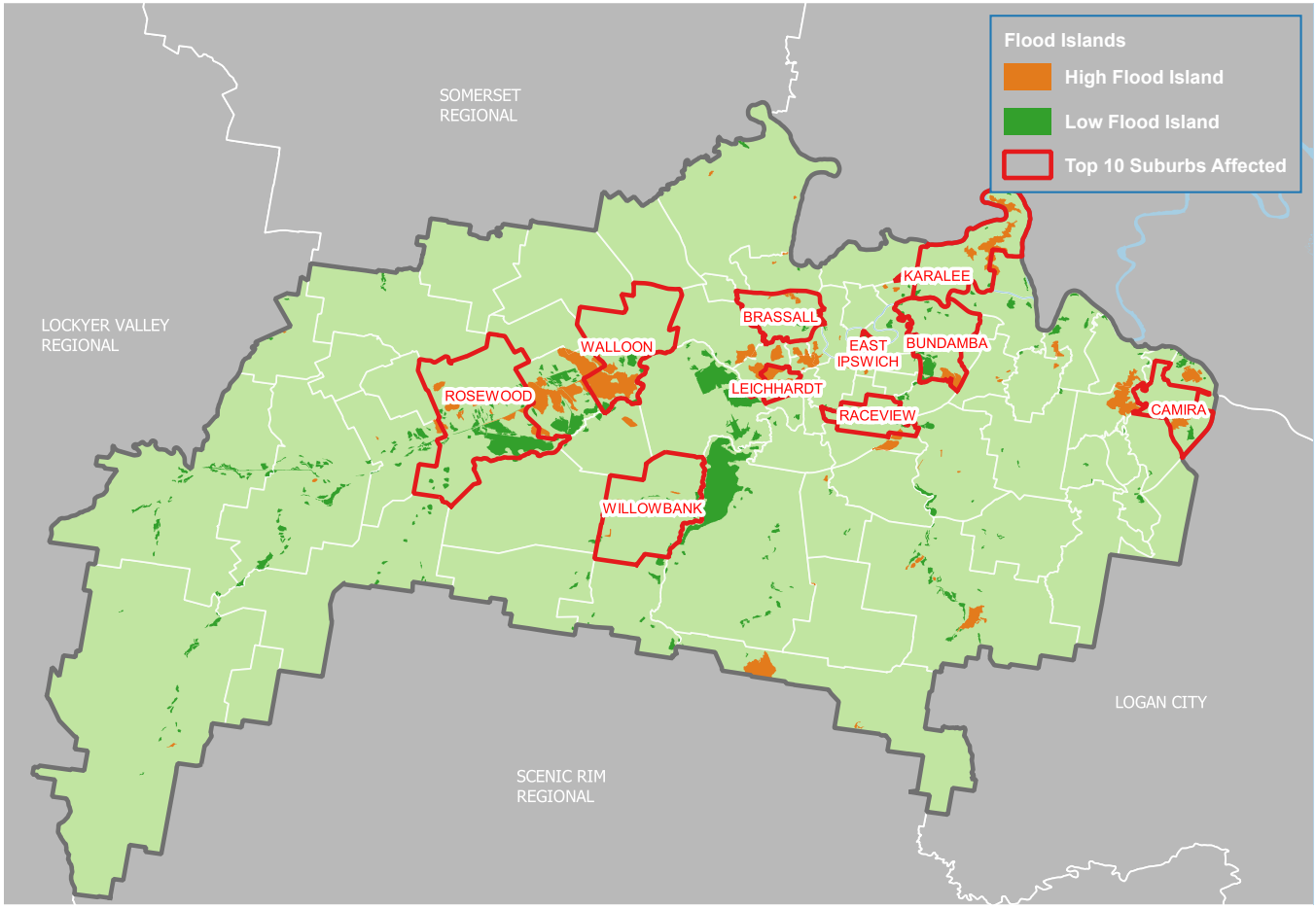


Figure 16 Distribution of flood islands and suburbs with the highest number of properties affected

VULNERABILITY

An assessment of the social characteristics of the population has been undertaken to understand particular vulnerability indicators that may affect the community's response to a flood event and increase their exposure to the impacts of flooding.

This assessment goes beyond the conventional risk assessment by ensuring a full understanding of the potential risks to vulnerable communities.

There are many aspects of social vulnerability to flooding, but four vulnerability indices were considered by the SFMP in detail and have also been adopted by IICP. The factors of awareness, physical vulnerability, socio-economic vulnerability and mobility are social attributes that strongly relate to vulnerability during floods.

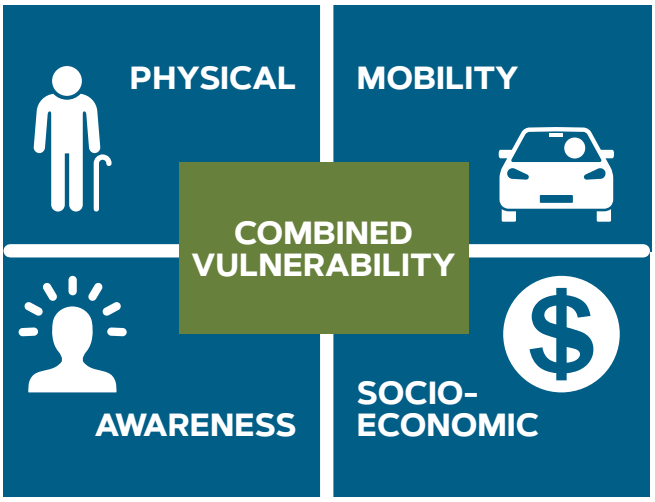


Figure 17 Combined vulnerability

Using the 2016 Australian Bureau of Statics (ABS) census records, suburb-level analysis (at the SA1 level) has been undertaken and presented in the community profile summary. The types of vulnerability and the data indicators are listed below.

Highly vulnerable persons are residents within the SA1 that represent the upper 20 per cent of the relative vulnerability ranking for each indicator. The population within the SA1 was calculated by multiplying the number of buildings by the average number of residents per building.

CATEGORIES	VULNERABILITY INDICES	NUMBER OF VULNERABLE PERSONS EXPOSED TO FLOODING	NUMBER OF VULNERABLE PERSONS EXPOSED TO HIGH HYDRAULIC RISK
Physical Vulnerability	▪ Under 5 years ▪ Over 65 years ▪ Over 65 and lone person household ▪ Require assistance (age/disability)	2,145	540
Social & Economic Vulnerability	▪ Renting (house tenure) ▪ Household income (<$650) ▪ Unemployed (seeking work)	1,137	311
Mobility Vulnerability	▪ Without vehicle access ▪ One parent families ▪ Group households	613	193
Awareness Vulnerability	▪ Speaks language other than English (LOTE) at home ▪ Without internet access	3,259	614
Combined Vulnerability	▪ Most vulnerable people across LGA affected by a combination of vulnerability indicators	1,596	311

Table 7 Vulnerability across Ipswich

To provide an overall picture of vulnerability, these indices are combined by a process of normalisation to bring the values to a standard scale. An average of each indicator was then totalled to create a combined vulnerability index.

There are about 1,500 people in the floodplain that are in the upper 20 per cent of relative vulnerability of all indicators. Over 1,000 are located in the lowest hydraulic risk category of HR5.

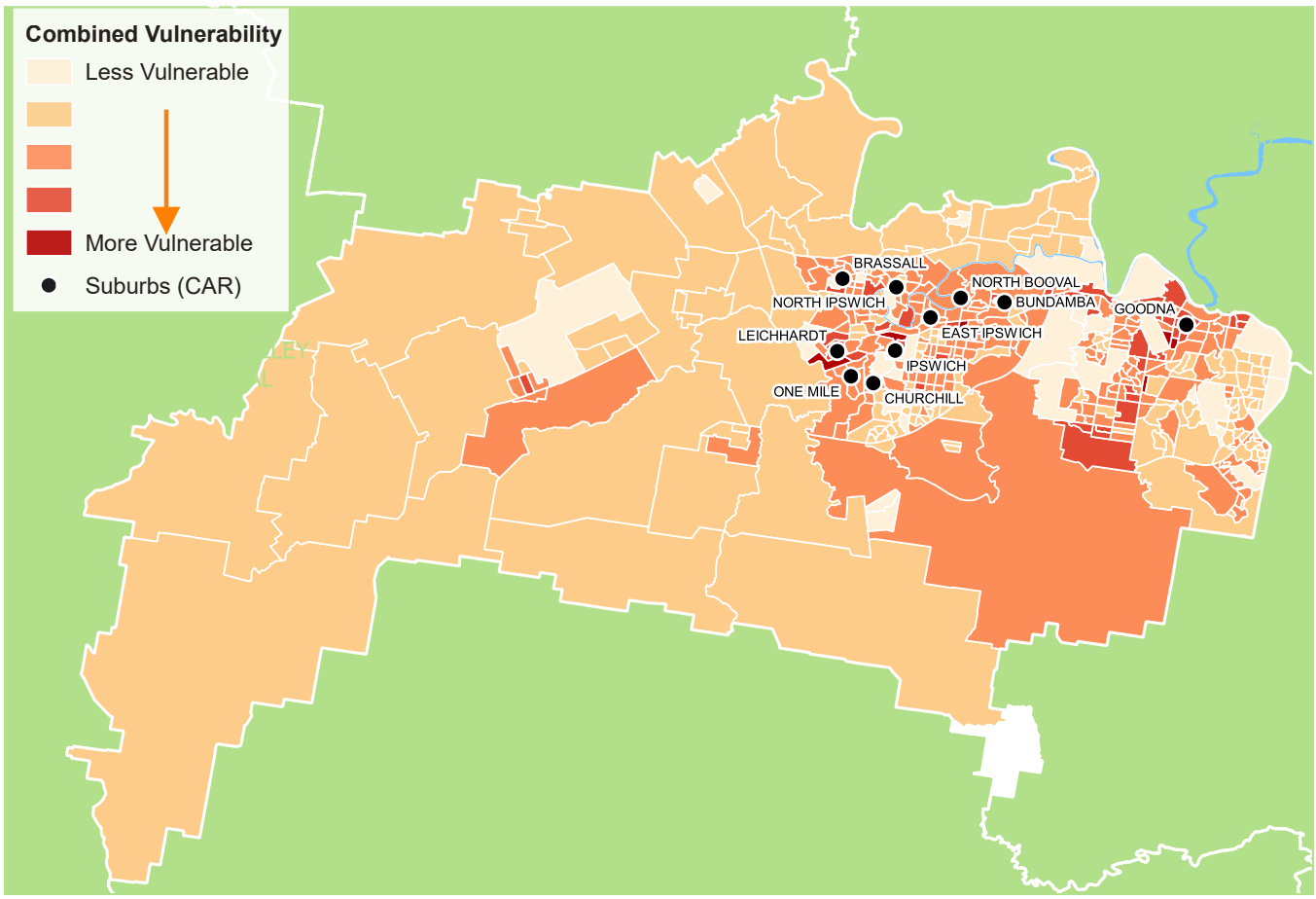


Figure 18 Distribution of most vulnerable people across Ipswich

ECONOMIC IMPACTS

Annual Average Damages (AAD) is the defining factor of how much flood damages are expected to cost the Ipswich community each year on average. It represents the amount of money that would need to be set aside every year to cover long-term flood damage costs.

The IICP adopts the SFMP methodology for the flood damage assessment. Full technical details are provided in Section 4 of the TER.

The cost of flooding in the Ipswich LGA has been estimated by including both tangible and intangible damages from all flood sources (Bremer River, Brisbane River and the local creeks).

- Tangible damages are a combination of both direct damages (internal, external and structural damage to a building) and indirect damages (clean up, recovery and potential losses of revenue) and have been calculated with a general degree of accuracy due to several surveys, research and flood events where data has been collected and analysed.
- Intangible damages includes the 'social costs' of flooding reflected in increased levels of emotional stress and psychological and physical illness including loss of life. Intangible damages also includes environmental, cultural and heritage losses incurred.

Overall, the IICP has estimated an AAD of $160 million, which incorporates all flooding sources, building types, tangible and intangible damages.

Ultimately while total damages per magnitude of flood event is an important aspect to consider and understand, reducing AAD is how traditional floodplain management approaches reduce the overall impact of flooding. This target is not an isolated goal however and is also part of a multi-pronged approach to floodplain management considering a suite of measures.

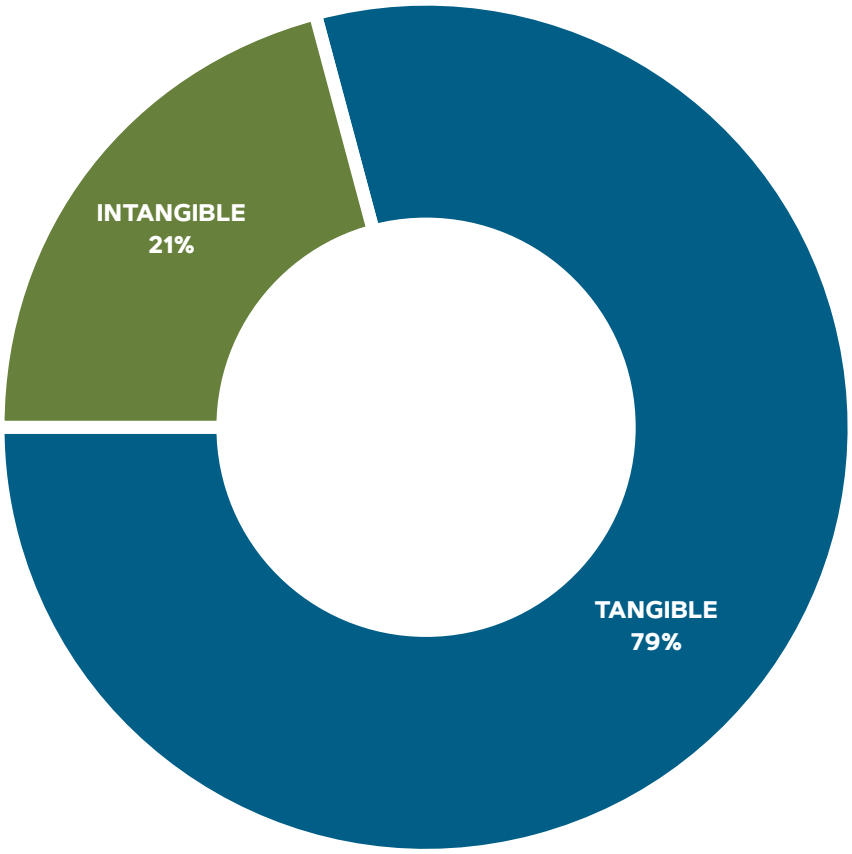


Figure 19 Average Annual Damages split (total cost $160 million per year)

AEP (1 IN X)"	TANGIBLE	INTANGIBLE	TOTAL
2	$67,540,247	$-	$67,540,247
5	$88,878,965	$-	$88,878,965
10	$124,435,782	$-	$124,435,782
20	$186,458,457	$-	$186,458,457
50	$1,028,617,346	$156,611,665	$1,185,229,011
100	$1,808,739,758	$587,925,069	$2,396,664,827
500	$4,115,642,924	$2,894,512,601	$7,010,155,525
2000	$6,243,988,458	$5,743,439,795	$11,987,428,252
PMF	$13,919,946,809	$20,989,518,636	$34,909,465,445

Table 8 Total AAD damages

Generally, there are very high residential damages in more frequent flood events. These damages are primarily associated with local creek flood events, for example the 1 in 2 and 1 in 5 AEP events.

The graphics show large increases in AAD between the 1 in 100 and 1 in 500 AEP event for residential and non-residential buildings. Damage figures are used to assess the potential economic benefits of both physical mitigation measures and property specific actions, i.e. how much damage will these measures reduce each year.

There are many limitations to creating an exact flood damages figure, such as:

- property floor levels can have a substantial impact on damages figures
- information on the value of commercial building contents was not available
- actual damage in a flood is almost always less than the potential damage.

As a result, these figures do not provide an 'exact bill' of costs likely to occur as a result of a flood event. Instead, it helps to understand the magnitude of impact for different events.

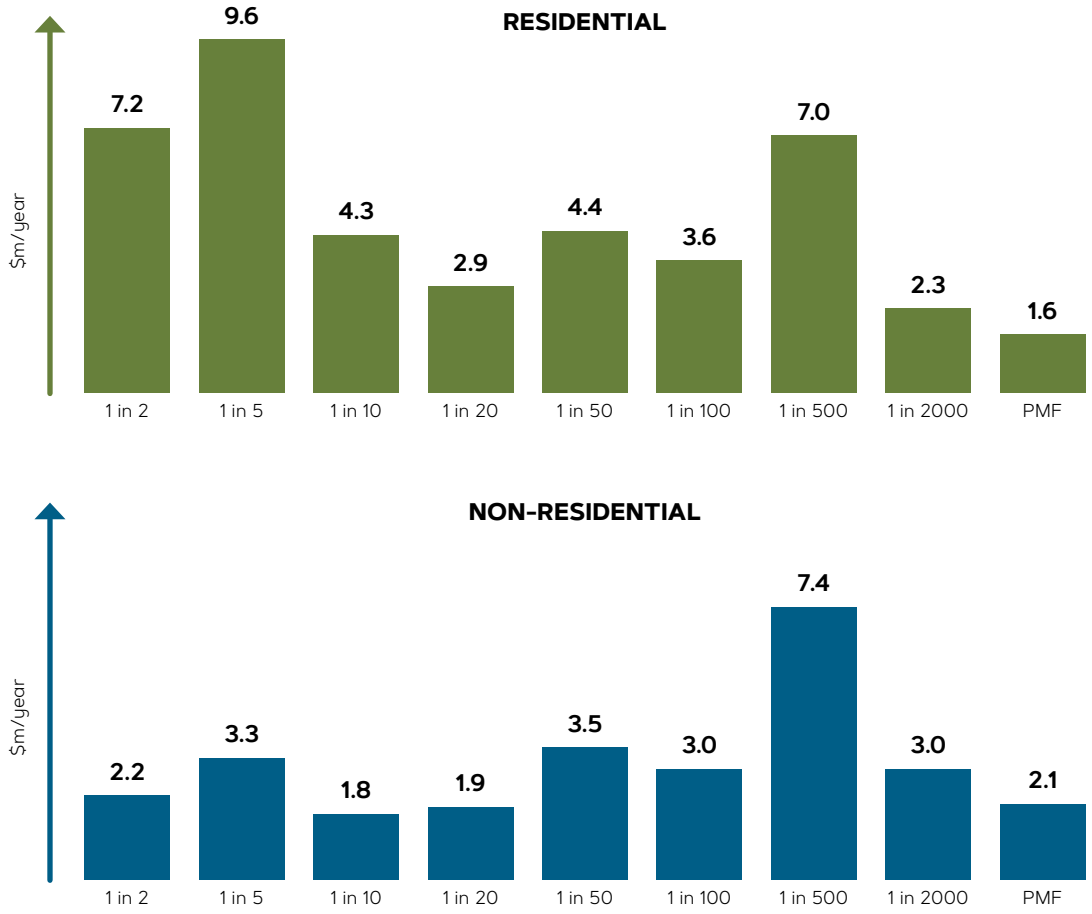


Figure 20 AAD for residential and non-residential buildings

EXPECTED TANGIBLE COSTS FOR A 1-IN-100 AEP FLOOD EVENT:

Residential **$490 million**	**Other buildings** **$133 million**	**Commercial/industrial** **$287 million**
Utilities **$37 million**	**Transport** **$735 million**	**Clean up** **$126 million**

TOTAL $1.8 BILLION

FUTURE FLOOD RISK

Assessment of future urban development scenarios in the floodplain is important as increased development can affect the behaviour of floodwaters by blocking or constraining critical flow paths, reducing the volume of floodplain storage and potentially increasing rainfall run-off associated with an increase in impervious surfaces.

The analysis undertaken in the IICP models the potential changes to the riverine and local creek catchments to better understand areas that may be sensitive to development.

There are a range of other catchment changes that can affect future flood risk, such as land use, as well as the inclusion of physical flood mitigation measures such as a dam or detention basin.

There is much uncertainty about future flooding conditions and it is therefore difficult to accurately predict and model. An assessment of future flood risk has been based on consideration of increased development activity and floodplain change with a focus on filling within the floodplain and an increase in floodplain roughness.

FUTURE URBAN DEVELOPMENT SCENARIOS

The future development scenario analyses are not intended to be predictive or provide an accurate forecast of future development conditions and do not specifically reflect council's policy regarding filling within the floodplain or what would likely be supported or otherwise. Rather, the assessment has been undertaken to better understand the overall sensitivity of the floodplain to a specific change in future development.

Full details and results of the future development sensitivity testing are provided in Section 4 of the TER. While there are a small number of areas sensitive to filling and increased roughness within the floodplain, generally;

- The future development scenarios tested do not show a significant impact on flood levels, increased hydraulic risk or flood damages across the Ipswich LGA, and
- The extent of flooding largely does not change with just a slight increase in flood level and Hydraulic Risk categories (increase of approximately 0.2m, with a change in annual flood damages of under $1 million for both of the scenarios that were tested).

CLIMATE CHANGE SENSITIVITY

Sensitivity testing to explore the impacts of increased rainfall due to climate change was also undertaken.

The Intergovernmental Panel on Climate Change (IPCC) has predicted a five per cent increase in rainfall intensity per degree of global warming. This increase in intensity was applied to the 1 in 100 AEP model which found that many areas across the Ipswich region would experience up to a 0.3m flood level increase. Suburbs most sensitive to these increases include:

- Rosewood
- Thagoona
- Deebing Heights
- Yamanto
- Churchill
- Ripley Valley
- Bundamba
- Tallegalla
- Marburg
- Mount Mort
- Calvert
- Lanefield

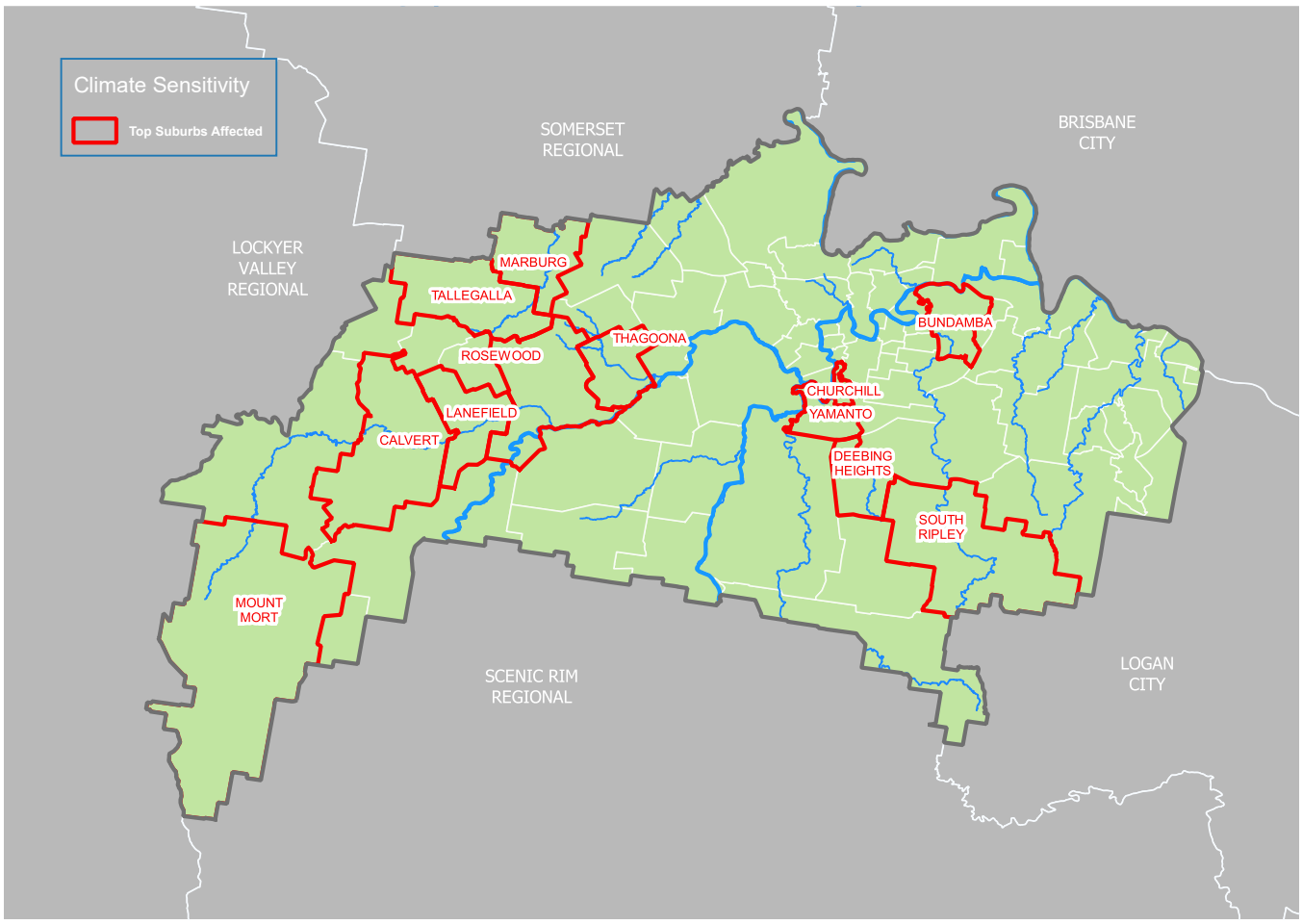


Figure 21: Suburbs most sensitive to flood level increases

RISK TREATMENT MEASURES

A continuous improvement and update cycle to ensure models remain contemporary will be implemented. This will include an investigation to undertake floor level surveys for residential buildings that are mapped in the highest HR categories. This will refine the information within the building database to provide a more accurate understanding of flood exposure and the appropriate risk treatment measures. Updating commercial damage figures, if and when they become available, will also improve the understanding of annual flood damages.

It is recommended that the IICP be reviewed and updated every five years or after a major flood event to see if the approach to mitigating flood risk is working and to continually refine the methodology based on the lessons learned from different floods. This timing aligns with the expected review and update of the SFMP.

Summary of recommendations below – see Action Plan for full details.

CURRENT AND FUTURE FLOOD RISK			
ACTION	**FLOOD RISK ADDRESSED**	**PRIORITY**	**S-P-R**
Investigate damages due to flash flooding in Bremer River, Warrill, Western, Bundamba and Woogaroo creeks and all overland flowpath catchments.	▪ Flash flood ▪ Expensive flood damages	Medium	▪ Source ▪ Pathway
Update the commercial value damages assessment as information not available for IICP.	▪ Expensive flood damages	Low	▪ Receptor
Update the Sandy Creek model.	▪ Deep/strong/frequent flood ▪ Flash flood ▪ Long duration of flood ▪ Isolating flood island	High	▪ Source
Update Mi Hi Creek model to full hydrologic and hydraulic model.	▪ Deep/strong/frequent flood ▪ Flash flood ▪ Long duration of flood ▪ Isolating flood island	Low	▪ Source
Review and update IICP in the context of the current understanding of flood risk on a five year timeline.	-	Low	▪ Source ▪ Pathway ▪ Receptor



OBJECTIVE 2: ACHIEVE SUSTAINABLE FLOOD MITIGATION THROUGH PHYSICAL INTERVENTION

PHYSICAL MITIGATION

A CONTEMPORARY APPROACH TO EVALUATION

Ipswich City Council has been a leader in taking a contemporary approach that included ecosystem health as a criteria when assessing physical flood risk mitigation options. This ensured options would be considered from a holistic approach taking into account a balanced range of issues. However, the flood mitigation options have also been assessed against traditional criteria, to ensure accountability in any recommendations made.

To reduce the current flood hazard at the source and along the pathway of flooding, physical flood mitigation measures that adjust the behaviour of floodwaters and lower the impacts to people have been explored. The analysis has considered:

- Traditional engineering approaches such as dams, levees, floodgates, detention basins, and barriers
- Natural floodplain solutions such as revegetation, re-engaging the floodplain, and naturalisation of waterways that ensure ecosystem health

The SFMP established a regionally consistent framework for identifying and assessing floodplain mitigation options. The framework sought to move away from the reliance on economics as the sole determining factor by also undertaking the multi-criteria analysis (MCA) that has due consideration of social, environment and economic factors.

The IICP has also adopted this contemporary approach to evaluating flood mitigation options which ensures multiple perspectives have been applied, such as broader waterway and ecosystem health outcomes, in addition to the reduction of flood risks.

During the IICP community engagement phase, the Managing Future Floods survey asked Ipswich residents what outcomes mattered most when considering how council manages flood. The top response was 'increase community safety'. This has been reflected during the technical work in the MCA, which gave safety equal weighting as environmental, social and economic factors.

Each of the flood mitigation options were evaluated to by checking against the following key questions:

- Does it improve the safety of people, i.e., reduce risk to life?
- Does it meet social standards, i.e., will it target vulnerable communities or build stronger community resilience?
- Does it provide economic benefit, i.e., are flood damages reduced, do benefits outweigh costs?
- Is it technically feasible, i.e., what are the necessary approvals and are there any residual risks?
- Does it impact essential infrastructure, i.e., protect water supply or other critical networks?
- Does it impact the environment, i.e., does it improve water quality or enhance ecosystem health and connectivity?

Each issue was weighted to reflect the overall importance of each criteria. Further details of the MCA evaluation process is documented in Section 5 of the TER.

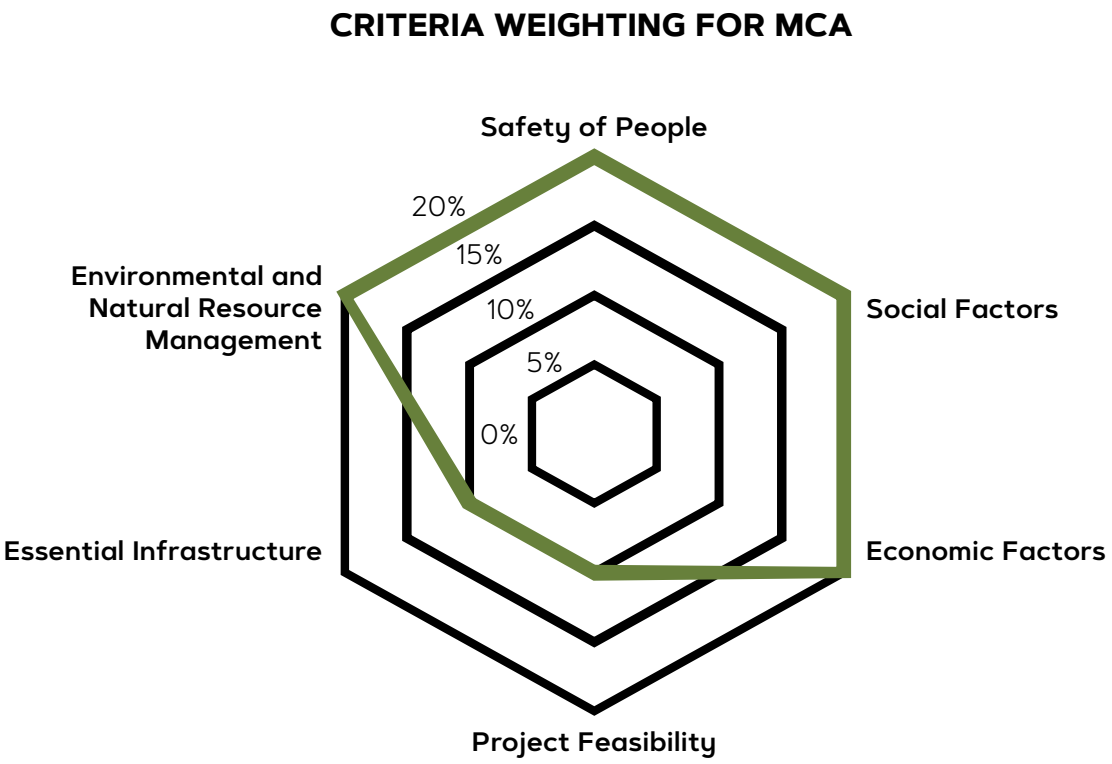


Figure 22 Criteria used in the multi-criteria analsyis (MCA)

PHYSICAL MITIGATION OPTIONS

There are a multitude of physical flood mitigation measures that can reduce flood damages within a catchment. These include:

- Dams;
- Detention basins;
- Permanent and temporary levees;
- Flood gates and backflow prevention devices;
- Channel modifications and straightening of creeks;
- High flow bypass channels/diversions;
- Dredging; and
- Natural floodplain management (NFM) measures, such as revegetation and floodplain re-engagement.

Physicall mitigations also have the potential to have adverse impacts on areas within the floodplain, and can be associated with high residual risk.

STRUCTURAL OPTIONS FROM THE SFMP FOR IPSWICH CITY COUNCIL

As a result of the SFMP, three structural options that may provide regional flood risk reduction benefits were recommended for further investigation:

- Structural Option 3: investigate potential for other locations for regional-scale dry flood mitigation dams at new floodplain crossings of the Inland Rail route or other major linear infrastructure. Any potential locations to be referred to the State for consideration in conjunction with SO2.
- Structural Option 5: Undertake a feasibility study for a flood gate at Marsden Parade as part of the Ipswich Local Floodplain Management Plan.
- Structural Option 7: Undertake a local options assessment for the Goodna CBD levee as part of the Ipswich Local Floodplain Management Plan.

These regional infrastructure solutions have been explored further in the IICP with due consideration of localised flood impacts, the MCA developed as part of the IICP and a high-level analysis of additional design features.

In addition to the three structural options recommended for further analysis from the SFMP, a range of other physical mitigation measures are considered in Section 5 of the TER.

The IICP has found that natural floodplain management (NFM) techniques such as large-scale revegetation had multiple benefits, with significant ecological and waterway health outcomes as well as significantly reducing the impact of flooding downstream. The assessment has demonstrated some examples where multiple objectives can be achieved and (in a new approach for Australia) incorporate flooding and waterway health considerations.

'Hard' engineering activities such as dams, levees, dredging and the straightening of waterways are a more 'traditional' floodplain management practice. There are many examples that have been successful in reducing the impact of flooding. However, from the long list of options, only four made it through the initial MCA and on to the shortlist.

The challenge with 'hard' structures is that they can also have a negative impact on water flows and disconnect floodplains. They also come with the burden of increased asset management, significant residual risk and issues of operating complex structures. They can also increase flooding downstream of concrete lined channels and levees, risking potential failure. Structures may also provide a false sense of security for the community and therefore reduce the community's overall flood resilience.

SHORTLISTING OPTIONS

The shortlisting process had due consideration of a range of additional tangible and intangible costs and benefits such as social health and the environment including potential recreation and amenity value associated with having connection to waterways and environmental areas.

The physical mitigation options that perform best when considering both the cost-benefit and MCA results are;

- Warrill Creek NFM Major
- Warrill Creek NFM Minor
- Bundamba Creek NFM Major
- Bundamba Creek NFM Minor.

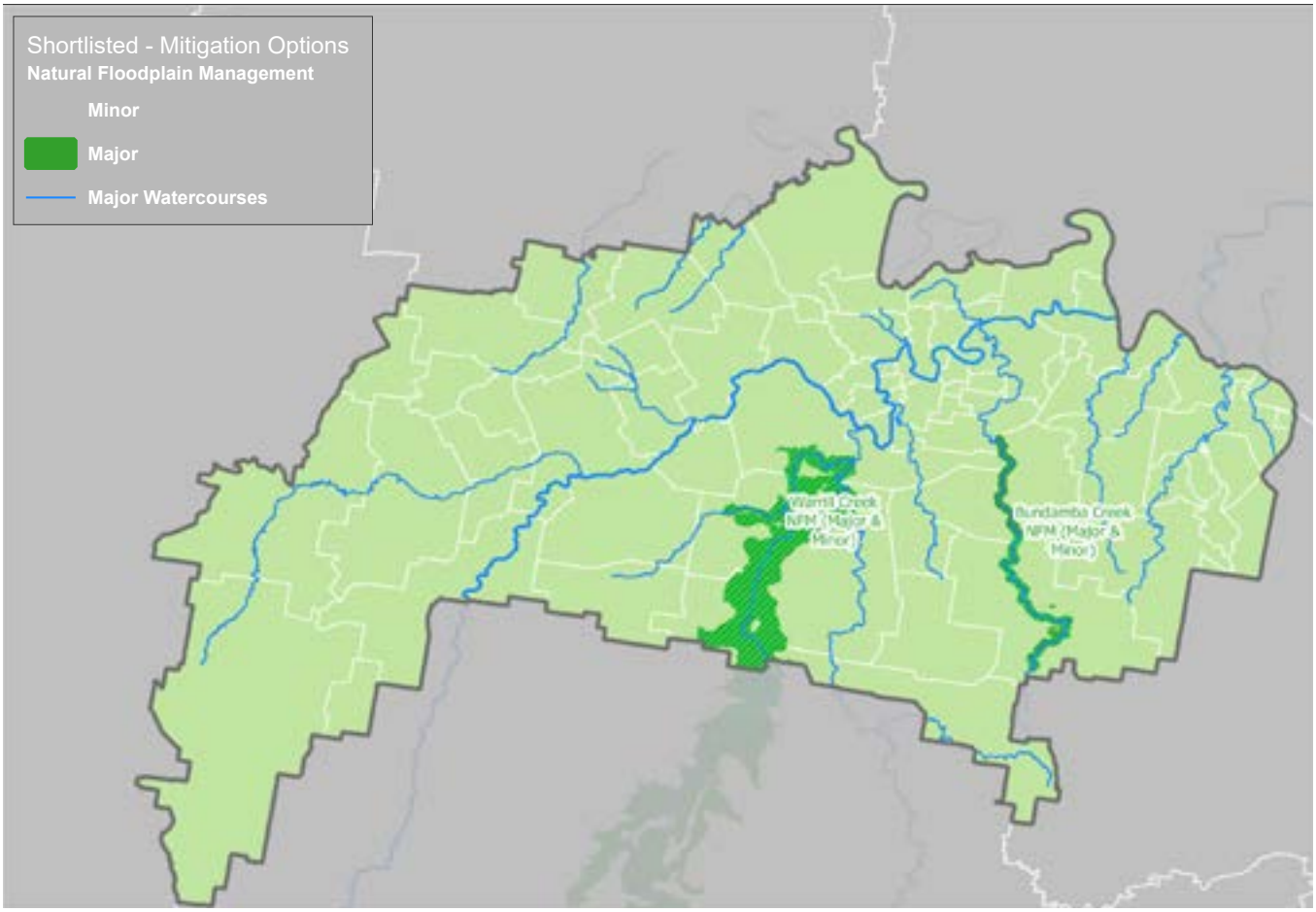


Figure 23: Location of shortlisted physical mitigation options

Further details on both the cost benefit analysis and MCA results and findings can be found in Section 5 of the TER.

INLAND RAIL

The proposed Inland Rail route passes through the Ipswich LGA, crossing both Warrill Creek (near Willowbank) and the Bremer River (near Rosewood).

A component of the IICP is to investigate upstream dams. Potential dam sites were shortlisted by SEQwater in the Warrill Creek and Bremer River catchments. As part of the IICP, council conducted a high-level assessment of the possibility of using the Inland Rail route as a flood mitigation asset.

Potentially, both proposed crossing sites could provide flood storage and downstream benefit. Combining the proposed Inland Rail with flood storage could provide cost savings compared to creating a new dam. However it is important to note:

- Inland Rail route is still under development
- flood mitigation of this magnitude would require coordination and implementation at a State level
- modelling carried out was only preliminary and the cost benefit analysis was performed as an estimate.

Therefore, the IICP assessment is centred on the potential to recognise opportunity from the Inland Rail route and refer these findings to the State.

Some of the potential opportunities identified in the IICP high-level assessment included:

- potential for storage behind the proposed Warrill Creek crossing that could provide significant downstream benefit
- the Bremer River crossing and rail embankment had potential to provide flood storage similar to the dam options identified by SEQwater
- combining proposed Inland Rail with flood storage could provide cost savings compared to creating a new dam.

Potential issues identified included:

- flood mitigation may require substantial modification to the proposed rail infrastructure
- using the proposed embankment height for flood mitigation could have significant ecosystem issues
- increasing water storage may affect properties and roads in the area.



NATURAL FLOODPLAIN MANAGEMENT

Revegetating, restoring and protecting catchments is a means of reducing flood risk as it decreases flood levels and velocities downstream. A naturally functioning floodplain fills and slowly drains, with vegetated waterways which hold back flows and soils into which floodwaters gradually soak.

Undertaking natural floodplain management (NFM) can also improve ecosystem health by connecting distant ecosystems via wildlife corridors and koala habitats, improve water quality and biodiversity in rivers and estuaries by reducing the downstream transport of nutrients and fine sediment and recharge groundwater reserves and increase dry weather and environmental flows. There is also potential to co-manage these areas as carbon offset or koala offset delivery areas and regenerate the vegetation understorey and ground layer species damaged by heavy grazing.

Water quality models can provide insights into how the water quality responds to management actions in the upstream catchment. The IICP examined two scenarios with the water quality model used as part of the Healthy Land and Water report card initiative. The two scenarios were an assessment of the Warrill Creek NFM and an assessment of the impacts of increasing dry weather and environmental flows.

The analysis did show that even large-scale restoration works associated with NFM results in minimal improvements in water quality in the river and estuary but has shown there is a significant benefit with the introduction of increased environmental flows for waterway health aspects of the Bremer River and Warrill Creek systems. There will be further investigation of possible intervention methods on irrigation uptake upstream and investigation of possible groundwater recharge locations in association with the potential future NFM works. Detailed analysis of the water quality scenarios tested can be found in Section 5 of the TER.

The scale of measures considered in the IICP may be impractical to deliver as a sole project but may be considered as part of a multiple delivery mechanism including strategic planning of the floodplain, community conservation groups and capital works. These options provide benefits for the community but also significant benefit for critical infrastructure downstream.

WHAT DOES NFM INVOLVE?

Revegetation – planting trees and other riparian species – is a key strategy of natural floodplain management. It contributes to land-based conservation outcomes and also intercepts rainfall and allows water to soak into the soil. This helps recharge the groundwater table and also prevents excessive runoff. This benefits farmers and other groundwater users because it helps build resilience in the land for dry periods, and reduces salinity.

Planting trees on the floodplain also slows the velocity of water, which reduces peak flows downstream in population centres. Slowing the water also reduces the damage to the waterway bed and banks and allows sediment to disperse on the floodplain, a key process in maintaining productive landscapes. Native trees provide deep anchoring of soils and provide critical shade over a waterway to manage water temperatures, reduce algal growth and restrict weeds. Branches and roots also provide habitat for native fish and other species. Groundcovers and rushes provide bank stability and filter water.

WHAT WOULD IT LOOK LIKE?

The most appropriate vegetation is the ecosystem that was generally present prior to clearing in the Ipswich catchments.



Within the riparian corridor (the area next to the water) this vegetation is a mix of eucalyptus, casuarinas and melaleuca species, and numerous shrubs and ground covers such as lomandra.

Within the floodplain, the vegetation would consist of blue gums and a variety of other canopy trees. To achieve a multi-stage vegetation benefit, more shrubs and ground covers would be introduced to act as a deterrent to invasive weeds such as lantana.



RISK TREATMENT MEASURES

In summary, the findings of the IICP investigations into the SFMP recommendation about upper catchment dams behind the proposed Inland Rail route will be referred to the Queensland Government for consideration.

A feasibility study into the favourable natural floodplain management options on Warrill Creek and Bundamba Creek will be implemented and as part of this investigation council will also look at how to increase environmental flows on the Bremer River and Warrill Creek through more detailed methods on irrigation uptake upstream and identifying possible groundwater recharge locations.

Other physical mitigation options have not been ruled out, for a full list of physical mitigation options refer to Section 5 of the TER.

Summary of recommendations below – see Action Plan for full details.

PHYSICAL MITIGATION			
ACTION	**FLOOD RISK ADDRESSED**	**PRIORITY**	**S-P-R**
Consider undertaking detailed design and assessment for the Warrill Creek NFM options.	▪ Deep/strong/frequent flood ▪ Long duration of flood ▪ Isolating flood island ▪ Expensive flood damages	Medium	▪ Pathway ▪ Receptor
Consider undertaking detailed design and assessment for the Bundamba Creek NFM option.	▪ Deep/strong/frequent flood ▪ Long duration of flood ▪ Isolating flood island ▪ Expensive flood damages	Medium	▪ Pathway ▪ Receptor
Consider undertaking more detailed assessment of intervention methods on irrigation uptake upstream and assessing possible groundwater recharge locations to increase environmental flows in the Bremer River and Warrill Creek systems.	-	Low	▪ Pathway



OBJECTIVE 3: PLAN FOR DEVELOPMENT OUTCOMES THAT ARE RISK-INFORMED

LAND USE PLANNING

Land use planning and development control represents one of the most cost-effective options for minimising flood risk, especially where development is restricted to occur outside the floodplain.

The range of flood risk factors considered in the IICP include flood frequency and hazard, flash flooding, long duration of inundation, isolation and vulnerable communities. This flood information is used to influence land use planning to ensure new developments are designed and situated away from flood risk areas or take appropriate mitigation measures to ensure risk is commensurate with the intended use of the site.

The highest at-risk areas which are exposed to high hazard and frequent flood events may be considered intolerable for people, property and most land uses. Tolerability of development and/or community tolerability to existing flood risks also depends how quickly and how long key access roads become flooded. Development in areas where some or all of these flood risk factors cannot be avoided must be able to provide for safe evacuation or safe refuge and must not burden effective emergency services operations during a flood event.

State, regional and local planning instruments have a role to play to ensure local development outcomes effectively manage flood risk by ensuring risk remains acceptable or tolerable, by maximising storage potential of the floodplain and by ensuring no increase in run-off from new developments.

This concept of 'tolerability' helps to identify what might be appropriate to manage the flood risk in a particular area. This might include where to locate certain facilities such as aged care or hospitals. Or it might be development requirements to manage flood risk on a site-by-site basis such as resilient design or emergency management procedures.

The SFMP, IICP and land use planning policy recommendations may inform State, regional and local planning instruments. The SFMP provides land use planning guidance material that specifically deals with integrating the SPP State interest in a regional Brisbane River catchment context. The IICP provides the tools to align with the recommendations of the SFMP Land Use Planning Guidance Material, refine future land use planning responses and incorporate these within the current, or future planning scheme.

SFMP RECOMMENDATIONS

The SFMP makes recommendations for regionally consistent land use planning responses, and with reference to the Land Use Planning Guidance Material helps in identifying flood hazard and local risk treatment measures.

Details of how SFMP recommendations will be addressed through local planning practice are provided in Section 6 of the TER.

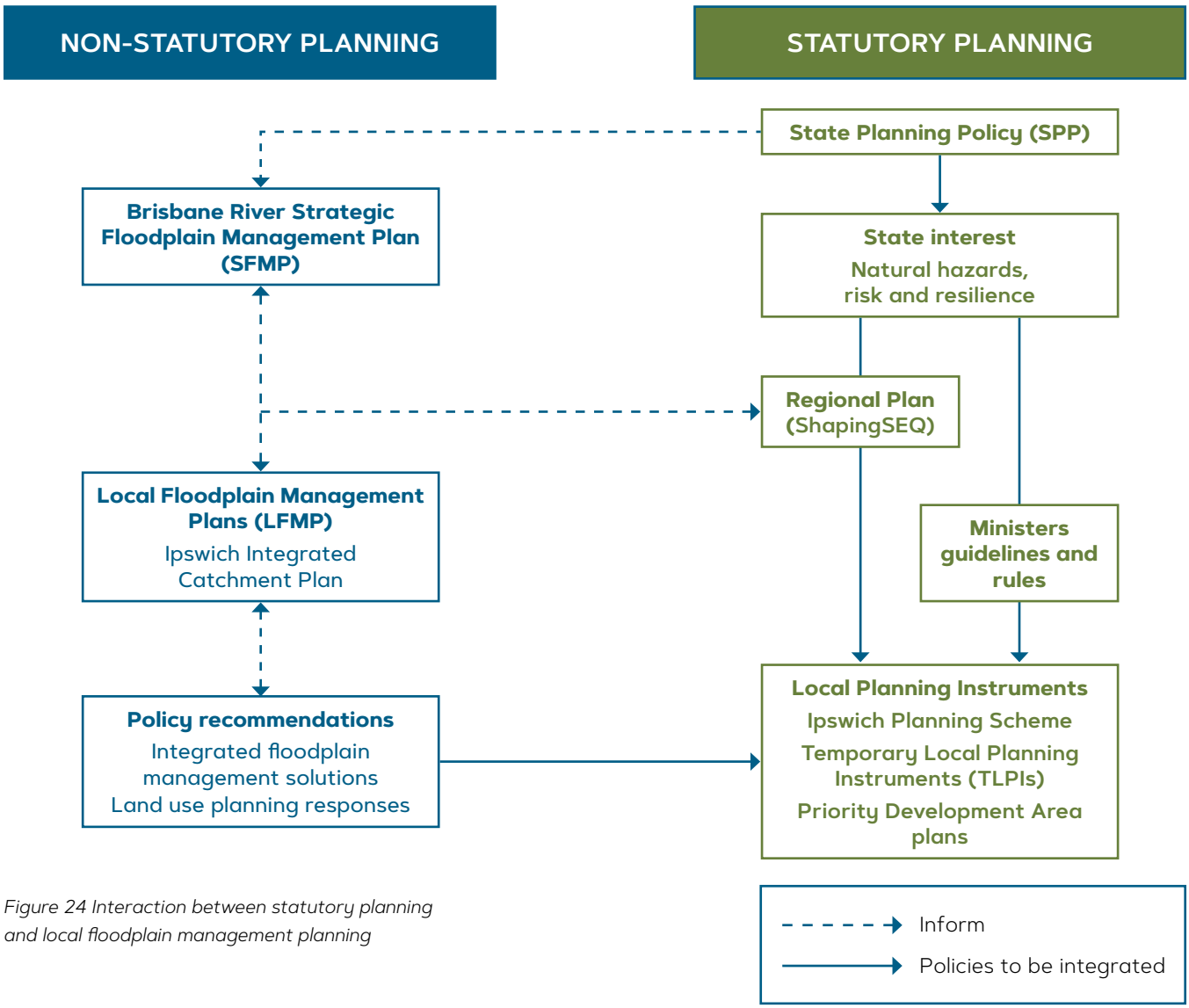


Figure 24 Interaction between statutory planning and local floodplain management planning

COMPLIANCE WITH STATE POLICY

Existing development and planning controls in Ipswich align with the key State Interest Policies that apply to land use planning in Queensland. The following policies are or will be fully integrated within the Ipswich planning framework:

- Natural hazard areas have been identified, including flood hazard areas.
- A fit-for-purpose risk assessment is undertaken to identify and achieve an acceptable or tolerable level of risk for personal safety and property in natural hazard areas.
- Development in flood hazard areas (a) avoids the natural hazard; or (b) where it is not possible to avoid the natural hazard area, development mitigates the risks to people and property to an acceptable or tolerable level.
- Development in natural hazard areas supports, and does not hinder disaster management capacity and capabilities.
- Development directly, indirectly, and cumulatively avoids an increase in the exposure or severity of the natural hazard and the potential for damage on the site or to other properties.
- Avoids risks to public safety and the environment from the location of the storage of hazardous materials and the release of these materials as a result of a natural hazard.
- Development maintains or enhances the protective function of landforms and vegetation that can mitigate risks associated with the natural hazard.
- Community infrastructure is located and designed to maintain the required level of functionality during and immediately after a natural hazard event.

RISK-BASED PLANNING

Flood overlays create a 'footprint' that help determine appropriate land uses for those areas. The IICP will assist council to develop a more informed land use planning approach that uses a risk-based approach. Comprehensive data and modelling will inform the development of a new flood hazard overlay. This will ensure the level of exposure from new development is appropriate to the level of risk.

With this information, land use can be located in areas commensurate with the risk. It's an approach to future land use planning that aligns with floodplain management best practice.

The risk-based approach has a particular focus on HR to determine the four categories of hazard in a new flood overlay which shows council's future land use planning responses align with floodplain management best practice. Classifying hazard across the floodplain provides baseline information for council to undertake strategic land use planning and fulfil the risk-based approach.

There are other ways the IICP will assist the drafting of the new Ipswich Planning Scheme to take a contemporary approach to managing flood risk for future development. This includes managing vulnerable uses within the floodplain, examining the impact of climate change, and introducing flood resilient precincts. The draft Ipswich Planning Scheme is still in development.

Refer to Section 6 of the TER for a detailed review of the current planning scheme and recommendations for future code and planning scheme policy wording that assists in the draft Ipswich Planning Scheme.

COMBINATION OF FLOOD RISK FACTORS

There are many ways that land use planning can help manage particular flood risks. Due consideration has been given to the flood risk factors and the impact these factors have on tolerability to flood risk.

HYDRAULIC RISK

The frequency and impact of flood events including the depth of water and velocity.

Land use planning responses may include:

- restrictions on future development intensity;
- ensuring flood water is not impeded by built structures; and controls that support building critical infrastructure (e.g. hospitals, motorways) in areas that have lowest hydraulic risk.

TIME TO INUNDATION

How many hours it takes water to reach a property from a flood source. If it takes less than six hours for floodwaters to reach a property, then residents have a short time to react.

Land use planning responses may include:

- restrictions on future development intensity;
- avoid allowing land uses that are vulnerable or difficult to evacuate; and
- consideration of specific requirements, such as Flood Emergency Management Plans, to demonstrate how occupants are able get to higher ground in times of flooding and how the land use functions in a flood event.

DURATION OF INUNDATION

How many hours properties will be affected by flood water. If properties are affected for more than 36 hours, residents may need to be self-sufficient for an extended time if sheltering at home.

Land use planning responses may include:

- restrictions on intensity of accommodation or residential land uses;
- avoiding allowing land uses that are vulnerable or difficult to evacuate; and
- consideration of specific requirements, such as the use of flood resilient building materials that reduce economic damages and enable residents to safely return to their homes faster.

FLOOD ISLANDS

Areas that are surrounded by flood water and at risk of isolation.

Land use planning responses may include:

- avoiding the creation of new flood islands in future development by having regard to flood events up to the Probable Maximum Flood;
- restrictions in increasing the density of existing (brownfield) development on low flood islands;
- restrictions on new development (greenfield) on flood islands;
- avoid vulnerable, accommodation and residential land uses on flood islands; and
- consideration of specific requirements such as sheltering in place strategies.

VULNERABILITY

Vulnerable communities have been mapped based on particular indicators known to increase risk during flood events.

Land use planning responses may include:

- long term infrastructure upgrades to ensure critical connections to emergency services and community; and
- consideration of specific requirements to ensure access/egress to higher ground during flood events.

These flood risk factors have been reviewed in the context of local planning framework. These factors and land use responses are discussed in more detail in Section 6 of the TER.

FUTURE FLOOD RISK

The IICP has assessed future development scenarios in the floodplain.

With Ipswich's population set to double in 20 years, it is important to consider how increased development can affect the behaviour of flood waters. The modelling created two 'ultimate development' scenarios – essentially considering all future development areas that could reasonably be expected to be developed.

The assessment identified areas that are highly sensitive to filling and development activities within the floodplain. For these areas it may be important to:

- make sure that areas that allow floodwater to flow are not developed in a way that creates ponding or blocks floodwater;
- ensure that filling activities do not worsen the flow of floodwater or flood storage in an area; and
- assess impacts of development on flood events beyond the traditional 'defined flood event'.

Testing the impacts on flooding from filling in developable areas between the 1 in 20 AEP and 1 in 100 AEP show that areas particularly sensitive to fill are:

- South Ripley
- Ipswich CBD
- Walloon.

Testing the 'roughness' of the floodplain to simulate activities such as fences and buildings in the floodplain shows that areas sensitive to increased development activity are:

- Blackstone in the Bundamba Creek catchment
- Ipswich CBD, Six Mile Creek catchment and
- South Ripley near Wards Rd.

Generally, future development scenarios do not show a significant impact on flood levels, increased hydraulic risk or flood damages across the Ipswich LGA. The modelled future development scenarios are discussed in more detail in Section 6 of the TER.

RISK TREATMENT MEASURES

The findings in the IICP relating to HR, TTI, DFI, Flood Islands, vulnerability and future flood risk will be used to inform and assist the drafting of the new Ipswich Planning Scheme.

Generally, by avoiding the intensification of residential and vulnerable uses in areas with high HR, TTI of under 6 hours, inundation of greater than 36 hours or upon flood islands, future development will not be subjected to intolerable risks.

Acceptable responses for certain uses that mitigate the risk to a tolerable level such as use of resilient built form and building materials in areas of low flood hazard, or requirements for a Flood Risk and Emergency Management Plan (FEMP) will be encouraged.

Using knowledge of flooding behaviours can preserve pockets of flood storage to minimise future flood risk impacts in areas identified as particularly sensitive to fill or development activity.

In the longer term, strategic land use and infrastructure planning will ensure existing vulnerable communities have flood-free access to critical connections, key services and facilities. Climate change projections and flooding modelling to inform future decision making will continue to be monitored and reviewed.

Summary of recommendations below – see Action Plan for full details.

LAND USE PLANNING			
ACTION	**FLOOD RISK ADDRESSED**	**PRIORITY**	**S-P-R**
Apply a consistent methodology to the identification of hazard categories for the purposes of draft new flood hazard overlay.	▪ Deep/strong/frequent flood	Medium	▪ Pathway
Extend any development controls for residential uses to the HR4 category to include the 1 in 500-year H3 hazard category.	▪ Deep/strong/frequent flood	Medium	▪ Receptor
Monitor and review climate change projections and flood modelling recommendations over time to inform future land use planning decision making.	Deep/strong/frequent flood Expensive flood damages	Low	▪ Source ▪ Pathway
Develop and include a city-wide overland flow path assessment to allow risk-based assessment of this type of flood risk.	▪ Flash floods	Medium	▪ Source ▪ Pathway
Avoid intensification of development in areas mapped in HR1c and HR1b.	▪ Deep/strong/frequent flood	High	▪ Receptor

LAND USE PLANNING			
ACTION	**FLOOD RISK ADDRESSED**	**PRIORITY**	**S-P-R**
Continue the existing requirements in the current planning scheme that promote built form and resilient building materials as an acceptable mitigation response such as building on stilts, or with wet / dry proofing on ground floor, but may consider revising trigger areas based on lower risk areas such as HR2a, HR3a, HR4 and HR5.	▪ Deep/strong/frequent flood	Medium	▪ Receptor
Include requirements for easements in greenfield areas up to the DFE.	▪ Deep/strong/frequent flood	Medium	▪ Source ▪ Pathway
Flood Risk and Emergency Plan (FEMP) for non-residential uses in locations where TTI is <6 hours and where DFI is >36 hours.	▪ Flash floods ▪ Long duration of flood	Medium	▪ Receptor
Responses such as FEMPs linked to new development in locations subject to flood islands.	▪ Flood islands	Medium	▪ Pathway
Development control measures that may be applied to the development assessment process of vulnerable uses below the PMF.	▪ Deep/strong/frequent flood ▪ Flash floods	Medium	▪ Pathway
Provide a definition of vulnerable uses in the new Ipswich Planning Scheme.	▪ Deep/strong/frequent flood ▪ Flash floods ▪ Long duration of flood ▪ Isolating flood island ▪ Expensive flood damages	High	▪ Receptor
Avoid vulnerable uses and non-intensification of residential uses in locations where TTI is <6 hours and DFI is >36 hours, or locations subject to flood islands. In areas of low hazard built form and resilient building materials should be considered as an acceptable mitigation response	▪ Flash floods ▪ Long duration of flood	High	▪ Receptor

LAND USE PLANNING			
ACTION	**FLOOD RISK ADDRESSED**	**PRIORITY**	**S-P-R**
Consider the following changes in draft planning scheme: ▪ Request a Flood Risk Assessmentin terms of the acceptability or tolerability of flood risk on a particular use or activity; ▪ Adding a provision for commercial, industrial and other non-residentual uses to avoid increasing the concentration of people in areas in HR1c and HR1b; ▪ For residential uses removing provision relating to a flood depth of no more than 800mm; ▪ Minimum clearance for the construction of undercrofts.	▪ Deep/strong/frequent flood ▪ Flash floods ▪ Long duration of flood ▪ Isolating flood island ▪ Expensive flood damages	Medium	▪ Source ▪ Pathway ▪ Receptor
Provide all GIS datasets to developers to ensure safety to people and property and to ensure emergency services are not burdened during flood event.	▪ Deep/strong/frequent flood ▪ Flash floods ▪ Long duration of flood ▪ Isolating flood island ▪ Expensive flood damages	High	
Preserve pockets of flood storage in the catchment to avoid future flood risk impacts in areas where HR categories and flood levels may increase as a result of filling or due to development activity.	▪ Deep/strong/frequent flood	Medium	▪ Pathway
Continue provisions that maintain flood storage capacity and do not create impacts on sites upstream or downstream – this is normally a request to provide hydraulic and hydrology report demonstrating compliance.	▪ Deep/strong/frequent flood	Medium	▪ Pathway ▪ Receptor



OBJECTIVE 4: PROMOTE FLOOD-RESILIENT BUILT FORM

PROPERTY SPECIFIC ACTIONS

Houses that are most at risk of hazardous floodwater may benefit from a range of property specific actions that can help reduce the impact of flood on the property and the occupants.

There are many ways homeowners can adapt building design, construction and materials so their property can withstand substantial, and multiple, inundations with floodwater. A good flood resilient design can allow occupants to safely store belongings before a flood and easily clean, repair and move back into their house. This can include:

- Wet and dry-proofing methods
- House raising
- Retrofitting with resilient building materials

There are circumstances, however, where removing a building from harm's way is the best approach. For this reason, properties that are most at risk of hazardous floodwater need to be identified so that voluntary house purchase can be considered as an option.

Whilst the onus to enact these measures will predominately reside with homeowners, the process can be facilitated by council by considering the recommendations made to ensure implementation is effectively coordinated.

The Queensland Reconstruction Authority provides tips for homeowners to renovate using flood resilient materials. This will be encouraged through the implementation of community awareness and resilience work actions in Ipswich. For consistent messaging and advice regarding flood resilient building techniques refer to www.getready.qld.gov.au/get-prepared.

The SFMP presents the basis for a coordinated, regional response for the uptake of flood resilient built form. The desired outcome 6 of the SFMP states:

'Building design and construction improves community resilience and reduces property damage'

Recommended strategies to achieve this outcome are through the development of guidance material and greater clarity in legislative arrangements. Every house type can be improved to better prepare for and recover from flood events via flood resilient design solutions and consideration of building materials.

VOLUNTARY HOUSE PURCHASE

House purchase programs are used in areas susceptible to frequent and severe flooding to mitigate the risk posed to life and property. Due to the associated high cost, they are only implemented when other measures are not suitable for reducing flood risk. In addition, the market value of their property must have decreased to an extent that the owners do not feel they will get a better price on the open market. With that in mind, it is considered that VHP schemes will enable a longer-term floodplain management strategy.

CONSIDERATIONS

It is important to note that there will be no forced resumption of buildings under a VHP program. If a program of VHP is implemented, any offers of purchase made by council would be the choice of the owner whether to accept.

Each financial year, for as long as a program(s) may continue, all buildings that meet the criteria for purchase, whether identified by council or offered by the owner, will be prioritised for purchase based on the seriousness of anticipated flooding. This priority may change through the financial year depending on the number of council offers accepted or declined.

Further considerations are discussed in Section 7 of the TER.

CASE STUDY – BRISBANE CITY COUNCIL VHP SCHEME

An example of a successful VHP scheme is in the Brisbane LGA. In 2009, Brisbane City Council (BCC) invited homeowners with buildings within the 1 in 2 AEP creek flood extent to be part of the program. Once successfully purchased, the homes were removed from the site and the land turned into parkland. Homes in these areas had experienced regular nuisance flooding, either across habitable floor or utility areas. The Brisbane VHP program concluded in 2017.

Without appropriate planning to accompany property buy-backs, land may remain unused for any purpose for an extended period of time. The removal of buildings from the flood affected area, coupled with a moratorium on any new development, can amount to 'sterilisation' of the land. Sites are typically next to creeks and present opportunities for multiple benefits to the community.

Further details of the BCC voluntary house purchase scheme, and analysis undertaken on voluntary house purchase options in Ipswich are contained in Section 7 of the TER.

RETROFITTING BUILDING MATERIALS

There are a range of building techniques and materials that can be retrofitted to homes in flood risk areas aimed at improving the resilience of buildings and their contents.

Examples of this include materials resistant to inundation damage such as double-brick, brick veneer and tiling or waterproof flooring and lining, water-resistant timber framing, closed-cell insulation, and eliminating cavities behind stairs and wall spaces. Also included is the raising of internal services such as electricity power points, air conditioning units and/or hot water units.

Retrofitting building materials is a suitable method for houses that are subject to lower hazard flood areas such as H1 to H4 where there is no real risk of structural damage.

Voluntary house raising is also an effective method of reducing damages as a result of flood hazards.

Consideration must be given to the design flood event, as rarer, larger flood events can still inundate habitable floor levels of raised houses. House raising applies to homes that are either low or highset timber houses.

A building permit is issued by council once plans for the building work comply with the Building Code of Australia and applicable Australian Standards.

APPLICATIONS	PURPOSE
Raising appliances	Maintain essential services during a flood event, improve electrical safety, minimise risk of damage or replacement costs.
Flood resilient floors and cabinets	Avoid damage to floors and cabinets by using water resistant building materials. This will also improve cleaning capacity to aid rapid recovery after a flood event.
Flood resilient walls	Prevent inundation of wall cavities to reduce wall damage and limit mould growth, aiding rapid recovery after a flood event.
Shifting house footprint within site	Shifting the house to a higher location on the site aims to maximise conveyance capacity of the site, ensure floodwaters can pass unimpeded and minimise disruption to residents during flood events.
House raising by increasing the floor level by use of stumps	Many homes across Australia were constructed prior to contemporary planning levels. Raising older houses to achieve a higher flood immunity is a good solution to reducing potential flood risks.
House raising by replacing stumps to be more flood resilient	Older constructions typically used wooden stumps as foundation for a 'Queenslander' style house. Replacing these wooden stumps with more resilient materials can provide added benefits of protection against termites, water and rotting.
Other simple measures for consideration: ▪ **Reduce impervious surface areas** ▪ **Permeable fencing to allow flood waters through** ▪ **Bioswales** ▪ **Berms** ▪ **Rainwater tanks** ▪ **Improved drainage**	Replacement of materials to avoid flood damage, slow the flow of waters and help redirect waters away from properties.

Table 9 Examples of retrofitting flood resilience actions and materials



Image: Example of house raising, Lismore NSW (Source: ABC News, Margaret Burin)

RISK TREATMENT MEASURES

Investigation of a program of retrofitting building materials to residential properties mapped in highest flood risk areas is recommended. This will include the feasibility of implementing house raising to eligible buildings across Ipswich. A voluntary house purchase program to residential properties mapped in highest flood risk areas and exposed to over flooding in a 1 in 10 AEP flood event will also be investigated.

These investigations will include a detailed floor level survey for all residential buildings mapped in the highest HR categories HR1c and HR1b and a survey of building types within council's building database to ensure an assumption of property-scale flood risk is based on the most accurate data available. Property specific actions reduce flood risk to homes and can lower flood damages by contributing to reductions in personal loss, danger to personal safety and stress.

House purchase is the most effective means of removing residents from the risk of flood inundation. To improve flood resilience to homes that are exposed to flood risk, encouraging flood resilient building materials to be retrofitted to buildings helps to reduce economic and social impacts.

Summary of recommendations on following page – see Action Plan for full details.

PROPERTY SPECIFIC ACTIONS			
ACTION	**FLOOD RISK ADDRESSED**	**PRIORITY**	**S-P-R**
Explore a region-wide building specification dataset in coordination with the Insurance Council of Australia as to minimum requirements and if Commonwealth funding will be available to develop the central database.	▪ Deep/strong/frequent flood ▪ Expensive flood damages	Low	▪ Receptor
Undertake detailed floor level survey of all residential buildings in the highest risk areas.	▪ Deep/strong/frequent flood	High	▪ Receptor
Investigation of a retrofitting building materials program.	▪ Deep/strong/frequent flood	High	▪ Receptor
Investigation of a Voluntary House Purchase Program	▪ Deep/strong/frequent flood	High	▪ Receptor



OBJECTIVE 5: ENABLE OUR COMMUNITY TO ANTICIPATE, RESPOND AND ADAPT TO FLOODS AND FLOODING

COMMUNITY AWARENESS AND RESILIENCE

Computer modelling and historical records can tell us where fast-moving and dangerous flood water may flow. Census and other demographic data can tell us which parts of our communities are most vulnerable in terms of people's ability to prepare, respond and recover from a flood event.

These flood risk and community factors have been combined to determine priority Ipswich suburbs that require particular attention for Community Awareness and Resilience (CAR) programs.

There is already significant work and research that has been undertaken, from the international stage through to local initiatives, to build community flood awareness and resilience.

By drawing on extensive international, national, Queensland and local research and resources a comprehensive picture of Ipswich's flood resilience and awareness has been developed. This has led to four principles: Awareness, Preparedness, Response and Recovery.

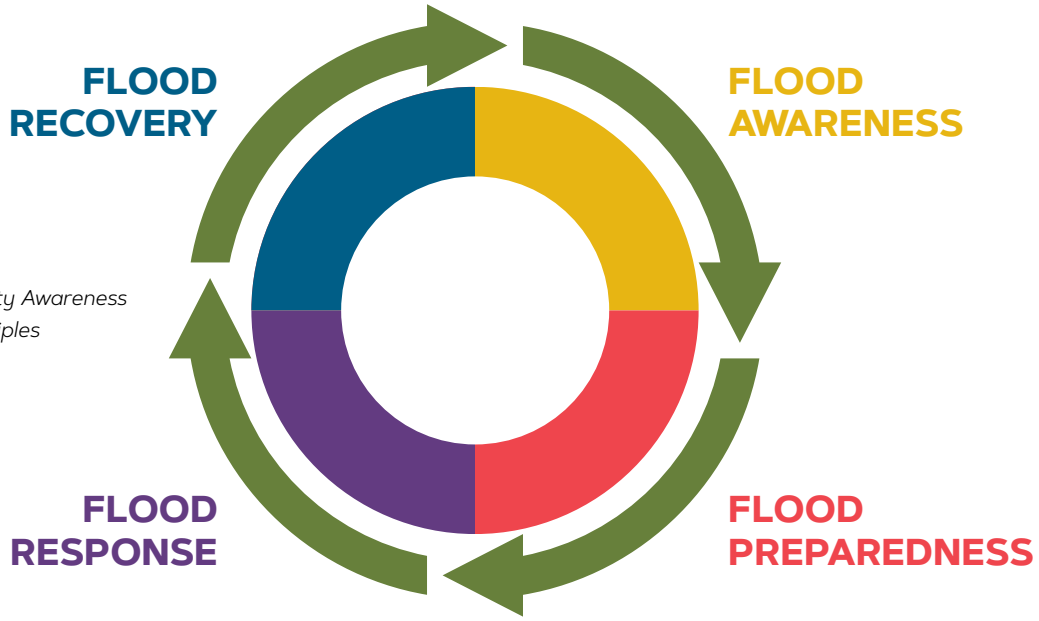


Figure 25 Community Awareness and Resilience principles

Aligning with the CAR principles shown above, the vision for a flood aware and resilient Ipswich can be summarised as follows; the Ipswich community are:

- Aware of flood risk, past flood events, and have a high level of water literacy. The community has access to all the information required to be able to prepare and respond to a flood event;
- Prepared for a flood event, with appropriate steps taken to be ready to respond to a flood hazard at any time. Plans allow for adaptability and resilience to the unknown risk of flood hazards;
- Empowered to respond to the occurrence of a flood event efficiently and effectively; building on flood awareness and previously prepared response plans; and
- Have high levels of tolerability and resilience, enabling rapid recovery from a flood event; as well as the ability to adapt to future flood events as a recovery measure.

While resilience and awareness could be built in all suburbs, it is most relevant to those with the highest flood exposure, as well as social factors that increase a community's risk.

USING DATA TO CREATE A TAILORED APPROACH

Each community in Ipswich has its own character and identity. Similarly, flooding affects each community in a different way.

Developing community awareness and resilience strategies is not a one-size-fits-all approach as each suburb has its own factors that need to be addressed. It was important to gather and combine a range of information that helped determine technical and social factors affecting Ipswich suburbs – especially those most at risk during a flood event.

The data is important because an area that scores high in physical vulnerability drivers may require additional evacuation planning, whereas a suburb that has a large number of properties on high flood islands may require a focus on creating emergency kits for sheltering in place.

The data and information included:

- regional market research through the SFMP. Ipswich was included in a telephone survey on key flood topics;
- local feedback through the Managing Future Floods survey. This extended the regional market research and provided important information on Ipswich's understanding of flood;
- comments and feedback from early consultation for the next Ipswich planning scheme;
- census data for key vulnerability indicators for Ipswich suburbs; and
- extensive modelling to map flood risk factors across Ipswich suburbs

The flood modelling and vulnerability data analysis highlighted ten suburbs that are a priority for actions to build community awareness and resilience are shown below. Details of the analysis undertaken on determine priority suburbs can be found in Section 8 of the TER.

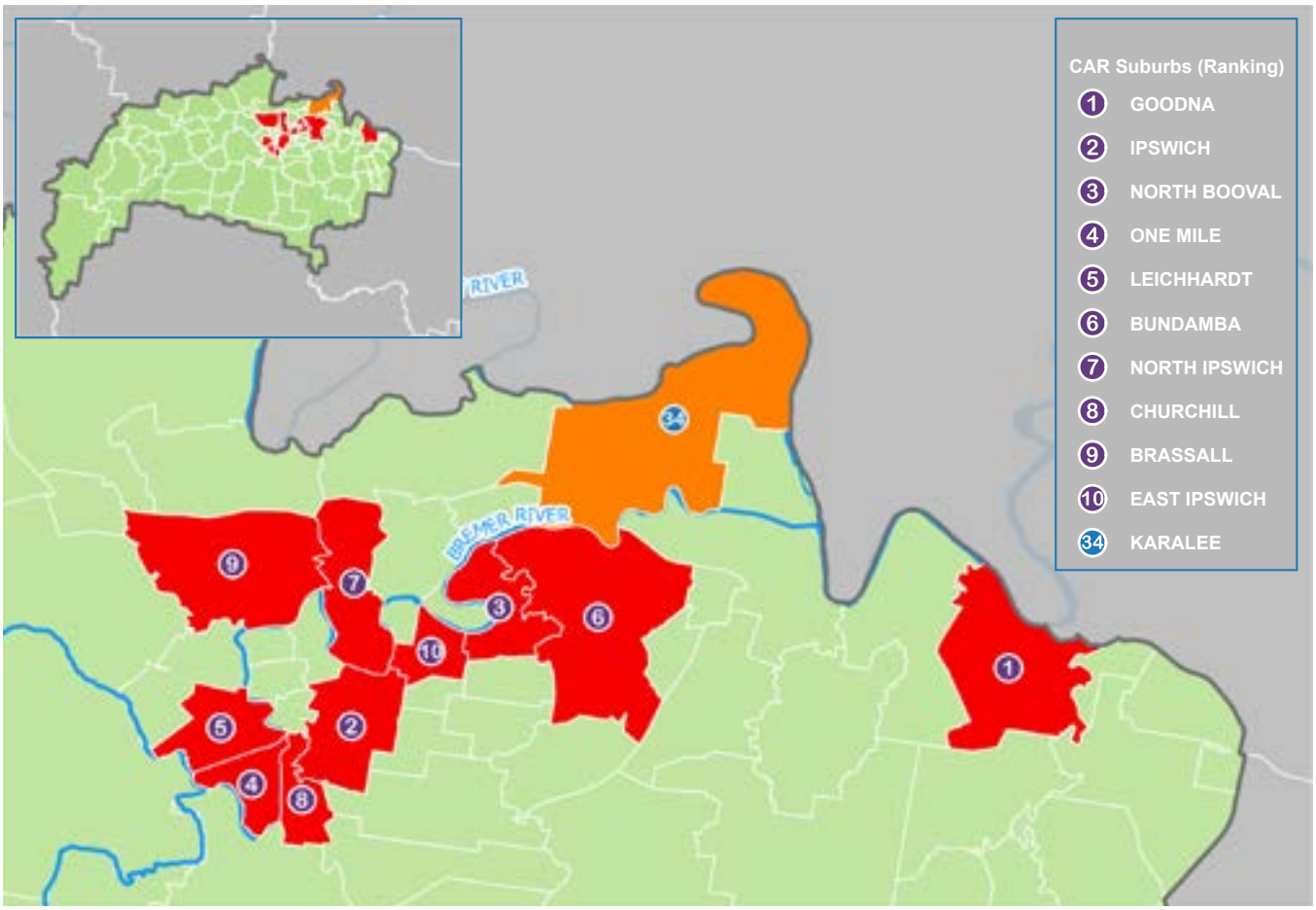


Figure 26 Priority suburbs for actions to build community awareness and resilience

IMPLEMENTATION PLAN FOR CAR ACTIVITIES

An Implementation Plan has been developed to engage each priority suburb, considering localised flood impacts and activities to communicate and engage local communities within each priority suburb.

A six-step approach has been developed to guide CAR activity planning and implementation in priority suburbs. These steps are discussed in more detail in Section 8 of the TER.

STEP 1 Understand local flood risk

- Understand flood risk concepts
- Use suburb-scale flood risk mapping
- Translate flood risk for communities

STEP 2 Understand vulnerability drivers

- Understand vulnerability concepts
- Consider suburb-based vulnerability data
- Focus on suburb-based vulnerability driver

STEP 3 Understand local context

- Suburb prioritisation
- Community profile data
- Vulnerable audiences

STEP 4 Select engagement activities

- AIDR Model for Emergency Management
- Vulnerability drivers and CAR principles
- Communication, educatio and engagement

STEP 5 Apply considerations

- Utilising existing resources
- Regionally consistent messaging
- Accessibility and inclusion considerations

STEP 6 Ongoing monitoring and evaluation

- Achievement of CAR objectives
- Collection and analysis of monitoring metrics
- Evaluation reporting

RISK TREATMENT MEASURES

Regionally consistent messaging, particularly for social media use will be rolled out by implementing resources provided Queensland Reconstruction Authority for effective communication about flooding.

Implementation of community awareness and resilience activities listed in the Implementation Plan and Goodna Case Study:

- **Collateral** –distributed in hardcopy, online and through mailouts
- **Community surveys** – multiple collection methods
- **Event-based engagement** – pop-up events, presence at community events, townhall meetings, online sessions, etc
- **Cultural engagement** – interactive art events, artwork installations, etc
- **Education** – flood awareness, flood preparedness, business continuity planning workshops
- **Community programs** – school education program, flood resilient community champions program
- **Community networks** – integration with existing community groups and activities.

These activities will target high-flood risk areas within priority suburbs, using mapping and other awareness tools for communication, education, and engagement.

Summary of recommendations on following page – see Action Plan for full details.



COMMUNITY AWARENESS AND RESILIENCE			
ACTION	**FLOOD RISK ADDRESSED**	**PRIORITY**	**S-P-R**
Adopt the IICP CAR definitions, vision and objectives. Implement activities detailed in the Implementation Plan. Consider implementing Ipswich-wide general CAR activities as soon as possible.	▪ Deep/strong/frequent flood ▪ Flash flood ▪ Long duration of flood ▪ Isolating flood island ▪ Expensive flood damages	High	▪ Receptor
Adopt the AIDR Community Engagement Model for Emergency Management to guide CAR implementation activities.	▪ Deep/strong/frequent flood ▪ Flash flood ▪ Long duration of flood ▪ Isolating flood island ▪ Expensive flood damages	Medium	▪ Pathway ▪ Receptor
Implement use of QRA Flood Communication Toolkit (and QRA Council Hub resources) to form social media posts, and adopt similar language in other communication, education, and engagement activities.	▪ Deep/strong/frequent flood ▪ Flash flood ▪ Long duration of flood ▪ Isolating flood island ▪ Expensive flood damages	High	▪ Pathway ▪ Receptor
Implement CAR activities in Goodna. As the highest-ranking priority suburb, consider focusing on Goodna for immediate implementation.	▪ Deep/strong/frequent flood ▪ Flash flood ▪ Long duration of flood ▪ Isolating flood island ▪ Expensive flood damages	High	▪ Receptor
Further targeted communication, education and engagement activities on high-risk streets within each priority suburb. Additionally, a property list is presented for Goodna.	▪ Deep/strong/frequent flood ▪ Flash flood ▪ Long duration of flood ▪ Isolating flood island ▪ Expensive flood damages	High	▪ Receptor
Implementing CAR activities to additional suburbs over the long-term (in order of ranked prioritisation) may also be considered.	▪ Deep/strong/frequent flood ▪ Flash flood ▪ Long duration of flood ▪ Isolating flood island ▪ Expensive flood damages	Medium	▪ Receptor
Using the 6-step approach for additional suburbs over time. The suburb plans in the Implementation Plan provide a template to follow.	▪ Deep/strong/frequent flood ▪ Flash flood ▪ Long duration of flood ▪ Isolating flood island ▪ Expensive flood damages	Medium	▪ Receptor

OBJECTIVE 6: DELIVER EMERGENCY RESPONSE AND RECOVERY DECISIONS THAT ARE INTELLIGENCE BASED

EMERGENCY MANAGEMENT

The responsibility for Emergency Management actions is a complex arrangement that is often discussed and actioned jointly between different levels of government.

Emergency Management measures in response to local scale disasters such as creek flooding can often be undertaken exclusively by council's Local Disaster Management Group (LDMG). As the scale of a disaster grows, so do the complexities, powers, and limitations of local government to respond, often then requiring elevation to regional, state and federal levels.

Ipswich already has established emergency management systems and resources.

The IICP has investigated options that could build upon Ipswich's current capabilities, particularly in five key topics:

- **Evacuation:** Using extensive modelling, identifying specific evacuation measures for the highest priority clusters of at-risk properties;
- **Flood forecasting:** Examining a range of technology options that could extend council's existing flood forecasting capability;
- **Flood classifications:** Providing potential updates to community messaging about what 'minor', 'moderate' and 'major' flood impacts are at key local flood gauge sites;
- **Emergency alerts:** Suggesting electronic maps, known as polygons, linked to flood triggers which would send customised messages to phones registered to homes in that area; and
- **Critical infrastructure:** Understanding the flood risk to vital infrastructure – such as emergency services stations, hospitals, power and water supply – required to operate during and after a flood.



EVACUATION

When a flood strikes, it is much safer for people to shelter in place (if safe to do so) or to voluntarily evacuate to family and friends outside of flood areas well before floods happen.

Large-scale mandatory evacuation operations are difficult to manage. Adding to the complexity is human behaviour under stress, flood hazards on roads, as well as the sheer number of people, resources, organisations and government departments needed to undertake mass evacuation.

The objective of evacuation analysis is to prioritise areas for emergency management planning through city-wide analysis. This includes identification of at-risk areas which may require early evacuation or additional management options. Given the complexity of emergency management and evacuation, a prioritised 'triage' approach to evacuation was developed, which considered:

- Exposure and hazard categories;
- Time to inundation;
- Duration of inundation;
- High and low-set residential building impacts; and
- Vulnerability data and analysis results.

The evacuation capability analysis considers critical infrastructure, evacuation routes, flood warning, and isolation risk data. Evacuation for the most at-risk suburbs and neighbourhoods is complex due to a range of factors including:

- potential for flash-flooding or fast inundation of roads and houses (under six hours)
- potential for hazardous water (deep and fast flowing) to affect roads and houses
- potential for flooding from multiple sources (urban overland flow, creek and river) which all behave in different ways
- potential for areas to be isolated on a flood island
- social and economic vulnerability factors.

One of the most crucial aspects was the impact to local roads, which would be key evacuation routes for at risk suburbs and neighbourhoods. The IICP examined the best case (normal route) and worst-case (semi-blocked route) using road capacity figures to calculate estimated evacuation withdrawal times.

Full details of the evacuation analysis are provided in Section 9 of the TER.

FLOOD FORECASTING AND INTELLIGENCE

Flood forecasting systems are an extremely important component of a total flood warning system. In particular, they are important for areas subjected to flash flooding.

The systems have been attributed to reducing the costs of flood damages significantly by providing the necessary warning time to plan and adequately react to flood events. Also, with the advantage of further planning time, high risk residents can be provided further warning and, if necessary, evacuated from dangerous situations.

There are a multitude of forecasting systems that range from simple and inexpensive such as river and rainfall gauges, to complex and expensive such as live hydraulic models. It should be noted, however, that advanced systems require adequate technical resourcing and staff to operate during flood events. Flood forecasting is also targeted at high risk or complex catchments, and isn't feasible for all flooding types, such as smaller streams or stormwater.

Ipswich City Council is considered advanced in flood forecasting, operating a combination of the more complex systems that run 'synthetic' flood events with a team that includes specialised staff – but there are always improvements that could be made depending on available resources.

Flood forecasting and intelligence is a multi-agency effort that requires federal, state and local government input. There are opportunities to improve data such as formalising data sharing arrangements and potential automation such as system data transfers.

Data from the IICP such as property levels and road low points could also be incorporated into flood forecasting systems to increase local flood intelligence.

A detailed discussion of flood forecasting and flood intelligence is provided in Section 9 of the TER.

FLOOD GAUGES AND CLASSIFICATIONS

The SFMP identified two disaster management actions for local governments:

- DM3.1 Identify (rainfall and stream) gauges to be included in the Bureau of Meteorology's forecast network based on the Queensland Flood Gauge Network Review; and
- DM3.2 Review stream gauge classifications and amend where necessary.

SETTING CLASSIFICATIONS

Flood classifications for stream gauges are critical for planning and flood response.

Each flood gauge has an area of influence around it which contains assets such as buildings, roads and utility services. Describing how these local assets and the surrounding community could be affected in a minor, moderate or major flood and linking that to a specific gauge height provides a common reference point.

The Bureau of Meteorology uses these classifications to communicate flood impacts. Flood classifications are used for a variety of purposes, including:

- to understand the severity of a flood and also relate previous historical floods to this reference;
- to communicate flood impacts through the classifications to the community via the BoM website; and,
- to determine the necessary emergency management resources.

The general classifications can then be applied at a local level using key flood gauges.

MINOR	Causes inconvenience. Low-lying areas next to watercourses are inundated. Minor roads may be closed, and low-level bridges submerged. In urban areas, inundation may affect some backyards and buildings below the floor level as well as bicycle and pedestrian paths. In rural areas, removal of stock and equipment may be required.
MODERATE	In addition to the above, the area of inundation is more substantial. Main traffic routes may be affected. Some buildings may be affected above the floor level. Evacuation of flood affected areas may be required. In rural areas, removal of stock is required.
MAJOR	In addition to the above, extensive rural areas and/or urban areas are inundated. Many buildings may be affected above the floor level. Properties and towns are likely to be isolated and major rail and traffic routes closed. Evacuation of flood affected areas may be required. Utility services may be impacted.

Table 9 Minor, moderate and major flood classifications

Council is responsible for setting the classifications used by BoM and is one of the first local governments in Queensland to investigate improvements to the BoM flood gauge network based on a number of technical reviews by the State Government. Key gauges that have been reviewed as part of the IICP are shown in Figure 27. Full details of the flood gauge classification review are provided in Section 9 of the TER.

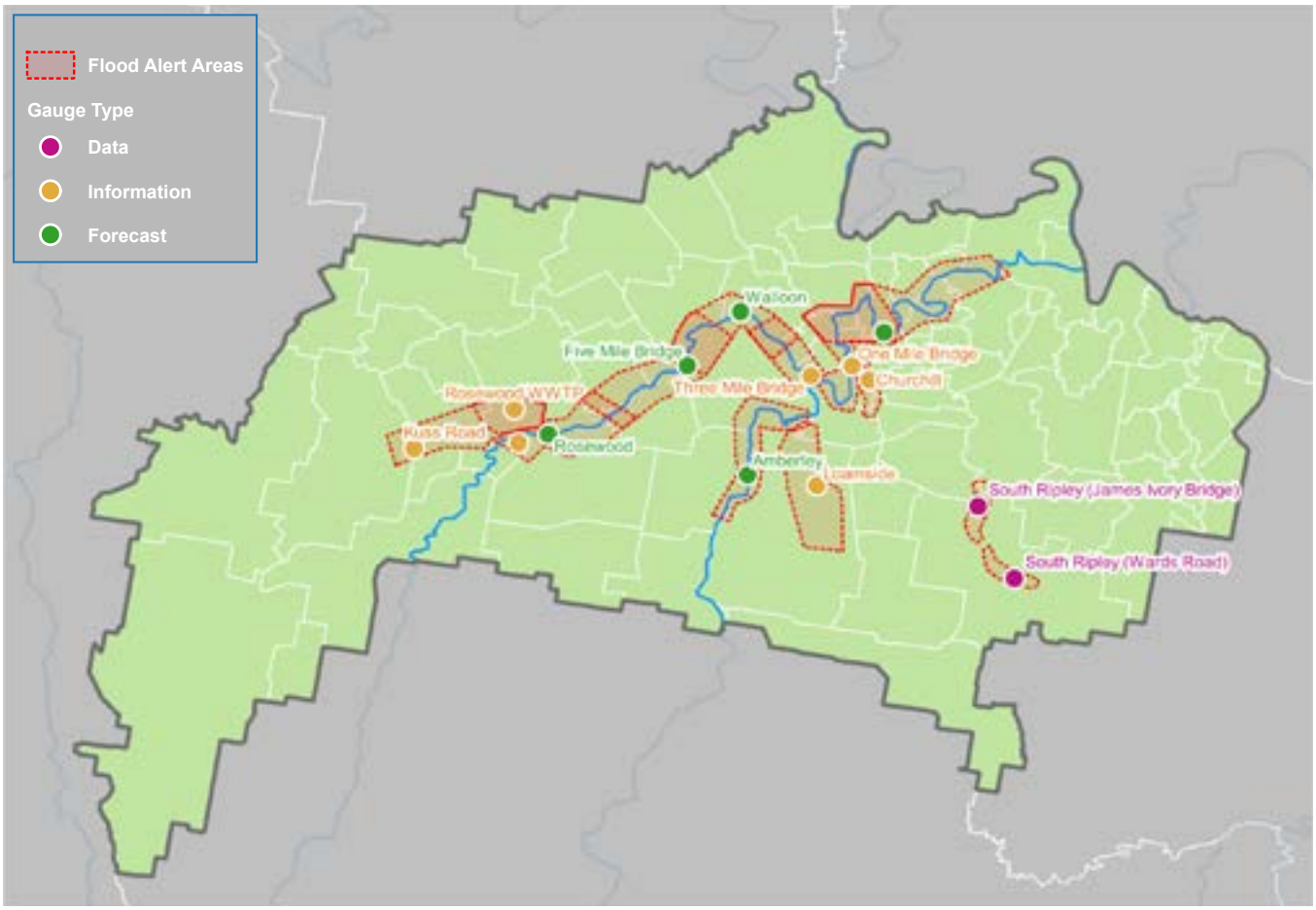


Figure 27 Gauge locations



Image: Rosewood gauge, Ipswich-Rosewood Road

FLOOD GAUGE NETWORK REVIEW

The Queensland Flood Gauge Network Review includes a systematic scoring process for all water level gauges in Queensland based on factors such as coverage, number of ungauged areas, gauge diversity and communications.

In combination with an analysis of flood hazard within the settlements the Queensland Flood Gauge Network Review provides a prioritised approach for improvements to the flood warning gauge network.

Within the Brisbane/Bremer River catchment, there are 11 settlements deemed low priority and nine a very low priority for gauge network improvements. No settlements were recommended as a moderate, high or very high priority within the Brisbane/Bremer River catchment.

Ipswich LGA is therefore considered a low priority, within Queensland, for gauge network improvements. With regard to rainfall gauges, a spatial analysis undertaken as part of the review reveals that the existing gauge density criteria within the entire Brisbane/Bremer catchment meets the minimum density criteria of urban areas (i.e. 20 per km^2).

CRITICAL INFRASTRUCTURE

Critical infrastructure is often required to operate during and after a flood event for the purposes of recovery. Infrastructure plays a key role in providing facilities for evacuation, power and water supply and to effectively keep services and facilities running during flood events and to aid in faster recovery.

The exposure of critical infrastructure and sensitive institutions to flooding risk is now better understood, for example whether buildings are exposed to over-the-floor flooding, the location relative to HR and which critical evacuation routes are affected and by what magnitude flood event.

Further details of the exposure of critical infrastructure and sensitive institutions can be found in Section 9 of the TER.

RISK TREATMENT MEASURES

The outputs of the evacuation analysis will be used to inform emergency response, infrastructure upgrades and strategic land use planning.

- Critical evacuation routes have been identified and key road upgrades will be investigated.
- Strategic land use planning policy will recognise suburbs and neighbourhoods that have problems with access and egress which may burden emergency services in times of flooding.

Meteorological products and subscriptions that provide necessary combinations of accuracy and lead time for flash flood forecasting systems will be rolled out. A new forecast location to provide more intelligence on flooding within the Bremer River, Warrill and Purga Creek catchments will be formalised.

In partnership with the BoM, the flood classifications levels for key gauges in the BoM's flood gauge network will be revised based on new intelligence.

The RAAF Base Amberley has been identified as a critical asset exposed to high flood risk. Findings of the IICP will be communicated to the Federal Government and Department of Defence (through the LDMG) to further investigate this flood risk and ongoing management of flooding to the base.

Summary of recommendations on following page – see Action Plan for full details.



EMERGENCY MANAGEMENT			
ACTION	**FLOOD RISK ADDRESSED**	**PRIORITY**	**S-P-R**
Subscriptions to best available BoM rainfall prediction and radar rainfall products and data to provide the necessary combinations of accuracy and lead time for potential flash flood forecasting systems and council's existing forecasting systems.	▪ Flash flood ▪ Flood islands	Medium	▪ Source
Introduce of a new forecast location near RAAF Base Amberley and formalise Loamside as a forecast location to improve the accuracy and definition of flooding of Bremer River, Warrill and Purga Creeks. This should be jointly investigated by BoM and council for any opportunities, constraints, and cost effectiveness.	▪ Deep/strong/frequent flood ▪ Flash flood ▪ Long duration of flood ▪ Isolating flood island ▪ Expensive flood	High	▪ Source
Council formalise the arrangement with BoM with regard to delivery of forecast levels for the Bremer River forecasting system. Currently this is verbally provided from BoM to council during flood events. Potential automation and formal provision of this data should be investigated through avenues such as system data transfers.	▪ Deep/strong/frequent flood ▪ Long duration of flood ▪ Isolating flood island ▪ Expensive flood damages	High	▪ Source
Implement simplified systems for low and medium risk flash flooding catchments such as automated flash flooding systems or the development of a gauged based trigger mapping system. (Six Mile, Deebing and Goodna creeks).	▪ Flash flood	Medium	▪ Source
Incorporate all data from the IICP project including road low points, buildings (with floor levels) into council's flood forecasting systems to provide further intelligence on road closures and flooded properties.	▪ Deep/strong/frequent flood ▪ Flash flood ▪ Long duration of flood ▪ Isolating flood island ▪ Expensive flood damages	High	▪ Pathway

EMERGENCY MANAGEMENT			
ACTION	**FLOOD RISK ADDRESSED**	**PRIORITY**	**S-P-R**
Investigate a 'central' forecast database to simultaneously initiate multiple forecasts and intelligence outputs.	▪ Flash flood	Medium	▪ Source
Consider the suggested changes to the Flood Classifications for the forecast gauge locations.	▪ Deep/strong/frequent flood ▪ Flash flood ▪ Long duration of flood ▪ Isolating flood island ▪ Expensive flood damages	High	▪ Pathway
Share findings of the IICP to relevant stakeholders; e.g. Federal Government and Department of Defence (through the LDMG) to further investigate the flood risk at the RAAF Base Amberley; and QFES to implement Emergency Alert Polygons.	▪ Deep/strong/frequent flood ▪ Expensive flood damages	High	▪ Receptor
Consider, in the next revision of the IICP, the citywide road database network is up to date to inform road low points, road immunity and evacuation assessment.	▪ Flash floods ▪ Long duration of flood ▪ Isolating flood island	Low	▪ Pathway
Lobby Dept Transport and Main Roads to consider upgraded primary evacuation routes identified in the most at-risk suburbs to 1 in 100 AEP and trafficable in a 1 in 500 AEP.	▪ Deep/strong/frequent flood ▪ Long duration of flood ▪ Isolating flood island	High	▪ Source ▪ Pathway
Further investigate road immunity upgrades for key suburban access routes, including culvert and pipe upgrades or road raising.	▪ Deep/strong/frequent flood ▪ Long duration of flood ▪ Isolating flood island	Medium	▪ Pathway
Rezone areas to encourage more resilient land uses such as expanding the Limited Development zone in areas identified as difficult to evacuate (Goodna, East Ipswich and One Mile).	▪ Deep/strong/frequent flood ▪ Flash flood ▪ Long duration of flood ▪ Isolating flood island ▪ Expensive flood damages	High	▪ Pathway

EMERGENCY MANAGEMENT			
ACTION	**FLOOD RISK ADDRESSED**	**PRIORITY**	**S-P-R**
Consider intensifying both residential and non-residential uses in areas that have generally flood free to higher ground.	▪ Deep/strong/frequent flood ▪ Long duration of flood ▪ Isolating flood island	Medium	▪ Pathway
Consider as part of development within the Urban Investigation Area in Rosewood the provision or contribution of transport infrastructure and necessary emergency services to facilitate intensification of residential uses.	▪ Deep/strong/frequent flood ▪ Long duration of flood ▪ Isolating flood island	Medium	▪ Pathway
Continuing the Business and Incubator Zone in Raceview and negotiate upgrades to road immunity of key transport links such as Briggs Road during the development assessment process.	▪ Deep/strong/frequent flood ▪ Long duration of flood ▪ Isolating flood island	Medium	▪ Pathway
Formalise resupply arrangements on the high flood islands in conjunction with a community awareness and education campaign.	▪ Long duration of flood ▪ Isolating flood island	Medium	▪ Receptor
Investigate stormwater infrastructure upgrades in the Ipswich CBD to provide relief from overland flow flooding and road immunity upgrades.	▪ Flash floods	Low	▪ Pathway
As part of a citywide implementation of Community Awareness and Resilience activities, consider rolling out a targeted awareness campaign to Moores Pocket Road to ensure residents are aware of the short time to inundation and potential problems with self-evacuation.	▪ Flood islands	Medium	▪ Receptor



GLOSSARY

QFCoI	Queensland Flood Commission of Inquiry
SFMP	Brisbane River Strategic Floodplain Management Plan
LFMP	Local Floodplain Management Plan
IICP	Ipswich Integrated Catchment Plan
LGA	Local Government Area
BRCFS	Brisbane River Catchment Flood Studies
TER	Technical Evidence Report
SPR	Source Pathway Receptor
AHD	Australian Height Datum
AEP	Annual Exceedance Probability
BoM	Bureau of Meteorology
CBD	Central Business District
NERAG	National Emergency Risk Assessment Guidelines
HR	Hydraulic Risk
AIDR	Australian Institute of Disaster Resilience
PMF	Probable Maximum Flood
TTI	Time to Inundation
AR&R	Australian Rainfall and Runoff Guide
DFI	Duration of Flood Inundation
ABS	Australian Bureau of Statistics
SA1	Statistical Area 1
AAD	Average Annual Damages
MCA	Multi Criteria Analysis
NFM	Natural Floodplain Management
RAAF	Royal Australian Air Force
SPP	State Planning Policy
TLPIs	Temporary Local Planning Instruments
FEMP	Flood Risk and Emergency Management Plan
QRA	Queensland Reconstruction Authority
VHP	Voluntary House Purchase
RBM	Retrofitting with Resilient Building Materials
VHR	Voluntary House Raising
BCC	Brisbane City Council
CAR	Community Awareness and Resilience
LDMG	Local Disaster Management Group
LUP	Land Use Planning
EM	Emergency Management



ACTION PLAN

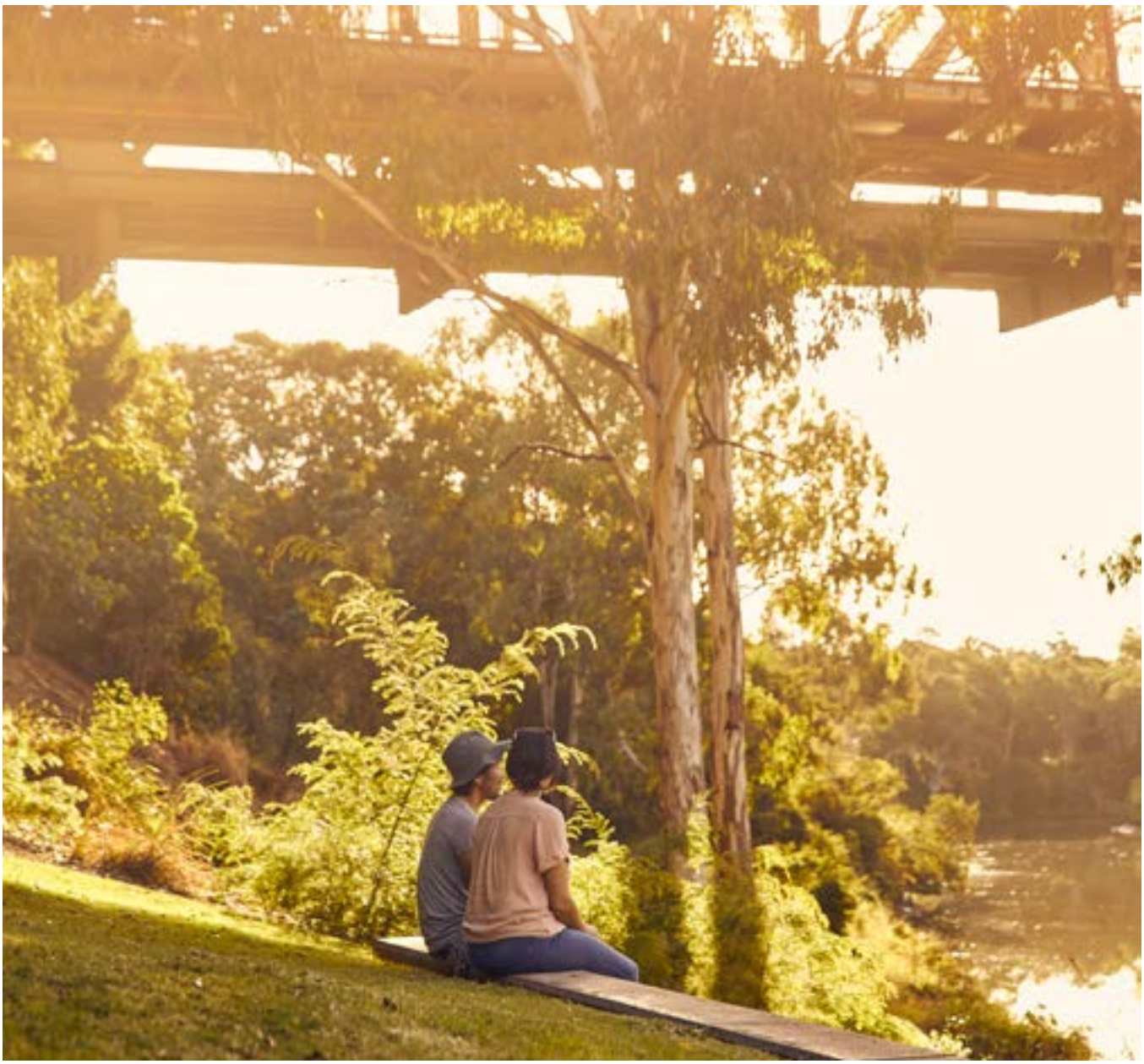
A series of actions are outlined in this section to achieve the flood management objectives that have been set out in this strategy document. The actions are based on a localised assessment of risks associated with flooding from the Brisbane and Bremer rivers and local creek and major urban flow paths in the Ipswich LGA based on understanding of the current and future flood risks at the time of writing.

The actions are related to an objective, are location specific and have been developed in the context of the Source-Pathway-Receptor (SPR) model applied to the IICP. Each action has been identified to impacts either at the source, along the pathways or at the receptors of flooding in sequential order.

As noted, the SPR model does not imply priority, and each action is part of an integrated catchment approach that cannot be implemented by applying individual treatment measures in isolation.

The table includes a reference and description of the action, along with what aspect of flood risk the action addresses, a cost where known, approximate timeframe, an order of priority (high medium or low), and a list of the key stakeholders that should address each action.

There is a requirement to call for funding opportunities to implement actions listed; thus, State, and Federal Government are required to think about integrated planning and the real opportunity to fund the actions across Ipswich.



ACTION TYPE	ID	TER SECTION REFERENCE	ACTION DESCRIPTION	SOURCE/ PATHWAY/ RECEPTOR	FLOOD RISK ADDRESSED					MPLEMENTATION PATHWAY	COST	BENEFITS	APPROX. TIMEFRAME	PRIORITY	STAKEHOLDERS
					DEEP, STRONG AND FREQUENT FLOODS (HYDRAULIC RISK)	FLASH FLOODS (TIME TO INUNDATION)	LONG FLOODS (DURATION)	ISOLATING FLOODS (FLOOD ISLAND)	EXPENSIVE FLOODS (DAMAGES)						
Investigating Flood Hazard	FS1	4.6.1.4	Investigate damages due to flash flooding in Bremer/Warrill, Western, Bundamba and Woogaroo Creeks and all overland flowpath catchments.	S P		✓			✓	Council's Infrastructure and Environment branch. Using existing flood modelling	$50,000	Understand impacts of flash flooding	6 – 12 months	M	Community members, QRA; Infrastructure and Environment Branch
Investigating Flood Hazard	FS2	4.6.1.3; 4.11.2.	Update the commercial value damages assessment as information not available for IICP.	R					✓	Data request to State Government	Nominal	Understand impacts to different commercial property types	6 – 12 months	L	Community members, QRA, Industry
Investigating Flood Hazard	FS3	4.11.2	Update the Sandy Creek model.	S	✓	✓	✓	✓		Council's Infrastructure and Environment branch; updating flood information.	$40,000	Understanding of flood risk	1 – 2 years	H	Community members, QRA, council staff from: Emergency Management Unit; Infrastructure and Environment Branch; Planning and Regulatory Services Department.
Investigating Flood Hazard	FS4	4.8.2.3, 4.11.2	Update Mi Hi Creek model to full hydrologic and hydraulic model.	S	✓	✓	✓	✓		Council's Infrastructure and Environment branch; updating flood information.	$50,000	Understanding of flood risk	1 – 2 years	L	Community members, QRA, council staff from: Emergency Management Unit; Infrastructure and Environment Branch; Planning and Regulatory Services Department.
Investigating Flood Hazard	FS5	General	Review and update IICP in the context of the current understanding of flood risk on a 5-year timeline.	S P R						Council's Infrastructure and Environment branch; updating flood information.	Unknown	Understanding of flood risk	5 years	L	Community members, QRA, council staff from: Emergency Management Unit; Infrastructure and Environment Branch; Planning and Regulatory Services Department.
Physical Mitigation	FM1	5.3.3.1 5.3.3.2	Consider undertaking detailed design and assessment for the Warrill Creek NFM options.	P R	✓		✓	✓	✓	Council's Infrastructure and Environment branch; achieving sustainable flood mitigation	$180–$490 million	Flood mitigation and wider benefits to ecosystem health	1 – 2 years	M	Landholders, community members, council staff from Infrastructure and Environment Branch; Planning and Regulatory Services Department.
Physical Mitigation	FM2	5.3.3.3 5.3.3.4	Undertake a detailed design and assessment for the Bundamba Creek NFM option.	P R	✓		✓	✓	✓	Council's Infrastructure and Environment branch; achieving sustainable flood mitigation	$30–$60 million	Flood mitigation and wider benefits to ecosystem health	1 – 2 years	M	Landholders, community members, council staff from Infrastructure and Environment Branch; Planning and Regulatory Services Department.

ACTION TYPE	ID	TER SECTION REFERENCE	ACTION DESCRIPTION	SOURCE/ PATHWAY/ RECEPTOR	FLOOD RISK ADDRESSED					MPLEMENTATION PATHWAY	COST	BENEFITS	APPROX. TIMEFRAME	PRIORITY	STAKEHOLDERS
					DEEP, STRONG AND FREQUENT FLOODS (HYDRAULIC RISK)	FLASH FLOODS (TIME TO INUNDATION)	LONG FLOODS (DURATION)	ISOLATING FLOODS (FLOOD ISLAND)	EXPENSIVE FLOODS (DAMAGES)						
Physical Mitigation	FM3	6.5.9.3	Undertake a more detailed assessment of intervention methods on irrigation uptake upstream and assess possible groundwater recharge locations to increase environmental flows in the Bremer River and Warrill Creek systems.	P						Council's Infrastructure and Environment branch; achieving sustainable flood mitigation	Unknown	Understanding of flood risk	1–2 years	L	Landholders, community members, council staff from Infrastructure and Environment Branch; Planning and Regulatory Services Department.
Land Use Planning	LUP1	7.2.4.2.1	Apply a consistent methodology to the identification of hazard categories for the purposes of draft new flood hazard overlay.	P	✓					Council Planning and Regulatory Services Department; draft new Planning Scheme	Unknown	Future development is commensurate to the known risks	1–2 years	M	Community members and council staff from the Planning and Regulatory Services Department.
Land Use Planning	LUP2	7.2.4.2.1	Extend any development controls for residential uses to the HR4 category to include the 1 in 500-year H3 hazard category.	R	✓					Council Planning and Regulatory Services Department; draft new Planning Scheme	Unknown	Future development is commensurate to the known risks	1–2 years	M	Community members and council staff from the Planning and Regulatory Services Department.
Land Use Planning	LUP3	7.4.3	Monitor and review climate change projections and flood modelling recommendations over time to inform future land use planning decision making.	S P	✓				✓	Council Planning and Regulatory Services Department; draft new Planning Scheme	Nominal	Understanding of flood risk	5 years	L	Community members and council staff from the Planning and Regulatory Services Department.
Land Use Planning	LUP4	7.2.4.4	Develop and include a city-wide overland flow path assessment to allowing risk-based assessment of this type of flood risk.	S P		✓				Council Planning and Regulatory Services Department; draft new Planning Scheme	Unknown	Future development is commensurate to the known risks	1–2 years	M	Community members and council staff from the Planning and Regulatory Services Department.
Land Use Planning	LUP5	7.3	Avoid intensification of development in areas mapped in HR1c and HR1b.	R	✓					Council Planning and Regulatory Services Department; draft new Planning Scheme	Unknown	Avoid intolerable risks to residential uses	1–2 years	H	Community members and council staff from the Planning and Regulatory Services Department.
Land Use Planning	LUP6	7.3	Continue the existing requirements in the current planning scheme that promote built form and resilient building materials as an acceptable mitigation response such as building on stilts, or with wet / dry proofing on ground floor, but may consider revising trigger areas based on lower risk areas such as HR2a, HR3a, HR4 and HR5.	R	✓					Council Planning and Regulatory Services Department; draft new Planning Scheme	Unknown	Appropriate measures ensure risk is commensurate with the intended use	1–2 years	M	Community members and council staff from the Planning and Regulatory Services Department.

ACTION TYPE	ID	TER SECTION REFERENCE	ACTION DESCRIPTION	SOURCE/ PATHWAY/ RECEPTOR	FLOOD RISK ADDRESSED					MPLEMENTATION PATHWAY	COST	BENEFITS	APPROX. TIMEFRAME	PRIORITY	STAKEHOLDERS
					DEEP, STRONG AND FREQUENT FLOODS (HYDRAULIC RISK)	FLASH FLOODS (TIME TO INUNDATION)	LONG FLOODS (DURATION)	ISOLATING FLOODS (FLOOD ISLAND)	EXPENSIVE FLOODS (DAMAGES)						
Land Use Planning	LUP7	7.3	Include requirements for easements in greenfield areas up to the DFE.	S P	✓					Council Planning and Regulatory Services Department; draft new Planning Scheme	Unknown	New developments are designed and situated away from flood risk	1–2 years	M	Community members and council staff from the Planning and Regulatory Services Department.
Land Use Planning	LUP8	7.3	In locations where the TTI is < 6 hours to inundation and where DFI is >36 hours, consider a requirement for a Flood Risk and Emergency Management Plan (FEMP) for non-residential uses.	R		✓	✓			Council Planning and Regulatory Services Department; draft new Planning Scheme	Unknown	Appropriate measures ensure risk is commensurate with the intended use	1–2 years	M	Community members and council staff from the Planning and Regulatory Services Department and: Emergency Management Unit.
Land Use Planning	LUP9	7.3	In locations subject to isolation via the formation of flood islands, consider responses such as FEMPs linked to new development.	P				✓		Council Planning and Regulatory Services Department; draft new Planning Scheme	Unknown	Appropriate measures ensure risk is commensurate with the intended use	1–2 years	M	Community members and council staff from the Planning and Regulatory Services Department and: Emergency Management Unit.
Land Use Planning	LUP10	7.2.4.5	Consider the suggested development control measures that may be applied to development assessment process of vulnerable uses below the PMF.	P	✓	✓				Council Planning and Regulatory Services Department; draft new Planning Scheme	Unknown	Emergency services are not burdened during a flood event	1–2 years	M	Community members and council staff from the Planning and Regulatory Services Department and: Emergency Management Unit.
Land Use Planning	LUP11	7.2.4.5	Provide a definition of vulnerable uses in the new Ipswich Planning Scheme.	R	✓	✓	✓	✓	✓	Council Planning and Regulatory Services Department; draft new Planning Scheme	Unknown	Appropriate measures ensure risk is commensurate with the intended use	1–2 years	H	Council staff from the Planning and Regulatory Services Department and: Emergency Management Unit.
Land Use Planning	LUP12	7.2.4.5	In locations where TTI is < 6 hours to inundation, where DFI is >36 hours or locations subject to isolation on flood islands, consider avoiding vulnerable uses and non-intensification of residential uses. In areas of low hazard built form and resilient building materials should be considered as an acceptable mitigation response.	R		✓	✓			Council Planning and Regulatory Services Department; draft new Planning Scheme	Unknown	Emergency services are not burdened during a flood event	1–2 years	H	Community members and council staff from the Planning and Regulatory Services Department and: Emergency Management Unit.

ACTION TYPE	ID	TER SECTION REFERENCE	ACTION DESCRIPTION	SOURCE/ PATHWAY/ RECEPTOR	FLOOD RISK ADDRESSED					MPLEMENTATION PATHWAY	COST	BENEFITS	APPROX. TIMEFRAME	PRIORITY	STAKEHOLDERS
					DEEP, STRONG AND FREQUENT FLOODS (HYDRAULIC RISK)	FLASH FLOODS (TIME TO INUNDATION)	LONG FLOODS (DURATION)	ISOLATING FLOODS (FLOOD ISLAND)	EXPENSIVE FLOODS (DAMAGES)						
Land Use Planning	LUP13	7.3	Consider the following changes in drafting of planning scheme: Request a Flood Risk Assessment in terms of the acceptability or tolerability of flood risk on a particular use or activity.	S P R	✓	✓	✓	✓		Council Planning and Regulatory Services Department; draft new Planning Scheme	Unknown	Appropriate measures ensure risk is commensurate with the intended use	1–2 years	M	Community members and council staff from the Planning and Regulatory Services Department
Land Use Planning	LUP14	7.3	For Commercial, Industrial and other Non-Residential Uses consider adding a provision to avoid increasing the concentration of people in areas in HR1c and HR1b.	R	✓					Council Planning and Regulatory Services Department; draft new Planning Scheme	Unknown	Appropriate measures ensure risk is commensurate with the intended use	1–2 years	M	Community members and council staff from the Planning and Regulatory Services Department
Land Use Planning	LUP15	7.2.3.3	For residential uses consider removing the provision of a flood depth of no more than 800mm.	P	✓					Council Planning and Regulatory Services Department; draft new Planning Scheme	Unknown	Appropriate measures ensure risk is commensurate with the intended use	1–2 years	M	Community members and council staff from the Planning and Regulatory Services Department
Land Use Planning	LUP16	7.2.3.3	For basements, undercrofts consider introducing minimum clearance requirements in relation to the construction of undercrofts.	R					✓	Council Planning and Regulatory Services Department; draft new Planning Scheme	Unknown	Appropriate measures ensure risk is commensurate with the intended use	1–2 years	M	Community members and council staff from the Planning and Regulatory Services Department
Land Use Planning	LUP17	7.3	Provide all GIS datasets to developers to ensure safety to people and property and to ensure emergency services are not burdened during flood event.		✓	✓	✓	✓	✓	Council Planning and Regulatory Services Department; draft new Planning Scheme	Unknown	Emergency services are not burdened during a flood event	Immediate	H	Community members and council staff from the Planning and Regulatory Services Department
Land Use Planning	LUP18	7.3	In areas where HR categories and flood levels may increase as a result of filling or due to development activity consider preserving pockets of flood storage in the catchment to avoid future flood risk impacts	P	✓					Council Planning and Regulatory Services Department; draft new Planning Scheme	Unknown	Avoids increase in the exposure or hazard and damage on site or to other properties.	1–2 years	M	Community members and council staff from the Planning and Regulatory Services Department
Land Use Planning	LUP19	7.3	Continue provisions that flood storage capacity and do not create impacts on sites upstream or downstream – this is normally a request to provide hydraulic and hydrology report demonstrating compliance.	P R	✓					Council Planning and Regulatory Services Department; draft new Planning Scheme	Unknown	Avoids increase in the exposure or hazard and damage on site or to other properties.	1–2 years	M	Community members and council staff from the Planning and Regulatory Services Department

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Property Specific Actions	PS1	8.1.4	Investigate a region-wide building specification dataset in coordination with the Insurance Council of Australia as to the minimum requirements and if commonwealth funding will be available to develop the central database.	R	✓				✓	Council to lobby State government via regional partnerships	Unknown	Promote use of resilient building materials consistent with reduced insurance premiums	Unknown	L	Councils in SEQ, QRA, Insurance Council Australia
Property Specific Actions	PS2	8.4.5 8.7.1	Undertake detailed floor level survey of all residential buildings in the highest risk areas.	R	✓					Council's Infrastructure and Environment branch; understanding of flood risk	Unknown	Property-scale flood risk based on is most accurate reliable data	6 – 12 months	H	Council staff in: Infrastructure and Environment Branch
Property Specific Actions	PS3	8.5.2.2	Investigate retrofitting building materials program.	R	✓					Council's Infrastructure and Environment branch; understanding of flood risk	Unknown	Property-scale flood risk based on is most accurate reliable data	6 – 12 months	H	Council staff in: Infrastructure and Environment Branch
Property Specific Actions	PS4	8.5.1.2	Investigate a Voluntary House Purchase Program.	R	✓					Council's Infrastructure and Environment branch; understanding of flood risk	Unknown	Property-scale flood risk based on is most accurate reliable data	6 – 12 months	H	Council staff in: Infrastructure and Environment Branch
Community Awareness and Resilience	CR1	9.6.1	Adopt the IICP CAR definitions, vision and objectives. Implement activities detailed in the Implementation Plan. Consider implementing Ipswich-wide general CAR activities as soon as possible.	R	✓	✓	✓	✓	✓	Council Corporate Communications	Staff time only.	Consistent messaging.	6 – 12 months	H	Council staff from: Emergency Management Unit; Environmental Education and Partnerships; Corporate Communications and Community Engagement; and Community Development.
Community Awareness and Resilience	CR2	9.6.4.	Adopt the AIDR Community Engagement Model for Emergency Management to guide CAR implementation activities.	P R	✓	✓	✓	✓	✓	Council EMU Continue partnerships with education Council EMU, Continue partnerships with education Corporate communications	Staff time only.	Increased community awareness and resilience to flood risk.	1 – 5 years	M	Council staff from: Emergency Management Unit; Environmental Education and Partnerships; Corporate Communications and Community Engagement; and Community Development.

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Community Awareness and Resilience	CR3	9.6.2.	Implement use of QRA Flood Communication Toolkit (and QRA Council Hub resources) to form social media posts, and adopt similar language in other communication, education, and engagement activities.	P R	✓	✓	✓	✓	✓	Council EMU Continue partnerships with education Corporate communications	Staff time only	Regionally consistent messaging.	6- 12 months	H	Community members, QRA, volunteers, council staff from: Emergency Management Unit; Environmental Education and Partnerships; Corporate Communications and Community Engagement; and Community Development.
Community Awareness and Resilience	CR4	9.12.3.1	Implement CAR activities in Goodna. As the highest-ranking priority suburb, consider focusing on Goodna for immediate implementation.	R	✓	✓	✓	✓	✓	CAR Implementation Strategy and Plan.	Staff time only	Increased community awareness and resilience to flood risk.	6 -12 months	H	Community members, QRA, volunteers, council staff from: Emergency Management Unit; Environmental Education and Partnerships; Corporate Communications and Community Engagement; and Community Development.
Community Awareness and Resilience	CR5	9.12.2. and Goodna Case Study	Investigate further targeted communication, education and engagement activities on high-risk streets within each priority suburb. Additionally, a property list is presented for Goodna.	R	✓	✓	✓	✓	✓	CAR Implementation Strategy and Plan.	Staff time only	Increased community awareness and resilience to flood risk.	6 -12 months	H	Community members, QRA, volunteers, council staff from: Emergency Management Unit; Environmental Education and Partnerships; Corporate Communications and Community Engagement; and Community Development.
Community Awareness and Resilience	CR6	TER Appendix T	Investigate continuing to implement CAR activities to additional suburbs over the long-term (in order of ranked prioritisation).	R	✓	✓	✓	✓	✓	CAR Implementation Strategy and Plan.	Staff time only	Increased community awareness and resilience to flood risk.	1 – 5 years	M	Community members, QRA, volunteers, council staff from: Emergency Management Unit; Environmental Education and Partnerships; Corporate Communications and Community Engagement; and Community Development.
Community Awareness and Resilience	CR7	9.12.3	Consider utilising the 6-step approach for additional suburbs over time. The suburb plans in the Implementation Plan provide a template to follow.	R	✓	✓	✓	✓	✓	CAR Implementation Strategy and Plan.	Staff time only	Increased community awareness and resilience to flood risk.	1 – 5 years	M	Community members, QRA, volunteers, council staff from: Emergency Management Unit; Environmental Education and Partnerships; Corporate Communications and Community Engagement; and Community Development.

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Emergency Management	EM1	10.3.6.1 10.3.3.3	Subscriptions to best available BoM rainfall prediction and radar rainfall products and data to provide the necessary combinations of accuracy and lead time for potential flash flood forecasting systems and council's existing forecasting systems.	S		✓		✓		Emergency Management Unit – Improving flood intelligence	Unknown	Improved flood warning for areas exposed to flash flooding	1 – 2 years	M	QRA, BoM, council staff from: Emergency Management Unit
Emergency Management	EM2	10.3.6.1	Introduction of a new forecast location near RAAF Base Amberley and formalising Loamside as a forecast location to improve the accuracy and definition of flooding of Bremer River, Warrill and Purga creeks. This should be jointly investigated by BoM and council for any opportunities, constraints, and cost effectiveness.	S	✓	✓	✓	✓	✓	Emergency Management Unit – Improving flood intelligence	Unknown	Improved flood warning for areas exposed to river and creek flooding	6 – 12 months	H	QRA, BoM, council staff from: Emergency Management Unit
Emergency Management	EM3	10.3.5.3.3	Council formalise the arrangement with BoM with regard to delivery of forecast levels for the Bremer River forecasting system. Currently this is verbally provided from BoM to council during flood events. Potential automation and formal provision of this data should be investigated through avenues such as system data transfers.	S	✓		✓	✓	✓	Emergency Management Unit – Improving flood intelligence	Nominal	Improved flood warning for areas exposed to river and creek flooding	6 – 12 months	H	QRA, BoM, council staff from: Emergency Management Unit
Emergency Management	EM4	10.3.6.2	Implement simplified systems for low and medium risk flash flooding catchments such as automated flash flooding systems or the development of a gauged based trigger mapping system. (Six Mile, Deebing and Goodna creeks).	S		✓				Emergency Management Unit – Improving flood intelligence	Unknown	Improved flood warning for areas exposed to flash flooding	1 – 2 years	M	QRA, BoM, council staff from: Emergency Management Unit
Emergency Management	EM5	10.3.6.2	Incorporate all data from the IICP project including road low points, buildings (with floor levels) into council's flood forecasting systems to provide further intelligence on road closures and flooded properties.	P	✓	✓	✓	✓	✓	Emergency Management Unit – Improving flood intelligence	Unknown	Improved flood warning for areas exposed to flash flooding	6 – 12 months	H	Council staff from: Emergency Management Unit

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Emergency Management	EM6	10.3.6.2	Consider investigating a 'central' forecast database to simultaneously initiate multiple forecasts and intelligence outputs.	S		✓				Emergency Management Unit – Improving flood intelligence	Unknown	Improved flood warning for areas exposed to flash flooding	1 – 2 years	M	QRA, BoM council staff from: Emergency Management Unit
Emergency Management	EM7	10.3.5.2	Consider the suggested changes to the Flood Classifications for the forecast gauge locations.	P	✓	✓	✓	✓	✓	Emergency Management Unit – Improving flood intelligence	Nominal	Improved flood warning for the Ipswich LGA	6 – 12 months	H	QRA, BoM council staff from: Emergency Management Unit
Emergency Management	EM8	10.6.3.2 and 10.5.3.2	Share findings of the IICP to relevant stakeholders; e.g., Federal Government and Department of Defence (through the LDMG) to further investigate the flood risk at the RAAF Base Amberley; and QFES to implement Emergency Alert Polygons.	R	✓				✓	Emergency Management Unit – Improving flood intelligence	Nominal	Improved flood intelligence and mitigation to protect critical infrastructure	6 – 12 months	H	Federal Government, Dept of Defence, LDMG, QFES. State Government. Other interested stakeholders and organisations Council staff from: Emergency Management Unit
Emergency Management	EM9	10.2.2.8	Consider, in the next revision of the IICP, the citywide road database network is up to date to inform road low points, road immunity and evacuation assessment.	P		✓	✓	✓		Council's Infrastructure and Environment branch; updating flood information.	Unknown	Understanding of flood risk	5 years	L	Community members, QRA, council staff from: Emergency Management Unit; Infrastructure and Environment Branch; Planning and Regulatory Services Department.
Emergency Management	EM10	10.2.2.7.1, 10.6.3.5 and 7.3	Lobby Dept Transport and Main Roads to consider upgraded primary evacuation routes identified in the most at-risk suburbs to 1 in 100 AEP and trafficable in a 1 in 500 AEP. This will involve lobbying DTMR for bridge and road upgrades for Arterial and Motorway routes.	S P	✓		✓	✓		Council to lobby State government via regional partnerships	Unknown	Emergency services are not burdened during a flood event	6 – 12 months	H	Council staff from the Planning and Regulatory Services Department and: Emergency Management Unit DTMR
Emergency Management	EM11	10.2.2.2.1	Further investigation of Brisbane Terrace, Smiths Road and Queen Street in Goodna for road immunity upgrades including culvert upgrades or road raising.	P	✓		✓	✓		Council's Infrastructure and Environment branch; potential road immunity upgrades.	Unknown	Emergency services are not burdened during a flood event	1 – 2 years	M	Council staff from the Planning and Regulatory Services Department and: Emergency Management Unit DTMR
Emergency Management	EM12	10.2.2.3.1	Further investigation of Fernvale Road and Hunter Street in Brassall for road immunity upgrades including culvert and pipe upgrades or road raising.	P	✓		✓	✓		Council's Infrastructure and Environment branch; potential road immunity upgrades.	Unknown	Emergency services are not burdened during a flood event	1 – 2 years	M	Council staff from the Planning and Regulatory Services Department and: Emergency Management Unit DTMR

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Emergency Management	EM13	10.2.2.4.1	Further investigation of North Station Road, Creek Street and Jacaranda Drive, North Booval for road immunity upgrades including culvert and pipe upgrades or road raising.	P	✓		✓	✓		Council's Infrastructure and Environment branch; potential road immunity upgrades.	Unknown	Emergency services are not burdened during a flood event	1 – 2 years	M	Council staff from the Planning and Regulatory Services Department and: Emergency Management Unit DTMR
Emergency Management	EM14	10.2.3.7	Further investigation of Clifton Street, Booval for road immunity upgrades including culvert and pipe upgrades or road raising.	P	✓		✓	✓		Council's Infrastructure and Environment branch; potential road immunity upgrades.	Unknown	Emergency services are not burdened during a flood event	1 – 2 years	M	Council staff from the Planning and Regulatory Services Department and: Emergency Management Unit DTMR
Emergency Management	EM15	10.2.3.6.1	Further investigation of Leslie Street, Chermside Road and Jacaranda Street, East Ipswich for road immunity upgrades including culvert upgrades or road raising.	P	✓		✓	✓		Council's Infrastructure and Environment branch; potential road immunity upgrades.	Unknown	Emergency services are not burdened during a flood event	1 – 2 years	M	Council staff from the Planning and Regulatory Services Department and: Emergency Management Unit DTMR
Emergency Management	EM16	10.2.2.6.1	Further investigation of Bergins Hill Road, Cornish Street and Hanlon Street, Bundamba for road immunity upgrades including culvert upgrades, road raising.	P	✓		✓	✓		Council's Infrastructure and Environment branch; potential road immunity upgrades.	Unknown	Emergency services are not burdened during a flood event	1 – 2 years	M	Council staff from the Planning and Regulatory Services Department and: Emergency Management Unit DTMR
Emergency Management	EM17	10.2.2.13.1	Further investigation of Chubb Street, One Mile for road immunity upgrades including road raising or culvert upgrades.	P	✓		✓	✓		Council's Infrastructure and Environment branch; potential road immunity upgrades.	Unknown	Emergency services are not burdened during a flood event	1 – 2 years	M	Council staff from the Planning and Regulatory Services Department and: Emergency Management Unit DTMR
Emergency Management	EM18	10.2.2.5.1	Further investigation of Chermside Road, Jacaranda Street, Basin Pocket for road immunity upgrades including road raising or culvert upgrades.	P	✓		✓	✓		Council's Infrastructure and Environment branch; potential road immunity upgrades.	Unknown	Emergency services are not burdened during a flood event	1 – 2 years	M	Council staff from the Planning and Regulatory Services Department and: Emergency Management Unit DTMR

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Emergency Management	EM19	10.2.2.2 10.2.2.3 10.2.2.4 10.2.2.5 10.2.2.7 10.2.2.8 10.2.2.9 10.2.2.10 10.2.2.11 10.2.2.12 10.2.2.13 10.2.2.15.	Further investigation of Chermside Road, Jacaranda Street, Basin Pocket for road immunity upgrades including road raising or culvert upgrades.	P	✓		✓	✓	✓	Strategic Planning: Council Planning and Regulatory Services Department; draft new Planning Scheme	Unknown	Emergency services are not burdened during a flood event	1–2 years	H	Community members and council staff from the Planning and Regulatory Services Department and: Emergency Management Unit
Emergency Management	EM20	10.2.2.16	Consider rezoning areas to encourage more resilient land uses such as expanding the Limited Development zone in areas identified as difficult to evacuate (Goodna, East Ipswich and One Mile).	P	✓	✓	✓	✓	✓	Strategic Planning: Council Planning and Regulatory Services Department; draft new Planning Scheme	Unknown	Emergency services are not burdened during a flood event	1–2 years	H	Community members and council staff from the Planning and Regulatory Services Department and: Emergency Management Unit
Emergency Management	EM21	10.2.2.7	Consider intensifying the Local Business and Industry Zone in Karalee to more commercial uses as the access / egress to Junction Road is generally flood free to higher ground.	P	✓		✓	✓		Strategic Planning: Council Planning and Regulatory Services Department; draft new Planning Scheme	Unknown	Emergency services are not burdened during a flood event	1–2 years	M	Community members and council staff from the Planning and Regulatory Services Department and: Emergency Management Unit
Emergency Management	EM22	10.2.2.8	Consider intensifying Residential Uses in Rosewood which has unhindered evacuation towards upper John Street.	P	✓		✓	✓		Strategic Planning: Council Planning and Regulatory Services Department; draft new Planning Scheme	Unknown	Emergency services are not burdened during a flood event	1–2 years	M	Community members and council staff from the Planning and Regulatory Services Department and: Emergency Management Unit
Emergency Management	EM23	10.2.2.8	Consider as part of development within the Urban Investigation Area in Rosewood the provision or contribution of transport infrastructure and necessary emergency services to facilitate intensification of residential uses.	P	✓		✓	✓		Strategic Planning: Council Planning and Regulatory Services Department; draft new Planning Scheme	Unknown	Emergency services are not burdened during a flood event	1–2 years	M	Community members and council staff from the Planning and Regulatory Services Department and: Emergency Management Unit
Emergency Management	EM24	10.2.2.10	Consider continuing the Business and Industry Zone in Raceview and negotiate upgrades to road immunity of key transport links such as Briggs Road during the development assessment process.	P	✓		✓	✓		Strategic Planning: Council Planning and Regulatory Services Department; draft new Planning Scheme	Unknown	Emergency services are not burdened during a flood event	1–2 years	M	Community members and council staff from the Planning and Regulatory Services Department and: Emergency Management Unit

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Emergency Management	EM25	10.2.2.11	Consider intensifying the Large Lot Residential Zone in Camira that has largely flood free access to higher ground.	P	✓		✓	✓		Strategic Planning: Council Planning and Regulatory Services Department; draft new Planning Scheme	Unknown	Emergency services are not burdened during a flood event	1–2 years	M	Community members and council staff from the Planning and Regulatory Services Department and: Emergency Management Unit
Emergency Management	EM26	10.2.2.12	Consider intensifying the existing Medium Density Residential Zone to a 'CBD' use such as High Density or Primary Commercial as these areas generally have flood free access to higher ground.	P	✓		✓	✓		Strategic Planning: Council Planning and Regulatory Services Department; draft new Planning Scheme	Unknown	Emergency services are not burdened during a flood event	1–2 years	M	Community members and council staff from the Planning and Regulatory Services Department and: Emergency Management Unit
Emergency Management	EM27	10.2.2.14	Consider intensifying the Character Housing Mixed Density and Character Mixed use zones along Warwick Road corridor in Ipswich as these areas generally have flood free access to higher ground.	P	✓		✓	✓		Strategic Planning: Council Planning and Regulatory Services Department; draft new Planning Scheme	Unknown	Emergency services are not burdened during a flood event	1–2 years	M	Community members and council staff from the Planning and Regulatory Services Department and: Emergency Management Unit
Emergency Management	EM28	10.2.2.7	Formalise resupply arrangements on the high flood islands in conjunction with a community awareness and education campaign.	R			✓	✓		Emergency response measure via LDMP and LDMG	Unknown	Emergency services are not burdened during a flood event	2 – 5 years	M	LDMG, council staff from: Emergency Management Unit
Emergency Management	EM29	10.2.2.14.1	Further investigate stormwater infrastructure upgrades in the Ipswich CBD to provide relief from overland flow flooding and road immunity upgrades.	P		✓				Infrastructure design and construction	Unknown	Emergency services are not burdened during a flood event	2 – 5 years	L	Community members and council staff from the Planning and Regulatory Services Department and: Emergency Management Unit
Emergency Management	EM30	10.2.3.6.3	As part of a citywide implementation of Community Awareness and Resilience activities, consider rolling out a targeted awareness campaign to Moores Pocket Road to ensure residents are aware of the short time to inundation and potential problems with self-evacuation.	R				✓		Council EMU Continue partnerships with education Corporate communications	Staff time only.	Increased community awareness and resilience to flood risk.	1 – 5 years	M	Council staff from: Emergency Management Unit; Environmental Education and Partnerships; Corporate Communications and Community Engagement; and Community Development.



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