Land Use Planning Guidance Material Addendum

Brisbane River Strategic Floodplain Management Plan - Land Use Planning Guidance Material

Amended Final – 10 October 2018

BMT WBM

ETHOS URBAN

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1.0 Using the Brisbane River Strategic Floodplain Management Plan – Land Use Planning Guidance Material

1.1 Introduction

The Queensland Government, in partnership with Seqwater and Brisbane City Council, Ipswich City Council, Somerset Regional Council and Lockyer Valley Regional Council, has prepared the Brisbane River Strategic Floodplain Management Plan (SFMP).

The SFMP provides a framework and shared regional vision to collectively manage current and future flood risks and deliver a regionally consistent and integrated response to flood management needed in the Brisbane River floodplain. The SFMP assesses the consequences which may occur for the full range of flood events and considers a range of flood mitigation measures to reduce risk to life and property from riverine flooding in the Brisbane River floodplain, including structural options, land use planning, building controls, landscape management, disaster management and community resilience.

The SFMP Land Use Planning Guidance Material (SFMP Planning Guidance) is intended to be read in conjunction with the SFMP, the State Planning Policy (SPP) July 2017 and the supporting State Planning Policy – state interest guidance material for natural hazards, risks and resilience – Flood (SPP Guidance Material) and the South East Queensland Regional Plan 2017 (ShapingSEQ). From a flood risk management and land use planning perspective, these documents perform a complementary role.

To maintain a direct line of sight to the SPP state interest, the SPP Guidance Material is used as the foundation document for the structure and content of this SFMP Land Use Planning Guidance material. Where direct extracts from the SPP Guidance Material are provided, these are shown in italics to distinguish between content carried across from the SPP Guidance Material and specific guidance for the Brisbane River floodplain. In other instances, references back to the SPP Guidance Material are made to reduce duplication.

There may be no variation or additional guidance to that already provided in the SPP Guidance Material. Where there is no additional guidance, the SPP Guidance Material applies and where the SFMP Planning Guidance is able to provide more regionally specific or detailed guidance, it may be used. This Land Use Planning Guidance is subordinate to, and has been drafted to align with, the SPP Natural hazards, risk and resilience (flood) state interest; if not applicable, the SPP (and the SPP Guidance) applies.

1.2 Statutory standing

Phase 3 (SFMP) advances the ShapingSEQ action, provides context to the State Planning Policy – July 2017 (SPP) state interest - natural hazards, risk and resilience (flood) and provides a non-statutory framework to guide State and local planning authorities in the Brisbane River floodplain and catchment.

The purpose of Phase 3 (SFMP) in land use planning is to provide regional context for flood risk management and strategic land use planning to support implementation of the state interest – natural hazards, risk and resilience through local land use planning processes. While Phase 3 (SFMP) is not statutory in its effect, it will help inform the development of local planning instruments (as outlined in the Minister's Guidelines and Rules (MGR)) and related to the state interest – natural hazards, risk and resilience (flood) (specifically, SPP policy elements 1, 2, 4, 5 and 6).

Phase 3 (SFMP) seeks to achieve regionally consistent flood risk management outcomes, with flexibility in local implementation approaches and processes. It does not alter the statutory effect of the SPP (including the need to balance other state interests), but provides additional regional strategies and context for flood risk management in future iterations of local planning instruments.

The Phase 3 (SFMP) has the potential to inform the review of ShapingSEQ in cognisance of balancing other planning interests at the time.

Recommended tools and guidance have also been developed as part of the Brisbane River Phase 3 (SFMP) Land Use Planning Guidance Material.

These tools and guidance are non-statutory and are intended as a resource to assist local governments in addressing the Phase 3 (SFMP) outcomes through local planning instruments. They represent one way of meeting the outcomes of the Phase 3 (SFMP), without restricting other suitable alternative solutions that also meet the outcomes and strategies of Phase 3 (SFMP).

It is likely that land use planning responses within the various planning instruments will be different depending on the land use context across the floodplain (i.e. in rural, established urban, greenfield areas etc.). Because of the varied and diverse distribution of land uses across the floodplain, and the need to tailor planning responses to the land use context, this guidance material explains how the relevant flood risk factor tools can be applied – individually and collectively – to inform and better understand flood risk in the local circumstance.

1.3 Relationship between flood risk management planning process and statutory planning instruments

The relationship between the Brisbane River SFMP, Local Floodplain Management Plans (LFMPs) and statutory planning instruments is shown in Figure 1.

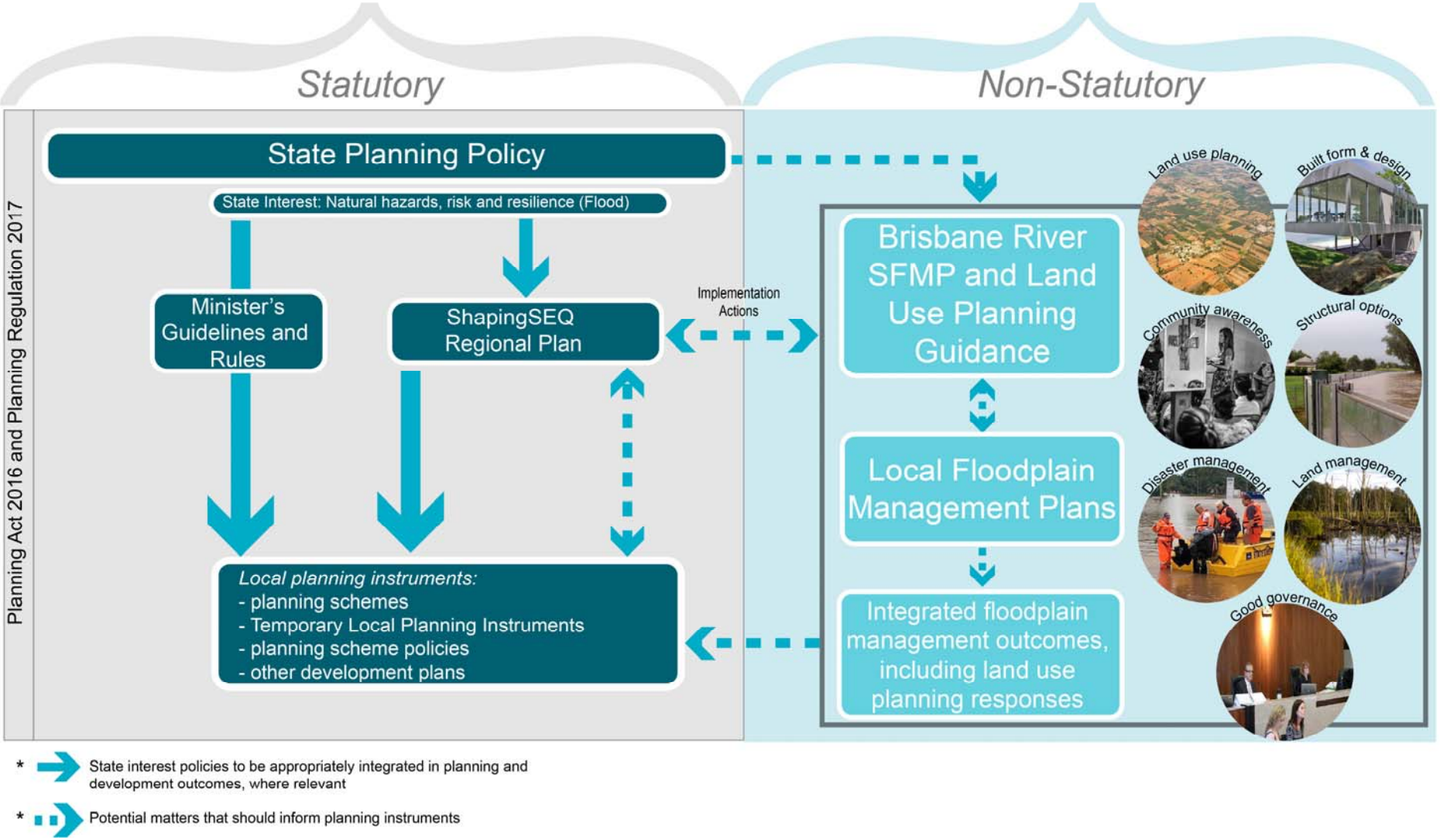

Figure 1 – Relationship of Brisbane River SFMP with statutory planning instruments

1.4 Area to which the SFMP Planning Guidance Applies

This SFMP planning guidance material applies to Brisbane River flooding only, within the Brisbane River SFMP Study Area (SFMP Study Area) shown in Figure 2. While the SFMP Planning Guidance material includes specific guidance for the SFMP Study Area, planning authorities may choose to apply a similar risk-based planning approach within the broader Brisbane River Catchment (also shown in Figure 2) and also when considering flood risk from local waterways.

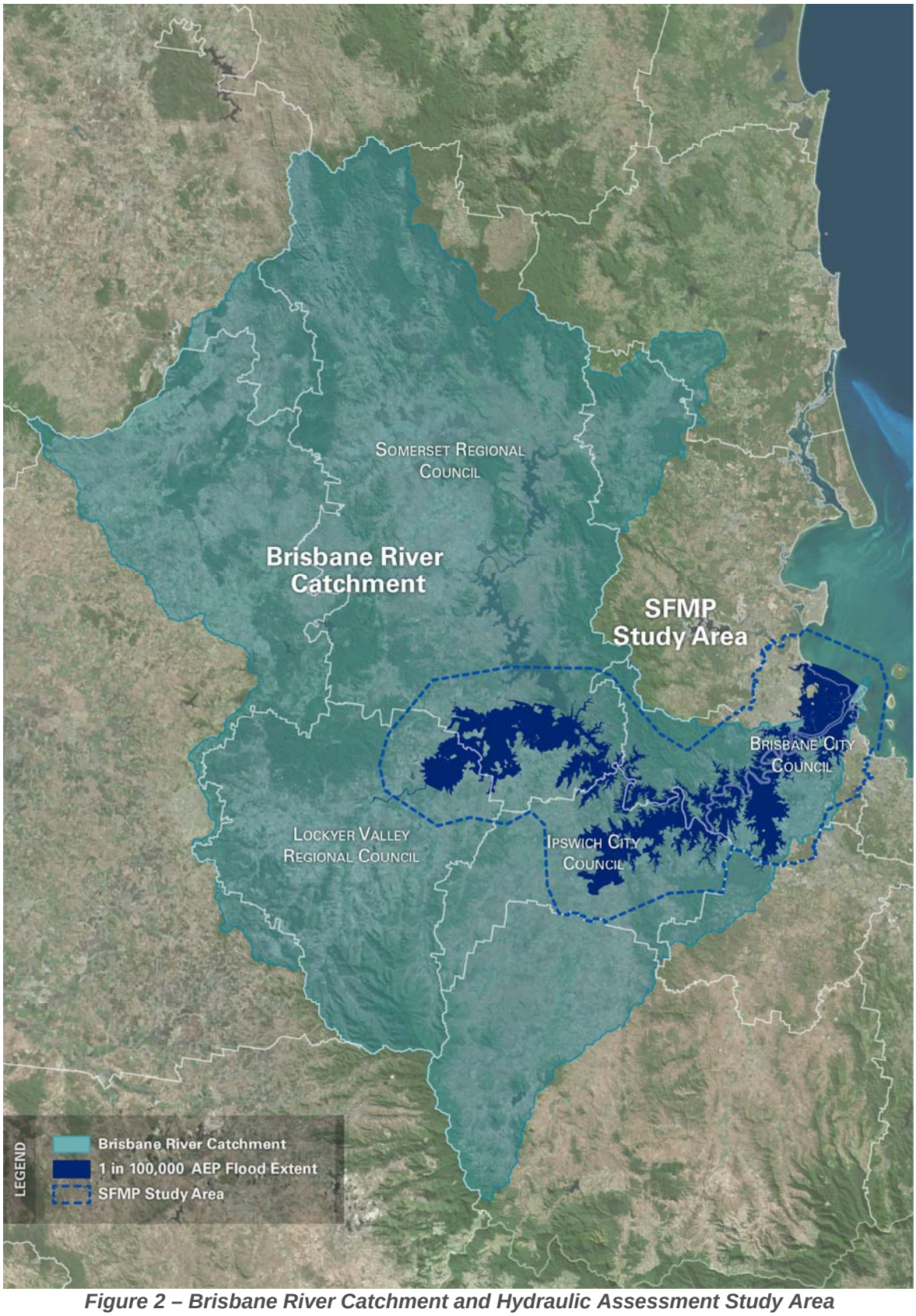

Figure 2 – Brisbane River Catchment and Hydraulic Assessment Study Area

2.0 Background

2.1 SFMP relationship to land use planning – planning is one of an integrated set of tools responding to flood risk

Effective floodplain management requires a consistent and integrated approach using a suite of actions and delivery tools to respond to current and future flood risks.

The SFMP identifies a vision and nine floodplain management outcomes supported by a range of strategies aligned under these aspiration statements, one of which is land use planning. These aspiration statements are:

- Floodplain management initiatives are delivered using a holistic, integrated and collaborative approach;
- Floodplain management initiatives are informed by a regional understanding of current flood risks;
- Future climate change impacts are recognised and planned for through adaptation and resilience building;
- Community awareness, understanding and response is the foundation for community resilience;
- Land use is planned, located and considers design elements to ensure development appropriately responds to the level of flood risk;
- Building design and construction improves community resilience and reduces property damage;
- Infrastructure is used to reduce flood risks where appropriate;
- Landscape management across the catchment contributes to flood risk reduction; and
- Disaster management planning and response applies a regionally consistent approach whilst recognising local flood risks.

Implementing the SFMP outcomes and strategies in combination, based on a shared and regionally consistent understanding of floodplain behaviour, delivers the effective and integrated response to floodplain management sought in the Brisbane River SFMP Study Area. The SFMP Technical Evidence Report (2017) (TER) provides important context and technical information relevant to defining and understanding regional floodplain behaviour and the integrated management of flooding and land use planning in the SFMP Study Area.

Land use planning is an important and effective response in influencing the level of future flood risk in the Brisbane River floodplain and can also ‘arrest’ or limit adverse material increases in the current flood risk profile of existing development. The State has an interest in responding to this risk through, in part, land use planning approaches in the Brisbane River SFMP Study Area that align with both the SPP state interest for natural hazards, risk and resilience and the SEQ Regional Plan, and support the flood risk management outcomes and strategies identified in the SFMP.

The Brisbane River floodplain spans four local government areas and all planning authorities (State and local) currently have different approaches and methodologies to defining and planning for floods. Having a common region-wide understanding of flood behaviour is essential for effective and integrated flood risk management and is underpinned by a consistent methodology for defining and understanding flood likelihoods and flood hazard. The outputs from the SFMP include a methodology for defining five categories of Potential Hydraulic Risk for the Brisbane River SFMP Study Area and provides a technically robust and consistent understanding of flood likelihoods and flood behaviour and the consequences of flooding at the regional level.

Having a shared understanding of Potential Hydraulic Risk across the floodplain provides the technical foundation for a regionally consistent risk-based approach to land use planning by defining the potential frequency and resulting hazard that may occur within the Brisbane River floodplain and is a key input in undertaking local risk assessments and local flood risk management plans.

The tolerability of land uses in the floodplain is understood by considering the overall flood risk profile which is informed by a range of flood risk factors; that is, the 'unmitigated' Potential Hydraulic Risk together with other flood risk tools, locally relevant factors, local and regional planning considerations and consultation on community tolerance. These tolerability levels may be determined through an integrated Phase 4 (LFMP) and local flood risk assessment (or alternative ISO compliant risk assessment), which considers land use planning responses as only one (in the context of several) flood risk management measures needed to consider whether the risk is acceptable, tolerable or intolerable and what the role of land use planning is in treating the level of risk.

The SFMP flood risk factor tools provide a consistent starting point to inform the development of the Phase 4 (LFMPs) and local flood risk assessments (or alternative ISO compliant risk assessment) and to inform the drafting of nuanced and risk appropriate planning responses. For example, the indicative land use tolerability table begins to articulate how planning responses can distinguish between existing urban and greenfield areas and more vulnerable or sensitive types of community infrastructure. The tools are not intended to pre-empt the land use planning response or prescribe that an intolerable or tolerable level of risk be applied in all like areas of the floodplain. The outcomes of the Phase 4 (LFMP) and local flood risk assessment (or alternative ISO compliant risk assessment) should be relied on to inform land use strategy and development policy decision making, either as part of the LFMP and risk assessment process or, as part of a separate strategic planning process (including planning scheme reviews and amendments). Through the local planning process, it may be determined by a planning authority that the extent or magnitude of need and public benefit for certain uses or development in the floodplain 'outweighs' the level of risk to life and property, and that other flood risk management measures (in addition to or separate from land use planning controls, such as flood resilient building design[2]) can reduce the risk to a level that is acceptable or tolerated by the community.

[2] At the time of drafting, the State was in the process of preparing guidance to improve understanding on the principles, techniques and appropriateness of materials and structural and non-structural options to achieve flood resilient building design. The outcomes of this guidance will be considered further in terms of implications for building controls; however, this is not a matter that can be dealt with in the planning scheme.

3.0 Risk-based planning for Natural Hazards – Flood in the Brisbane River Catchment

3.1 What is risk-based planning

In the context of flood risk management and land use planning, different land uses have different sensitivities to flood risk and this means that some land uses are more or less appropriate to floodplains, depending on the vulnerability of people, land use type, built form, density and community resilience and acceptability of risk.

Natural hazard (flood) risk-based planning is founded on the principle of distributing land use and development within the floodplain in a way that is responsive to this susceptibility, in order to manage the risk of flooding to an acceptable or tolerable level and avoid exposure to intolerable risk. The intent is not to 'sterilise' the floodplain from all development, but to provide better information for the planning process to place more vulnerable land uses in less hazardous locations, to better manage the design of development in the floodplain and to provide a consistent approach with emergency management and other flood risk management measures.

To help inform where risk appropriate development can occur in the floodplain, it is important to have a robust understanding of region-wide flood behaviour. Understanding areas of the floodplain that are potentially higher risk because of more hazardous, deep or fast flowing floodwaters versus lower risk where the flood hazard is low or likelihood is extremely rare, is a critical input to informing land use planning policy and locating development in the floodplain in a risk appropriate manner.

A risk-based planning approach is fundamentally suited to a holistic analysis of the entire floodplain as opposed to solely relying on site-by-site flood risk assessments at the development application stage. It also moves beyond relying only on a single flood event triggered through the flood hazard overlay as the only measure in planning instruments to regulate development in the floodplain. Risk based planning is based on an understanding of flood behaviour across the full range of flood events and flood hazard conditions for the full extent of the floodplain. It involves preparing flood risk mapping to inform whole-of-floodplain flood risk assessments and preparation of local flood risk management plans to provide an integrated and coordinated response to floodplain management. This in turn informs local level strategic planning, including land use and development policy decision making, planning scheme reviews and the drafting of specific development assessment benchmarks that integrate risk-based considerations into all levels of a planning instrument – e.g. strategic framework, allocation of zones and the establishment of flood overlays, local plans, policies, etc.

A risk-based land use planning approach to flood risk management also accords with the Queensland Floods Commission of Inquiry (March 2012) recommendations, leading national practice (e.g. AIDR, 2017), the SPP and SPP Guidance Material (refer to chapter 9 of the SFMP TER).

The SFMP (refer section 3 land use strategies) and this SFMP Planning Guidance, recommend a regionally consistent approach to risk-based planning for land use and development in the Brisbane River SFMP Study Area.

3.2 Drivers

Queensland Floods Commission of Inquiry

The Brisbane River Catchment Flood Studies (BRCFS), of which the SFMP forms Phase 3 of the 4 Phase program, commenced in direct response to recommendations from the Queensland Floods Commission of Inquiry (QFCoI) following the devastating floods across Queensland in 2010/2011.

The Queensland Government and all relevant local governments have committed to implementing the recommendations of the QFCoI. The QFCoI recommendations included a number of changes to how the State and local governments should manage flooding and focussed on improving the resilience of Queensland communities through consistent and integrated floodplain management, supported by detailed and reliable flood data in the Brisbane River Catchment.

Recommendations included flood controls, dam release and procedures, planning, emergency procedures and management of future development in the Brisbane River floodplain.

QFCoI recommendations particularly relevant to land use planning are:

Recommendation 2.13
For urban areas or areas where development is expected to occur:
- *Councils with the requisite resources should develop a flood map which shows 'zones of risk' (at least three) derived from information about the likelihood and behaviour of flooding;*
- *Councils with the requisite resources to produce a flood behaviour map should develop a flood map which shows the extent of floods of a range of likelihoods (at least three).*

Recommendation 7.16
The Queensland Government should consider drafting assessment criteria to be included in the model flood planning controls which require that works in a floodplain:
- *Do not reduce on-site flood storage capacity;*
- *Counteract any changes the works will cause to flood behaviour of all floods up to and including the applicable defined flood event by measures taken within the subject site (for example, use of compensatory works, detention basins or other engineering mechanism)*
- *Do not change the flood characteristics outside the subject site in ways that result in:*
  - *loss of flood storage;*
  - *loss of/changes to flow paths;*
  - *acceleration or retardation of flows, or*
  - *any reduction in flood warning times elsewhere on the floodplain.*

The QFCoI findings also made it clear that traditional approaches of relying on a single defined flood event as the only measure to manage flood risk for planning purposes, such as the 1 in 100 year AEP, are too simplistic because the full understanding of flood risk is not known. Relying only on a single flood likelihood can misrepresent the potential dangers to the community because it limits the consideration of consequences to one event only and not the full extent of possible floods including larger and more rare floods, while also not considering flood hazard or behaviour.

A key output from the Phase 3 (SFMP), is a consistent methodology and definition of five categories of Potential Hydraulic Risk for the Brisbane River floodplain. Potential Hydraulic Risk is defined purely on the basis of the hydraulic conditions and behaviour of the flood events and is determined by analysing the likelihood of floods and the hydraulic hazard that occurs during floods of different size and likelihood.

A consistent methodology and definition of Potential Hydraulic Risk across the Brisbane River SFMP Study Area provides the foundation for a regionally consistent risk-based approach to land use planning and addresses the requirements of the QFCoI by identifying at least three 'zones' of flood risk.

Relationship to SPP and SPP Guidance Material 2017

The State Planning Policy identifies natural hazards – flood as a State interest and requires that "*the risks associated with natural hazards, including the projected impacts of climate change, are avoided or mitigated to protect people and property and enhance the community's resilience to natural hazards.*" (SPP 2017, pg. 51)

The SPP and SPP Guidance Material reinforces a risk-based approach to land use planning across Queensland including the requirement for local governments to undertake a flood risk assessment in accordance with the International Risk Standard AS/NZS ISO 31000:2009 approach.

The intent of the risk assessment is to identify whether flood risk is acceptable, tolerable or intolerable in the context of existing and future development. The flood risk assessment informs planning responses that deliver risk appropriate land use planning policy and development outcomes.

The SFMP and this SFMP planning guidance provide regional context for the State's interest for Natural Hazards – flood and managing flood risk in the Brisbane River floodplain.

Relationship to South East Queensland Regional Plan 2017 (ShapingSEQ)

ShapingSEQ is a state planning instrument for South East Queensland (SEQ) and provides a regional framework to sustainably manage the anticipated growth over a 25 year period in a way that maintains the region's prosperity and liveability, while protecting regional natural values and assets.

ShapingSEQ is both a plan making and decision making tool, which complements and advances the SPP by providing the basis for prioritising, qualifying and resolving state interests in response to the region's projected growth, community expectations and values. It encourages the principle of designing communities to be safe and hazard-resilient places by using disaster management planning, adaptation strategies and avoidance of exposure to high risk areas, to minimise SEQ's vulnerability to natural hazards.

Chapter 4 of ShapingSEQ identifies the preparation of the Brisbane River SFMP and implementing its outcomes through planning schemes, as one of the actions to advance the directions and outcomes sought for natural hazard management (flood risk) in SEQ. Phase 3 (SFMP) delivers on this action within the context of the SPP state interest – natural hazards, risk and resilience (flood). The SFMP identifies those flood risk management outcomes requiring regional consistency and, in doing so, sets a regional framework to achieve risk-responsive, strategic land use planning and to inform the making or amending of local planning instruments in the floodplain.

Part A: Understanding the state interest

State interest statement

The risks associated with natural hazards, including the projected impacts of climate change, are avoided or mitigated to protect people and property and enhance the community's resilience to natural hazards.

Refer to Part A of the SPP - state interest guidance material for natural hazards, risk and resilience (SPP Guidance Material) for an explanation of the state interest statement and the role of land use planning in responding to flood risk and in supporting other flood risk management and community resilience objectives.

Additional Core Concepts for the Brisbane River SFMP Study Area

In addition to the core concepts identified in the SPP Guidance Material, the following core concepts are also relevant to the Brisbane River SFMP Study Area:

Flood hazard area
For the purpose of satisfying the requirements of the State Planning Policy definition for flood hazard area, the BRCFS Phase 2 (Flood Study) is considered a fit-for-purpose flood study and the SFMP Potential Hydraulic Risk mapping (derived from the SFMP defined matrix) identifies the extent of the regional scale area of flood hazard for riverine flooding in the Brisbane River floodplain.

To meet the definition of flood hazard area under the SPP, planning authorities can use the SFMP Potential Hydraulic Risk mapping to identify or inform the LGA wide flood hazard area in planning instruments. Alternatively, where a planning authority seeks to refine the resolution of SFMP Potential Hydraulic Risk mapping to address limitations of the regional study, they apply the SFMP Potential Hydraulic Risk matrix through local flood studies to inform the flood hazard area in a planning instrument[3]. It is recommended that the Phase 2 (Flood Study) and Phase 3 (SFMP) Potential Hydraulic Risk mapping be relied on to inform the identification of a flood hazard area within the Brisbane River floodplain instead of areas currently shown on the SPP Interactive Mapping System (IMS).

Potential hydraulic risk
Hydraulic risk is defined on the basis of the hydraulic conditions and behaviour of flood events[4]. It is determined by analysing the likelihood of floods and the hydraulic hazard that occurs during floods of different sizes and likelihood. It is the inherent or 'unmitigated' flood risk.

[3] The SFMP Potential Hydraulic Risk mapping is limited to Brisbane River flooding only and does not consider other sources of flooding from local waterways, creeks or overland flow. The identification of the LGA wide flood hazard area in the planning instrument also needs to consider other sources of flooding.

[4] Potential hydraulic risk is defined purely on the basis of hydraulic conditions and behaviour of flood events and is independent of existing or future land use and development or other factors that contribute to flood risk. It is the 'unmitigated' or untreated risk of Brisbane River flooding.

Figure 3 – Potential hydraulic risk

The Brisbane River Strategic Floodplain Management Plan (SFMP) and SFMP Technical Evidence Report (2017) defines Potential Hydraulic Risk categories for the Brisbane River floodplain. For the Brisbane River floodplain, potential hydraulic risk is defined by a combination of seven (7) likelihoods and six (6) hydraulic hazard categories to produce five (5) categories of potential hydraulic risk, from HR1 (highest risk) to HR5 (lowest risk). The potential hydraulic risk matrix definition for the SFMP Study area is identified in Figure 4 below.

AEP	H1	H2	H3	H4	H5	H6
1 in 100k	HR5	HR5	HR5	HR5	HR5	HR5
1 in 2000	HR5	HR5	HR4	HR4	HR4	HR4
1 in 500	HR5	HR4	HR4	HR3	HR3	HR3
1 in 100	HR4	HR4	HR3	HR2	HR2	HR2
1 in 50	HR4	HR3	HR2	HR2	HR1	HR1
1 in 20	HR3	HR2	HR2	HR1	HR1	HR1
1 in 10	HR2	HR1	HR1	HR1	HR1	HR1

Figure 4 – Brisbane River SFMP Potential Hydraulic Risk Matrix

Community infrastructure comprises three broad categories of uses being:

- **vulnerable uses**
- **sensitive uses**
- **critical services**

Vulnerable use

Vulnerable uses comprise those uses or activities that accommodate vulnerable persons, the demographic or socio-economic characteristics (e.g. age, health, disability, need for assistance) of whom increase the severity of flood impact and the population's risk profile. The vulnerability of these uses' occupants creates a higher susceptibility to flood risk due to constraints on self-evacuation and self-assistance and require significant effort, assistance or resources from others to organise evacuation.

Examples of vulnerable people include children, elderly, disabled, inmates and hospital patients. Vulnerability also exists for people who lack local knowledge or awareness of local conditions such as visitors to an area who are not permanent residents or areas where there is a high turnover of renters. Uses involving vulnerable people means that managing risk to life is the highest priority when considering tolerability or acceptability of flood risk.

Examples of vulnerable land uses include:

- child care centre
- community care centre
- community residence
- correctional facility
- detention facility
- educational establishment

- hospital (and health care service where supporting a hospital)
- relocatable home park
- residential care facility
- retirement facility
- short term accommodation and other forms of tourist accommodation (e.g. resort complex, nature-based tourism)
- tourist park

Sensitive use
Sensitive uses are those that are particularly sensitive to the impacts of flooding on property loss or damage, such as those accommodating or storing sensitive content (e.g. precious or important documents, artefacts and cultural or historical records, animal refuges due to significant effort to organise evacuation). Managing risk to property is an important consideration when considering tolerability or acceptability of flood risk for these types of uses.

Examples of sensitive land uses include:

- cemetery
- community use (e.g. where for the storage of culturally or historically significant artefacts, documents and records, such as in an art gallery, library or museum)
- crematorium
- funeral parlour
- veterinary service (and the like including animal refuges/hospitals)

Critical services
Critical services have an active role in flood disaster management response and recovery and are required to operate during or immediately after a flood event to provide essential services to the community.

Examples of critical services include:

- air service
- emergency services (e.g. evacuation centre, disaster management, ambulance, fire and police stations)
- hospital
- major electricity infrastructure
- renewable energy facility
- substation (supporting other community infrastructure)
- telecommunications facility
- utility installation (for supply of water, hydraulic power, gas, sewerage, waste management)

Part B: Integrating the state interest policies

This section explains how the SFMP provides regional context for the integration of state interest policies 1, 2, 4, 5 and 6 of the Natural hazards, risk and resilience state interest (flood) into planning instruments, within the Brisbane River SFMP Study Area.

The SFMP planning guidance material focuses on three key elements relevant for preparing planning instruments: (flood) hazard identification, (flood) risk assessment and planning responses.

To meet the objectives of the SPP for the Natural hazards, risk and resilience state interest, planning authorities need to follow the process of (flood) hazard identification (policy 1) and (flood) risk assessment (policy 2) in order to develop fit-for-purpose measures in their planning instruments (policies 4–6). It is recommended that the local flood risk assessment be undertaken as part of a Local Floodplain Management Plan (LFMP) process (as delivered in Phase 4 of the Brisbane River Catchment Flood Studies), to provide a more complete understanding of local flood risk and to deliver an integrated and holistic response to flood risk management measures, including land use planning responses among the combination of risk treatment actions available. However, recognising that this may not always be the case, a local flood risk assessment to inform strategic planning processes (including planning scheme reviews and amendments) may be undertaken separately or may progress in the absence of Phase 4 (LFMPs), where an alternative ISO standard (AS/NZS ISO 31000:2009 Risk Management) compliant approach is used, as per SPP state interest policy 2.

The Potential Hydraulic Risk mapping (derived from the SFMP defined matrix and Technical Evidence Report, 2017) and other relevant SFMP flood risk factor tools, provide planning authorities with the technical inputs to help inform mapping for Brisbane River flood hazard identification (policy 1) within the SFMP Study Area. Planning authorities can also use the Phase 3 (SFMP) Potential Hydraulic Risk mapping and other SFMP flood risk mapping tools, where relevant, to undertake a local flood risk assessment (policy 2) and to inform land use planning responses in planning instruments (policies 4–6).

Figure 5 identifies at a high level the relationship between the Brisbane River Phase 3 (SFMP), SPP policy elements and Phase 4 (LFMPs). The Phase 3 (SFMP) takes planning authorities ‘part of the way’ in addressing the SPP requirements by providing important information to understand flood risk at the regional level and other flood risk factor ‘tools’ to inform the risk appropriateness of land use allocation. Phase 4 (LFMPs) will provide a more complete understanding of local flood risk and present an opportunity to evaluate the most appropriate suite or combination of risk treatment actions at the local level – and not any one outcome (e.g. land use planning) in isolation. Figure 6 gives an overview of the relationship between the ISO international risk management framework, the Phase 3 (SFMP) and Phase 4 (LFMP) and SPP requirements.

Phase 4 (LFMPs) are encouraged to be prepared using the best available data to planning authorities. Key inputs to Phase 4 (LFMPs) include those future regional assessments required to deliver key SFMP outcomes and actions in the context of land use planning. These include a consistent definition of hydraulic risk and analysis of land use exposure, a regional cumulative impact assessment, a regional evacuation capability assessment and a coordinated climate change adaptation response.

The SFMP flood risk factor tools, particularly the Potential Hydraulic Risk mapping, provide important technical inputs to derive an understanding of flood behaviour and the inherent or unmitigated flood risk, to inform strategic planning and to frame the land use planning options available to treat flood risk, as identified through the Phase 4 (LFMPs) and local flood risk assessment (or alternative ISO compliant risk assessment). While the LFMP only considers flood risk, the broader planning scheme is required to consider, balance and respond to many strategic planning considerations, constraints, state interests and regional outcomes to determine the optimum land use planning outcome for the benefit of the community. Where possible, these planning considerations (where relevant and appropriate to do so) can be factored into the Phase 4 (LFMP) process. However, the Phase 4 (LFMP) may also be used to inform the ‘balancing’ of planning issues as part of a separate strategic planning process (such as a planning scheme review). Through the Phase 4 (LFMP) process, existing and proposed land use planning and development policy responses to ‘treat’ flood risk can be considered in the context of other flood risk management measures, and where appropriate, may be considered together with other planning objectives and outcomes being sought for the community.

Similar to how the SPP Guidance is applied, this SFMP Land Use Planning Guidance Material suggests possible solutions for how the natural hazards, risk and resilience (flood) state interest could be integrated in planning instruments in the SFMP Study Area; however, recognises that planning authorities need to balance competing state interests (other than flood) to respond to specific local and regional circumstances. This balance of state interests may mean that the planning instrument preferences one state interest policy over another. It is expected that the state interest policy for flooding be considered as part of the state interest review, and ministerial approval means the approach taken by the local government in balancing the state interest polices is endorsed by the State.

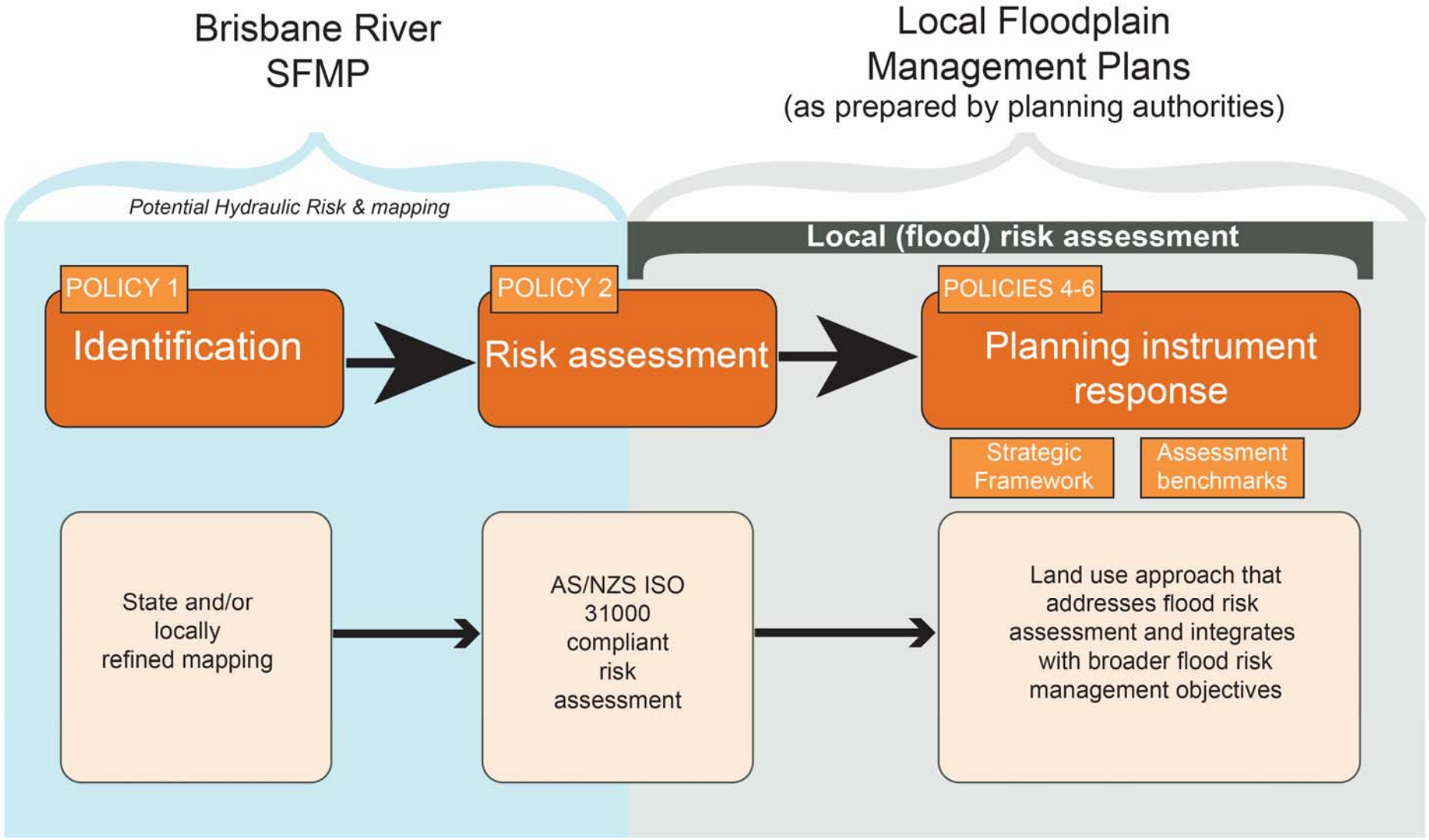

Figure 5 – Alignment of fit-for-purpose assessment with the SPP guidance material in this document. The SFMP addresses SPP Policy 1 and part of SPP Policy 2

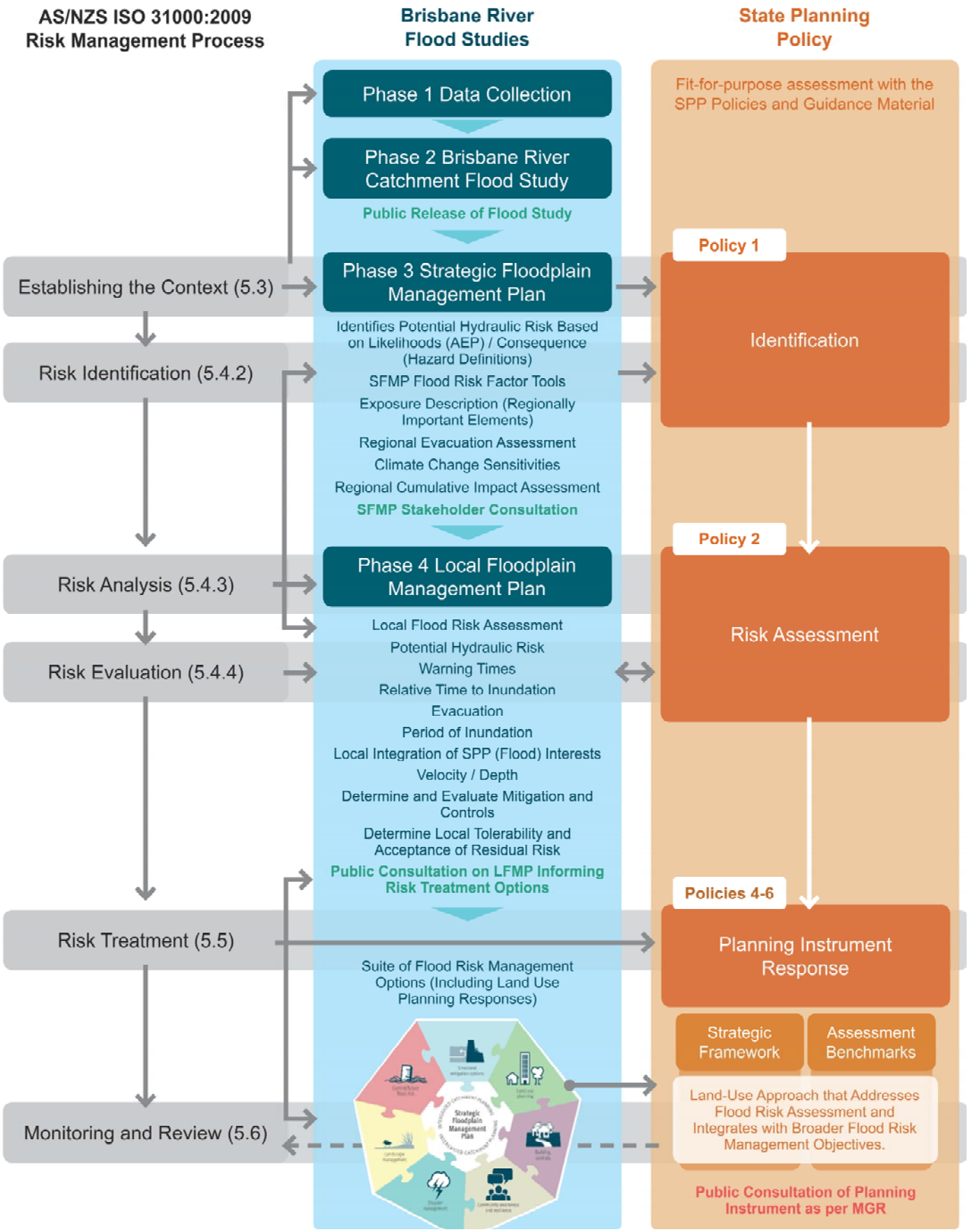

Figure 6 – Relationship between ISO Risk Management framework, Brisbane River SFMP and SPP state interest policy elements.

4.0 Guide to applying the SPP State Interest Guidance Material in the Brisbane River Catchment

State interest policy 1

Natural hazards areas are identified, including:
(a) bushfire prone areas
(b) flood hazard areas
(c) landslide hazard areas
(d) storm tide inundation areas
(e) erosion prone areas.

Brisbane River Floodplain Background

The regional context in which State interest policy 1 is applied in the Brisbane River SFMP Study Area is explained in **Appendix A**.

How to appropriately integrate the policy

The planning scheme is informed by and contains mapping that identifies an LGA-wide flood hazard area derived from:

- *locally prepared fit-for-purpose flood studies*
- *the compilation of suitable existing flood mapping where available.*

SPP Guidance Material	*Application to Brisbane River SFMP Study Area*
1.1 The flood studies used to identify the LGA-wide flood hazard area are fit-for-purpose, and are of a precision that reflects the level of population, future growth and floodplain complexity of the areas to which the studies relate.	1.1.1 The Phase 2 (Flood Study) (BMT WBM, 2017) is the fit-for-purpose flood study for Brisbane River flooding within the Brisbane River SFMP Study Area and can be used to inform planning instruments and LGA wide flood hazard area mapping and any local flood study, local flood risk assessment or Local Flood Risk Management Plan (LFMP). *Note: Phase 2 (Flood Study) is the most sophisticated and comprehensive regional flood study and hydrologic and hydraulic modelling of its kind to be prepared for the Brisbane River floodplain. The study provides the best available data to understand flood behaviour at the regional level and is a fit-for-purpose representation of the extent of the regional scale area of flood hazard for riverine flooding in the Brisbane River floodplain.* *Note: It is recommended that the Phase 2 (Flood Study) and SFMP Potential Hydraulic Risk mapping be relied on to inform the identification of a flood hazard area within the Brisbane River floodplain instead of areas currently shown on the SPP IMS. Alternatively, where a planning authority seeks to refine the resolution of SFMP Potential Hydraulic Risk mapping, they apply the SFMP Potential Hydraulic Risk matrix through local flood studies, the Phase 4 (LFMP) and local flood risk assessment* (or alternative ISO compliant risk assessment) *to inform the flood hazard area in a planning instrument.*

SPP Guidance Material	Application to Brisbane River SFMP Study Area
	Note: Local planning authorities may elect to refine the Phase 2 (Flood Study) regional modelling and its spatial resolution, to apply to the site or property level. 1.1.2 When preparing local flood studies, local risk assessments or LFMPs, planning authorities' planning instruments and LGA wide flood hazard area mapping is informed by the SFMP Potential Hydraulic Risk matrix definition, as detailed in the SFMP and Technical Evidence Report, 2017. *Note: Refer to Part A of this SFMP planning guidance material for the Brisbane River SFMP Potential Hydraulic Risk categories and matrix definition for the SFMP Study Area.* *Note: To maintain regional consistency and a shared understanding of flood behaviour, independent variation of the Potential Hydraulic Risk categories and matrix definition by individual planning authorities or development applicants is not supported. It is important that the SFMP PHR categories be maintained in the Phase 4 (LFMPs) and/or local flood studies and local flood risk assessments to provide a consistent technical understanding of flood behaviour (i.e. the inherent or 'unmitigated' base constraint) across the floodplain.* *A variation to the SFMP defined matrix may be potentially appropriate where: the proposed change is informed by a robust technical and scientific review, the change to the matrix definition is collectively agreed by the State and all local governments through a collaborative process and the change occurs at the regional level across the entire Brisbane River floodplain.*
1.2 Flood studies are undertaken prior to or as early as possible in the preparation of the planning scheme to inform how flood risk will be addressed through land-use strategy and development assessment.	No additional guidance for the Brisbane River SFMP Study Area.
1.3 Flood mapping compiled to represent the flood hazard area, wherever available information permits, reflects the broad spectrum of flood risk (and/or flood potential of an area) by including: • *events of lesser and greater magnitude than the DFE* • *information regarding flood behaviour, such as flood depth, velocity and/or hazard or risk* • *areas where flood potential exists but detailed studies may not be available.*	1.3.1 The SFMP Potential Hydraulic Risk matrix defines five categories of Potential Hydraulic Risk (HR1 to HR5) based on a combination of seven likelihoods and six flood hazard levels, as detailed in the SFMP and Technical Evidence Report (2017). For the SFMP Study Area, using that matrix, the agreed likelihoods and flood hazard levels include: a) the 1 in 10 AEP, 1 in 20 AEP, 1 in 50 AEP, 1 in 100 AEP, 1 in 500 AEP, 1 in 2,000 AEP and 1 in 100,000 AEP events; and b) six levels of flood hazard (H1 to H6) calculated based on combinations of flood depth, flood velocity and velocity-depth product as defined by Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia (AIDR, 2017).

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	Note: The SFMP Potential Hydraulic Risk matrix provides a regionally consistent understanding of riverine flood risk across the Brisbane River SFMP study area. For other sources of flooding or areas outside the study area, planning authorities are encouraged to use a similar approach to identifying hydraulic risk using a range of AEPs and flood hazard levels. 1.3.2 Potential Hydraulic Risk mapping derived from the SFMP defined matrix represents the spatial extent of the regional scale area of flood hazard for Brisbane River flooding and, given its fit-for-purpose application to the Brisbane River SFMP Study Area, can be used to inform the flood hazard area in the planning instrument. Refer to **Appendix B –** Potential Hydraulic Risk Categories Map. A planning authority can either: a) Use the SFMP Potential Hydraulic Risk mapping to inform or identify the flood hazard area in the planning instrument; or b) Apply the SFMP Potential Hydraulic Risk matrix through a local flood study, local risk assessment or LFMP to refine the on-the-ground mapping and to inform or identify a flood hazard area. *Note: The Phase 2 (Flood Study) and SFMP Potential Hydraulic Risk mapping can be relied on to inform the identification of a flood hazard area within the Brisbane River floodplain instead of areas currently shown on the SPP IMS. Alternatively, where a planning authority seeks to develop its own flood risk mapping by refining the Phase 2 (Flood Study) and Phase 3 (SFMP) mapping, it applies the SFMP Potential Hydraulic Risk matrix through local flood studies to inform the flood hazard area in a planning instrument.* 1.3.3 Planning instruments, in identifying and mapping the LGA wide 'flood hazard' area, include at least three (3) categories of flood hazard or flood risk, ranging in severity from low to high/extreme, consistent with best practice. Ideally, this is informed by the categories of Potential Hydraulic Risk identified in Phase 3 (SFMP) to reflect the same technical hazard 'baseline' and understanding of flood behaviour; however, categories can be simplified or expanded when translated in local planning instruments and mapping to reflect local circumstances, account for a broader range of flood risk factors and align with community expectations. Refer to **Appendix E** – Example of translation of Potential Hydraulic Risk categories into overlay mapping. 1.3.4 Planning instruments may also incorporate into this mapping, where relevant, other flood risk factors, such as relative time to inundation, evacuation capability/networks, flood flow conveyance and storage areas and low and high flood islands to inform the severity of flood risk. 1.3.5 Planning instruments, in identifying and mapping the LGA wide flood hazard area, may also be informed

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	by the SFMP flood risk factor tools in **Appendix C** and **Appendix D**, where relevant. *Note: The Phase 2 (Flood Study) focuses on riverine flooding from the Brisbane River. Planning authorities when considering flood hazard and risk assessments for local waterways and creek flooding are encouraged to use a similar approach to defining Potential Hydraulic Risk that includes a combination of both likelihood and flood hazard to reflect the full spectrum of flood risk.*
1.4 Based on local circumstances and needs, the fit-for-purpose approach may identify flood hazard areas through one or a combination of the following means: • *the use of state-wide mapping and data at a scale and precision appropriate to the local context* • *locally refined state-wide mapping and data* • *local flood studies that are prepared in accordance with national and state best practice.*	1.4.1 The Phase 2 (Flood Study) and SFMP Potential Hydraulic Risk mapping can be relied on to inform the identification of a flood hazard area within the Brisbane River floodplain instead of areas currently shown on the SPP IMS. Alternatively, where a planning authority seeks to refine the resolution of SFMP Potential Hydraulic Risk mapping, they apply the SFMP Potential Hydraulic Risk matrix through local flood studies, local flood risk assessments or the LFMP process to inform the flood hazard area in a planning instrument. *Note: Planning authorities, when considering flood hazard and risk assessments for local waterways and creek flooding within and outside of the SFMP Study Area, are encouraged to use a similar approach to defining Potential Hydraulic Risk that includes a combination of both likelihood and flood hazard to reflect the full spectrum of flood risk.* 1.4.2 It is recommended that all local flood studies, local flood risk assessments and LFMPs follow the same methodology for defining Potential Hydraulic Risk and apply the SFMP matrix in accordance with the SFMP and Technical Evidence Report (2017). 1.4.3 Planning instruments, in identifying and mapping the flood hazard area, may also be informed by the SFMP flood risk factor tools in **Appendix D** where relevant. 1.4.4 Where LGAs have areas outside of the BRCFS Phase 2 (Flood Study) modelled area, flood hazard areas are informed and identified in accordance with the SPP and SPP Guidance Material (flood).
1.5 Existing mapping that includes climate change factors should be used to identify the flood hazard area, in preference to mapping without climate change factors. New flood studies produced for the purpose of identifying the flood hazard area should	1.5.1 Planning instruments are informed by the outcomes of a regional climate change adaptation response[5]. 1.5.2 When preparing LFMPs, local flood studies, local flood risk assessments or mapping to inform the planning instrument: a) The SFMP sensitivity analysis as detailed in the Technical Evidence Report (2017) is appropriate for use and it is recommended it be relied on to inform assessment of potential climate change impacts. Planning instruments can consider the

[5] At the time of preparing this guidance, the regional climate change adaptation response had not been prepared by the State Government. This study will not be applicable to the use of this guidance until completed and made available to planning authorities. However, the absence of this regional study should not delay planning authorities from proceeding with Phase 4 (LFMPs) and local flood risk assessments (or alternative ISO compliant risk assessment), which can be incorporated in parallel to the preparation of Phase 4 (as the study emerges). It is understood the timing of this study has been discussed with the SFMP Steering Committee.

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incorporate climate change factors in the modelling.	solution in section 1.5.3 below in applying climate change factors; or b) Where the planning authority determines that further investigations are required to assess potential future climate change impacts, all studies are undertaken in accordance with the *Australian Rainfall and Runoff (AR&R) 2016* methodology and projections. Planning authorities can consider the following solution in using the Phase 3 (SFMP) climate change modelling: 1.5.3 Future climate change conditions are considered when preparing planning instruments and undertaking strategic land use planning: a) For flood risk planning purposes, particularly when preparing mapping to inform the LGA flood hazard area, planning authorities consider using the SFMP climate change scenario CC4 (model reference) out to 2090, as detailed in the Technical Evidence Report. CC4 is based on the RCP 8.5 scenario at 2090 and adopts a 20% increase in rainfall and a sea level rise of 0.8m (compared to 1990 levels) to identify the possible affected area. b) In addition to (a) and to understand how potential hydraulic risk is expected to change over time, an interim planning horizon may also be used in the assessment of potential climate change impacts. The SFMP climate change scenario CC2 (model reference) out to 2050 as detailed in the Technical Evidence Report is an appropriate interim forward timeframe. CC2 is based on the RCP 8.5 scenario conditions at 2050 and adopts a 10% increase in rainfall and a 0.3m sea level rise (compared to 1990 levels). *Note: Being able to understand the expected changing profile of potential hydraulic risk across the floodplain under current conditions, at 2050 and 2090 assists planning authorities in making informed decisions about risk appropriate land use and planning responses to avoid and manage this risk. This approach is intended to provide planning authorities with regionally consistent climate change assumptions when preparing mapping to identify the flood hazard area across the floodplain (e.g. out to the RCP 8.5 scenario by 2090) and is consistent with AR&R guidance (2016), which recommends two climate change scenarios, RCP 4.5 and RCP 8.5, be tested at 2050 and 2090 intervals.* 1.5.4 Table 1 provides a suggested starting point for planning authorities to apply a more nuanced response using the SFMP modelled climate change scenarios to various land uses within the floodplain and to inform planning scheme provisions. If planning authorities choose to undertake further testing using the SFMP modelled climate change scenarios, planning authorities have the flexibility to choose timeframes that are relevant to their local context.

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	Note: While regional consistency in climate change assumptions used to update flood hazard mapping in planning instrument is important, it is recognised that the land use planning response to climate change may vary across LGAs and the floodplain. Planning authorities may choose to take a more nuanced approach to account for the implications of climate change on specific land uses by applying different climate change scenarios to land use, appropriate to the longevity or resilience of the land use to changing flood risk exposure over time.
1.6 Where a local government's resources to undertake natural hazards studies are constrained and state-wide mapping is not sufficiently detailed to support plan-making, localised flood studies should be prioritised for areas where growth and development pressures are greatest and most imminent. A program of mapping updates should identify how the necessary level of mapping will be made available to enable informed development decisions (e.g. scheduled local area planning or site-based mapping as part of a development application).	No additional guidance for the Brisbane River SFMP Study Area.

Table 1 – Indicative climate change scenarios for land use activity 'groups' in the SFMP Study Area

Land use activity	Scenario (model reference)	Climate change conditions	Planning horizon
Community infrastructure and critical services (Examples of such uses that are likely to permanently 'locate' in the floodplain up to 2090 and define the settlement pattern include: hospital, air service, major electricity infrastructure, emergency services)	CC4	RCP 8.5 – 20% and 0.8m	2090
Vulnerable uses (involving vulnerable persons) (Examples of such uses that are likely to permanently 'locate' in the floodplain up to 2090 and define the settlement pattern include: hospital, community use, correctional facility, detention facility, educational establishment)	CC4	RCP 8.5 – 20% and 0.8m	2090
Filling	CC4	RCP 8.5 – 20% and 0.8m	2090
Subdivision	CC5	RCP 4.5 – 10% and 0.63m	2090
Residential and accommodation uses (Examples of such uses that are likely to permanently 'locate' in the floodplain up to 2090 and define the settlement pattern include: resort complex, hotel, tourist park)	CC5	RCP 4.5 – 10% and 0.63m	2090
Commercial and industrial uses	CC5	RCP 4.5 – 10% and 0.63m	2090
Non-urban and recreation uses	CC2	RCP 8.5 – 10% and 0.3m	2050

State interest policy 2

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.

Brisbane River Floodplain Background

The regional context in which State interest policy 2 is applied in the Brisbane River SFMP Study Area is explained in **Appendix A**.

How to appropriately integrate the policy

The preparation of the planning scheme is informed by a fit-for-purpose flood risk assessment, consistent with best practice guidance, tailored to the flood information available, population at risk, expected growth rates and other local circumstances.

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2.1 Based on local circumstances and needs, the fit- for- purpose risk assessment for flood related risks is consistent with national flood risk management best practice and the principles provided in Table 1 below.	2.1.1 It is recommended that a comprehensive local flood risk assessment consistent with the principles in Table 1 of the SPP Guidance Material, should form part, and inform the preparation, of a Local Flood Risk Management Plan (LFMP). However, it is recognised there may be circumstances where a local flood risk assessment (or alternative ISO compliant risk assessment) is undertaken as a separate process to the Phase 4 (LFMP) preparation. 2.1.2 For the purpose of satisfying the SPP, the preparation of a Phase 4 (LFMP) is considered one way in which a planning authority may meet the requirements of the SPP risk assessment process. A planning authority who prepares a Phase 4 (LFMP) to inform their planning instruments, ensures that the LFMP scope also considers the requirements of the SPP flood risk assessment principles in Table 1 of the SPP Guidance Material and can choose to prepare a Natural Hazards (Flooding) Evaluation Report to support any proposed planning changes to respond to flood risk.
2.2 A fit-for-purpose flood risk assessment is to be undertaken for all urban areas in the LGA.	2.2.1 Planning authorities undertake a comprehensive (flood) risk assessment for all urban areas at the local level in accordance with state interest policy 2. It is recommended that Phase 4 (LFMPs) and local flood risk assessments (or an alternative ISO compliant risk assessment) follow a regionally consistent methodology and are informed by the SFMP Potential Hydraulic Risk mapping derived from the SFMP defined matrix as detailed in the SFMP and Technical Evidence Report (2017). In the context of integrated floodplain risk management, the Phase 4 (LFMP) and local flood risk assessment (or alternative ISO compliant risk assessment) may analyse, where relevant, the impact of other SFMP flood risk factors on current and future flood risk, as identified in **Appendix D**.

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	2.2.2 It is recommended that Phase 4 (LFMPs) and local flood risk assessments (or an alternative ISO compliant risk assessment) include an assessment of a range of potential flood events, up to and including the extent of extreme flood inundation defined by the 1 in 100,000 AEP. For the SFMP Study Area, it is recommended that Phase 4 (LFMPs) and local flood risk assessments include: a) at a minimum, the following events to define 'likelihood': the 1 in 10 AEP, 1 in 20 AEP, 1 in 50 AEP, 1 in 100 AEP, 1 in 500 AEP, 1 in 2,000 AEP and 1 in 100,000 AEP events; and b) the following flood hazard levels to define 'consequence': the six levels of flood hazard (H1 to H6) calculated and used based on combinations of flood depth, flood velocity and velocity-depth product as defined by *Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia* (AIDR, 2017). *Note: In accordance with the SPP Guidance, the local flood risk assessment (ideally to be undertaken through the Phase 4 (LFMP)) should be tailored to be fit-for-purpose depending on the characteristics of the hazard, the floodplain settlement pattern and the rate of growth anticipated and population exposed. Refer to SPP Guidance on state interest policy 2.* 2.2.3 In addition to the Phase 3 (SFMP) Potential Hydraulic Risk mapping and matrix to define the level of flood risk, it is recommended that Phase 4 (LFMPs) and local flood risk assessments (or alternative ISO compliant risk assessment) are informed by the following technical inputs (where such studies are available) to support further evaluation and analysis of current and future flood risk at the local level in the context of integrated flood risk management measures[6]: a) A regional cumulative impact assessment prepared for the Brisbane River floodplain as recommended by this SFMP; b) A regional evacuation capability assessment prepared for the Brisbane River floodplain as recommended by this SFMP; c) A regional climate change adaptation response as recommended by this SFMP; d) Current and Future Risk Assessment and strategic analysis of land use as detailed in the Technical Evidence Report (2017), and e) where relevant, the SFMP tools in **Appendix B**, **Appendix C** and **Appendix D**. *Note: The regional cumulative impact and regional evacuation capability assessments are ideally undertaken as*

[6] At the time of preparing this guidance, the regional cumulative impact assessment, regional evacuation capability assessment and regional climate change adaptation response inputs had not been prepared by the State Government. These studies will not be applicable to the use of this guidance until they are completed and made available to planning authorities. However, the absence of these regional studies should not delay planning authorities from proceeding with Phase 4 (LFMPs) and local flood risk assessments (or an alternative ISO compliant risk assessment), which can be incorporated in parallel to the preparation of Phase 4 (as these studies emerge). It is understood that the timing of these studies has been discussed with the SFMP Steering Committee.

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	part of a regional floodplain risk management study, such as the Phase 3 (SFMP), and it is preferable to not defer these to the preparation of the Phase 4 (LFMP) by each individual planning authority. Where these studies are completed and become available, they 'feed into' and inform the Phase 4 (LFMP) and local food risk assessment (or alternative ISO compliant risk assessment)*, irrespective of the status of the LFMPs.*
2.3 Some examination of risk is expected to be undertaken in non-urban or areas of very limited development. This may lead to the requirement to undertake more precise flood studies in those areas, and/or to implement more conservative land-use controls in those areas until a more detailed risk assessment is undertaken.	No additional guidance for the Brisbane River SFMP Study Area.
2.4 At a minimum, for land-use planning purposes, the risk assessment should result in: • *the identification of land uses that should not occur in a flood hazard area* • *the risk criteria (that considers the community's exposure, tolerability and vulnerability) used to identify a broadly acceptable, tolerable or intolerable level of risk for each land use* • *the planning provisions used to ensure that the community is not exposed to an unacceptable level of risk* • *the hazard and risk information that is available or will be required to achieve the planning provisions.*	2.4.1 Using the mapping tools in the SFMP, Technical Evidence Report (2017) and this SFMP Planning Guidance, planning authorities can: a) undertake a local level analysis of flood risk to current and future land use and development, including consideration of exposure, tolerability and vulnerability. Phase 3 (SFMP) undertook a strategic, whole-of-floodplain analysis of current and future land use exposure; however, the Phase 4 (LFMP) and local flood risk assessment (or alternative ISO compliant risk assessment) may involve a more detailed analysis of zoning exposure to Potential Hydraulic Risk and other flood risk and locally relevant factors, to determine the community's tolerance to flood risk and the planning response for different land uses. *Note: It is recommended that this strategic, local level analysis be undertaken by overlaying the relevant SFMP tools identified in **Appendix D** and other locally relevant factors contributing to flood risk with the existing planning scheme zoning to identify the flood impact on all zoned land, as is suggested by the risk assessment process in the SPP Guidance (refer to Table 1, principle 3).* b) evaluate flood risk to determine whether development can occur within the floodplain to an acceptable or tolerable level. The higher the risk, the less likely the location is suitable for urban development without appropriate risk treatment. In determining the acceptability, tolerability or intolerability of land uses in the floodplain and whether development does or does not occur, planning authorities refer to the regional guidance on indicative land use compatibility and tolerability in **Appendix C** together with the other flood risk factor tools in **Appendix D**, where relevant.

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	Note: The indicative land use compatibility table is a tool to help inform the tolerability of different land uses based on Potential Hydraulic Risk. This tolerability is based on the inherent or 'unmitigated' flood risk using the Phase 3 (SFMP) Potential Hydraulic Risk mapping and potential consequences that could occur if no risk treatment or mitigation is taken. It does not consider other flood risk or locally relevant factors, or the community's tolerance to flood risk, which may influence the land use planning responses chosen to treat the risk. The table is considered guidance and it is recognised that planning authorities may determine different tolerability levels to those identified in the table through the Phase 4 (LFMP) and local flood risk assessment process. c) through the Phase 4 (LFMP) process and local flood risk assessment (or alternative ISO compliant risk assessment), identify planning responses and development controls to treat the level of risk, where it is determined that land use planning has a role in avoiding future risk that is potentially intolerable or unacceptable and reducing an increase in current risk to acceptable or tolerable levels.

State interest policy 4

Development in bushfire, flood, landslide, storm tide inundation or erosion prone natural hazard areas:
(a) avoids the natural hazard area; 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.

Brisbane River Floodplain Background

The regional context in which State interest policy 4 is applied in the Brisbane River SFMP Study Area is explained in **Appendix A**.

How to appropriately integrate the policy

SPP Guidance Material	*Application to Brisbane River SFMP Study Area*
4.1 A risk-responsive settlement strategy is developed for inclusion in the strategic framework and reflected in zoning for at-risk locations. The strategy: *1. is informed by the outcomes of the flood risk assessment* *2. addresses flood risk to both existing and future development to achieve broader flood risk management objectives.*	4.1.1 It is recommended that planning instruments are informed by, and respond to, the outcomes of a Phase 4 (LFMP) and a local flood risk assessment (or alternative ISO compliant risk assessment) undertaken in accordance with State interest policy 2 - refer to this SFMP Planning Guidance for application of State interest policy 2 to the Brisbane River SFMP Study Area[7]. 4.1.2 Planning instruments are consistent with the SFMP Land Use Planning strategies for Aspiration 5. In developing a risk appropriate LGA wide settlement pattern, land use planning responses to treat flood risk support the achievement of other relevant flood risk management outcomes and strategies identified in the Brisbane River SFMP. 4.1.3 A risk-based approach to the drafting of planning scheme provisions will ensure that the settlement pattern and allocation of land use zoning responds, and is appropriate, to flood risk for the location in the floodplain. *Note: The allocation of zones is an important land use planning tool to manage flood risk as it sets land use policy and development expectations. Other land use planning and plan making tools, such as overlays or precincts within zones, are also effective to identify and manage the impacts of flooding in the development assessment process and to tailor land use planning and development responses to flood*

[7] A local flood risk assessment is required to inform the preparation of new planning instruments under the State Planning Policy 2017. The Phase 4 (LFMP) provides an ideal process to undertake an integrated local flood risk assessment in the context of broader flood risk management objectives and risk factors. The LFMP and risk assessment and plan making process under the MGR should not be delayed by the timing of other strategic/regional studies recommended by the SFMP (i.e. regional cumulative impact assessment, regional evacuation capability assessment, regional climate change adaptation response). These inputs can be incorporated in parallel to Phase 4 (LFMPs), or form part of a future review process.

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	risk. Overlays are discussed in section 4.2 and 4.5 of this guidance material.
4.2 Planning schemes are to incorporate provisions consistent with the example and model provisions contained in Part E, tailored to meet local needs and circumstances.	In addition to the SPP Guidance provided in 4.2, the following additional guidance is provided for the SFMP Study Area: 4.2.1 Where the planning authority determines the land use is tolerable for its location in the floodplain, planning instruments can incorporate risk-appropriate development controls, such as flood immunity levels that are tailored to the compatibility of the land use exposed and the overall flood risk profile for the location in the floodplain (which takes into account Potential Hydraulic Risk and other relevant flood risk factors). *Note: The indicative land use compatibility table is a tool to help inform the tolerability of different land uses based on Potential Hydraulic Risk. This tolerability is based on the inherent or 'unmitigated' flood risk using the Phase 3 (SFMP) Potential Hydraulic Risk mapping and potential consequences that could occur if no risk treatment or mitigation is taken. It does not consider other flood risk or locally relevant factors, or the community's tolerance to flood risk, which may influence the land use planning responses chosen to treat the risk. The table is considered guidance and it is recognised that planning authorities are likely to determine different tolerability levels to those identified in the table through the Phase 4 (LFMP) and local flood risk assessment* (or alternative ISO compliant risk assessment) *and based on this understanding of flood behaviour.* 4.2.2 The SFMP Potential Hydraulic Risk category mapping represents the inherent or potential 'unmitigated' flood risk. It is recommended that the Phase 4 (LFMP) and local flood risk assessment (or alternative ISO compliant risk assessment) use the Potential Hydraulic Risk matrix as the technical basis to inform flood overlay mapping in planning instruments. In addition to Potential Hydraulic Risk, a planning authority may also choose to use other locally relevant flood risk factors identified through the same Phase 4 (LFMP) process to inform and refine its overlay mapping. 4.2.3 Consistent with the intent of recommendation 2.13 of the QFCoI, a flood overlay map identifies at least three categories of 'flood risk' ranging in severity. It is also recommended that the map uses plain English terms to describe or identify the flood risk areas. The categories of flood risk can be simplified, expanded, categorised or identified in a planning instrument at the discretion of planning authorities to reflect local circumstances and align with community expectations. For planning authorities choosing to use the SFMP Potential Hydraulic Risk mapping as the basis for the flood overlay mapping, the following two examples are suggested possible approaches and show how the SFMP Potential Hydraulic Risk mapping can be

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	translated into a planning instrument. This is only one possible way and planning authorities may have alternative approaches to inform flood overlay mapping by, for example, further refining the spatial resolution of the Potential Hydraulic Risk mapping categories through the Phase 4 (LFMP) and local flood risk assessment (or alternative ISO compliant risk assessment) and considering other locally relevant flood risk factors (e.g. relative time to inundation, evacuation capability). The examples are further described in **Appendix E**. **Example 1:** a) 3 categories of flood risk areas are identified in the flood overlay map and could be described as: • Extreme/High flood risk • Medium flood risk • Low flood risk Where 'extreme/high flood risk' is based on Potential Hydraulic Risk Categories HR1 and HR2, 'medium flood risk' is based on HR3 and HR4 and 'low food risk' aligns with the HR5 Potential Hydraulic Risk category. **Example 2:** b) 4 categories of flood risk areas are identified and could potentially be described as • Extreme • High • Moderate • Low Where 'extreme' is informed by Potential Hydraulic Risk Categories HR1 and HR2, 'high' is informed by HR3, 'moderate' is informed by HR4 and 'low' is informed by HR5. *Note: Wherever possible, planning instruments consider the use of plain English terms to identify or describe 'flood hazard or flood risk' areas. The use of generic or numerical descriptions is discouraged. For example, denoting flood risk (FR) areas or flood hazard (FH) areas or priority areas (P) as 'FR1, FR2, FR3 or PR1, or FH1, FH2 etc, can be difficult to understand. The use of plain English terms, such as the examples provided in 4.2.3 above, are preferred approaches.* 4.2.4 Planning authorities may choose to have a suite of maps (or map layers) forming part of the flood hazard overlay with elements of the flood overlay code responding to different flood risk factors, as relevant. *For example, the Potential Hydraulic Risk map could be adapted to be the trigger map for the flood overlay code and assessment benchmarks respond specifically to each potential hydraulic risk category or flood risk area in terms of risk appropriate development and outcomes sought. Both Potential Hydraulic Risk and relative time to inundation*

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	mapping (where available) could be considered, as these are key factors influencing risk to life and the appropriateness of development according to the level of risk.
4.3 In drafting planning provisions, the use of terminology that may impede an understanding of the risk of natural hazards to development should be avoided.	No additional guidance for the Brisbane River SFMP Study Area.
4.4 The strategic framework should articulate risk-responsive settlement strategies for at-risk locations and establish the principle of only appropriate development occurring in flood hazard areas.	4.4.1 In developing a flood risk-responsive LGA wide settlement strategy, planning instruments may be informed by: a) LFMPs, which incorporate a local flood risk assessment (in accordance with State Interest Policy 2) to determine the tolerability of land use in the floodplain and what land use is appropriate considering the relevant SFMP flood risk and other locally relevant factors. An example of how a Phase 4 (LFMP) and local flood risk assessment (or alternative ISO compliant risk assessment) may arrive at risk-responsive settlement strategies (in response to Potential Hydraulic Risk only) is provided in the Indicative Land Use Compatibility Table at **Appendix C**. *Note: The indicative land use compatibility table identifies how the tolerability of different land uses may (in part) be determined relative to Potential Hydraulic Risk being the inherent or unmitigated flood risk. The tolerability levels determined by planning authorities will depend on the outcomes of the full local flood risk assessment, an understanding of the overall flood risk profile and other flood risk factors and the risk treatment responses adopted. These considerations have not formed part of the Phase 3 (SFMP).* *Note: SPP Guidance Table 2 – Land Use Response in Part E provides useful guidance on land use responses to avoid, mitigate, accept and retreat.* 4.4.2 When evaluating flood risk and determining land use compatibility as part of the Phase 4 (LFMP) and local flood risk assessment (or other ISO compliant risk assessment) process to inform a risk responsive settlement strategy, it is recommended that the following Potential Hydraulic Risk characteristics be considered: a) The HR1 and HR2 Potential Hydraulic Risk categories, particularly at the 1 in 100 AEP (or more frequent events) and with a flood hazard level of H3 or higher – as having a potential high risk to life. Locations with limited relative time to inundation (< 24 hours) may also be considered high risk. b) The Potential Hydraulic Risk category of HR3 at the 1 in 100 AEP (or more frequent events) and with a flood hazard level of H3 (or higher) – as

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	being potentially intolerable for vulnerable uses involving vulnerable persons. c) The Potential Hydraulic Risk category of HR3 at the 1 in 100 AEP likelihood and with a flood hazard level of H3 – as being the potential upper threshold for tolerable risk for residential development (but not for vulnerable uses involving vulnerable persons), subject to mitigation measures to achieve an acceptable level of risk. d) The Potential Hydraulic Risk category of HR2 at the 1 in 100 AEP likelihood (or more frequent events) and with a flood hazard level of H4, H5 or H6 – as being potentially intolerable for residential development because of higher flood hazard levels, with abled bodied adults unable to wade safely through flood waters, or life threatened through the potential loss of structural integrity of buildings where characterised by a flood hazard level of H5 or H6. 4.4.3 LGA wide settlement strategies and allocation of land use zoning acknowledges, and is responsive to, the sensitivity of flood behaviour in the Brisbane River floodplain, particularly if filling is proposed to mitigate flood risk to achieve a DFE.
4.5 Zoning must achieve the settlement strategy – for example, through avoiding urban uses if needed, limiting density relative to the risk, or promoting more compatible or resilient land uses in flood hazard areas. Zone and/or the flood hazard overlay codes should clearly articulate acceptability of land uses, lot reconfigurations and works relative to the flood risk.	In addition to the SPP Guidance provided in 4.5, the following additional guidance is provided for the Brisbane River SFMP Study Area: 4.5.1 An important first principle of risk-based planning is the establishment and allocation of land use that is appropriate for its location in the floodplain. Potential Hydraulic Risk and relative time to inundation, in particular, are key flood risk factors when considering risk to life from flood and determining if land use is risk appropriate for its location in the floodplain. The use of a DFE and other development assessment controls are also secondary measures important for managing risk to property. *Note: Allocation of land to zones also considers future climate change impacts increasing potential hydraulic risk profiles and other relevant SFMP flood risk factors in the future.* 4.5.2 Informed by the outcomes of the Phase 4 (LFMP) and local flood risk assessment (or alternative ISO compliant risk assessment), underlying land use zones (or zone precincts) achieve flood risk compatibility and assessment benchmarks in the zone code make it clear what land uses are considered acceptable, tolerable and intolerable, and whether development is appropriate within a flood risk area, including where development controls can mitigate risk to more tolerable levels. Zones and zone codes can be used in addition to provisions that may trigger a site-based flood risk assessment at the

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	development assessment stage to determine the appropriateness of land use. *Note: The LFMP will provide part of the evidence to demonstrate how the matters for a Feasible Alternatives Assessment Report have been addressed when considering zoning changes in response to flood risk, as well as requirements for Natural Hazards Evaluation reporting (flood).* *Note: The recommendation to use zones (or zone precincts) to achieve flood resilient outcomes is not intended to change the 'mechanics' of how planning schemes currently operate. For example, some planning schemes provide that overlay levels of assessment and overlay code provisions prevail over zone code provisions and levels of assessment. Planning authorities will need to consider the effectiveness, practicalities and other operational aspects of their planning schemes in integrating this guidance. The intent is to have a 'clear line of sight' in policy outcomes across all scheme elements and for provisions to work in concert to express the tolerability or acceptability of land uses and set clear development expectations and outcomes in response to the level of flood risk.* 4.5.3 Where the Phase 4 (LFMP) and local flood risk assessment (or alternative ISO compliant risk assessment) identifies areas in which existing and future land use and development is potentially intolerable or tolerable considering the SFMP flood risk factors or other locally relevant factors for the location in the floodplain, a range of zoning approaches are available, such as zone changes, use of zone precincts or drafting specific assessment benchmarks to either encourage or discourage certain uses in the zone relative to flood risk. The aim of these approaches is to limit current flood risk and not increase exposure of people and property to intolerable risk through development that may be permitted under existing zoning. *Note: The below approaches are examples only and identify possible ways that zoning can be used to respond to flood risk and achieve a risk appropriate settlement strategy in the floodplain. The appropriateness of these approaches will be dependent on local circumstances and factors. These do not change the planning scheme 'mechanics' or interpretation rules and the approach taken by planning authorities will depend on how the planning scheme currently operates.* 1) Where zones are intended to provide for multiple uses and development outcomes, assessment benchmarks (including overall outcomes) can be used to provide clear direction on the acceptability, or otherwise, of land uses within the zone to ensure they are risk appropriate. For example, residential zones often accommodate a range of diverse housing types, including multiple dwellings and aged care accommodation. Within the zone code, the planning authority may have

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	determined (through its Phase 4 (LFMP) and local flood risk assessment) that a multiple dwelling use is tolerable in areas of the floodplain identified as HR3 at the 1 in 100 AEP likelihood and with a flood hazard level of H3, subject to development assessment requirements and evacuation capability. However, within the same Potential Hydraulic Risk category, the same residential zone code may include assessment benchmarks that make it clear an aged care accommodation use is encouraged in the zone where it does not occur in these parts of the floodplain because of higher risk to life and inability to evacuate vulnerable persons. *Note: The regulated requirements in the Planning Regulation 2017 apply a standard suite of zones and purpose statements; however, planning authorities have discretion to develop risk-appropriate assessment benchmarks.* *Note: This approach does not apply to the siting of building work assessable under the building assessment provisions, which is subject to the requirements of the building legislation and not based on planning considerations (such as Potential Hydraulic Risk or scheme zoning).* 2) A zone precinct can be used as a tool to identify specific areas of the floodplain where existing uses or infill development has occurred (or is occurring under existing zoning) and is potentially tolerable to the Potential Hydraulic Risk in combination with other flood risk factors, but where the level of risk needs to be mitigated to an acceptable level. A zone precinct can be used to identify more specific types of development, development assessment requirements and density outcomes than intended by the underlying zone. For example, a flood resilient precinct or similar may be used where the Phase 4 (LFMP) or local flood risk assessment (or alternative ISO compliant risk assessment) has determined that the level of risk can be reduced to an acceptable level by applying specific development, density or land use outcomes. The zone precinct sits over the existing zone and identifies where more specific development outcomes are required to maintain or limit development within (or reduce) the current risk profile. *Note: If using a precinct-based approach, care is taken to avoid adding unnecessary complexity to the planning scheme.* 3) Zoning changes can help reduce the risk profile by ensuring future land use is risk appropriate. This option may be pursued where the current zoning is creating (and will in the future create) an intolerable level of risk to land uses envisaged in the zone and an incompatible settlement pattern. Other, more resilient zones may be used in this instance to 'transition down' the risk while avoiding loss of development potential. The following provide examples of where zoning changes (referred to as

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	'back zoning' or 'down zoning') may potentially be considered appropriate: (a) the potential hydraulic risk and SFMP flood risk and other locally relevant factors are considered intolerable for existing or future land use, and other flood risk mitigation measures are unlikely to reduce the level of risk to an acceptable or tolerable level; (b) the intent of the underlying zone is incompatible with the hydraulic risk conditions and other SFMP flood risk and locally relevant factors; and (c) the type of land use permitted under the existing zone will exacerbate flood risk and increase exposure to an unacceptable level. For example, zones such as the Limited Development, Rural, Environmental Management, Open Space, Sport and Recreation and Conservation zones can be used to limit or restrict the type of uses and development to only those that are tolerable or acceptable to the Potential Hydraulic Risk category and other flood risk factors. *Note: An overlay code approach, as triggered by flood overlay mapping and containing relevant flood planning provisions, is discussed in sections 4.2 and 4.5 of this guidance material.* **Planning changes to reduce a material risk of serious harm to people or property from flood risk** 4.5.4 The Phase 3 (SFMP) Potential Hydraulic Risk mapping represents the inherent or 'unmitigated' flood risk, with potential consequences for risk to life and damage to property if the risk is untreated. Using the SFMP Potential Hydraulic Risk mapping as the technical basis to inform the Phase 4 (LFMP) and local flood risk assessment (or alternative ISO compliant risk assessment), an assessment of existing planning controls, as well as other flood risk mitigation options can be undertaken. If it is determined that despite existing planning controls and other flood risk mitigation options, there still remains an intolerable level of risk, additional land use planning responses may be considered to reduce the risk to a tolerable or acceptable level, given there are no other feasible alternatives. The Phase 4 (LFMP) and local flood risk assessment process provides the evidence to assist planning authorities in meeting the requirements of the Feasible Alternatives Assessment Report. It is recommended that the outcomes of Phase 4 (LFMP) and the local flood risk assessment (or alternative ISO compliant risk assessment) be used to determine the nature of an adverse planning change in the local context and in accordance with

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	section 30(4)(e) of the *Planning Act 2016* (i.e. where the change 'reduces a material risk of serious harm to persons or property on the premises from natural events or processes (…flooding))' and is under the Minister's Guidelines and Rules (2017) and supported by the Feasible Alternatives Assessment Report. It is possible that the following may be examples of where a Feasible Alternative Assessment Report is warranted, subject to the outcomes of the Phase 4 (LFMP) and local flood risk assessment (or alternative ISO compliant risk assessment): (a) Potential Hydraulic Risk categories of HR1, HR2 or HR3, where defined at or more frequent than the 1 in 100 AEP and with flood hazard levels of H3 to H6, making it potentially intolerable for vulnerable people (at H3) and abled bodied adults cannot safely wade through flood water (at H4 or greater). Risk to life and property is also threatened because of potential structural failure of buildings with a flood hazard level of H5 or H6; (b) areas with limited relative time to inundation (being less than 24hrs for vulnerable uses and less than 12hrs for residential uses) and fast/high expected rates of rise/inundation, making it difficult or impossible to evacuate; (c) low immunity sections of an evacuation route; (d) development controls (density, DFEs, basement design etc.) are unlikely to be effective in increasing flood resilience or treating risk to an acceptable or tolerable level, or the impacts associated with implementing the measures would be unacceptable; (e) filling to the DFE as an option to mitigate flood risk is intolerable because such filling is within flow conveyance areas (which may be defined as HR1 or HR2) and will obstruct or alter flow, or filling is within flood storage areas (which may be defined as HR3 or HR4) and will reduce flood storage volume resulting in unacceptable impacts – regionally or elsewhere in the floodplain (when considered on a cumulative basis). 4.5.5 The zoning approaches outlined in 4.5.3 can be used in combination with overlay provisions, as necessary, to provide greater certainty around the land use intent and development expectations that can occur in response to the underlying potential hydraulic risk conditions and other SFMP flood risk and other locally relevant factors. *Note: Using strategic framework elements and both zone and overlay provisions to provide flood risk related land use and development policy is not intended to duplicate content or create complexity and ambiguity in its application. It is*

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	intended to provide clear upfront policy direction and a line of sight for land use and development expectations.
4.6 The risk assessments for flood hazard should be used as a tool to inform drafting of planning provisions: • *Selection of the DFE /or the selection of a range of flood events or hazard/risk levels to manage land use and development may involve the definition and mapping of a particular flood event or events (e.g. 1 per cent, 0.5 per cent, 0.2 per cent AEP or hazard/risk level (e.g. very high, high, medium, low)) that will initiate planning and building controls (e.g. in zones, local plans or overlay codes).* • *Assignment of categories of assessment within zones affected by flood risk is to ensure sensitive or vulnerable uses are avoided or are subject to a higher category of assessment.* • *Special consideration is given to community infrastructure where it is anticipated to perform a role or service during and immediately following a natural hazard event, or where the infrastructure is utilised by people who are particularly vulnerable to the effects of flooding.* • *A planning scheme policy may specify the scope and methodology to be followed in preparing a site-based natural hazards study and risk assessment, in support of a development*	In addition to the SPP Guidance provided in 4.6, the following additional guidance is provided for the Brisbane River SFMP Study Area: 4.6.1 For the SFMP Study Area, planning instruments are informed by a Phase 4 (LFMP) and local flood risk assessment (or alternative ISO compliant risk assessment), and use of the SFMP Potential Hydraulic Risk categories (defined by the Phase 3 (SFMP) and Technical Evidence Report (2017)) is recommended as a tool to inform and identify risk levels to manage land use and development. Other SFMP flood risk and locally relevant factors can also be considered. 4.6.2 The Phase 3 (SFMP) Potential Hydraulic Risk mapping, Phase 4 (LFMPs) and local flood risk assessment (or alternative ISO compliant risk assessment) outcomes are used to inform the planning instrument's overlay code provisions and flood overlay mapping, as explained in section 4.2.3 of this guidance material, to indicate different categories of flood risk across the floodplain. 4.6.3 Land uses may have different flood immunity levels/DFEs depending on their tolerability and acceptability to the category of Potential Hydraulic Risk, as well as other relevant flood risk factors. The land use planning response for land uses that are potentially tolerable subject to development requirements, such as achieving flood immunity levels, are risk-appropriate to the location in the floodplain. Refer to the Indicative Land Use Compatibility Table in **Appendix C** as an example of how development assessment requirements may be related to the category of Potential Hydraulic Risk where the land use is tolerable to the risk (see 'Summary – Indicative Land Use Compatibility Against Potential Hydraulic Risk Categories in the Brisbane River Floodplain' table). **Climate adaptation** 4.6.4 The outcomes of a regional climate change adaptation response[8] are to inform land use planning adaptation responses to manage climate change risks associated with flooding. The consideration of future climate conditions to inform land use planning could include the following: • avoiding inappropriate uses in locations where the existing flood risk profile will increase or worsen with future climate change from current

[8] At the time of preparing this guidance, the regional climate change adaptation response had not been prepared by the State Government. This study will not be applicable to the use of this guidance until completed and made available to planning authorities. However, the absence of this regional study will not delay planning authorities from proceeding with Phase 4 (LFMPs) and local flood risk assessments (or an alternative ISO compliant risk assessment), which can be incorporated in parallel to the preparation of Phase 4 (as the study emerges). It is understood that the timing of this study has been discussed with the SFMP Steering Committee.

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application for a site in a flood hazard area. *The use of thresholds, overlay maps and codes, and the setting of categories of development for uses in areas affected by flood hazard are helpful tools. They may:* • *trigger a higher category of development if required* • *encourage development to avoid hazard areas* • *require site-specific hazard investigation and risk assessment where required* • *apply special conditions to development approvals to avoid or mitigate risk to an acceptable or tolerable level* • *clearly communicate the risk to the community.* *Overlays should not be the sole tool to manage flood risk in an area. Where flood risk cannot be addressed through built form, this should be reflected through the most appropriate allocation of zoning and the principle of avoidance of the risk.*	to potentially intolerable risk levels (e.g. areas where the existing hydraulic risk conditions for HR3 are likely to change and worsen to HR2 and may no longer be a risk appropriate location in the floodplain for vulnerable people etc.); • for tolerable uses in the floodplain, consider using a DFE that incorporates an additional climate change factor allowance and/or in combination with resilient building design[9] to accommodate the risk; • using a greater DFE and scaling up by event in parts of the floodplain where peak flood levels are expected to increase under the climate change scenario (e.g: scaling up the 1 in 100 AEP to a 1 in 200 AEP flood immunity level). 4.6.5 It is recommended that where a site-based flood study or flood risk assessment is required for a development application, the flood planning scheme policy documents the approach to define and evaluate flood risk using the same combinations of flood hazard levels and likelihoods that informed the Phase 3 (SFMP) Potential Hydraulic Risk matrix and mapping (and any other potentially relevant flood risk factors that inform overall flood risk). This provides a consistent framework and methodology for undertaking local site assessments across the Brisbane River SFMP study area to ensure content and objectives are consistent in terms of assessing flood impacts. Planning authorities, when considering flood hazard and risk assessments outside of the SFMP study area and for local waterways and creek flooding, are also encouraged to use a similar approach to defining Potential Hydraulic Risk. The flood planning scheme policy achieves alignment with the outcomes of the local flood risk assessment; however, does not direct the land use planning policy response (i.e. that a certain DFE be achieved). *Note: The Phase 3 (SFMP) scope and methodology does not apply to site assessments for building work undertaken during building certification.*

[9] At the time of drafting, the State was in the process of preparing guidance to improve understanding on the principles, techniques and appropriateness of materials and structural and non-structural options to achieve flood resilient building design. The outcomes of this guidance will be considered further in terms of implications for building controls; however, this is not a matter that can be dealt with in the planning scheme.

State interest policy 5

Development in natural hazard areas:

(a) supports, and does not hinder disaster management capacity and capabilities

(b) directly, indirectly and cumulatively avoids an increase in the exposure of severity of the natural hazard and the potential for damage on the site or to other properties

(c) 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

(d) maintains or enhances the protective function of landforms and vegetation that can mitigate risks associated with the natural hazard.

Brisbane River Floodplain Background

The regional context in which State interest policy 5 is applied in the Brisbane River SFMP Study Area is explained in **Appendix A**.

How to appropriately integrate the policy

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5.1 *Development requirements in zone, local plan, overlay and development codes should ensure that development in an area affected by a flood hazard area:* • *avoids or mitigates the risk to people, property and infrastructure to an acceptable or tolerable level* • *does not increase the number of people at risk to an intolerable level* • *provides safe and efficient access and operation for emergency services* • *enables the self-evacuation of occupants and visitors – people need to be able to safely shelter in place or evacuate via safe routes from the hazard area prior to or during an event* • *does not cause or contribute to an increased level of risk affecting surrounding areas*	In addition to the matters raised in 5.1, the following additional guidance is provided for the Brisbane River SFMP Study Area: 5.1.1 It is recommended that provisions in planning instruments use a risk-based approach to land use planning and are informed by the outcomes of Phase 4 (LFMP) and a local flood risk assessment (as required by State interest policy 2). 5.1.2 In determining land use tolerability to flood risk as part of a Phase 4 (LFMP) and local flood risk assessment (or alternative ISO compliant risk assessment), land use planning responses can refer to the guidance on indicative land use tolerability in **Appendix C**. The tolerability table begins to recognise the different land use planning responses required to manage flood risk in existing urban versus greenfield areas. For example, through the Phase 4 (LFMP) and local flood risk assessment process (or alternative ISO compliant risk assessment), it may be determined that in an existing urban area, a level of residual risk may be acceptable, having regard to, and balancing, the range of other flood risk tools (e.g. relative time to inundation, evacuation capability), locally relevant factors (e.g. protective function of natural landforms in the area), planning objectives (e.g. commercial value of a town centre) and the effectiveness of other flood risk management measures (e.g. early flood warning systems) available to treat the risk to an acceptable or tolerable level.

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• *incorporates natural processes, landforms and vegetation that contribute to the mitigation of natural hazards and risks into development design, location and operation to enable these natural processes and functions to continue.*	*Note: The indicative land use compatibility table is a tool to help inform the tolerability of different land uses based on Potential Hydraulic Risk. This tolerability is based on the inherent or 'unmitigated' flood risk using the Phase 3 (SFMP) Potential Hydraulic Risk mapping and potential consequences that could occur if no risk treatment or mitigation is taken. It does not consider other flood risk or locally relevant factors, or the community's tolerance to flood risk, which may influence the land use planning responses chosen to treat the risk. The table is considered guidance and it is recognised that planning authorities are likely to determine different tolerability levels to those identified in the table through the Phase 4 (LFMP) and local flood risk assessment (or alternative ISO compliant risk assessment) based on this understanding of flood behaviour.* **Evacuation** 5.1.3 Planning instruments are informed by a regional evacuation capability assessment prepared for the Brisbane River floodplain[11]. 5.1.4 A local flood risk assessment for the purpose of land use planning evaluates the ability for safe evacuation of occupants from flood-affected land. Assessment of evacuation capability considers relative time to inundation, expected rate of flood rise and potential for the constraint of lower-immunity sections of an evacuation route. 5.1.5 For the Brisbane River SFMP Study Area, relative time to inundation considers data from upstream forecast gauge locations (as provided in BoM's Service Level Specification for Flood Forecasting and Warning Services for Queensland, 2013 and as detailed in the Technical Evidence Report, 2017). **Freeboard** 5.1.6 It is recommended that uncertainty in, or sensitivity to, flood behaviour predictions (arising from factors such as model uncertainty) be factored into land use planning responses. One possible way of achieving this may be to include appropriate freeboard provisions that are tailored to the different hydraulic sensitivities and flood behaviour uncertainties across the floodplain. Risk-appropriate freeboards are best determined through the Phase 4 (LFMP) and local flood risk assessment process (or alternative ISO compliant risk assessment) and may be a minimum 300mm under section 13 of the *Building Regulation 2006.* However, this guidance material recommends a minimum 500mm freeboard in the Brisbane River

[11] At the time of preparing this guidance, the regional evacuation capability assessment had not been prepared by the State Government. The study will not be applicable to the use of this guidance until completed and made available to planning authorities. However, the absence of this regional study will not delay planning authorities from proceeding with Phase 4 (LFMPs) and local flood risk assessments (or alternative ISO compliant risk assessment), which can be incorporated in parallel to the preparation of Phase 4 (as the study emerges). The timing of this study has been discussed with the SFMP Steering Committee.

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	SFMP Study Area due to the floodplain's sensitivity to changes in flood behaviour and catchment conditions. Planning authorities may also choose to use a higher freeboard to reflect local circumstances and the sensitivity of the location in the floodplain and land use proposed. **Filling** 5.1.7 It is recommended that Phase 4 (LFMPs) and local flood risk assessments (or alternative ISO compliant risk assessment) are informed by a regional cumulative impact assessment[12] of filling and land form change (where available). Planning instruments are informed by an assessment of regional cumulative impacts across the floodplain to assess the consequences of currently planned and future development on flood behaviour under planning instruments' land use planning assumptions. *Note: In the Brisbane River SFMP Study Area, cumulative development is understood by modelling of the third party impact of multiple developments across the floodplain against the Phase 2 (Flood Study) 60 ensemble design events, where changes to flood hazard conditions are < 10mm (as is accepted industry practice). This establishes a strategic filling or land form change 'envelope' for the floodplain, development within which has an acceptable total impact and does not create unacceptable impacts beyond the individual site or local area boundaries.* *Note: A regional cumulative assessment of filling/land form change can avoid the need to do a site or LGA-based assessment of impacts. A LGA or site based assessment cannot determine whether a planning instrument's settlement pattern, and the growth and development assumptions that underpin it, are achievable, or implications for flood behaviour across the floodplain. However, development that might exceed or be outside the assumptions of the strategic filling or land form change 'envelope', or where impacts are >10mm, would require a cumulative assessment. It is suggested this occurs against development forming part of the regional cumulative impact assessment as the 'base case'.* 5.1.8 Land use planning that proposes filling or changes to land form and the construction of buildings and other infrastructure results in a 'no worsening' of flood hazard conditions or flood risk to other properties in the floodplain. For the Brisbane River floodplain, no worsening is defined below : a) no increase in flood hazard conditions (flood levels, flood velocities, evacuation conditions and capability, flood hazard categories and potential

[12] The regional cumulative impact assessment is a strategic, whole-of-floodplain study to be undertaken by the State Government in consultation with project partners. At the time of drafting, these findings and their potential to achieve regionally consistent outcomes, were still under investigation. Sections 5.1.9 of this guidance material identifies how local planning authorities may incorporate considerations of cumulative impact in the absence of this regional assessment, which will not delay the Phase 4 (LFMP) and local risk assessment (or alternative ISO compliant risk assessment) or affect the development assessment process.

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	hydraulic risk categories) to surrounding properties; b) no increase in the level of flood risk to surrounding properties; c) results in a total impact from cumulative filling across the LGA of < 10mm; d) no alteration to the flood hydrograph, and timing of the flood wave/s; and e) no impact on flood warning times elsewhere in the floodplain. 5.1.9 Planning instruments maintain or consider including provisions that recognise development for filling or land form change in the floodplain results in a 'no worsening' of flood hazard conditions or flood risk to other properties, as defined in section 5.1.8 above. In particular, planning instruments consider outcomes in the strategic framework and assessment benchmarks that recognise: a) land use and development avoids obstruction or alteration of flow in a flow conveyance area (which may be defined as HR1 and HR2, or as otherwise defined by the planning authority); b) filling is potentially intolerable in flow conveyance areas and does not occur. While filling to achieve a DFE in flow conveyance areas (defined as HR2, or as otherwise defined by the planning authority) is not preferred, it may potentially be tolerable where it is demonstrated, through the Brisbane River regional cumulative impact assessment, a Phase 4 (LFMP) or local flood risk assessment (or alternative ISO compliant risk assessment) that there is no impact or alteration to flow conveyance and no change in flood level (either increase or decrease) beyond property boundaries exceeding 10mm, when assessed against the 60 scenarios that make up the design event ensembles in the Phase 2 (Flood Study); c) filling is potentially tolerable in flood storage areas (which may be defined as HR3 and HR4, or as otherwise defined by the planning authority) where it is demonstrated that there is no reduction in flood storage volume when assessed for a range of AEPs relevant to the development site. Any proposed compensatory cut and fill is at the same flood level and does not alter hydraulic behaviour; and d) filling outside the flow conveyance area and flood storage area (which may be defined as HR5, or as otherwise defined by the planning authority) is considered acceptable, subject to not creating local drainage and surface water issues.

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5.2 Where other instruments regulate development affected by flood hazard, the planning scheme should avoid duplicating assessment and regulation. In some cases the planning scheme plays a role in triggering these requirements. For example the Building Regulation 2006 allows a local government through its planning scheme to designate a 'flood hazard area', which triggers building requirements related to the mitigation of risks.	5.2.1 Building design may consider the use of flood-compatible building components and methods as supported by the application of the Australian Building Codes Board (ABCB) Handbook and Queensland Development Code MP 3.5 for the Construction of Buildings in Flood Hazard Areas; however, this is not a land use planning consideration that can be dealt with in planning schemes. *Note: At the time of drafting, the State was in the process of preparing guidance to improve understanding on the principles, techniques and appropriateness of materials and structural and non-structural options to achieve flood resilient building design. The outcomes of this guidance will be considered further in terms of implications for building controls, although the extent to which these can be addressed through a planning scheme is limited and cannot duplicate the building assessment provisions.* *Note: Refer to SPP Guidance, Table 17 for further guidance on the relationship with building assessment provisions as outlined in section 13 of the Building Regulation 2006.*

State interest policy 6

Community infrastructure is located and designed to maintain the required level of functionality during and immediately after a natural hazard event.

Brisbane River Floodplain Background

The regional context in which State interest policy 6 is applied in the Brisbane River SFMP Study Area is explained in **Appendix A**.

How to appropriately integrate the policy

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6.1 Planning provisions (including land-use strategies, zoning and assessment benchmarks) respond to the flood risk assessment and achieve an acceptable level of risk for community infrastructure.	6.1.1 It is recommended that planning instruments adopt a risk-based approach to land use planning and are informed by a Phase 4 (LFMP) and a local flood risk assessment (or alternative ISO compliant risk assessment) (as required by State interest policy 2), including consideration of the Phase 3 (SFMP) Potential Hydraulic Risk matrix category in combination with other SFMP flood risk factors identified in **Appendix B**, **Appendix C** and **Appendix D**, where relevant, and local planning factors. In particular, planning instruments can incorporate the following: a) strategic outcomes and measures to achieve risk appropriate land use and development outcomes; b) assessment benchmarks that: (i) confirm site-based flood hazards and risks; (ii) avoid new development where the flood risks are intolerable or unacceptable; (iii) where development cannot practicably be avoided, mitigate flood risks to a tolerable or acceptable level; (iv) address the specific flood risks to community infrastructure, including vulnerable uses, sensitive uses and critical services required to continue operating during or after a flood event or with a role in flood response and recovery; (v) address evacuation requirements and relative time to inundation; (vi) address the on-site, off-site and cumulative impacts of filling on the floodplain; and c) planning scheme policies, which direct the methodology for local flood hazard and risk assessments, recommend use of the Phase 3 (SFMP) Potential Hydraulic Risk categories and

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	matrix (as defined in the Technical Evidence Report (2017)).
6.2 Community infrastructure catering for vulnerable persons, or infrastructure that must continue operating during or after a flood event, should avoid areas of flood risk. These facilities are best located outside flood hazard areas (preferably above the height of the PMF or other known extreme event) to achieve the highest practical level of flood immunity. *Expansion of existing facilities in flood hazard areas should occur only where appropriate evacuation solutions and resilient design can be achieved.*	**Community infrastructure, where for critical services (required to operate during or after a flood event)** 6.2.1 Land use allocation for critical services is risk-appropriate and informed by the outcomes of the Phase 4 (LFMP) and local flood risk assessment (or alternative ISO compliant risk assessment), including the Phase 3 (SFMP) Potential Hydraulic Risk matrix categories and, where relevant, other SFMP flood risk tools and local planning factors. *Note: The definition of a critical service is provided in Part A of this SFMP Planning Guidance.* **Community infrastructure, where for vulnerable uses involving vulnerable persons** 6.2.2 Vulnerable uses involving vulnerable persons do not occur in areas or circumstances of intolerable risk, which may be defined as HR1 and HR2 areas in the Brisbane River SFMP Study Area (or as otherwise defined by the planning authority). Wherever possible, the establishment of new vulnerable uses locates outside the floodplain, or in areas of lowest Potential Hydraulic Risk or where the overall flood risk profile is acceptable. Where relevant, guidance on other SFMP flood risk factors that contribute to higher overall flood risk for these uses is provided in **Appendix B**, **Appendix C** and **Appendix D**. *Note: The tolerability levels determined by planning authorities for vulnerable uses will depend on the outcomes of the full flood risk assessment, an understanding of the overall flood risk profile and other flood risk factors and the risk treatment responses adopted through the plan making process. These considerations have not formed part of the Phase 3 (SFMP).* 6.2.3 Where the planning authority determines that the intensification of existing, or establishment of new, vulnerable uses involving vulnerable persons is tolerable in the floodplain, development: • includes appropriate evacuation solutions to protect life; and • is located and designed to achieve an acceptable level of risk, for example by selecting flood risk immunity levels compatible with the level of flood risk and exposure. *Note: Guidance on how minimum flood risk immunity levels for vulnerable uses may be tailored to different areas of flood risk is provided in **Appendix C**. This gives planning authorities an example of determining the tolerability of vulnerable uses and locating and designing such development to treat the level of flood risk (where deemed to be tolerable for the location in the floodplain). However, this is one tool only and planning authorities need to determine whether other flood risk factors or development controls exist to manage the flood risk to an acceptable or tolerable level and that may support uses' location in the floodplain.*

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	Note: The definition of a vulnerable use is provided in Part A of this SFMP Planning Guidance and is in accordance with the Queensland Emergency Risk Management Framework (QERMF)
6.3 Community infrastructure sensitive to property loss (such as museums, libraries, art galleries) should seek to avoid areas affected by the DFE. Where this is not possible, the development should be located above the height of the DFE and incorporate resilient design to protect valuable equipment and artefacts.	**Community infrastructure, where for sensitive uses** 6.3.1 Land use allocation for sensitive uses is appropriate to the flood risk, as informed by the Phase 3 (SFMP) Potential Hydraulic Risk matrix category in combination with other SFMP flood risk factor tools identified in **Appendix B**, **Appendix C** and **Appendix D**, where relevant, and local planning factors. 6.3.2 Where the planning authority determines the establishment of new, or intensification of existing, sensitive uses is tolerable, these uses are located and designed to achieve an acceptable level of risk, for example by considering flood risk immunity levels compatible with the level of flood risk and exposure, or other development controls – determined and balanced by the planning authority with other local and regional flood risk considerations – to reduce and treat the level of risk to property. *Note: Guidance on how minimum flood risk immunity levels for sensitive uses may be tailored to different areas of flood risk is provided in **Appendix C**. This gives planning authorities an example of determining the tolerability of sensitive uses and locating and designing such development to treat the level of flood risk (where tolerable). However, this is one tool only and planning authorities need to determine whether other flood risk factors or development controls exist to manage the flood risk to an acceptable or tolerable level and that may support uses' location in the floodplain.* *Note: The definition of a sensitive use is provided in Part A of this SFMP Planning Guidance.*
6.4 Community infrastructure with a role in flood response and recovery should be located outside areas affected by the DFE.	6.4.1 Land use allocation for community infrastructure where for a critical service with a role in flood response and recovery, is appropriate to the flood risk as informed by the Phase 3 (SFMP) Potential Hydraulic Risk matrix category in combination with other SFMP flood risk factor tools identified in **Appendix B**, **Appendix C** and **Appendix D**, where relevant, and local planning factors. 6.4.2 Where the planning authority determines the establishment of new, or intensification of existing, critical services is tolerable, these are located and designed to achieve an acceptable level of risk to maintain the intended role and level of service in flood response and recovery, for example by considering flood risk immunity levels compatible with the level of flood risk exposure to property, or other development controls – determined and balanced by the planning authority with other local and regional flood risk considerations – to reduce and treat the level of risk.

SPP Guidance Material	Application to Brisbane River SFMP Study Area
	*Note: Guidance on how minimum flood risk immunity levels for critical services may be tailored to different areas of flood risk is provided in **Appendix C**. This gives planning authorities an example of determining the tolerability of critical services and locating and designing such development to treat the level of flood risk (where tolerable). However, this is one tool only and planning authorities need to determine whether other flood risk factors or development controls exist to manage the flood risk to an acceptable or tolerable level and that may support critical services' location in the floodplain.*
6.5 Development requirements in the planning scheme should stipulate a minimum level of immunity and/or location and design standards for the establishment of each type of community infrastructure. The requirements should consider the role and level of service the infrastructure would perform during and immediately following a natural hazard event.	6.5.1 Where the community infrastructure is considered tolerable after assessing the implications of the Phase 3 (SFMP) Potential Hydraulic Risk matrix category and other SFMP flood risk factor tools in **Appendix B**, **Appendix C** or **Appendix D**, where relevant, and local planning factors, planning instruments include assessment benchmarks that set a flood risk immunity level compatible with the level of flood risk to life, property and service. Other development assessment requirements capable of reducing the level of risk to an acceptable or tolerable level can be identified by planning authorities through the Phase 4 (LFMP) and local flood risk assessment (or alternative ISO compliant risk assessment). *Note: An example of how minimum flood risk immunity levels can be applied to the different types of community infrastructure and levels of flood risk is provided in **Appendix C**. In order to inform future planning instruments and scheme amendments, planning authorities can choose to refine immunity levels to the category of flood risk through the Phase 4 (LFMP) and local flood risk assessment process, based on a detailed assessment of the risk and selection of most appropriate management responses from the suite of tools available.*
6.6 Infrastructure designation should consider: • *the function the infrastructure serves during or immediately after a flood event and if it contributes to a broader community infrastructure network* • *the standards proposed for the location and design of the community infrastructure* • *the consequences of loss of service* • *community tolerance to loss of service during or immediately after a flood event* • *the natural hazard scenario under which the community infrastructure will cease to function effectively*	6.6.1 In addition to the matters identified in 6.6 of the SPP Guidance, the acceptability, tolerability or intolerability of infrastructure designations can be determined through the outcomes of a Phase 4 (LFMP) and a local flood risk assessment (or alternative ISO compliant risk assessment) process – and having regard to, and balancing, overall flood risk with relevant local and regional planning considerations and the effectiveness of other flood risk management measures to determine its compatibility to the level of flood risk. Guidance on how a planning authority may consider other SFMP flood risk factor tools to determine the overall flood risk profile resulting to infrastructure is provided in **Appendix B**, **Appendix C** and **Appendix D**, where relevant. *Note: An example of how tolerability levels may be applied to the different types of community infrastructure and levels of flood risk is provided in **Appendix C**. In order to inform future planning instruments and scheme amendments, planning authorities can refine the tolerability of land uses to the level of flood risk through the Phase 4 (LFMP) and local flood risk assessment, based on a detailed assessment of the risk and*

SPP Guidance Material	Application to Brisbane River SFMP Study Area
• *the compatibility of the siting of the infrastructure with the nature and extent of the hazard* • *where flood hazard areas cannot be avoided, whether the risks associated with the hazard can be mitigated to acceptable levels to achieve the required level of service during and immediately after a defined event* • *the likelihood and consequences of a future natural hazard event that exceeds the defined event.*	*selection of most appropriate management responses from the suite of tools available.*

Part C: Mapping

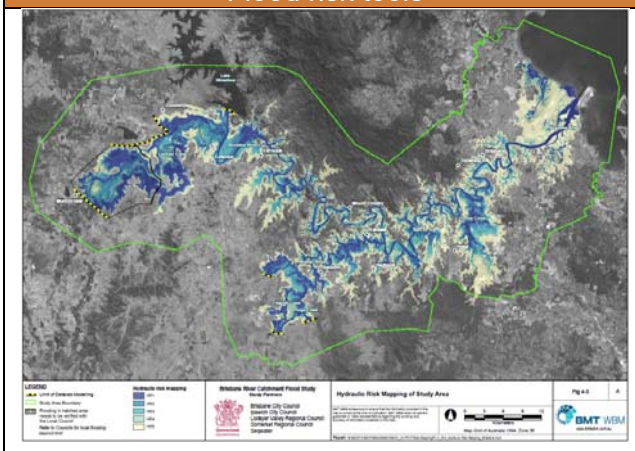
The Potential Hydraulic Risk mapping derived from the Potential Hydraulic Risk matrix as defined in the Phase 3 (SFMP) and Technical Evidence Report (2017), is considered the initial 'baseline' flood map that represents the spatial extent of the regional scale area of flood hazard for riverine flooding in the Brisbane River floodplain. The consistent application of the Potential Hydraulic Risk matrix as defined in the SFMP provides a robust technical basis to informing the consistent definition, identification and understanding of flood behaviour at the regional level.

To maintain regional consistency in how Potential Hydraulic Risk is defined and understood across the floodplain, it is important for State and local planning authorities to all use and apply a regionally agreed Potential Hydraulic Risk matrix in a consistent way to identify and inform the flood hazard area in planning instruments.

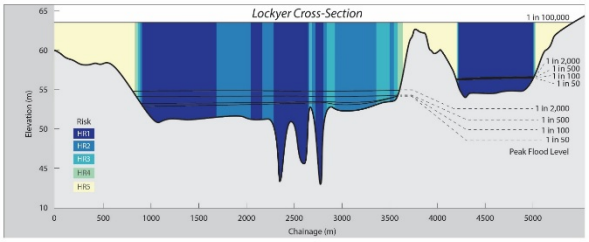
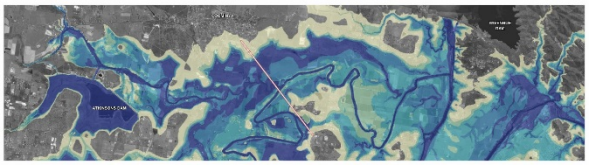
This can be achieved by one or a combination of:

- using the Phase 3 (SFMP) Potential Hydraulic Risk category mapping derived from the matrix, as defined in the SFMP and Technical Evidence Report (2017); and/or
- applying the Phase 3 (SFMP) Potential Hydraulic Risk category matrix, as defined in the SFMP and Technical Evidence Report (2017), but refining the Potential Hydraulic Risk mapping at the local level through local flood studies, local flood risk assessments or LFMPs.

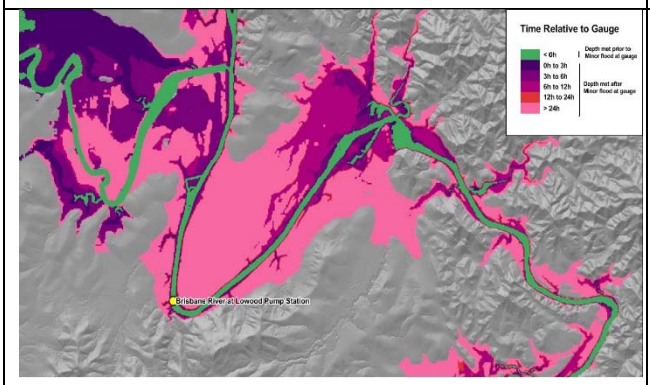
In development of the Phase 3 (SFMP) and Technical Evidence Report (2017), a range of potentially applicable tools have been made available to planning authorities to assist in evaluating and treating risk at the local level. The Potential Hydraulic Risk map, in combination with the following SFMP mapping tools, where relevant, provide a resource for planning authorities to inform the preparation of Phase 4(LFMPs), local level assessment and evaluation of flood risk and identification of risk treatment options, including proposed land use planning and development responses in planning instruments. With the exception of the Phase 3 (SFMP) Potential Hydraulic Risk matrix and associated mapping, the balance flood risk factor tools[13] listed in the below table are intended as guidance and examples to assist planning authorities identify, assess, respond to and integrate land use planning responses into broader flood risk management objectives through the Phase 4 (LFMP) and local flood risk assessment (or alternative ISO compliant risk assessment), without limiting other suitable ways to determine the overall flood risk profile and manage the flood risk in the local circumstance. These tools are further explained in **Appendix B**, **Appendix C** and **Appendix D**.

Flood risk tools	Application to LUP
	<u>Potential Hydraulic Risk category mapping</u> This is a regional spatial representation of the five (5) categories of Potential Hydraulic Risk derived from the Potential Hydraulic Risk matrix as defined in the SFMP and Technical Evidence Report (2017). The five Potential Hydraulic Risk categories (HR1 areas of highest risk and priority, to HR5 areas of lowest risk and priority) are identified across the Brisbane River floodplain within the SFMP Study Area. The SFMP Potential Hydraulic Risk matrix (and resultant mapping) were derived using best practice flood risk assessment standards. A range of defined hydraulic hazard characteristics, as per the six identified in the AIDR guideline, were considered for seven AEP likelihoods. A two-dimensional, 42 cell matrix was then produced. A gradation of risk is captured vertically (i.e.

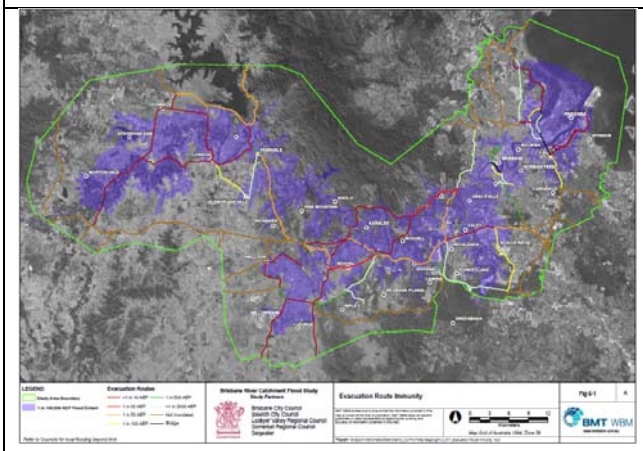
[13] These tools do not apply to the siting of building work assessable under the building assessment provisions, which will continue to be informed by the requirements of the building legislation and not these flood risk factors. The 'head of power' for planning schemes to designate a flood hazard area and declare a defined flood level is the Building Regulation 2006, which determines the building response.

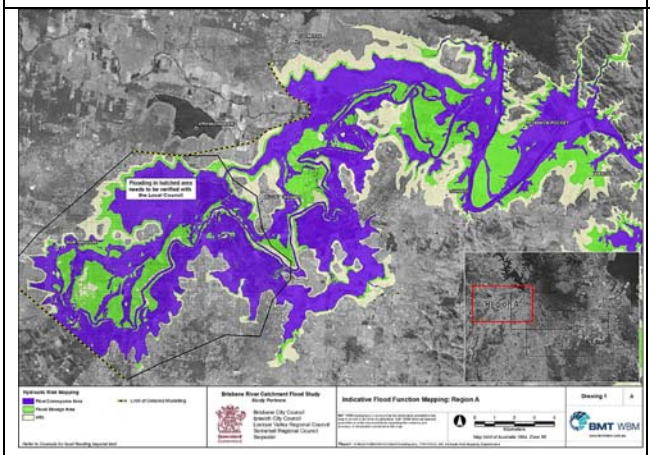
Flood risk tools	Application to LUP
	between areas more vs. less frequently inundated), and horizontally (i.e. between areas where the hazard creates a high vs. low risk to life). The mapping of this matrix "on the ground" adopts the maximum Potential Hydraulic Risk in any given location (i.e. the highest risk rating possible). As is discussed in section 4.2.4 of the Technical Evidence Report (2017), the mapping is sufficiently granular to pick up different bands and areas of flood risk across the floodplain. For land use planning purposes, a regionally agreed Potential Hydraulic Risk matrix and its mapping is critical to representing the "base constraint" and setting the foundation for having a regionally consistent understanding of flood behaviour in the SFMP Study Area.
 	<u>Potential Hydraulic Risk cross-sections</u> The gradation of the five 'zones' of hydraulic risk in the Potential Hydraulic Risk matrix can be effectively shown at key floodplain cross-sections across the SFMP Study Area. Selected cross-sections were produced for the SFMP Study Area as part of understanding which 'dominant cells' were driving the maximum Potential Hydraulic Risk results identified in the mapping of the matrix. Cross-section locations were selected in each local government area, showing the spread of Potential Hydraulic Risk at different elevations and across different flood event sizes along the cross-section chainage. This tool can be used in land use planning to convey the different levels of hydraulic risk when considered cumulatively for sites across the floodplain section. The tool is useful in communicating the nuances and complexity of flood behaviour across the floodplain. Understanding these nuances means that land use planning can respond appropriately. For example, it clearly shows that the traditional approach of relying on the 1 in 100 AEP, as the means to regulate residential development, is too simplistic to recognise the 'full' flood hazard. The cross-sections interpret the potential Hydraulic Risk mapping in another way, and again represent the 'baseline' hydraulic hazard (considering depth and velocity and how these conditions are influenced by the

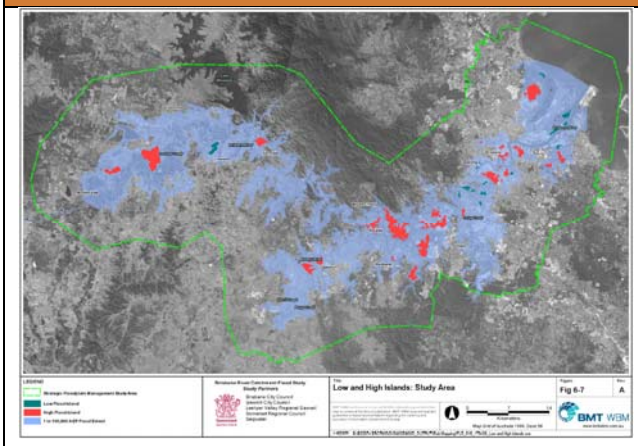
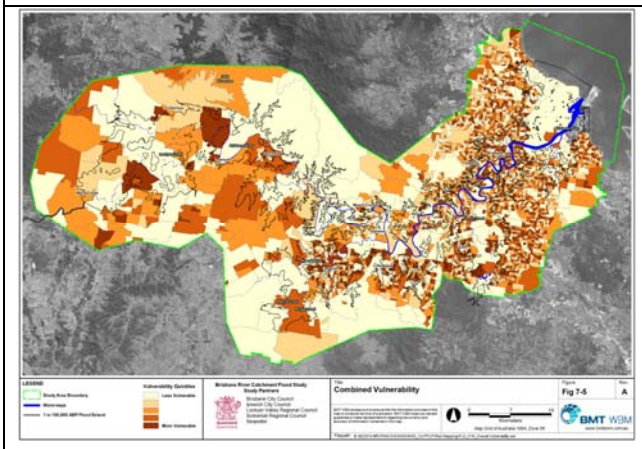
Flood risk tools	Application to LUP
	physical characteristics of the floodplain).
Land use activity group / Potential Hydraulic Risk Category HR1 | HR2 | HR3 | HR4 | HR5 Critical uses & essential community infrastructure: Intolerable | Intolerable | Intolerable | Tolerable* | Acceptable Vulnerable uses: Intolerable | Intolerable | Intolerable | Tolerable* | Acceptable Filling: Intolerable | Intolerable | Tolerable* | Tolerable* | Acceptable Residential & accommodation: Intolerable | Intolerable | Tolerable* | Tolerable* | Acceptable Commercial & industrial: Intolerable | Intolerable | Tolerable* | Acceptable | Acceptable Non-urban & recreation uses: Tolerable* | Tolerable* | Tolerable* | Acceptable | Acceptable	Indicative land use compatibility table Ideally, land use tolerability is informed by the outcomes of an integrated Phase 4 (LFMP) and a fit-for-purpose local flood risk assessment in accordance with SPP policy element 2. In the absence of a local flood risk assessment, this table provides a consistent starting point for the preparation of planning instruments and development assessment and gives guidance only on the potential appropriateness and tolerability of each land use activity group, based on the inherent or unmitigated hydraulic risk. It is a starting point to inform a preliminary decision as to whether the proposed land use is acceptable, tolerable or intolerable to the Potential Hydraulic Risk category, as it identifies potential consequences from the unmitigated flood risk based on an understanding of flood behaviour and hazard. The table identifies the uses' tolerability to the category of Potential Hydraulic Risk and, in doing so, differentiates between flood behaviour characteristics across the floodplain, and the risk appropriateness of the land use class proposed. Considering the vulnerability of particular land uses to changes in flood behaviour and understanding that the hydraulic risk profile varies across the floodplain (with some areas having a higher or less hazardous hydraulic risk profile), means that land uses can be allocated across the floodplain (and reflected in the settlement pattern for the region) in the most risk-appropriate way for the location in the floodplain. The location of infill development in existing areas can also be tailored to address the current level of risk. For each land use group, this tool summarises indicative land use compatibility with potential hydraulic risk and relative time to inundation (being the two factors most important in determining risk to life) and suggests three development responses: avoid areas of **intolerable** risk, mitigate (subject to requirements) in areas of **tolerable** risk and allow development in areas of **acceptable** risk. Where tolerable subject to requirements, footnotes can be added to the indicative land use compatibility matrix, as relevant, to clarify development requirements.

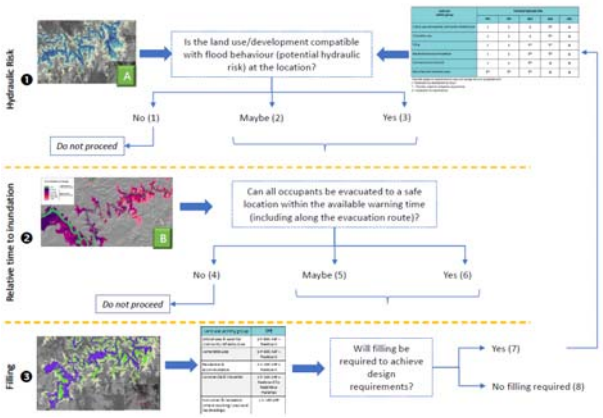
Flood risk tools	Application to LUP
	This high level tolerability assessment directly aligns with state interest policies for Natural hazards, risk and resilience in the SPP and therefore, helps reflect the State interest in planning instruments. It can then be refined through the Phase 4 (LFMP) and local flood risk assessment process, including consideration of other locally relevant flood risk factors and in the context of other flood risk management measures. The tolerability table is guidance only and considered a 'starting point' from which planning authorities can evaluate, determine and consult the community on potential tolerability and appropriate land use responses. Tolerability levels are therefore likely to be different to those identified in the potential land use tolerability table. It is also recognised that flood risk is only one of many planning considerations and constraints to be 'balanced' in the strategic planning processes. All aspects need to be considered and 'weighed' against each other to determine the optimum planning outcome for the benefit of the community. Note: The indicative land use compatibility table applies to aspects of development involving a material change of use and reconfiguring a lot – not the siting of, or filling (i.e. within building envelope) associated with, building work defined and assessable under section 5 of the *Building Act 1975* and the building assessment provisions. Planning schemes do not have jurisdiction to determine building controls; these are in accordance with the building assessment provisions.
	<u>Relative time to inundation mapping</u> Relative time to inundation mapping was developed to provide a high-level indication of relative flood inundation timing which may occur throughout the floodplain. Mapping has been provided for the 1 in 500 AEP, which allows for consideration of impacts beyond the standard 1 in 100 AEP. This mapping provides the time to inundation relative to the local reference gauge (as described in the Technical Evidence Report 2017) and describes the duration between that gauge reaching 'minor' flood levels (per the gauge classification levels provided in the Service Level Specifications) and inundation occurring at that location. The process used to develop this mapping is further explained in the Technical Evidence Report (2017). The 'minor' flood level (or 300mm

Flood risk tools	Application to LUP
	threshold) was chosen as this depth of flooding highly constrains self-evacuation using regular vehicles. In considering evacuation, it is recommended that the relative time to inundation be assessed along the entire evacuation route, with the minimum time used as a basis for response and action. Five major gauges have been used for mapping, viz: Lowood pump station, David Trumpy Bridge, Moggill, Jindalee and Brisbane City. Phase 3 (SFMP) is a regional scale study and relative time to inundation mapping has been derived across the whole floodplain at a high level. Local planning authorities can further refine this mapping and use additional local flood gauge information to assess times to inundation. Actual time of inundation for each flood experienced in the Brisbane River SFMP Study Area varies, depending on the characteristics of the flood hydrology. Also, not every flood which exceeds minor flood level will reach levels sufficient to inundate all areas of the floodplain. In the event of a large flood (above minor flood levels), it is possible that in some areas of the floodplain, flooding from local waterways is likely to occur before flooding from the Brisbane River (due to smaller catchments and short flood response time). The tool is not used to determine flood warning times, which will depend (in part) on other flood risk factors, such as community resilience, hazard warning and forecasting systems, dam operations, flood mitigation infrastructure, the resilience of road evacuation networks, the extent of flood risk mapping used for land use planning purposes, the risk tolerance of sheltering in place etc. In some circumstances, it may be the case that warning times are greater than the relative time to inundation identified in the Phase 3 (SFMP) where planning authorities have flood risk management systems in place prior to flood gauges reaching minor levels. Planning authorities consider undertaking a similar investigation as part of any local flood studies to understand relative inundation timing between properties, where required. In land use planning, the tool is very useful for strategic planning purposes as it identifies those locations in the floodplain

Flood risk tools	Application to LUP
	that have more (or less) relative time available for response and action before inundation. This mapping tool can assist in planning evacuation routes and prioritising where new, or upgrades to existing, evacuation routes need to occur and can help assess the shortest available time for the evacuation route.
	<u>Potential evacuation route immunity mapping</u> The SFMP proposes a regional evacuation capability assessment. In the absences of this regional assessment, the SFMP provides a tool which maps the major State Controlled Roads (SCRs) across the SFMP Study Area that may be relied on by emergency services and disaster management during a flood event. Importantly, the mapping records the potential flood immunity of these road segments. The mapping identifies the most frequent flood event that would cut-off access to each segment of road. Six AEPs are included: • ≤ 1 in 10 AEP • 1 in 20 AEP • 1 in 50 AEP • 1 in 100 AEP • 1 in 500 AEP • 1 in 2,000 AEP This mapping tool is useful in network analysis and infrastructure planning. It is noted that the SFMP can provide more detailed information on the timing and duration of the earliest road closure, beyond the information shown on this mapping. This relies on the BRCFS Phase 2 (Flood Study) fast model, which simulated 11,300 unique events for design purposes. The estimated time and duration of road closure data may be used by local governments in strategic land use and contingency planning to better understand isolation risk. This tool does not consider the immunity of local feeder roads and may overestimate network immunity. As such, this map is indicative only and it is recommended that planning authorities undertake local studies to assess the immunity of local evacuation routes. For future development, consideration of evacuation constraints is an important

Flood risk tools	Application to LUP
	consideration in understanding flood risk and determining the suitability of land for urban purposes and the need for new or upgraded infrastructure (e.g.: improving flood immunity of roads) to improve evacuation capacity.
	<u>Indicative flood function mapping</u> Flood function mapping characterises the floodplain into areas of flow conveyance and flood storage. For the purpose of the Brisbane River SFMP Study Area, indicative flow conveyance areas comprise the Potential Hydraulic Risk categories of HR1 and HR2, and typically include areas within or immediately adjacent to the river bank and channel and areas that can have deep and fast flowing water, which results in high risk to life and the potential structural failure of buildings. For the purpose of the Brisbane River SFMP Study Area, indicative flood storage areas consist of Potential Hydraulic Risk categories HR3 and HR4, and depict those overbank floodplain areas used for flood storage capture. Flood storage areas can also be deep but the velocities are lower. Loss of flood storage (through development, for example) can change flood detention behaviour and result in worsening of flood flows elsewhere. The balance of the floodplain is the 'flood fringe' area as defined, in the Brisbane River SFMP Study Area, by Potential Hydraulic Risk category HR5. In land use planning, this mapping tool is useful in helping to identify locations that are more or less sensitive to filling and changes to land form. For the SFMP Study area, this will be determined through a regional cumulative impact assessment and identification of a strategic filling or land form change 'envelope'. As explained by the Phase 3 (SFMP) sensitivity testing, the incised valley and other physical characteristics of the Brisbane River floodplain make some parts of the floodplain very sensitive to changes in land form (from activities such as filling). Until the regional cumulative assessment is completed, LFMPs, risk assessments and planning instruments may use this mapping tool to inform development of a flood hazard overlay to manage the impact of changes to flood behaviour and flow regimes resulting from future development.

Flood risk tools	Application to LUP
	<u>Low and high flood islands mapping</u> Mapping identifies isolation risk in the form of high and low flood islands. High islands are not inundated in the 1 in 100,000 AEP. Low islands are areas that become isolated in smaller events but eventually become completely flooded as flows rise up to a rare event. The mapping only considers those islands that are substantially developed, as the isolation of these areas has more significant implications region-wide. From a land use planning perspective, this information would best be used in conjunction with potential evacuation and warning time mapping to determine the number of properties and residents potentially isolated.
	<u>Combined vulnerability mapping</u> The vulnerability of a particular land use or community can exacerbate the level of exposure and its flood risk. The SFMP has produced combined vulnerability mapping, built into which are the following key social vulnerability metrics: • physical (age and disability) • social and economic (financial and employment) • mobility (evacuation means and living situation) • awareness (barriers to language and access to information) Four vulnerability indices were derived based on the characteristics described above using census data. Normalising each index gave a value from 0 (less vulnerable) to 1 (more vulnerable). The sum of each vulnerability index can be mapped individually. Alternatively, all four indices can be summed to show combined vulnerability (or an 'overall ranking') across the floodplain. Although not considered suitable for direct inclusion in a planning instrument to regulate development, the combined vulnerability mapping can be a key input into local flood risk assessments (prepared in accordance with SPP policy element 2) and the Phase 4 (LFMP) to inform strategic land use planning and the responses in planning instruments to treat flood risk. Combined vulnerability mapping also influences community resilience, recovery and response and can be used to identify where certain community vulnerabilities exist that factor into, and increase, the overall flood risk profile. However, the mapping does not seek to map or inform

Flood risk tools	Application to LUP
	the location of vulnerable uses accommodating vulnerable persons, as defined in Part A of this guidance material. The location of vulnerable uses is determined through the Phase 4 (LFMP) and local flood risk assessment (or alternative ISO compliant risk assessment) process and is subject to the overall flood risk profile and tolerability of the vulnerable use to its location in the floodplain.
 1 Flood behaviour (potential hydraulic risk) is too hazardous for the proposed development. **Do not proceed**. 2 Proposed development may be compatible with flood behaviour (potential hydraulic risk), depending on design conditions, an acceptable evacuation solution and other flood risk factors and tools. **Proceed to step 2**. 3 Proposed development is compatible with flood behaviour (potential hydraulic risk). **Proceed to step 2**. 4 Occupants cannot be safely evacuated. Significant risk to life. **Do not proceed**. 5 Occupants may be safely evacuated if specific actions are put in place. This could include physical works (raising, drainage) to evacuation route or enhancement of warning time. Warnings during night may reduce response time. **Proceed to step 3**. 6 Safe evacuation of all occupants from the proposed development is achievable. **Proceed to step 3**. 7 Check filling compatibility at step 1. Filling is a designated land use/development type. 8 No filling required as part of proposed development. Proceed subject to other site-based conditions as requirements.	<u>Flood risk factors decision support tool ('support tool')</u> The decision support tool provides a 'problem solving tree' or framework that incorporates the majority of (but not all) SFMP flood risk factor tools presented earlier in this table. It focusses on the key SFMP flood risk factors that are of the highest priority when considering risk to life, including Potential Hydraulic Risk, relative time to inundation and indicative flood function mapping, and considers how the tolerability of land uses may be impacted (and their level of risk amplified) by these, and the suite of other, flood risk tools considered relevant by the planning authority. The tool is intended to show an example of how these key SFMP flood risk factor tools come together and can be logically applied. Appended to the support tool are a series of outcome statements to assist in decision-making. These statements correspond to key risk-based questions posed in the support tool, the answers to which determine the most risk-appropriate development pathway: 1) *Is the land use/development compatible with the flood behavior (potential hydraulic risk) at the location?* 2) *Can all occupants be evacuated to a safe location within the available warning time (including along the evacuation route)?* 3) *Will filling be required to achieve design requirements?* Note that decision-making in respect of the above statements is to be informed by the outcomes of the relevant regional studies (such as the regional cumulative impact assessment, regional evacuation capability assessment, regional climate change adaptation response), as refined and applied by planning authorities through their Phase 4 (LFMP) and flood risk assessment process (or later implemented), to determine locally appropriate land use

Flood risk tools	Application to LUP
	planning responses to flood risk. The tool is guidance only and is one suggested way of bringing together a range of potentially relevant SFMP flood risk factor tools and explains how these can be used to determine the compatibility of different land uses in the floodplain. The tool sets up a potential framework for deciding land use and development within the SFMP Study Area. From a flooding perspective, it also identifies the most relevant items of technical information or flood 'evidence' upon which to base the decision. Used in land use planning, the tool would help inform risk appropriate land use planning, including a risk-responsive settlement pattern, as well as provide a consistent method for assessing site-based flood studies and flood risk assessments prepared during at the development assessment stage for development in the floodplain. Planning authorities can choose to add to, adapt or develop their own framework, also incorporating consideration of other locally relevant flood risk factors.

Part D: Applying assessment benchmarks

Refer to the SPP and state interest guidance material for specific assessment benchmarks for the Natural hazards, risk and resilience state interest.

This SFMP Planning Guidance does not vary the assessment benchmarks or provide additional guidance for its application in the Brisbane River SFMP Study Area.

Part E: Example planning scheme provisions

Part E of the SPP - state interest guidance material for natural hazards, risk and resilience contains example planning provisions that are considered useful and relevant to the Brisbane River SFMP Study Area.

Part F: Supporting information

1. *BMT WBM 2017, Technical Evidence Report for the Brisbane River Strategic Floodplain Management Plan* [INSERT WEB LINK ONCE AVAILABLE]

2. *Planning Institute of Australia 2015, National land use planning guidelines for disaster resilient communities. www.planning.org.au/policy/national-land-use-planning-guidelines-for-disaster-resilient-communities-2*

3. *Queensland Government 2018, Brisbane River Strategic Floodplain Management Plan* [INSERT WEB LINK ONCE AVAILABLE]

4. *Queensland Government 2017, State Planning Policy - July 2017 https://dilgpprd.blob.core.windows.net/general/spp-july-2017.pdf*

5. *Queensland Government 2017, State Planning Policy – State Interest Guidance Material for Natural Hazards, Risks and Resilience – Flood https://dilgpprd.blob.core.windows.net/general/spp-guidance-natural-hazards-risk-resilience-flood.pdf*

6. *Queensland Floods Commission of Inquiry: Final report, 2012. www.floodcommission.qld.gov.au/publications/final-report/*

Appendix A: Regional context for State interest policies (flood) in the Brisbane River floodplain

Regional contextual information is provided to support the application of relevant State interest policies (flood) to the Brisbane River SFMP Study Area.

State interest policy 1

Natural hazards areas are identified, including:
(a) bushfire prone areas
(b) flood hazard areas
(c) landslide hazard areas
(d) storm tide inundation areas
(e) erosion prone areas.

In response to Recommendation 2.2 of the Queensland Floods Commission of Inquiry (QFCoI), the BRCFS Phase 2 (Flood Study) (BMT WBM, 2017) has been completed for riverine flooding in the Brisbane River floodplain and spans across four local government areas: Brisbane City Council, Ipswich City Council, Somerset Regional Council and Locker Valley Regional Council.

The BRCFS Phase 2 (Flood Study) includes state-of-the-art hydrologic and hydraulic models and aligns with national and state best practice including Australian Rainfall and Runoff (2016). At the time of developing the SFMP, the Brisbane River Catchment Flood Studies, incorporating both the Phase 1 data collection and Phase 2 hydrologic and hydraulic assessments, represented one of the most advanced and sophisticated flood models in Australia and internationally.

The SFMP and this SFMP land use planning guidance have been informed by the previous technical studies and provide a comprehensive region wide understanding of flood behaviour across the Brisbane River floodplain, using a combination of 7 likelihoods and 6 levels of flood hazard. The largest event considered was the 1 in 100,000 AEP and has been used in the SFMP to define the extent of extreme flood inundation (i.e. the Probable Maximum Flood (PMF)).

For the purpose of the SPP and SPP Guidance, the Phase 2 (Flood Study) provides a fit-for-purpose flood study at the regional level and describes, assesses and characterises the nature of flood behaviour across the Brisbane River floodplain. The Phase 2 (Flood Study) and Phase 3 (SFMP) Potential Hydraulic Risk mapping and matrix and other tools are ideally used to inform local flood studies, local risk assessments, LFMPs and the LGA wide flood hazard area in planning instruments.

The Potential Hydraulic Risk mapping derived from the Potential Hydraulic Risk matrix, as defined in the SFMP and Technical Evidence Report (2017) identifies the spatial extent of the regional scale area of flood hazard for riverine flooding in the Brisbane River floodplain. Planning authorities can choose to use the Phase 3 (SFMP) Potential Hydraulic Risk mapping to inform or identify the LGA wide flood hazard area in planning instruments or apply the Phase 3 (SFMP) Potential Hydraulic Risk matrix through local flood studies, local risk assessments or the LFMP process to refine the on-the-ground mapping of the SFMP Potential Hydraulic Risk matrix at the local level. This presents planning authorities with the opportunity to further refine the spatial resolution of the Phase 2 (Flood Study) modelling and Phase 3 (SFMP) Potential Hydraulic Risk mapping at the local (i.e. site or property) level. Notwithstanding, the Phase 3 (SFMP) Potential Hydraulic Risk mapping is fit-for-purpose in identifying the regional flood hazard area in the Brisbane River floodplain, instead of the current area shown on the SPP IMS. The SFMP and Technical Evidence Report (2017):

- provides a methodology and defined matrix to identify five (5) categories of Potential Hydraulic Risk across the entire Brisbane River floodplain;
- establishes a methodology that local flood studies and floodplain management plans can follow; and

- provides outputs and mapping tools to inform local risk assessments, Phase 4 (LFMPs) and land use planning in the Brisbane River floodplain.

The Phase 3 (SFMP) Potential Hydraulic Risk matrix and mapping provides a robust understanding of flood behaviour across a range of flood events and flood hazard conditions for the full extent of the floodplain. The five levels or categories of hydraulic risk provides granularity across the different areas of flood risk and how these areas are defined (ie: there is a gradation in hazard and likelihood levels to reflect hydraulic variations across the floodplain). This provides a nuanced differentiation in the hydraulic flood risk profile across the floodplain and is an important technical input to identifying those parts of the floodplain that are potentially more or less hazardous or have a higher or lower flood risk.
Having a shared understanding of potential hydraulic risk across the floodplain provides the foundation for regional consistency in floodplain management and risk-based land use planning by defining the potential frequency and resulting hazard that may occur within the Brisbane River floodplain. It is important the Potential Hydraulic Risk matrix and categories, as defined in the Phase 3 (SFMP) and Technical Evidence Report (2017), are applied consistently across the SFMP Study Area. Where new or altered flood risk is identified within this mapping, it is important that direct action is taken to respond to the risk.

Independent variation of the Phase 3 (SFMP) Potential Hydraulic Risk categories and matrix definition by individual planning authorities or development applicants does not occur. However, variation may be supported where it is informed by a robust scientific review and the change to the matrix definition is collectively agreed by the State and all local government stakeholders through a collaborative process and the change also occurs across the entire Brisbane River floodplain.

When preparing any Phase 4 (LFMPs), local flood hazard studies, local flood risk assessments (or alternative ISO compliant risk assessment) or planning instruments including 'constraint' overlay mapping, it is recommended that planning authorities use the Phase 2 (Flood Study) and the Phase 3 (SFMP) Potential Hydraulic Risk categories and matrix, as defined in the SFMP and Technical Evidence Report (2017). However, it is recognised that translating the Potential Hydraulic Risk categories into planning instrument overlays and mapping conventions will depend on consideration of other relevant flood risk factors and local planning considerations, and whether the Phase 3 (SFMP) Potential Hydraulic Risk mapping is further refined by the local planning authority through the Phase 4 (LFMP) and local flood risk assessment (or alternative ISO compliant risk assessment).

In addition to Potential Hydraulic Risk mapping, the Phase 2 (Flood Study) and the Phase 3 (SFMP) have produced a number of other 'tools' that, in combination, can be used by planning authorities to inform Phase 4 (LFMP) and local flood risk assessments and land use planning responses and mapping in the planning instrument, together with other locally relevant factors. The SFMP mapping tools that may be used to inform planning instruments, subject to their relevance to planning authorities and in planning instruments in the local circumstance, are:

- indicative land use compatibility table in **Appendix C**[14];
- flood risk factors in **Appendix D** including, where relevant:
    - potential hydraulic risk mapping;
    - indicative flood function - flow conveyance and flood storage areas;
    - evacuation route immunity mapping;
    - relative time to inundation;
    - low and high flood islands; and
    - combined vulnerability mapping.

To help understand the sensitivity of flooding to changes in future climate conditions, the Technical Evidence Report (2017) discusses the results of sensitivity analysis of potential future climate change, based on the hydrologic modelling undertaken as part of the Phase 2 (Flood Study). The

[14] The indicative land use compatibility table is an example of how the tolerability of different land uses can be quantified to the category of Potential Hydraulic Risk (amongst other relevant flood risk factors and local and regional planning considerations to be determined by the planning authority). It is not a tool to be used in isolation and considers those most important risk to life factors impacting flood risk (i.e. Potential Hydraulic Risk and relative time to inundation). The table is a starting point to considering the role of land use planning responses and other development controls in identifying (as acceptable, tolerable or intolerable) and treating the level of risk. This is most effectively undertaken in the context of a Phase 4 (LFMP) and local flood risk assessment, as other floodplain risk management measures (aside from land use planning) may be available to planning authorities to further reduce the level of risk, such that a residual risk may be accepted and retained by the community.

adopted rainfall and sea level rise conditions and associated RCP scenarios and timeframes are shown in Table 2 below.

Table 2 – Scenarios adopted for SFMP sensitivity analysis of flooding to future climate conditions

	Adopted rainfall increase [ARR recommendations]	Sea level rise increase
RCP 8.5 by 2050	10% [8.8%]	0.3m
RCP 8.5 by 2090	20% [18.6%]	0.8m
RCP 4.5 by 2090	10% [9.1%]	0.63m

The sensitivity testing shows that sea level rise has impacts on the most downstream reaches of the Brisbane River; however, changes to rainfall and catchment runoff conditions have the most significant influence on flood behaviour in the broader floodplain. The Brisbane River floodplain is particularly sensitive to changes in rainfall, with any increase in flow resulting from changes in rainfall and significantly higher flood levels in some locations due to the incised valley and physical characteristics of the floodplain.

While the investigations undertaken are considered a sensitivity analysis, they are consistent with the recommendations of Australian Rainfall and Runoff (AR&R, 2016), which recommends testing both RCP 4.5 and RCP 8.5 scenarios. The sensitivity analysis included two planning horizons (i.e. 2050 and 2090). Identifying an interim planning horizon is important to understand how the flood risk profile is expected to change (either increase or decrease) over time, and can assist in the application of the SPP state interest policy of "avoid, or where it is not possible to avoid, mitigate" the flood hazard under a consistent set of change assumptions. The sensitivity analysis demonstrates that the Brisbane River catchment is very sensitive to climate change and has the potential to significantly alter flood behaviour in the floodplain, including notable increases in flood levels (and hence flood risks) across most of the floodplain. For example, as outlined in the Technical Evidence Report (2017), sensitivity testing under scenario RCP 8.5 by 2050 (SFMP model reference CC2) has shown that the current 1 in 100 AEP flood levels are projected to produce similar peak levels to the current 1 in 200 AEP by 2050, and more than double the number of residential properties inundated (above floor level). The extent of land identified in the highest potential hydraulic risk categories, HR1 and HR2, is also expected to increase significantly under the higher RCP 8.5 scenario by 2090 (Technical Evidence Report, 2017). From a risk-based perspective, this increase in frequency and likelihood increases the overall risk profile across most of the floodplain.

It is important that the consequences of a range of climate change probabilities are understood within the Brisbane River floodplain to test and plan for changes in flood risk over time. Land use planning has a central role in avoiding flood risk to future development and potentially intolerable consequences to communities. The effect of different flood futures on existing land use and development within the floodplain is important, particularly for those uses that permanently 'establish' in floodplains over their lifetime or have a key role in strategically shaping or influencing settlement patterns or how communities function (e.g. airports, hospitals, correctional facilities, transport infrastructure etc.). These uses are not readily relocatable or adaptable over time and are inherent to the strategic settlement pattern of an LGA and region.

Using land use planning as one such mechanism to manage current and reduce future flood risk will improve resilience and provide greater community certainty than relying on potential structural mitigation options (e.g. Warrill Creek dry flood mitigation dam). Chapter 8 of the Technical Evidence Report (2017) explains that the net flood risk benefit accruing to these mitigation options – in terms of peak flood levels at a regional scale – are nullified over time by the effect of climate change. Therefore, an understanding of how the current flood risk profile will change as a result of worsening flood futures is recommended to inform Phase 4 (LFMPs) and local flood risk assessments (or alternative ISO compliant risk assessments), and to guide floodplain management decisions, including land use planning responses.

The sensitivity testing undertaken as part of the Phase 3 (SFMP) supports action to respond to climate change and consider its effect on the current flood risk profile across the floodplain. It is recommended that for the purpose of informing mapping to identify the flood hazard area in planning schemes and to have regional consistency in climate change assumptions across the floodplain, planning authorities may consider adopting the more 'conservative' RCP 8.5 scenario (for 2050 and 2090) or take a more nuanced approach by applying different climate change scenarios to land use, appropriate to the longevity or resilience of the land use to changing flood risk exposure over time.

This can be achieved by undertaking further testing and modelling of the impacts of a number of interim (or farther) planning horizons than the 2050 and 2090 horizons considered in Phase 3 (SFMP), or by using the SFMP modelled scenarios. The outputs of such further testing can be used to inform planning scheme provisions and development controls for specific land use and development.

Refer to Table 1 (in section 1.5.3 of this guidance) – Indicative climate change scenarios for land use activity 'groups' in the SFMP Study Area, as a guide to applying this more nuanced approach. Planning authorities can use the Phase 3 (SFMP) modelled scenarios as a 'starting point', as recommended in Table 1. If planning authorities choose to undertake further modelling, the preferred planning horizons are to be determined in the context of local circumstances.

State interest policy 2

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.

The SFMP undertook a region-wide assessment of current and future flood risk across the four local government areas within the SFMP Study Area. Details of the Current and Future Risk Assessment can be found in the Technical Evidence Report (2017). The region-wide assessment identifies and describes the current flood risk across the Brisbane River floodplain and analysed key factors contributing to flood risk including:

- the hydraulic behaviour of flooding and defining five categories of Potential Hydraulic Risk (HR1 to HR5);
- the properties and infrastructure exposed to flood;
- the vulnerability of the communities that reside in the floodplain; and
- susceptibility of the state road network to isolation and evacuation constraints.

These risk factors were assessed in combination and on an individual property basis. A flood risk property database to inform the identification and assessment of risk treatment measures has been provided to local government partners to enable further local level evaluation of flood risk and risk treatment options to inform land use planning responses and to achieve other floodplain management outcomes.

While the SFMP region-wide assessment defines and maps Potential Hydraulic Risk in the context of the extent to which the 'unmitigated' flood risk affects each LGA and the Technical Evidence Report includes a strategic analysis of zoning exposure at the regional level, the SFMP has not involved a local level analysis of the implications, or acceptability or tolerability, of Potential Hydraulic Risk (and other flood risk factors) on existing and future land use, infrastructure and settlement patterns across the four local government areas to define the flood risk. Therefore, to meet the requirements of the SPP, planning authorities need to undertake further analysis to assess the risk posed to people, property and infrastructure. This involves undertaking a fit-for-purpose flood risk assessment at the local level for relevant parts of the LGA and evaluating community tolerability or acceptability to flood risk in the context of land use planning.

To provide an integrated flood risk management response, the SFMP envisages this flood risk assessment to be undertaken as part of the Phase 4 (LFMP) process and prepared by planning authorities at the local level.

The Potential Hydraulic Risk mapping derived from the Phase 3 (SFMP) matrix provides an essential mapping tool to inform local flood risk assessments to be undertaken by planning authorities. The Phase 3 (SFMP) Potential Hydraulic Risk matrix defines five categories of Potential Hydraulic Risk (HR1 to HR5) based on a combination of seven likelihoods and six flood hazard levels, as detailed in the Phase 3 (SFMP) and Technical Evidence Report (2017).

It is important to note that the SFMP Potential Hydraulic Risk is defined purely on the basis of the hydraulic conditions and behaviour of flood events and is defined by analysing the likelihood of floods and the hydraulic hazard that occurs during floods of different size and likelihood. Therefore, the SFMP Potential Hydraulic Risk represents the potential flood risk independent of existing land use or development of the land within the floodplain; it is the 'unmitigated' or inherent (i.e. untreated) hydraulic risk. Based on this robust understanding of flood behaviour, planning authorities are best able to determine the tolerability of different land uses and, in consideration to other flood risk factors, the balancing of planning interests and community engagement outcomes, the most risk appropriate management response/s to be adopted. Land use planning responses, including determining tolerability and achieving an acceptable level of risk, needs to be considered in the context of other flood risk management measures, ideally as part of an integrated Phase 4 (LFMP) and local flood

risk assessment. Flood risk is one, of a number of issues and objectives, considered in the planning process and in formulating land use and development policy.

The Phase 3 (SFMP) and Technical Evidence Report (2017) provides the technical basis and methodology for planning authorities to evaluate flood risk at the local level in a consistent way, inform their planning responses and allocate land uses and derive development controls in a risk appropriate manner. It is important to have a regionally consistent understanding of floodplain behaviour to inform local flood risk assessments and for these assessments to follow a regionally consistent methodology.

Given the sensitivity of parts of the Brisbane River floodplain, the complexity, severity and extent of flooding, the size of the population and exposure of property and infrastructure, planning authorities need to undertake a comprehensive and fit-for-purpose flood risk assessment in accordance with the SPP and SPP Guidance material using the technical evidence from the Phase 2 (Flood Study).

The Phase 2 (Flood Study) and the Phase 3 (SFMP) have produced a number of 'tools' that, in combination, may be used by planning authorities to inform a local level evaluation of flood risk and identify risk treatment options, including proposed land use planning responses in planning instruments. These tools are provided in the Technical Evidence Report (2017) and summarised in Part C – Mapping of this SFMP Planning Guidance; however, their relevance to planning authorities and in planning instruments needs to be considered in the local circumstance. These tools include:

- flood risk factors decision support tool in **Appendix B**[15];
- indicative land use compatibility table in **Appendix C**[14]; and
- flood risk factors in **Appendix D** including, where relevant:
    - potential hydraulic risk mapping;
    - indicative flood function - flow conveyance and flood storage areas;
    - evacuation route immunity mapping;
    - relative time to inundation;
    - low and high flood islands; and
    - combined vulnerability mapping.

Refer to **Table 1** in the SPP state interest guidance material for principles of preparing flood risk assessments, which remain relevant to the Brisbane River SFMP Study Area.

[15] The flood risk factors decision support tool and indicative land use compatibility table are tools to help inform the tolerability of different land uses based primarily on Potential Hydraulic Risk (i.e. the 'unmitigated' or untreated risk). These are considered guidance and it is recognised that planning authorities may determine different tolerability levels to those identified by the tools in **Appendix B** and **Appendix C** through the Phase 4 (LFMP) and local flood risk assessment (or alternative ISO compliant risk assessment) process and subject to other flood risk and locally relevant factors and the community's tolerance to flood risk.

State interest policy 4

Development in bushfire, flood, landslide, storm tide inundation or erosion prone natural hazard areas:
(a) avoids the natural hazard area; 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.

Land use planning is a very effective way to avoid and manage future flood risks that may occur as a result of greenfield development or future climate change. Land use planning can also 'arrest' or limit the exacerbation of current flood risk to existing development, particularly where this current risk is intolerable and other flood risk management options (e.g. structural mitigation options) are not sufficient to reduce the current risk profile. The establishment of risk appropriate or compatible land use and development in the floodplain is an important first principle of risk-based planning. It is, for example, possible for land use planning to reduce a potentially intolerable level of flood risk created through the existing allocation of zones in higher hydraulic risk areas of the floodplain, and to ensure the zoning pattern transitions to a more resilient outcome while retaining development potential.

The Phase 3 (SFMP) has been informed by the Phase 2 (Flood Study), which provides a comprehensive understanding of flood behaviour across the Brisbane River floodplain and provides a defensible technical basis for localised, fit-for-purpose flood risk assessments.

The Phase 3 (SFMP) Potential Hydraulic Risk categories and matrix, as defined in the Technical Evidence Report (2017), provides a regionally consistent definition of hydraulic risk across the SFMP Study Area and is considered fit-for-purpose.

In the Brisbane River floodplain, regional consistency is primarily achieved by having a shared understanding of the inherent, 'unmitigated' flood risk and the hydraulic conditions/flood behaviour consequences of flood events that contribute to this risk. The Phase 3 (SFMP) Potential Hydraulic Risk matrix categories and mapping: (a) provides the consistent hydraulic risk baseline and understanding of flood behaviour to inform Phase 4 (LFMPs) and local flood risk assessments (or alternative ISO compliant risk assessment), (b) ensures this risk is defined across the whole of the floodplain in the same manner and (c) delivers a common methodology that may be used for local-based flood studies. In land use planning, consistently defining the 'unmitigated' hydraulic flood risk ensures that all Phase 4 (LFMP) and local flood risk assessments (or alternative ISO compliant risk assessment) helps to inform the distribution of land uses according to their tolerability to the same hydraulic conditions across the range of event likelihoods in the floodplain. Considering the implications of Potential Hydraulic Risk, in combination with other relevant SFMP flood risk tools and locally relevant factors, is a way of assisting planning authorities better understand the overall flood risk profile, distribute land uses and locate development in risk appropriate areas of the floodplain and determine adequate land use planning responses in the context of other flood risk management measures.

The Phase 3 (SFMP) has produced a number of tools that, when used in combination to inform a Phase 4 (LFMP) and local flood risk assessment (or alternative ISO compliant risk assessment), provide a useful resource for planning authorities to assess the appropriateness and tolerability of land use to potential hydraulic risk (and other flood risk factors) and to inform a risk-based approach to land use planning. However, it is noted that a full flood risk assessment is required to provide a more complete understanding of the overall flood risk profile of the floodplain and the tolerability of land uses proposed therein – beyond the understanding of flood behaviour given by the Phase 3 (SFMP) Potential Hydraulic Risk mapping and matrix.

These tools are provided in the Technical Evidence Report (2017) and are further described in Part C of this SFMP Planning Guidance; however, their relevance to planning authorities and in planning instruments needs to be considered in the local circumstance. These tools include:

- flood risk factors decision support tool in **Appendix B**[16];
- indicative land use compatibility table in **Appendix C**[14]; and

- flood risk factors in **Appendix D** including, where relevant
    - potential hydraulic risk mapping;
    - indicative flood function - flow conveyance and flood storage areas;
    - evacuation route immunity mapping;
    - relative time to inundation;
    - low and high flood islands; and
    - combined vulnerability mapping.

In responding to flood risk, Phase 4 (LFMPs) and local flood risk assessments (or alternative ISO compliant risk assessment) rely on the Phase 3 (SFMP) defined Potential Hydraulic Risk matrix and mapping as the technical basis to identify the inherent or 'unmitigated' flood risk and the consequences of this untreated risk at the regional level. The Phase 4 (LFMP) and local flood risk assessment (or alternative ISO compliant risk assessment) outcomes provide critical inputs to inform future scheme amendments, by assessing the risk appropriateness of land use distributions across the floodplain and the flood risk management measures available to treat the flood risk to an acceptable or tolerable level. The effectiveness of existing land use planning responses to flood risk need also be evaluated as part of this process. .
Potential Hydraulic Risk is one of the most important flood risk factors when considering risk to life from flood and determining if land use is risk appropriate for its location in the floodplain. Other flood risk factors, such as relative time to inundation and evacuation capability, are also important risk to life considerations. Establishing a Defined Flood Event (DFE) and other built form controls are important for managing risk to property, but are secondary to first determining whether the land use is appropriate for the location after considering the hydraulic conditions and implications of flood behaviour.

The Phase 3 (SFMP) Technical Evidence Report (2017) notes that when floods threaten lives, which can happen in floodwaters characterised by a flood hazard level of H3 to H6, the level of risk is commensurate. Given that the 1 in 100 AEP likelihood is broadly accepted as the default standard and (generally) the acceptable level of flood immunity by the community, a combination of H3 to H6 flood hazard levels with floods at, or more frequent than, the 1 in 100 AEP can be regarded as higher overall risk, and planning instruments may identify certain land uses as potentially intolerable in these areas, particularly where relative time to inundation is constrained. Having a comprehensive and consistent understanding of Potential Hydraulic Risk across the floodplain, in combination with other relevant flood risk factors, means that land use planning responses can be tailored and appropriate to flood risk. This may involve avoiding new urban uses in greenfield areas of intolerable risk, or removing high risk areas from the Urban Footprint as part of an investigation of regional land use, land supply and outcomes following the review of the SEQ Regional Plan. It may also involve planning responses that limit increases in risk to existing development, e.g. back zoning or limiting intensification of certain uses that increase exposure of people in areas of intolerable risk due to extreme hydraulic risk and unacceptable evacuation risks, or providing opportunities for redevelopment and changing land use to reduce flood risk where the hydraulic risk 'impact' is tolerable or acceptable. It is recommended that these approaches use the full suite of land use planning and plan making tools, including strategic framework provisions, the allocation of land to zones and zone code assessment benchmarks, flood provisions in an overlay code, use of flood overlay mapping to trigger the code and flood planning scheme policies that align with the flood risk assessment and policy response.

It is neither ideal to rely only on flood risk assessments to be undertaken on a site-by-site basis at the development assessment stage to determine the appropriateness of development in the floodplain, nor to use only flood overlays in the planning instrument to identify and regulate flood risk. The complete suite of planning instrument risk treatment tools can be used, including allocation of zoning to reflect the type of land use and development that is most risk appropriate for the location in the floodplain. This is particularly important given the Phase 2 (Flood Study) and Phase 3 (SFMP) technical outputs developed, which provide a comprehensive understanding of flood behaviour in the SFMP Study Area. Site-based flood risk assessments may be appropriate where a comprehensive understanding of flood risk is lacking in certain areas, or where applicants wish to pursue a performance-based approach in a higher hydraulic risk area where land use may be potentially tolerable, subject to requirements.
Determining flood related planning responses to treat flood risk are decisions for the planning authority to determine (in part) through a Phase 4 (LFMP) and local food risk assessment (or alternative ISO compliant risk assessment) process. However, it is important that planning instruments provide clear policy direction on the tolerability (or intolerability) of land use and development occurring in a Potential Hydraulic Risk category for its location and in combination with

other relevant regional and local flood risk factors. This ideally occurs as part of the full flood risk assessment and understanding of the overall flood risk profile and appropriate risk treatments available – and is not determined in the Phase 3 (SFMP). The SFMP flood risk factor tools provided in this guidance material are guidance only and are a 'starting point' which may help inform risk tolerability and risk appropriate treatment options.

State interest policy 5

Development in natural hazard areas:

(a) supports, and does not hinder disaster management capacity and capabilities

(b) directly, indirectly and cumulatively avoids an increase in the exposure of severity of the natural hazard and the potential for damage on the site or to other properties

(c) 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

(d) maintains or enhances the protective function of landforms and vegetation that can mitigate risks associated with the natural hazard.

The largely incised nature of the Brisbane River floodplain means that flood levels and flood behaviour are sensitive to changes in land form from activities such as filling. Sensitivity testing carried out in the Technical Evidence Report (2017) showed that flood behaviour in some areas is particularly sensitive to further development if filling is proposed to achieve a DFE to mitigate flood risk and provide an acceptable level of flood immunity.

Flow conveyance areas are the parts of the floodplain that convey the majority of flood flows and are to be maintained. They include the river channels and immediate overbank areas, as well as some meander cut-offs and critical overland flow paths. Flood waters in conveyance areas are typically deep (> 1 metre) and flow fast. For this reason, flow conveyance areas can be very dangerous during floods. Intrusion of development into flow conveyance areas has the potential to cause impacts on flow conveyance, and buildings can be seriously damaged or structurally fail during a flood event.

Flood storage areas are critical for temporarily storing and detaining floodwaters as they travel downstream. Reduction in flood storage can potentially change flood behaviour, worsening flooding elsewhere in the floodplain. Flooding within flood storage areas is typically deep (more than 0.5m to 1.0m or so in major events), but velocities are lower than flow conveyance areas.

In the absence of local detailed hydraulic investigations applying the Phase 3 (SFMP) Potential Hydraulic Risk categories and matrix as defined in the Technical Evidence Report (2017):

- flow conveyance areas may be defined as areas mapped as HR1 and HR2 Potential Hydraulic Risk categories (or as otherwise defined by the planning authority); and
- flood storage areas may be defined as areas mapped as HR3 and HR4 Potential Hydraulic Risk categories (or as otherwise defined by the planning authority).

Land use and development that has the potential to obstruct or alter flows in flow conveyance areas, or reduce potential flood storage volume, may worsen flood hazards and flood risks elsewhere on the floodplain and may not be supported by the planning authority.

Land use planning and proposed development relying on filling in the Brisbane River floodplain to achieve a DFE is not the preferred flood risk mitigation measure for the floodplain. Any proposed filling is to be carefully considered and result in a ‘no worsening’ of flood hazards and risks in other areas of the floodplain. The principle of ‘no worsening’ is discussed in the Technical Evidence Report (2017) and encourages the assessment of proposals relying on development fill or land form change (to achieve a tolerable or acceptable level of flood risk) as part of a regional cumulative impact assessment prepared by the State Government.

At the time of drafting this guidance, the regional cumulative impact assessment had not been prepared. In the absence of the assessment, current industry best practice is relied on to define ‘no worsening’ and to achieve the intent of state interest policy 5(b). The following definition is provided:

(a) no increase in flood hazard conditions – flood levels, velocities, evacuation capability, flood hazard categories and potential hydraulic risk categories;

(b) no increase in the level of flood risk to surrounding properties;
(c) no total impact from cumulative filling that exceeds 10mm across the floodplain;
(d) no change to the flood hydrograph and timing of the flood wave/s; and
(e) no impact on flood warning times elsewhere in the floodplain.

It is important for development proposing filling or land form change in the floodplain to be assessed across the whole floodplain to understand cumulative impacts of changes in flood behaviour beyond site and LGA boundaries. This is most effectively undertaken at a strategic level as part of a regional cumulative impact assessment and involves detailed iterative modelling of the 60 ensemble design events from the Phase 2 (Flood Study) as a starting point to define an 'envelope' of acceptable areas of impact from filling or land form change across the whole floodplain. The limit of acceptable cumulative impact within this 'envelope' is < 10mm. It is not recommended that development controls for filling or land form change within the defined 'envelope' require additional cumulative impact assessments to be undertaken at the development assessment stage.

However, where filling or land form change (a) is proposed outside the 'envelope' as identified by the strategic modelling assumptions or (b) changes the flood level outside the development site by >10mm, it is recommended that the assessment benchmarks require a cumulative assessment of impact and include testing against the 'envelope' as the 'base case'. The TER recommends that the 'base case' model be updated periodically (e.g. every five years to coincide with the Phase 3 (SFMP) review) to include all subsequent development proposals that have been tested for cumulative impacts.

The evacuation capability of land, and the ability for self-evacuation to occur and provide for emergency service access, is an important land use planning consideration. Due to the magnitude of potential extreme floods in the Brisbane River SFMP Study Area, on-site refuge within developments is not a fail-safe alternative to early evacuation from flood affected land. As extreme flooding can be much higher than 1 in 100 AEP flood levels (up to 20 metres higher), people that think they are safely above potential flood levels may still be at risk. Flood free land that becomes isolated by flooding (i.e. flood islands) may also require early evacuation to mitigate risk to life. Therefore, locations with limited relative time to inundation may also be recognised as having a potentially high flood risk.

Land use and development that cannot safely evacuate all occupants to flood-free land within the relative time to inundation does not occur.

State interest policy 6

Community infrastructure is located and designed to maintain the required level of functionality during and immediately after a natural hazard event.

There are existing community infrastructure and facilities affected by flood risk, many of which have an important role in supporting and providing services to existing communities. Expansion of existing community facilities and infrastructure and the establishment of new facilities considers the full range of flood risks as part of planning for the delivery of these services.

The local flood risk assessment required by SPP policy 2 can determine appropriate locations for community infrastructure, including critical services and vulnerable and sensitive uses, depending on local flood behaviour and settlement characteristics. Planning authorities, in undertaking their local flood risk assessments, are required to determine the level of risk considered appropriate for existing and proposed community infrastructure in the context of their local communities and the different roles, functions and vulnerabilities of these facilities to flood risk. Planning responses to treat flood risk include appropriate planning provisions applied under SPP policy 4 during the preparation of planning instruments or designations of land for community infrastructure. However, the tolerability of community infrastructure is subject to the outcomes of the local flood risk assessment and, where relevant, will be determined in the context of the Phase 4 (LFMP) and local flood risk assessment (or alternative ISO compliant risk assessment).

The Technical Evidence Report (2017) identifies the floodplain exposure of critical services[16] used to assist people and provide crucial support and resources during a flood event. The Technical Evidence Report (2017) also identifies the exposure of vulnerable uses being those uses or activities that accommodate vulnerable persons, whose demographic and socio-economic characteristics (e.g. age, health, disability, care/assistance requirements) increase the severity of the flood risk experienced by the affected population due to constraints on self-evacuation and self-assistance.

For critical services, there are approximately 111 items situated in the highest three Potential Hydraulic Risk categories, HR1, HR2 and HR3. It is recommended that planning authorities, in undertaking their local flood risk assessments (as required by SPP Policy 2), determine the implications of Potential Hydraulic Risk and other relevant regional and local flood risk factors identified by the SFMP on existing and future community infrastructure (including critical services and vulnerable and sensitive uses). It is important that planning decisions avoid increasing the exposure of these uses in the Brisbane River SFMP Study Area.

The Indicative Land Use Tolerability[17] Table in **Appendix C** provides examples of the range of community infrastructure, including vulnerable uses, sensitive uses and critical services. Specific guidance is provided on vulnerable uses and sensitive uses and their compatibility and tolerability to flood risk.

In the Brisbane River SFMP Study Area, critical services that are central to the management of disaster response during a flood event are potentially intolerable in areas of high to extreme flood risk represented by:

- the Potential Hydraulic Risk categories of HR1, HR2 and HR3; and
- areas where the speed of flood onset or relative time to inundation is less than 24 hours.

For vulnerable uses involving vulnerable persons, the Potential Hydraulic Risk category HR3 (defined by events up to or more frequent than the 1 in 100 AEP, or with a flood hazard level of H3

[16] The property and community database developed to inform the SFMP includes information about building location and property type. Critical services were identified as a property type and include water supply and sewage treatment sites/facilities, telephone exchanges, TV transmitters, electricity substations, emergency response (fire, police, ambulance, SES) and defence force establishments. The Potential Land Use Tolerability Table in Appendix C also provides examples of these critical services.

[17] Land use tolerability to, and compatibility with, flood risk is a matter for the planning authority to determine through the Phase 4 (LFMP) and local flood risk assessment (or alternative ISO compliant risk assessment).

or more severe), is considered potentially intolerable. This is because even though the 1 in 100 AEP is a likelihood that is traditionally accepted as the design standard acceptable for residential development, a flood hazard level of H3 (or more severe flood hazard levels of H4, H5 or H6) makes it higher risk and intolerable for vulnerable persons to evacuate. Areas of the floodplain where the relative time to inundation is limited (less than 24 hrs) also contributes to an intolerable risk for vulnerable uses.

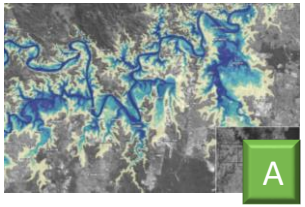
For sensitive uses where managing risk to property is paramount, the Potential Hydraulic Risk categories of HR1, HR2 and HR3 where characterised by a flood hazard level of H5 or greater, are considered potentially intolerable. This is because such uses often accommodate sensitive property that would be impacted under flood hazard conditions that cause buildings or infrastructure to be structurally damaged or fail (i.e. H5 or H6). Relative time to inundation is not as great a concern for sensitive uses, as it is often impractical to relocate these uses prior to a flood event.

Appendix B: Flood risk factors decision support tool

Concept Plan for Brisbane River SFMP Planning Framework (Flooding)

Hydraulic Risk

❶



Is the land use/development compatible with flood behaviour (potential hydraulic risk) at the location?

Land use activity group	Potential Hydraulic Risk				
	HR1	HR2	HR3	HR4	HR5
Critical uses and essential community infrastructure	I	I	I	T*	A
Vulnerable uses	I	I	I	T*	A
Filling	I	I	T*	T*	A
Residential and accommodation	I	I	T*	T*	A
Commercial and industrial	I	I	T*	A	A
Non-urban and recreation uses	T*	T*	T*	A	A

*tolerable subject to requirements to treat and manage risk to an acceptable level
I – Intolerable (no development to occur)
T – Tolerable, subject to mitigation requirements
A – Acceptable (no requirements)

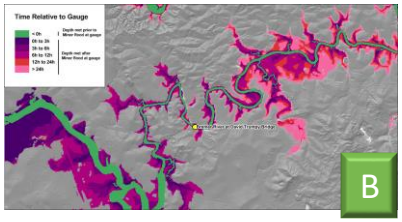
No (1) — *Do not proceed*

Maybe (2)

Yes (3)

Relative time to inundation

❷



Can all occupants be evacuated to a safe location within the available warning time (including along the evacuation route)?

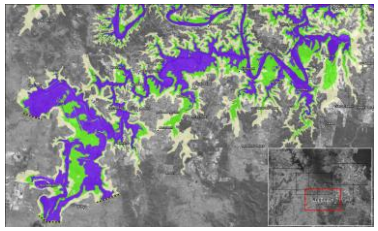
No (4) — *Do not proceed*

Maybe (5)

Yes (6)

Filling

❸



Land use activity group	DFE
Critical uses & essential community infrastructure	1 in 500 AEP + freeboard
Vulnerable uses	1 in 500 AEP + freeboard
Residential & accommodation	1 in 100 AEP + freeboard
Commercial & industrial	1 in 100 AEP + freeboard for hazardous materials
Non-urban & recreation (where involving rural/rural res dwellings)	1 in 100 AEP

Will filling be required to achieve design requirements?

Yes (7)

No filling required (8)

Framework decisions and outcomes

1	Flood behaviour (potential hydraulic risk) is too hazardous for the proposed development. **Do not proceed**.
2	Proposed development may be compatible with flood behaviour (potential hydraulic risk), depending on design conditions, an acceptable evacuation solution and other flood risk factors and tools. Proceed to step 2.
3	Proposed development is compatible with flood behaviour (potential hydraulic risk). Proceed to Step 2
4	Occupants cannot be safely evacuated. Significant risk to life. **Do not proceed.**
5	Occupants may be safely evacuated if specific actions are put in place. This could include physical works (raising, drainage) to evacuation route or enhancement of warning time. Warnings during the night may reduce response time. Proceed to Step 3.
6	Safe evacuation of all occupants from the proposed development is achievable. Proceed to Step 3.
7	Check filling compatibility at Step 1. Filling is a designated land use/development type
8	No filling required as part of proposed development. Proceed subject to other site-based conditions as requirements

Appendix C: Indicative land use compatibility table

Indicative Land Use Compatibility Table

In the context of flood risk management and land use planning, different land uses have different vulnerabilities or susceptibility to flooding and this means that some land uses are more or less appropriate to floodplains depending on the vulnerability of people, land use type, built form and density.

Risk-based planning is based on the principle of ensuring that land use planning and development outcomes are responsive to and appropriate to the level of flood risk. The intent is not to 'sterilise' development, but to provide better information for the planning process to place less appropriate or more sensitive land uses in less hazardous locations, to better manage the design of development in the floodplain and to provide a consistent approach with emergency management and other flood risk management measures.

To ensure planning responses are appropriate, it is important to have a robust understanding of region-wide flood behaviour. Understanding where areas of the floodplain are potentially more hazardous because of deep or fast flowing floodwaters, and lower risk areas because flood hazard is low or the likelihood is extremely rare, is a critical input to informing land use planning policy and development decisions. Understanding the differences in land use vulnerability to flood impacts, together with a robust understanding of region-wide flood behaviour, means that planning responses can be tailored to ensure that land use is appropriately planned and located in the floodplain.

Potential Hydraulic Risk is one of the most important flood risk factors when considering risk to life from flood and determining if land use is risk appropriate for the location in the floodplain. Other flood risk factors, such as relative time to inundation and evacuation capability, are also important risk to life considerations. Establishing a Defined Flood Event (DFE) and other built form controls are important for managing risk to property, but should be secondary to first determining whether the land use is appropriate for the location after considering the hydraulic conditions, evacuation capability and implications of floodplain behaviour.

Land use tolerability should be informed through a local flood risk assessment, including community engagement and, ideally, prepared as part of a local floodplain management plan process (or an alternative ISO compliant risk assessment). It is recognised that planning authorities will need to consider local circumstances and other issues in determining tolerance and risk appropriate land use. The SFMP flood risk factor tools, particularly the Potential Hydraulic Risk mapping, provide an understanding of flood risk that should be used to inform risk assessments and strategic planning processes, together with the range of other planning considerations (such as transport, infrastructure, ecology, heritage etc) that are balanced to determine the optimum plan to guide land use and development for the benefit of the community. It is possible that some risk might remain because the planning process determined certain land uses were desirable in the floodplain due to other planning considerations. The planning authority needs to 'weigh up' the potential consequences and impacts of flood risk with the extent of need and achieving other planning objectives.

The SFMP flood risk factor tools provide a consistent starting point to inform the development of the Phase 4 (LFMPs) and local flood risk assessments (or alternative ISO compliant risk assessment) and to inform the drafting of nuanced and risk appropriate planning responses. The indicative land use tolerability table begins to articulate how planning responses can distinguish between existing urban and greenfield areas and more vulnerable or sensitive types of community infrastructure. The tools are not intended to pre-empt the land use planning response or prescribe that an intolerable or tolerable level of risk be applied in all like areas of the floodplain. The outcomes of the Phase 4 (LFMP) and local flood risk assessment (or alternative ISO compliant risk assessment) should be relied on to inform land use strategy and development policy decision making, either as part of the LFMP and risk assessment process or, as part of a separate strategic planning process (including planning scheme reviews and amendments). Through the local planning process, it may be determined by a planning authority that the extent or magnitude of need and public benefit for certain uses or development in the floodplain 'outweighs' the level of risk to life and property, and that other flood risk management measures (in addition to or separate from land use planning controls, such as flood resilient building design[1]) can reduce the risk to a level that is acceptable or tolerated by the community.

[1] At the time of drafting, the State was in the process of preparing guidance to improve understanding on the principles, techniques and appropriateness of materials and structural and non-structural options to achieve flood resilient building design. The outcomes of this guidance will be considered further in terms of implications for building controls; however, this is not a matter that can be dealt with in the planning scheme.

Land use activity	Commentary on use vulnerability or sensitivity to flood
Community infrastructure – where for a critical service Examples include: • air service • emergency services (evacuation centre, disaster management, ambulance, fire and police stations) • hospital • major electricity infrastructure • renewable energy facility • substation (supporting other community infrastructure) • telecommunications facility • utility installation (for the supply of water, hydraulic power, gas, sewerage, waste management)	Community infrastructure where for critical services can be central to the management of disaster response during a flood event; they can also contribute to the broader community infrastructure network and significantly influence the ability of the community to respond and recover from a flood event. They provide essential services to the community and mayalso contain equipment that may be damaged by flooding.. These uses have different roles during and after a flood event and are generally considered highly vulnerable to flood impacts particularly if it is essential they are able to maintain functionality during and immediately after a flood event. In addition to hospitals, police/fire/ambulance stations, other examples can include show ground facilities, convention centres, large sport clubhouses and community halls, schools or university campuses which may function as emergency accommodation or for processing people and providing immediate relief to those who have evacuated their homes. Wherever possible, the establishment of new critical services avoids flood risk by locating outside the extent of the floodplain (defined by the 1 in 100,000 AEP) – regardless of whether in public or private ownership. Upgrading and expansion of existing critical services supporting communities within the floodplain should only occur where appropriate evacuation is possible (for uses where people are present) and flood-resilient design (for infrastructure in particular) can be achieved to mitigate the risks associated with the hazard to an acceptable level and achieve the required level of service and functionality during and immediately after a flood event. For utility installations, infrastructure should be located and designed to minimise risk from inundation and velocity of hazards e.g: the higher the land the better for easier recovery especially for essential infrastructure, provide structurally sound raised platforms for critical or expensive equipment, concrete walls to form a barrier against flooding and designed for no flood impact etc. In the Brisbane River SFMP Study Area, critical services should be considered potentially intolerable in areas of high to extreme flood risk represented by: • the Potential Hydraulic Risk categories of HR1, HR2 or HR3 particularly where characterised by a flood hazard level of H3, H4, H5 or H6; or • areas where the speed of flood onset or relative time to inundation is less than 24 hours. In the Brisbane River SFMP Study Area, critical services should be considered potentially tolerable in areas of low hydraulic risk and longer warning times represented by: • the Potential Hydraulic Risk category of HR4, subject to being located and designed to achieve an acceptable level of risk and maintain their required functionality during and/or after a flood event; and • areas where the speed of flood onset or relative time to inundation is more than 24 hours.

<table>
<tr><th>Land use activity</th><th>Commentary on use vulnerability or sensitivity to flood</th></tr>
<tr><td></td><td>
Critical services may be potentially acceptable within the HR5 Potential Hydraulic Risk category given that the likelihoods are extraordinarily rare or sufficiently unlikely and the flood hazard level is not a concern for evacuation.

For the Brisbane River SFMP Study Area, planning authorities should consider the following:

a) for expansion[3] (or greenfield) areas, new critical services should not establish in the floodplain wherever possible;
b) where location in the floodplain cannot be avoided, the establishment of new critical services should not occur in the Potential Hydraulic Risk categories of HR1, HR2 or HR3;
c) where location in the floodplain cannot be avoided, the establishment of new critical services, particularly where people are present, should not occur in areas where the speed of flood onset or relative time to inundation is less than 24 hours;
d) wherever possible, the material expansion of existing critical services should not occur in the HR1, HR2 or HR3 Potential Hydraulic Risk categories, or in areas where the speed of flood onset or relative time to inundation is less than 24 hours. Where avoidance is not possible, it should be demonstrated that critical services can achieve an acceptable level of risk including maintaining the required service and functionality during and/or immediately after a flood event and provide for safe evacuation for those uses where people are present;
e) the establishment of new critical services or expansion of existing development in the HR4 Potential Hydraulic Risk category may potentially be tolerable where it can be demonstrated that the risks can be mitigated to an extent where the use can maintain the required service and functionality during and immediately after a flood event;
f) where the planning authority determines the use to be tolerable, critical services should be designed to achieve an acceptable level of risk by compliance with the specified flood risk immunity levels at a minimum, in Table 1 of the SFMP Planning Guidance.

<u>Table 1: Minimum Flood Risk Immunity Levels –Critical services</u>
<table>
<tr><th>Potential Hydraulic Risk Categories and other flood risk factors</th><th>Minimum Flood Risk Immunity Levels</th></tr>
<tr><td colspan="2">Community infrastructure, where for a critical service</td></tr>
<tr><td>Where located in high hydraulic risk or limited warning:

a) Potential Hydraulic Risk categories of HR1, HR2 or HR3 areas; or
b) Areas where the speed of flood onset or relative time to inundation is less than 24hours.</td><td>a) The establishment of new critical services in expansion (or greenfield) areas locates outside the floodplain or outside the 1 in 500 AEP, at a minimum.
b) The intensification of existing critical services is located and designed to achieve an acceptable level</td></tr>
</table>
</td></tr>
</table>

[3] ShapingSEQ 2017 defines ‘expansion (form of development)’ as development on land outside the existing urban area boundary. Previously known as ‘greenfield development’. ‘Consolidation (form of development) as development on land inside the existing urban area boundary. Previously known as ‘infill development’.

Land use activity	Commentary on use vulnerability or sensitivity to flood	
		of risk up to and above the 1 in 500 AEP + freeboard for floor levels supporting critical services.
	Where located in low hydraulic risk and longer warning: a) Potential Hydraulic Risk categories of HR4 or HR5; and b) Areas where the speed of flood onset or relative time to inundation is more than 24hrs;	a) The establishment of new critical services in expansion (or greenfield) areas locates outside the floodplain or outside the 1 in 500 AEP, at a minimum. b) The intensification of existing critical services is located outside the 1 in 200 AEP + freeboard for floor levels supporting critical services. or c) The intensification of existing critical services is located and designed to achieve a level of flood immunity that is the same or higher than the existing development.

Land use activity	Commentary on use vulnerability or sensitivity to flood
Community infrastructure – where for a vulnerable use Examples include: • child care centre • community care centre • community residence • correctional facility • detention facility • educational establishment • hospital[4] (and health care service where supporting a hospital) • relocatable home park • residential care facility • retirement facility • short term accommodation (and other forms of tourist accommodation, e.g. resort complex, nature-based tourism) • tourist park •	Vulnerable uses include those uses or activities that are unable to self-evacuate or require significant effort, resources and assistance from others to organise evacuation because of the presence of vulnerable people due to demographic and socio-economic characteristics (e.g. age, health, need for assistance or disability, such as children, elderly, disabled, inmates, hospital patients, student populations, temporary/short-term accommodation etc.)). Uses involving vulnerable people means that managing risk to life is the most important consideration when considering tolerability or acceptability of flood risk. Often vulnerable occupants require relocation to other 'specialist' facilities outside the floodplain to ensure appropriate medical care, security, supervision etc. Inappropriate location of these uses can place people in a dangerous situation resulting in significant reliance on emergency response to provide for their safety. This can also result in significant burden on disaster management capacity at a time when resources would already be stretched during a flood event. For sensitive uses such as community uses (e.g. museums, art galleries, libraries and places storing important documents, artefacts, cultural or historical records) and veterinary services (i.e. animal hospitals/refuges), it is often not practical to assume that precious on-site contents can be relocated to higher ground. Managing risk to property is an important consideration for these types of uses. Vulnerable uses should avoid areas or circumstances of intolerable risk and locate outside the floodplain (defined by the extent of the 1 in 100,000 AEP) wherever possible. Within the Brisbane River SFMP Study Area, the Potential Hydraulic Risk category HR3 (up to and more frequent than the 1 in 100 AEP or with a flood hazard level of H3), should be applied as the upper or maximum threshold for potentially intolerable risk for vulnerable uses, particularly where involving vulnerable people. This is because even though the 1 in 100 AEP is a likelihood that is traditionally accepted as the design standard acceptable for residential development, a flood hazard level of H3 (or more severe flood hazard level of H4, H5 or H6) makes it higher risk and intolerable for vulnerable people. Areas of the floodplain where the relative time to inundation is limited (less than 24hrs) also contributes to an intolerable risk for vulnerable uses. These areas are characterised by higher velocities, deeper flows and more rapid rates of rise that make it difficult for assisted evacuation of vulnerable persons. In determining the land use tolerability of vulnerable uses, the risk to life condition is the most important consideration. In addition, the ability for disaster management response to access the site and organise evacuation is important to minimise levels of exposure. Due to their health, age and restricted mobility, vulnerable persons cannot self-evacuate and it is critically important that these uses are planned and located to enable vehicular access and emergency evacuation response.

[4] Hospitals should also be considered community infrastructure for a critical service.

<table>
<tr><th>Land use activity</th><th>Commentary on use vulnerability or sensitivity to flood</th></tr>
<tr><td>Community infrastructure – where for a sensitive use Examples include:
cemetery
community use (where for the storage of culturally or historically significant artefacts, documents, records, e.g. in an art gallery, library or museum)
crematorium
funeral parlour
veterinary service (refuges/animal hospitals)</td><td>Vulnerable uses should be considered potentially intolerable in areas of high to extreme flood risk characterised by:

a) the Potential Hydraulic Risk categories of HR1, HR2 and HR3, particularly where characterised by a flood hazard of H3 (or more severe) as these areas pose a serious risk to life for vulnerable people such as the elderly, children or disabled due to occupants being unable to safely wade through floodwaters. Areas characterised by a flood hazard level of H5 or H6 also threaten risk to life through loss of structural integrity of a building being used by people; or
b) areas where the relative time to inundation is limited or less than 24 hours making it difficult for safe evacuation, also contributes to an intolerable risk for vulnerable people.

Vulnerable uses may be considered potentially tolerable in Potential Hydraulic Risk categories of HR4 subject to requirements (such as complying with minimum flood risk immunity levels), and potentially acceptable in the Potential Hydraulic Risk category HR5 given that the likelihoods are either extraordinarily rare and flood hazard levels are low (H1 and H2) and are not generally problematic for evacuation.

For the Brisbane River SFMP Study Area, planning authorities should consider the following::

a) for expansion (or greenfield) areas, new vulnerable uses should not establish in the floodplain wherever possible;
b) where location in the floodplain cannot be avoided, the establishment of new vulnerable uses or the material expansion of existing vulnerable uses in the HR1, HR2 and HR3 Potential Hydraulic Risk categories should not occur wherever possible, particularly where there is a serious risk to life characterised by a flood hazard level of H3, H4, H5 or H6;
c) where location in the floodplain cannot be avoided, the establishment of new vulnerable uses or the material expansion of existing vulnerable uses should be avoided where the speed of flood onset or relative time to inundation is less than 24 hours;
d) the establishment of new vulnerable uses or expansion of existing vulnerable uses in the HR4 Potential Hydraulic Risk category may be tolerable where it can be demonstrated that the risks can be mitigated to an extent where development achieves an acceptable level of risk;
e) where the planning authority determines the use to be tolerable, vulnerable uses should be designed to achieve an acceptable level of risk by compliance with the specified flood risk immunity levels in Table 2 of the SFMP Planning Guidance, at a minimum, and have appropriate evacuation solutions in place to protect life.

<u>Table 2: Minimum Flood Risk Immunity Levels – Vulnerable Uses and Sensitive Uses</u>
<table><tr><th>Potential Hydraulic Risk Categories and other flood risk factors</th><th>Minimum Flood Risk Immunity Levels</th></tr><tr><td colspan="2">Community infrastructure, where for a vulnerable use</td></tr></table></td></tr>
</table>

<table>
<tr><th>Land use activity</th><th>Commentary on use vulnerability or sensitivity to flood</th></tr>
<tr><td></td><td>
<table>
<tr><td>Where located in high hydraulic risk or limited warning:

a) Potential hydraulic risk categories of HR1, HR2 or HR3 areas, particularly where characterised by a high flood hazard level of H3 or greater; or
b) Areas where the speed of flood onset or relative time to inundation is less than 24 hours.</td><td>a) The establishment of new vulnerable uses in expansion (or greenfield) areas locate outside the floodplain or outside the 1 in 500 AEP, at a minimum.

b) The intensification of existing vulnerable uses are located and designed to achieve an acceptable level of risk up to and above the 1 in 500 AEP + freeboard</td></tr>
<tr><td>Where located in low hydraulic risk and longer warning:

a) Potential hydraulic risk categories of HR4 or HR5; or
b) Areas where the speed of flood onset or relative time to inundation is more than 24hrs.</td><td>a) The establishment of new vulnerable uses in expansion (or greenfield) areas locate outside the floodplain or outside the 1 in 500 AEP, at a minimum.
b) The intensification of existing vulnerable uses is located and designed to achieve an acceptable level of risk up to and above the 1 in 500 AEP + freeboard particularly in locations where the flood hazard level is characterised as H3 or more severe;
or
c) The intensification of existing vulnerable uses locates outside the 1 in 200 AEP + freeboard where the flood hazard level is characterised as H2 or H1.</td></tr>
<tr><td colspan="2">Community infrastructure, where for a sensitive use</td></tr>
<tr><td>Where located:

a) Potential Hydraulic Risk categories HR1, HR2 or HR3, particularly where characterised by a flood hazard level of H5 or greater</td><td>a) The establishment of new sensitive uses in expansion (or greenfield) areas locate outside the floodplain or outside the 1 in 500 AEP, at a minimum.
b) The intensification of existing sensitive uses are located and designed to achieve an acceptable level of risk up to and above the 1 in 500 AEP + freeboard for floor levels supporting sensitive property;
or
c) The intensification of existing sensitive uses is located and designed to achieve a level of flood immunity that is the same or higher than the existing development.</td></tr>
</table>
</td></tr>
<tr><td>Filling</td><td>Sensitivity testing shows that areas of the Brisbane River floodplain are very sensitive to changes in land form from activities such as filling.</td></tr>
</table>

Land use activity	Commentary on use vulnerability or sensitivity to flood
	While filling can exclude floodwaters up to a certain design event (DFE), it can also change the flood behaviour by increasing flood depths, velocities and flows outside the site. Flood behaviour in the Brisbane River floodplain is particularly sensitive to further development and more so if filling is proposed to raise the level of land to be at or above the flood planning level (DFE + freeboard) to mitigate flood risk and enable development. This sensitivity is due to the incised valley and other physical characteristics of the floodplain. Development which will obstruct or alter flood flows in flow conveyance areas and reduce flood storage volume will have impacts elsewhere on the floodplain and should not be supported. This means land use planning and development relying on filling in the Brisbane River floodplain as a mitigation measure will need to be carefully considered. In the absence of more detailed hydraulic investigations applying the SFMP Potential Hydraulic Risk categories and matrix as defined in the Evidence Report (2017): • flood flow conveyance areas are defined as areas mapped HR1 and HR2. Land use and development cannot obstruct or alter flood flows in these areas; • flood storage areas are defined as areas mapped HR3 and HR4. Land use and development can not reduce the potential available storage volume, and any compensatory storage must maintain hydraulic connectivity. Filling should be considered potentially intolerable in the HR1 and HR2 categories and potentially tolerable subject to requirements in the HR3 and HR4 categories. While filling would also be potentially acceptable in the HR5 Potential Hydraulic Risk category, the need for filling activities to provide flood immunity to enable land use and development is considered highly unlikely. Land use planning and proposed development relying on filling in the Brisbane River floodplain to achieve a DFE as a flood mitigation measure will need to be carefully considered to ensure that flood hazards and risks are not worsened for other areas of the floodplain. Filling should not be relied on as the standard engineering solution to mitigate flood risk to enable development. This issue should also be a key consideration in strategic land use planning and determining the suitability of land for urban development and the allocation of land to zones. It is also important to note that earthworks that result in a no net worsening in the floodplain can provide raised ground levels to achieve the required DFE. Such approaches should be environmentally acceptable and in large scale situations may require modelling to ensure that finished ground level profiles do no create localised impacts on flood levels and velocities. This is important in providing flexibility to rationalise urban development footprints where needed. Local floodplain management plans should be informed by a regional assessment of cumulative impacts across the entire Brisbane River floodplain, including those parts of the floodplain that extend into adjoining local government boundaries. Land use and development proposing landform change within the floodplain does not result in any worsening of flood hazard conditions or flood risk to other properties within the Brisbane River

Land use activity	Commentary on use vulnerability or sensitivity to flood
	In addition to considering impacts on flood behaviour, filling in the floodplain should also be considered in terms of impacts on people's perceived sense of security that they are protected from all flood likelihoods and risks when they are only protected up to a certain event. Filling can also result in undesirable 'on the ground' planning and urban design outcomes such as creating 'island' neighbourhoods and, adverse impacts on the natural environment. For the Brisbane River SFMP Study Area, planning authorities should consider the following:: a) in the absence of more detailed hydraulic investigations demonstrating otherwise, flow conveyance areas can be defined as the HR1 and HR2 Potential Hydraulic Risk categories, while the flood storage areas can be defined as the HR3 and HR4 Potential Hydraulic Risk categories in the floodplain; b) filling or other development in the flood flow conveyance areas of HR1 or HR2, should not obstruct or alter flood flows; c) filling or other development in the flood storage areas of HR3 or HR4 Potential Hydraulic Risk categories should not result in a reduction in the potential flood storage volume; d) changes to landform and construction of buildings and other infrastructure associated with development within the Brisbane River SFMP study area, when considered cumulatively for similar sites, should not result in a worsening of flood hazard conditions or exacerbation of flood risks to other properties within the floodplain.
Residential and accommodation uses (all defined uses comprising 'accommodation activity' including resort complex, relocatable home park, short term accommodation and tourist park)	While the 1 in 100 AEP is a likelihood that has traditionally been accepted as the design standard acceptable for residential development, in addition to flood likelihood, it is also critically important to consider different types of residential development against a range of flood risk factors to determine overall flood risk and tolerability and risk treatment responses to provide an acceptable level of flood risk. These flood risk factors include: a) flood hazard and behaviour being how deep and fast the water flows b) the speed at which floodwater rises or relative time to inundation c) evacuation d) built form e) risk to life and the vulnerability of people f) risk to property and potential for damages and property loss Some residential land uses are less appropriate or suited to floodplains and therefore less tolerant of consequences: • houses are typically more sensitive to flood damage than a commercial building because of differing building standards - slab on ground and single storey are more vulnerable or susceptible to damage than 2 or 3 storey or multi-storey dwellings because a typical house will very likely be subjected to significant structural damage where flood waters exceed the height of about 'mid-wall'; • hotels and resorts including tourist and visitor accommodation or caretaker's component should have a 'Flood Planning Level' for habitable floors similar to permanent urban residential development to protect residents and property. Evacuation of these uses will be also be an important consideration in determining flood risk and tolerability;

Land use activity	Commentary on use vulnerability or sensitivity to flood
	• tourist parks such as caravan parks, self-contained cabins, tents or other similar structures are of light weight construction, very susceptible to flood damage and can easily float away if not secured or anchored to the ground and can cause significant damage downstream. While it is possible that existing caravans are 'relocatable' and may be moved to higher ground, this may not be practical if caravans are unoccupied, or there is limited relative time to inundation due to rates of rise/inundation, or there is limited or no higher ground to relocate caravans. New tourist parks with a residential component and where involving permanent caravan sites should be addressed in the same way as permanent residential development to protect residents and property; • relocatable home parks involving longer term accommodation or permanent residents have similar flood sensitivity to a tourist park use, however a key difference is the vulnerability of the people. It is not uncommon for relocatable home park residents to include a significant proportion of single households, older people and families who would be particularly vulnerable to the socio-economic impacts of flood and less likely to cope financially after a flood event. A relocatable home park with permanent residents should be addressed in the same way as permanent urban residential development to protect residents and property. Evacuation considerations for relocatable home parks must also be considered in the same way as other permanent residential areas and require internal access roads being designed to provide a continuously rising grade to higher land outside the floodplain. Rural residential development can be challenging from a flood risk management perspective in that it is very low density, evacuation routes can be difficult and expensive to provide, the low density and dispersed settlement pattern could potentially result in slower delivery of warning messages and residents are likely to delay evacuation as they will likely need longer response times to prepare their properties and secure or move animals to safety etc. Rural residential development should be treated similarly to urban residential development for habitable floor levels and include measures such as building envelopes for houses and driveways on the highest land possible. Within the Brisbane River SFMP Study Area, residential and accommodation uses should be considered potentially intolerable in areas of high to extreme flood risk defined as HR1 and HR2 Potential Hydraulic Risk or areas with less than 12hrs response time. HR1 and HR2 areas are also important for maintaining floodplain function including flood flow conveyance and residential development should avoid these areas wherever possible. In the Brisbane River floodplain, the Potential Hydraulic Risk category of HR3 at the 1 in 100 AEP likelihood should be the threshold for potentially tolerable risk for residential development, subject to risk mitigation options to achieve an acceptable level of risk. While people may be willing to tolerate a level of flood immunity up to the 1 in 100 AEP, the flood hazard level of H3 is starting to be life threatening with only abled bodied adults being able to wade through flood waters but not vulnerable people (children, elderly, disabled etc). Higher risk areas being the Potential Hydraulic Risk categories of HR2 at the 1 in 100 AEP pose a more significant risk to life because of the higher flood hazard levels (H4, H5 and H6) with abled bodied adults unable to wade safely through flood waters, or risk to life is threatened through loss of structural integrity of buildings.

Land use activity	Commentary on use vulnerability or sensitivity to flood
	Residential development should be considered potentially acceptable in the Potential Hydraulic Risk category of HR5, subject to no additional risk treatment options. While still in the floodplain, these areas are located well outside of the 1 in 100 AEP and the likelihoods are considered sufficiently unlikely (in some cases extremely rare) and flood hazard levels are not problematic for self-evacuation or assisted vehicular evacuation, such that the risk is considered low. For the Brisbane River SFMP Study Area, planning authorities should consider the following:: a) for expansion (or greenfield) areas, the establishment of new residential and accommodation uses should not occur in the HR1 or HR2 Potential Hydraulic Risk categories; b) the intensification or expansion of existing residential and accommodation uses should not occur in the HR1 and HR2 Potential Hydraulic Risk categories or where the relative time to inundation is less than 12 hours and development does not support preservation of life on-site. c) the establishment of new residential and accommodation uses or expansion of existing development in the HR3 or HR4 Potential Hydraulic Risk categories may be tolerable subject to certain requirements, including mitigation to an extent where development achieves an acceptable level of risk and is higher than or outside the 1 in 100 AEP + freeboard.
Commercial and industrial uses	Commercial, retail and industrial uses are generally less sensitive or vulnerable to flood impact than residential development, because they do not accommodate vulnerable people and their building construction is often more resilient to flood impacts. Commercial and industrial buildings may be more structurally robust as they've been built to withstand other hazards such as fire, and therefore are less vulnerable to flood damage. For example, a besser block wall, providing foundations are suitable, may sustain less structural damage from being submerged under deep flood waters. Appropriate building design for commercial, retail and industrial uses can reduce flood damage to buildings through flood-resilient building materials and high level storage of content, stock and plant equipment. However, issues of safety and evacuation of occupants in a flood event still remain including the need to protect contents and restore operations and services after a flood. For industrial activities involving storage or manufacture of hazardous materials (eg: chemical or fuel storage, toxic materials etc), these uses should locate outside the floodplain to avoid risks to public safety and the environment from the release of these materials during a flood event. Some industries may require longer response times to secure plant equipment and hazardous materials and close down industrial processes in preparation for a flood event. Therefore, longer relative time to inundation times being more than 24hours is required. For the Brisbane River SFMP Study Area, planning authorities should consider the following:: a) for expansion (or greenfield) areas, the establishment of new commercial and industrial development should not occur in the HR1 and HR2 Potential Hydraulic Risk categories;

Land use activity	Commentary on use vulnerability or sensitivity to flood
	b) the intensification or material expansion of existing commercial and industrial uses should not occur in the HR1 and HR2 Potential Hydraulic Risk categories or where Relative Time to Inundation is less than 12 hours; c) the establishment of new commercial or industrial uses or expansion of existing development in the HR3 or HR4 Potential Hydraulic Risk categories may be potentially tolerable subject to certain requirements, including mitigation to an extent where development achieves an acceptable level of risk and is located above the 1 in 100 AEP; d) ancillary activities associated with commercial and industrial uses which are more resilient to flooding impacts such as carparking, buffer areas etc. may be located in areas with a lower flood immunity than the primary uses; e) hazardous uses or the storage of hazardous materials occur in areas outside the floodplain (defined by the extent of the 1 in 100,000 AEP) or occur within facilities that should be designed to ensure hazardous materials are not released to flood waters during any flood event and where relative time to inundation is greater than 24 hours.
Non-urban and recreation uses	Low lying areas, even where the flood hazard is high or extreme and with frequent inundation, may accommodate certain occasional recreation and open space uses where such uses do not involve accommodation – e.g: public toilets, boatsheds, playground equipment, BBQ facilities, kiosks. Sports fields and other active open space uses may also be appropriate in low lying areas. The extent of flood immunity for these uses is often determined by the extent of infrastructure present on the site and the tolerability of impact of flood inundation frequency on turf and playing surfaces. Some rural land uses may also be appropriate to locate in the floodplain, including non-habitable rural buildings constructed of flood-resilient materials such as concrete panels, sheet metal etc. In the Brisbane River SFMP Study Area, non-urban uses and recreation uses should be considered potentially acceptable in the HR4 and HR5 Hydraulic Risk categories and potentially tolerable subject to requirements in the HR1, HR2 and HR3 areas, depending on the land use. Dwellings or accommodation uses associated with recreation or non-urban uses should not locate in the HR1 or HR2 Potential Hydraulic Risk categories. The HR1 and HR2 Potential Hydraulic Risk categories are important for flood flow conveyance functions and can also be characterised by severe flood hazard levels (H5 and H6) and more frequent events. Careful consideration needs to be given to the appropriateness of buildings and structures in the HR1 and HR2 areas particularly where structural building failure is possible. Where flood hazard levels are characterised as H5 or H6, buildings should be discouraged or structures should be sacrificial and non-buoyant to ensure buildings damaged or washed away by floodwaters do not worsen downstream debris load. For the Brisbane River SFMP Study Area, planning authorities should consider the following:: a) non-urban and recreational uses may potentially locate in areas of the floodplain where the risks to that use are determined by the planning authority to be tolerable or acceptable; b) the extent of flood immunity for recreational uses should be determined based upon the acceptability of the operational impacts of flooding on the level of service expected for that recreational use;

Land use activity	Commentary on use vulnerability or sensitivity to flood
	c) dwellings associated with rural or non-urban activities should not locate in the HR1 or HR2 Potential Hydraulic Risk categories, flood flow conveyance paths or areas with less than 24 hours relative time to inundation. Dwellings should be designed to mitigate risk to an extent where development achieves an acceptable level of risk and are located outside or above the 1 in 100 AEP + freeboard at a minimum; d) non-habitable buildings associated with non-urban and recreational uses should not impede flood flow conveyance or result in a material loss of flood storage.

Summary - Indicative Land Use Compatibility Against Potential Hydraulic Risk Categories in the Brisbane River Floodplain

Land use activity group	Potential Hydraulic Risk Category				
	HR1	HR2	HR3	HR4	HR5
Community infrastructure and critical services	Intolerable	Intolerable	Intolerable	Tolerable*	Acceptable
Vulnerable uses	Intolerable	Intolerable	Intolerable	Tolerable*	Acceptable
Filling	Intolerable	Intolerable	Tolerable*	Tolerable*	Acceptable
Residential and accommodation	Intolerable	Intolerable	Tolerable*	Tolerable*	Acceptable
Commercial and industrial	Intolerable	Intolerable	Tolerable*	Acceptable	Acceptable
Non-urban and recreation uses	Tolerable*	Tolerable*	Tolerable*	Acceptable	Acceptable

* Subject to requirements to treat and manage risk to an acceptable level (informed by local floodplain management plans and risk assessment process).

Appendix D: Flood risk factor tools

COOMINYA

ATKINSONS DAM

WIVENHOE POCKET

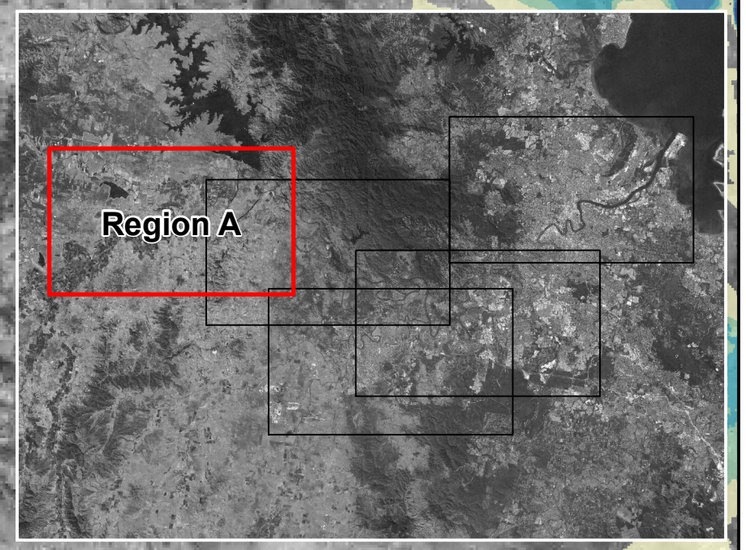
FERNVALE

LOWOOD

MOUNT TARAMPA

MORTON VALE

Flooding in hatched area needs to be verified with the Local Council



Hydraulic risk mapping

- HR1
- HR2
- HR3
- HR4
- HR5
- Limit of Detailed Modelling

Refer to Councils for local flooding beyond limit

Brisbane River Catchment Flood Study

Study Partners

Queensland Government

Brisbane City Council
Ipswich City Council
Lockyer Valley Regional Council
Somerset Regional Council
Seqwater

Hydraulic Risk Mapping: Region A

0 1 2 3 4
Kilometers

Map Grid of Australia 1994, Zone 56

Filepath : B:\B22374 BRCFMS\GIS\MXD\MXD_OUTPUT\Risk Mapping\FLD_005_Hydraulic Risk Mapping_RegionA.mxd

Drawing 1 | **A**

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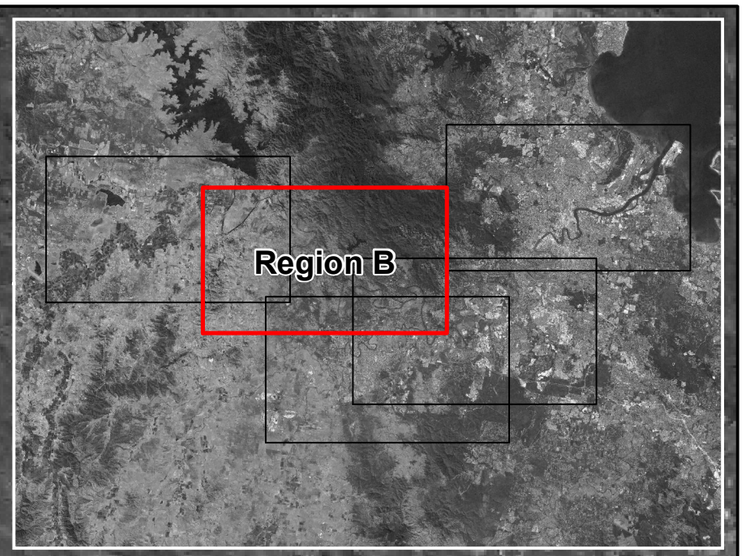

WIVENHOE POCKET
FERNVALE
LOWOOD
GLAMORGAN VALE
KHOLO
PINE MOUNTAIN
KARANA DOWNS
ANSTEAD
IRONBARK
KARALEE
MOGGILL

Hydraulic risk mapping

- HR1
- HR2
- HR3
- HR4
- HR5
- Limit of Detailed Modelling

Refer to Councils for local flooding beyond limit

Brisbane River Catchment Flood Study

Study Partners

Queensland Government

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Lockyer Valley Regional Council
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Hydraulic Risk Mapping: Region B

Drawing 2 | **A**

0 1 2 3 4
Kilometers

Map Grid of Australia 1994, Zone 56

Filepath : B:\B22374 BRCFMS\GIS\MXD\MXD_OUTPUT\Risk Mapping\FLD_006_Hydraulic Risk Mapping_RegionB.mxd

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KARANA DOWNS
MOUNT OMMANEY
IRONBARK
KARALEE
BELLBOWRIE
MOGGILL
WACOL
TIVOLI
RICHLANDS
BRASSALL
NORTH IPSWICH
RIVERVIEW
WALLOON
WOODEND
BUNDAMBA
REDBANK
GOODNA
BOOVAL
CAROLE PARK
FOREST LAKE
LEICHHARDT
IPSWICH
COLLINGWOOD PARK
EASTERN HEIGHTS
BLACKSTONE
CAMIRA
RACEVIEW
YAMANTO
REDBANK PLAINS
RIPLEY
WILLOWBANK
PURGA
Region C

Hydraulic risk mapping

- HR1
- HR2
- HR3
- HR4
- HR5
- Limit of Detailed Modelling

Refer to Councils for local flooding beyond limit

Brisbane River Catchment Flood Study
Study Partners

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Ipswich City Council
Lockyer Valley Regional Council
Somerset Regional Council
Seqwater

Hydraulic Risk Mapping: Region C

Drawing 3 | A

0 1 2 3 4
Kilometers

Map Grid of Australia 1994, Zone 56

Filepath : B:\B22374 BRCFMS\GIS\MXD\MXD_OUTPUT\Risk Mapping\FLD_007_Hydraulic Risk Mapping_RegionC.mxd

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ST LUCIA
ELEANOR SCHONNELL BRIDGE
WALTER TAYLOR BRIDGE
INDOOROOPILLY
GREENSLOPES
KENMORE
KHOLO
GRACEVILLE
SHERWOOD
ANSTEAD
KARANA DOWNS
MOUNT OMMANEY
ROCKLEA
KARALEE
BELLBOWRIE
OXLEY
MOGGILL
WACOL
TIVOLI
ACACIA RIDGE
RICHLANDS
RIVERVIEW
NORTH IPSWICH
REDBANK
BUNDAMBA
GOODNA
BOOVAL
CAROLE PARK
FOREST LAKE
IPSWICH
COLLINGWOOD PARK
EASTERN HEIGHTS
BLACKSTONE
CAMIRA
RACEVIEW
REDBANK PLAINS
Region D

Hydraulic risk mapping

- HR1
- HR2
- HR3
- HR4
- HR5
- Limit of Detailed Modelling

Refer to Councils for local flooding beyond limit

Brisbane River Catchment Flood Study

Study Partners

Queensland Government

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Ipswich City Council
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Somerset Regional Council
Seqwater

Hydraulic Risk Mapping: Region D

Drawing 4 | A

0 1 2 3 4
Kilometers

Map Grid of Australia 1994, Zone 56

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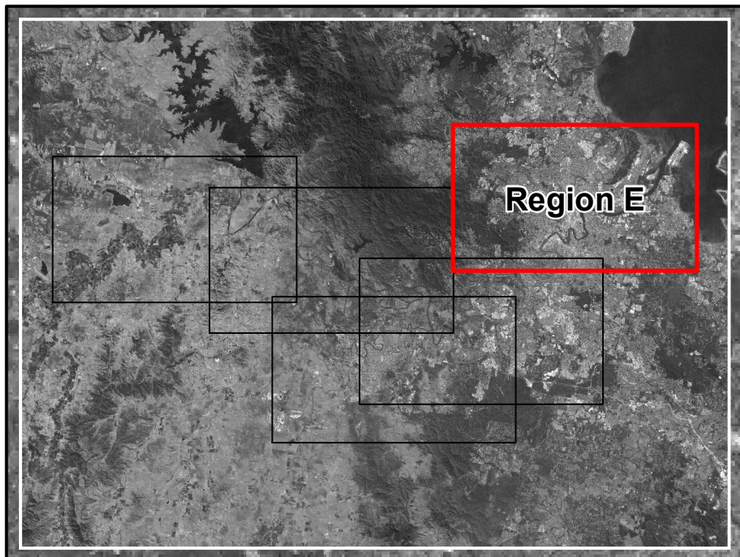

PINKENBA
EAGLE FARM
HAMILTON
WYNNUM
BULIMBA
MURARRIE
STORY BRIDGE
MILTON
BRISBANE
NEW FARM
VICTORIA BRIDGE
NORMAN PARK
SOUTH BRISBANE
TOOWONG
MOUNT COOT-THA
ST LUCIA
ELEANOR SCHONNELL BRIDGE
WALTER TAYLOR BRIDGE
INDOOROOPILLY
GREENSLOPES
CARINDALE

Hydraulic risk mapping

- HR1
- HR2
- HR3
- HR4
- HR5
- Limit of Detailed Modelling

Refer to Councils for local flooding beyond limit

Brisbane River Catchment Flood Study
Study Partners

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Somerset Regional Council
Seqwater

Hydraulic Risk Mapping: Region E

0 1 2 3 4
Kilometers

Map Grid of Australia 1994, Zone 56

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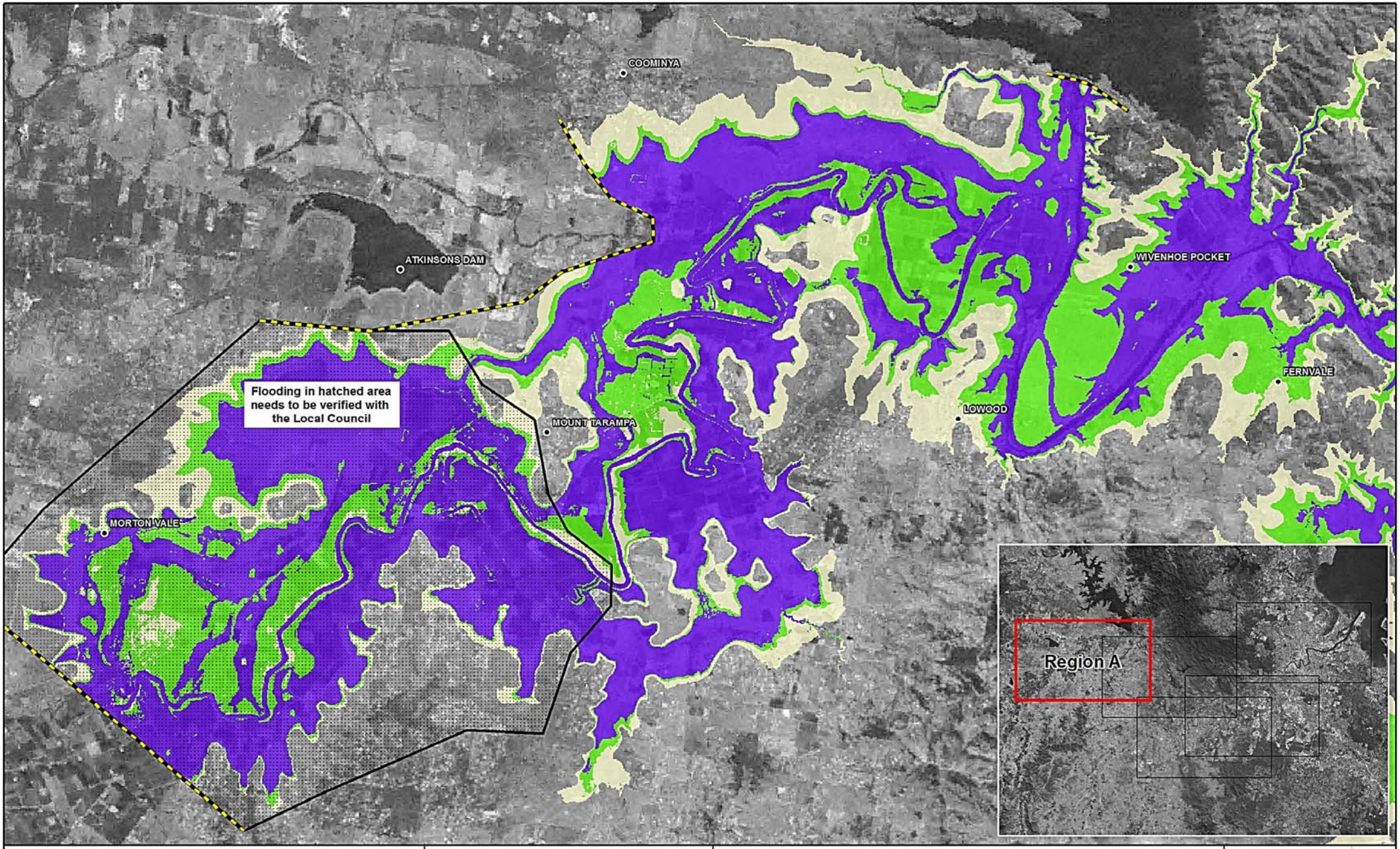

Hydraulic Risk Mapping

- Flow Conveyance Area
- Flood Storage Area
- HR5
- Limit of Detailed Modelling

Refer to Councils for local flooding beyond limit

Brisbane River Catchment Flood Study

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Indicative Flood Function Mapping: Region A

0 1 2 3 4
Kilometers

Map Grid of Australia 1994, Zone 56

Filepath : B:\B22374 BRCFMS\GIS\MXD\RiskMapping_170915\FLD_005_Hydraulic Risk Mapping_RegionA.mxd

Drawing 1 | A

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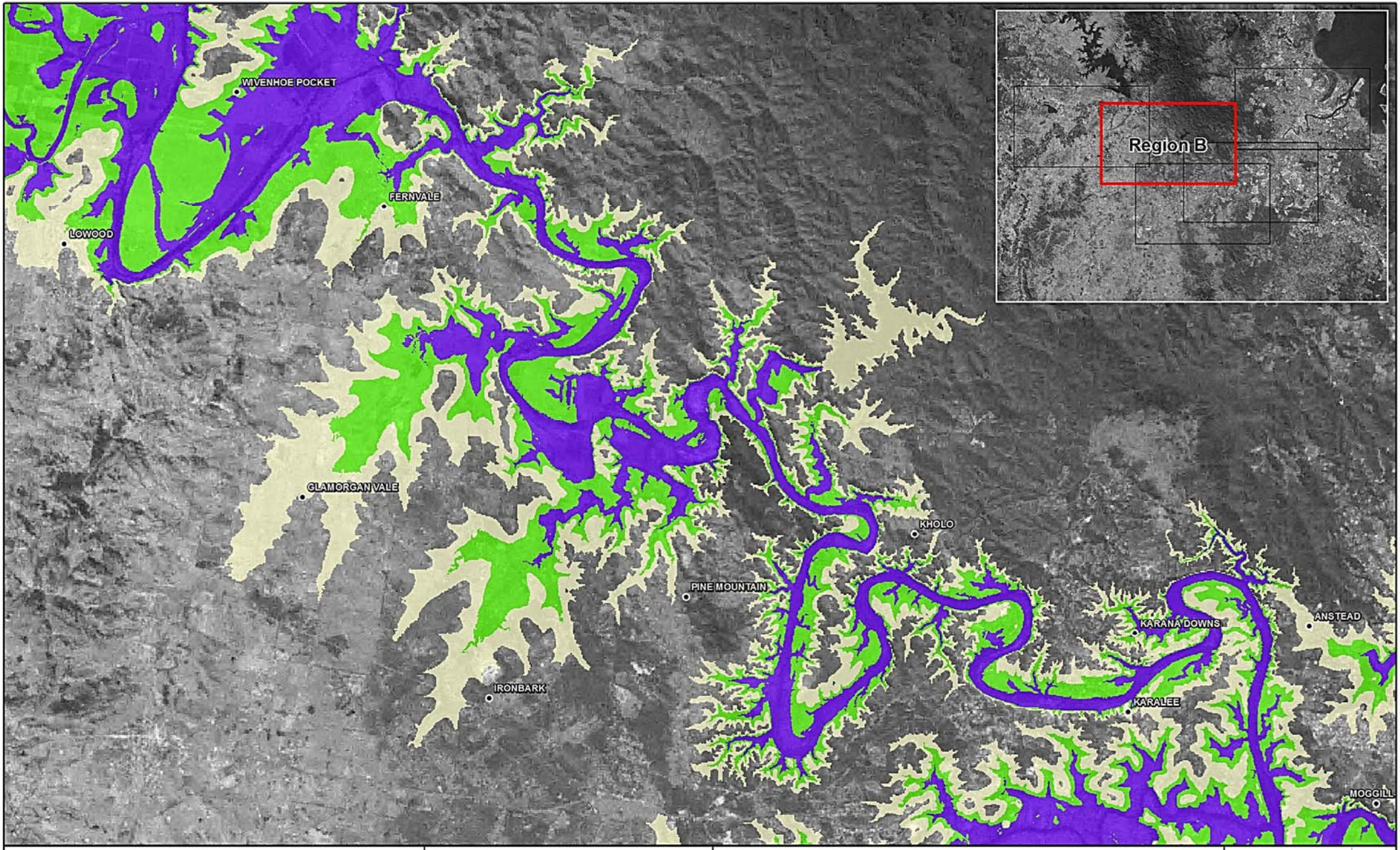

Hydraulic Risk Mapping

- Flow Conveyance Area
- Flood Storage Area
- HR5
- Limit of Detailed Modelling

Refer to Councils for local flooding beyond limit

Brisbane River Catchment Flood Study

Study Partners

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Seqwater

Indicative Flood Function Mapping: Region B

0 1 2 3 4
Kilometers

Map Grid of Australia 1994, Zone 56

Filepath : B:\B22374 BRCFMS\GIS\MXD\RiskMapping_170915\FLD_006_Hydraulic Risk Mapping_RegionB.mxd

Drawing 2 | **A**

BMT WBM
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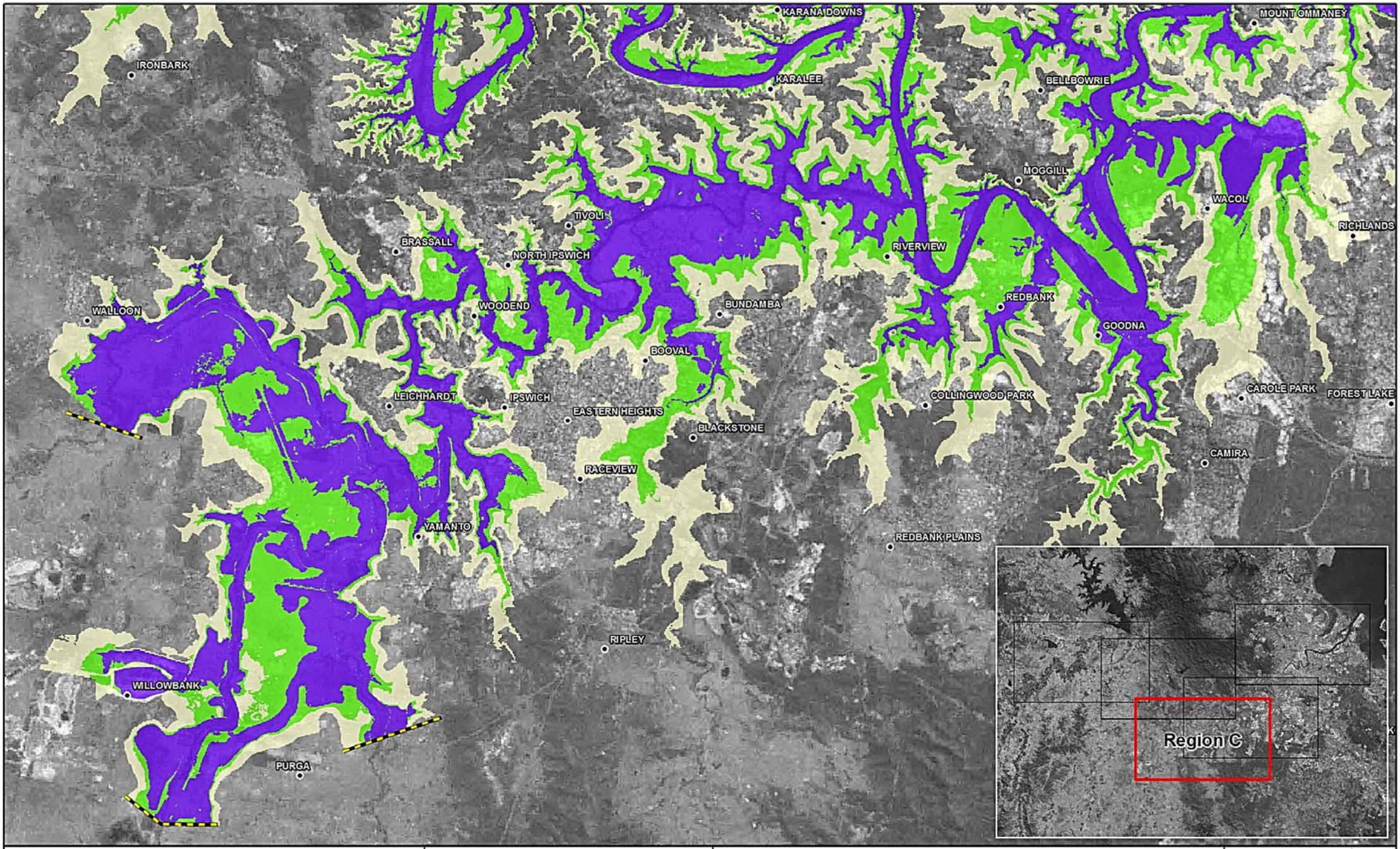

Hydraulic Risk Mapping

- Flow Conveyance Area
- Flood Storage Area
- HR5
- Limit of Detailed Modelling

Refer to Councils for local flooding beyond limit

Brisbane River Catchment Flood Study

Study Partners

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Somerset Regional Council
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Indicative Flood Function Mapping: Region C

0 1 2 3 4
Kilometers

Map Grid of Australia 1994, Zone 56

Filepath : B:\B22374 BRCFMS\GIS\MXD\RiskMapping_170915\FLD_007_Hydraulic Risk Mapping_RegionC.mxd

Drawing 3 | **A**

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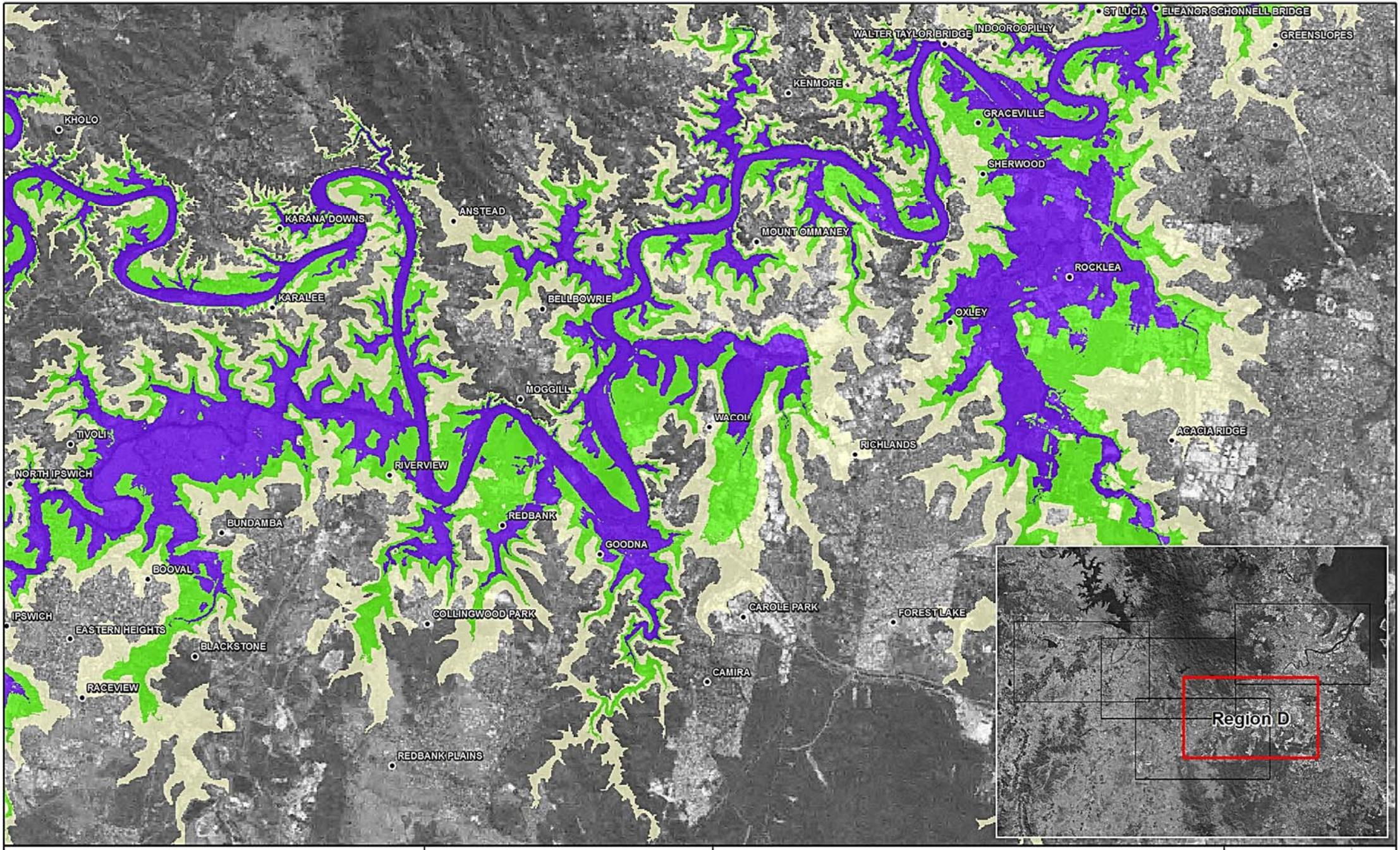

Hydraulic Risk Mapping

- Flow Conveyance Area
- Flood Storage Area
- HR5
- Limit of Detailed Modelling

Refer to Councils for local flooding beyond limit

Brisbane River Catchment Flood Study

Study Partners

Queensland Government

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Ipswich City Council
Lockyer Valley Regional Council
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Seqwater

Indicative Flood Function Mapping: Region D

Drawing 4 | **A**

0 1 2 3 4
Kilometers

Map Grid of Australia 1994, Zone 56

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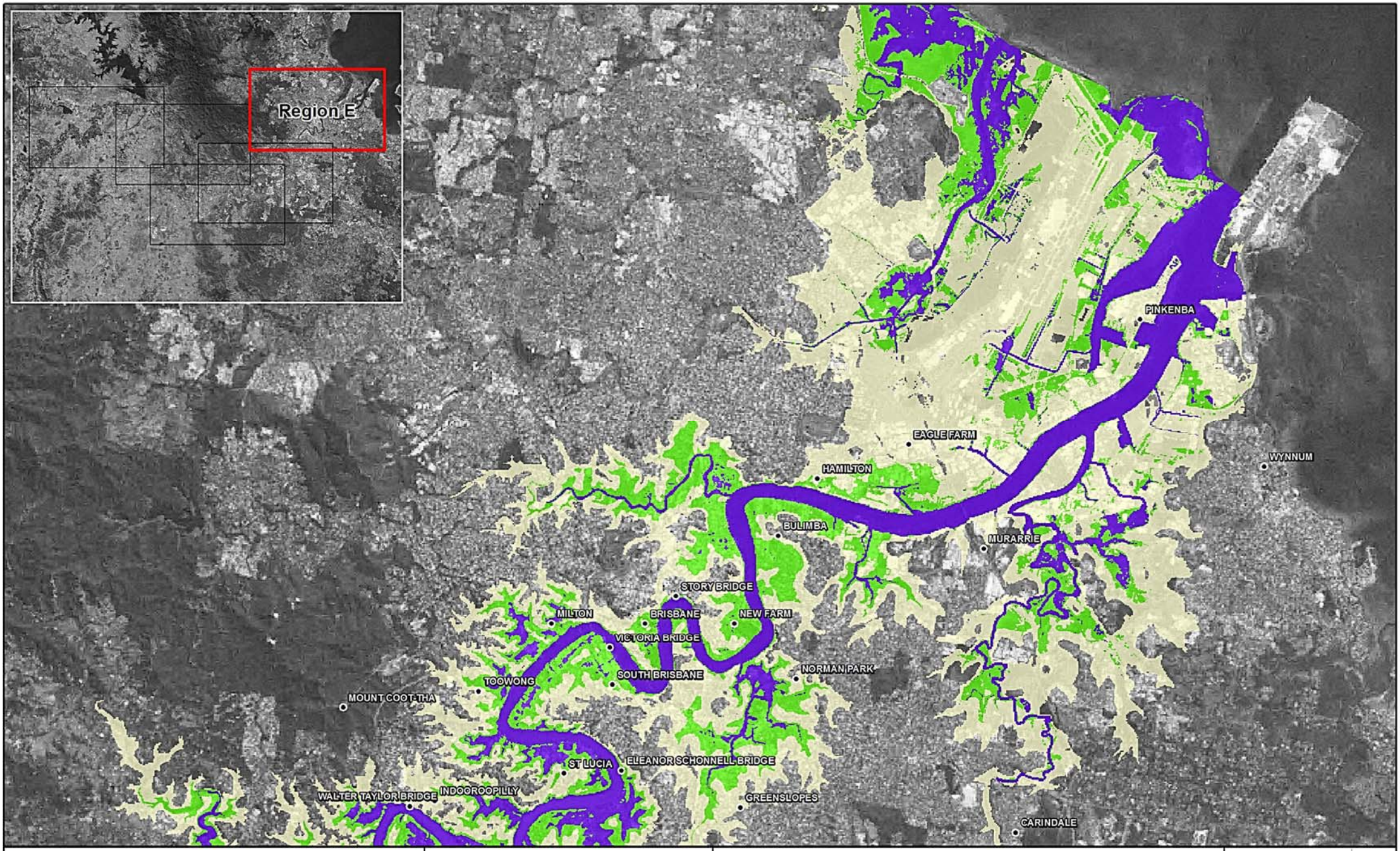

Hydraulic Risk Mapping

- Flow Conveyance Area
- Flood Storage Area
- HR5
- Limit of Detailed Modelling

Refer to Councils for local flooding beyond limit

Brisbane River Catchment Flood Study

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Queensland Government

Indicative Flood Function Mapping: Region E

Drawing 5 | A

0 1 2 3 4
Kilometers

Map Grid of Australia 1994, Zone 56

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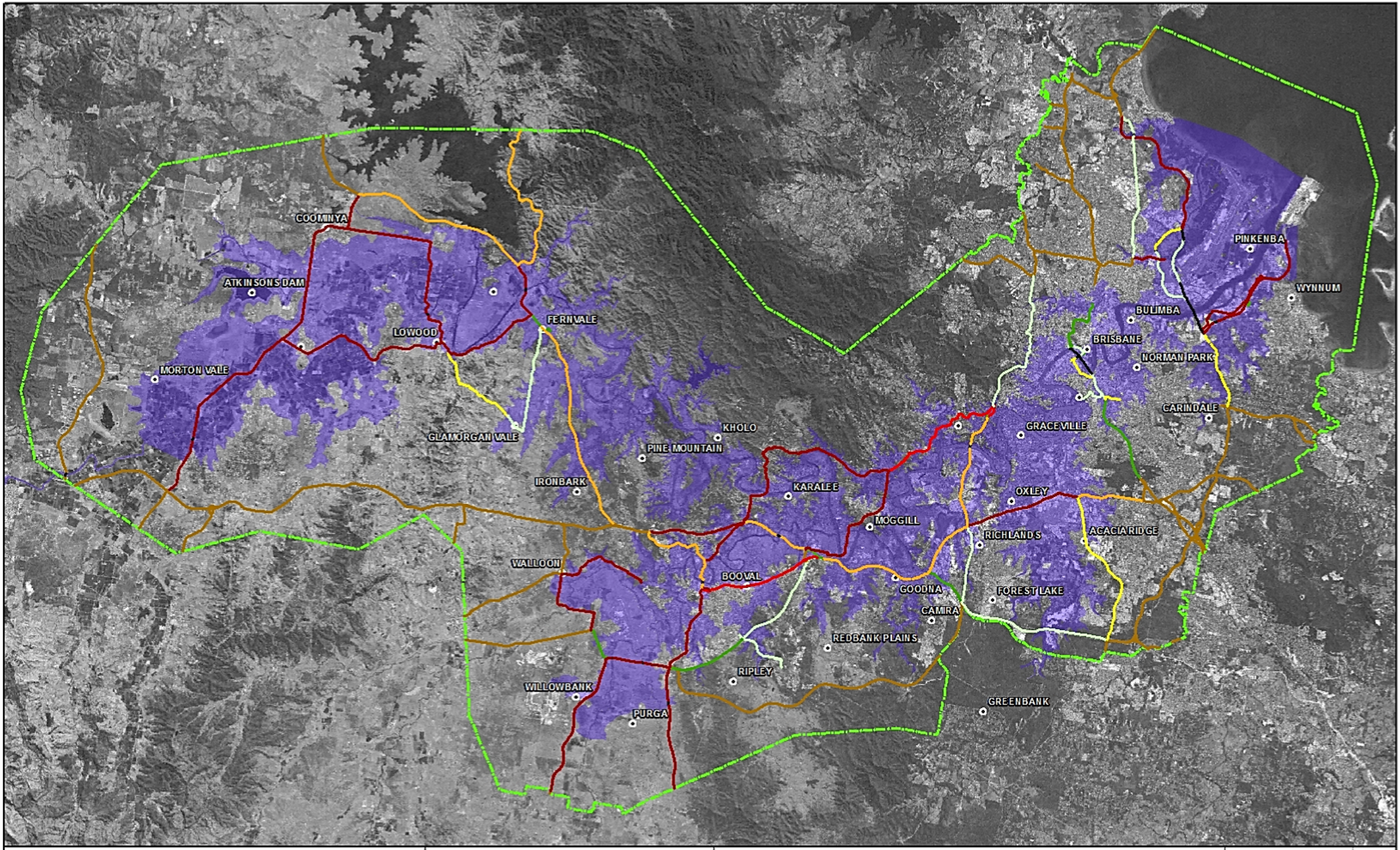

LEGEND

- Study Area Boundary
- 1 in 100,000 AEP Flood Extent

Evacuation Routes

- <1 in 10 AEP
- 1 in 20 AEP
- 1 in 50 AEP
- 1 in 100 AEP
- 1 in 500 AEP
- >1 in 2000 AEP
- Not Inundated
- Bridge

Refer to Councils for local flooding beyond limit

Brisbane River Catchment Flood Study

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Seqwater

Evacuation Route Immunity

0 3 6 9 12
Kilometers

Map Grid of Australia 1994, Zone 56

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Fig 6-1 | A

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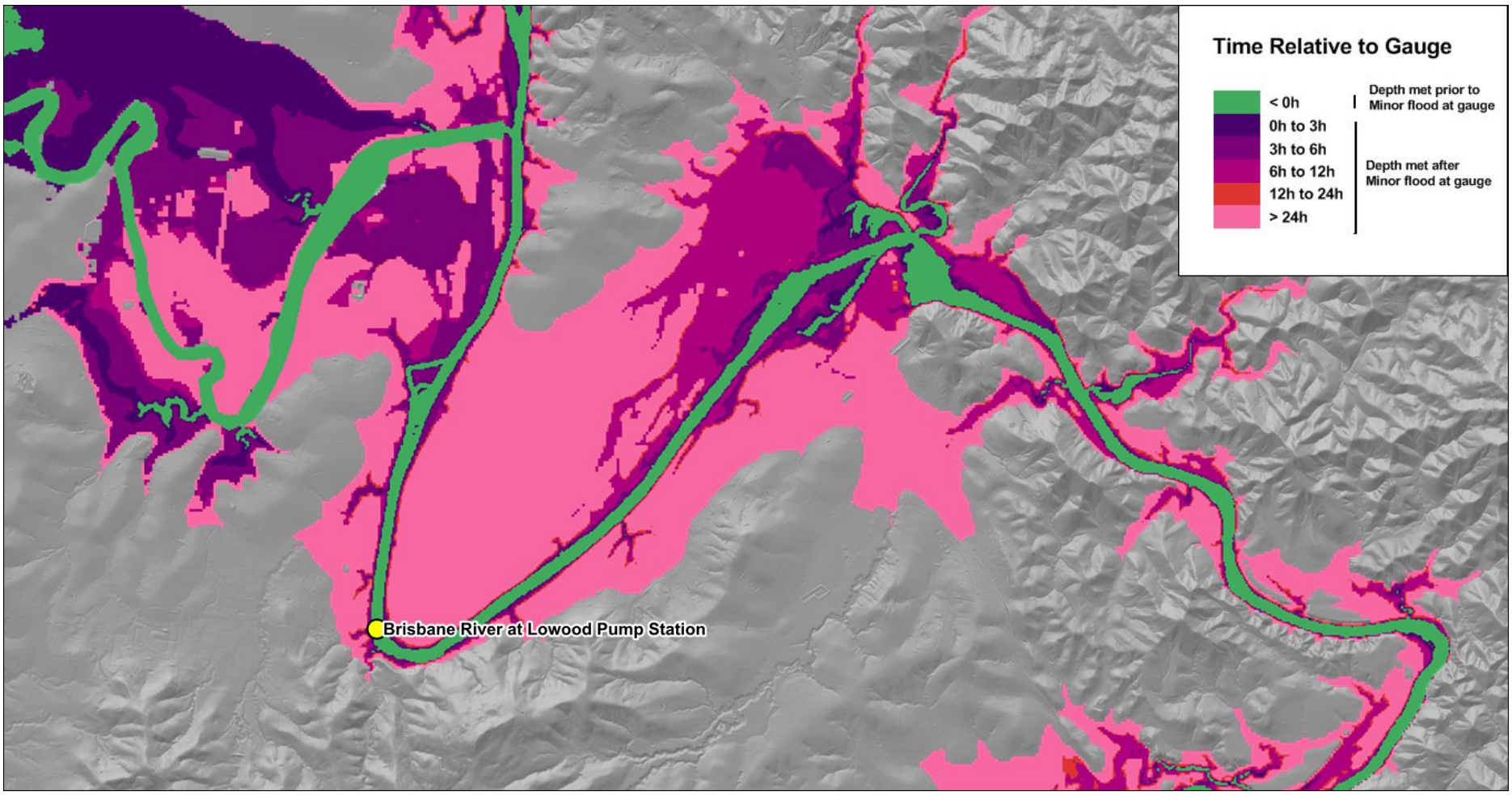
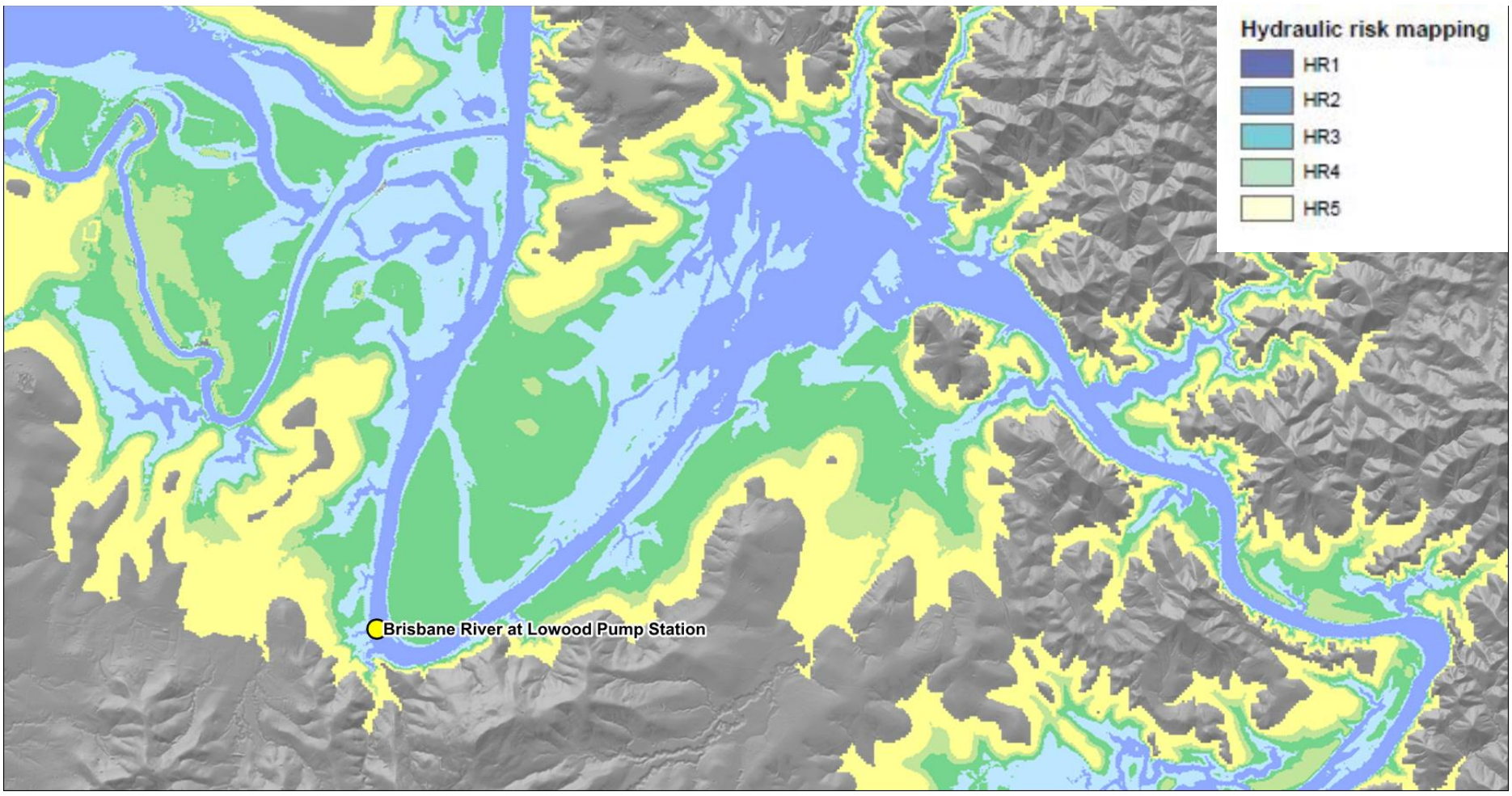
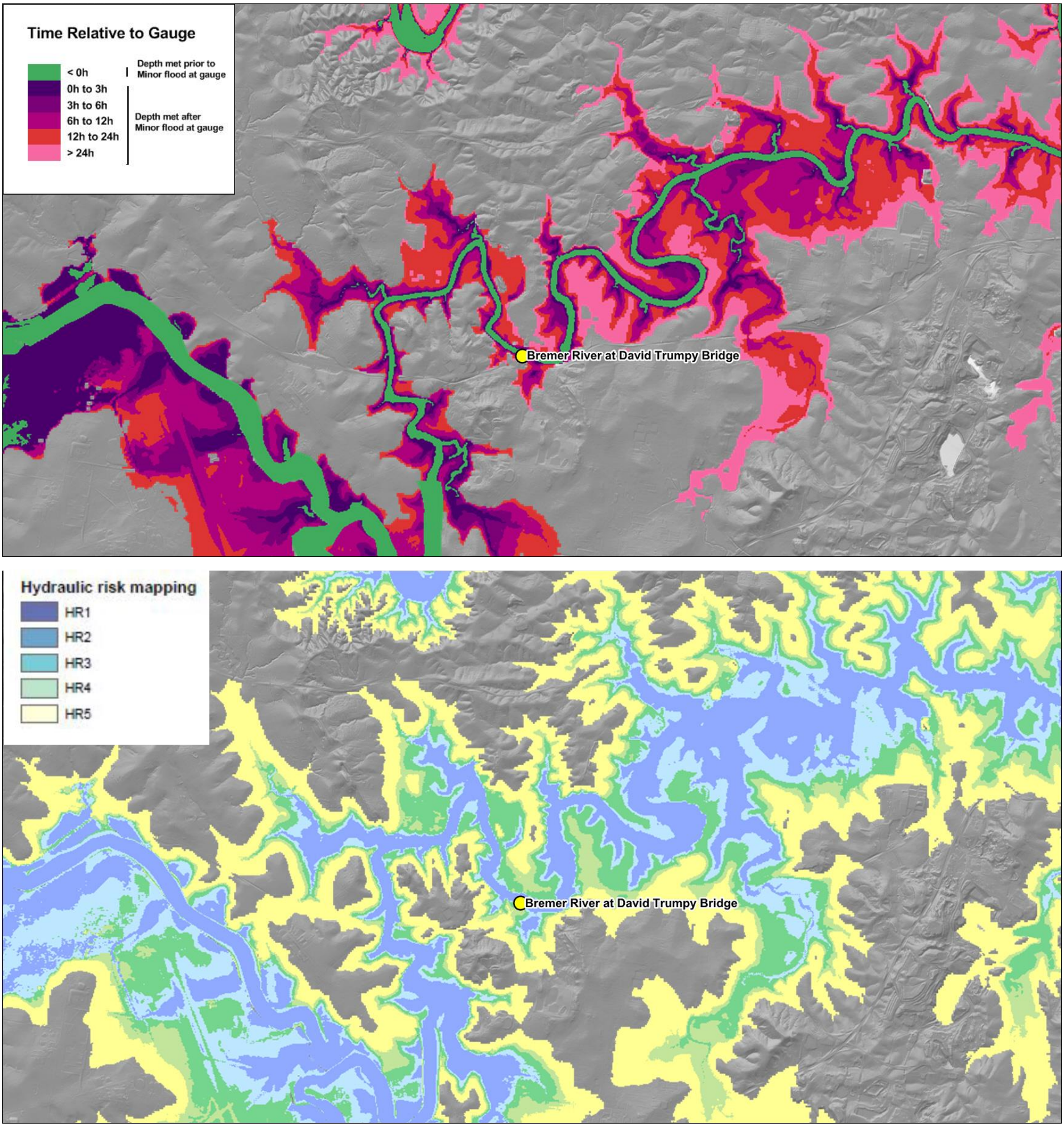
Lowood

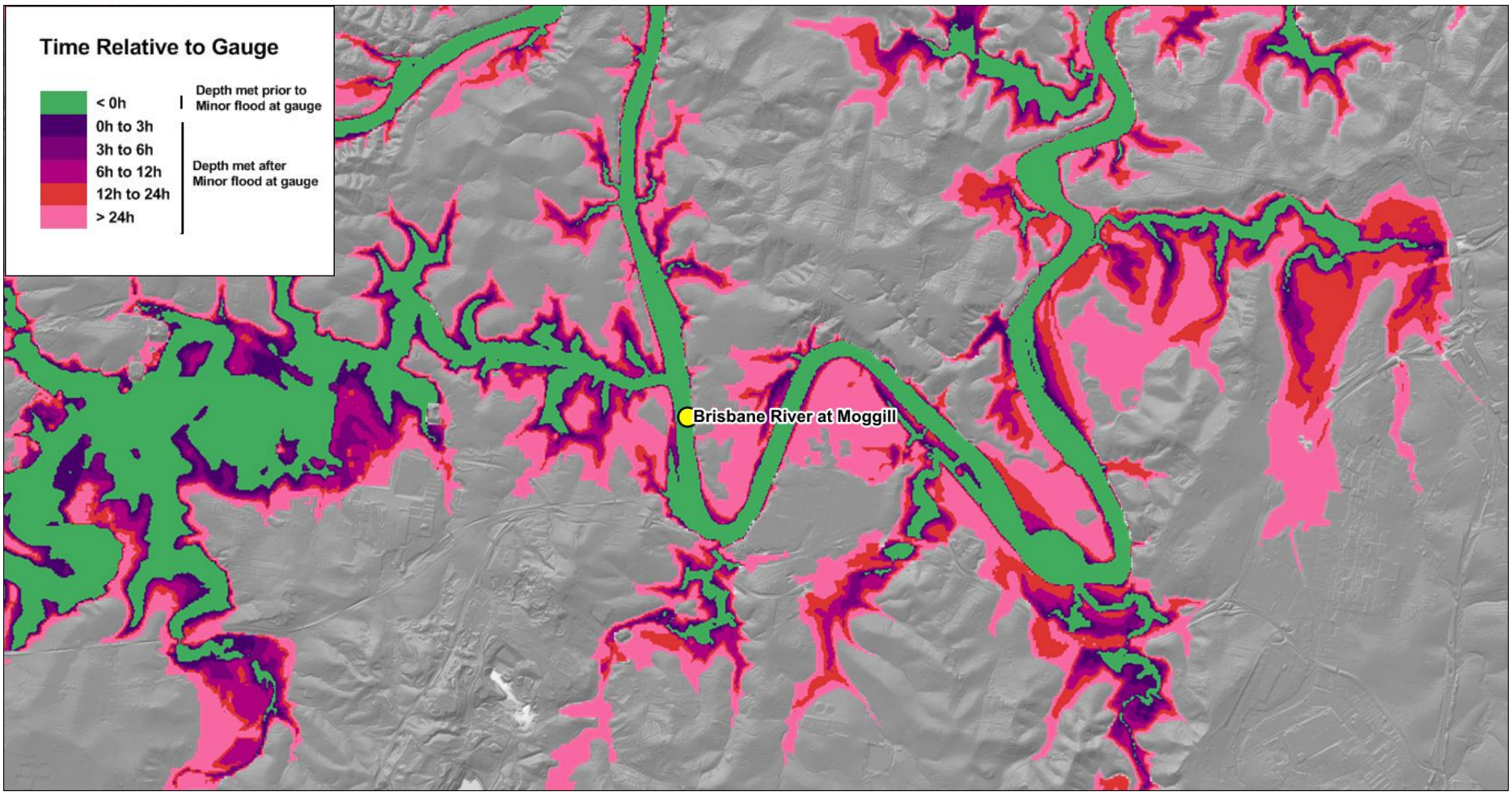

Time Relative to Gauge
< 0h
0h to 3h
3h to 6h
6h to 12h
12h to 24h
> 24h
Depth met prior to Minor flood at gauge
Depth met after Minor flood at gauge
Brisbane River at Lowood Pump Station


Hydraulic risk mapping
HR1
HR2
HR3
HR4
HR5
Brisbane River at Lowood Pump Station

Bremer River



Moggill


Time Relative to Gauge
< 0h
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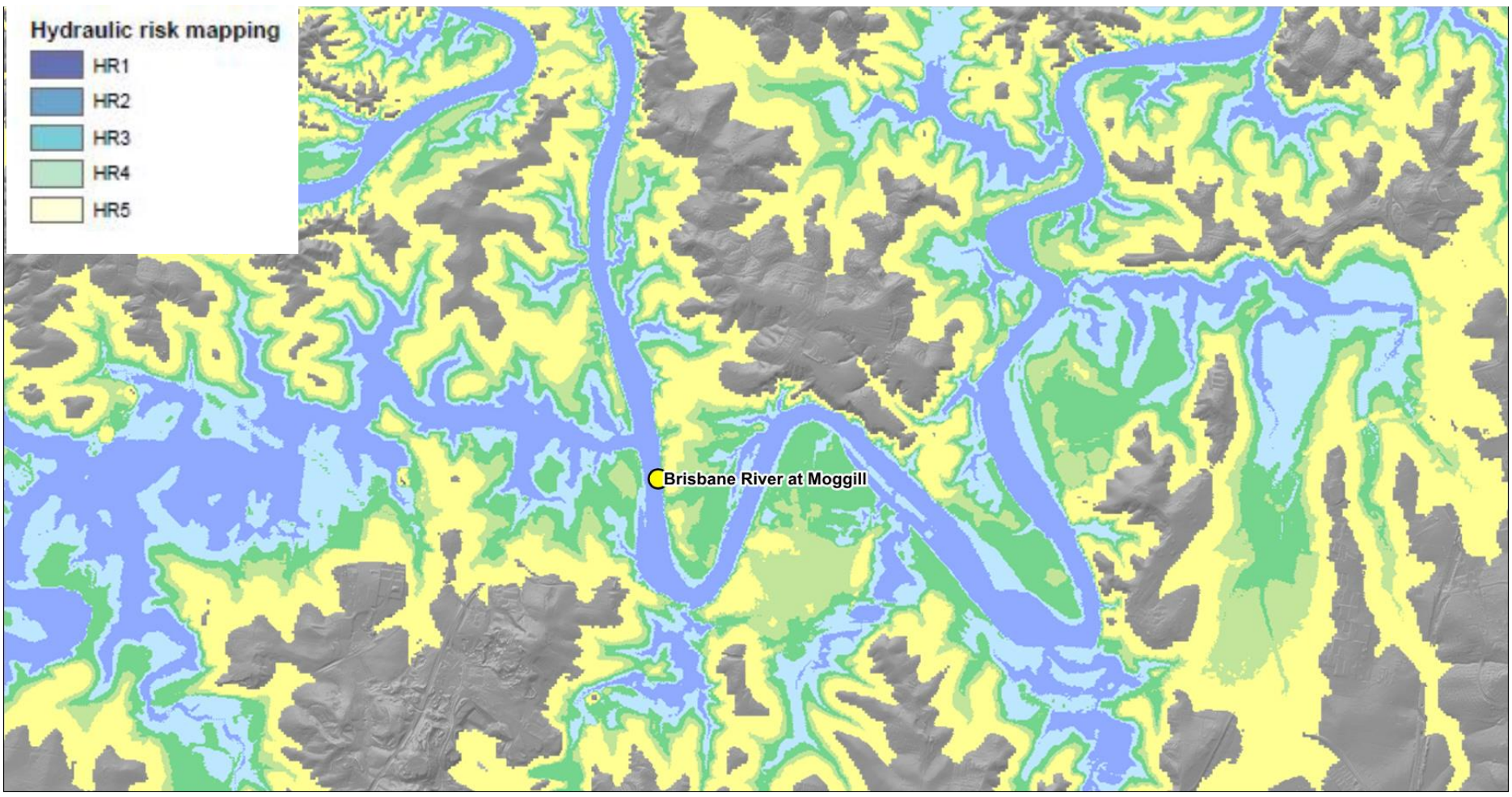
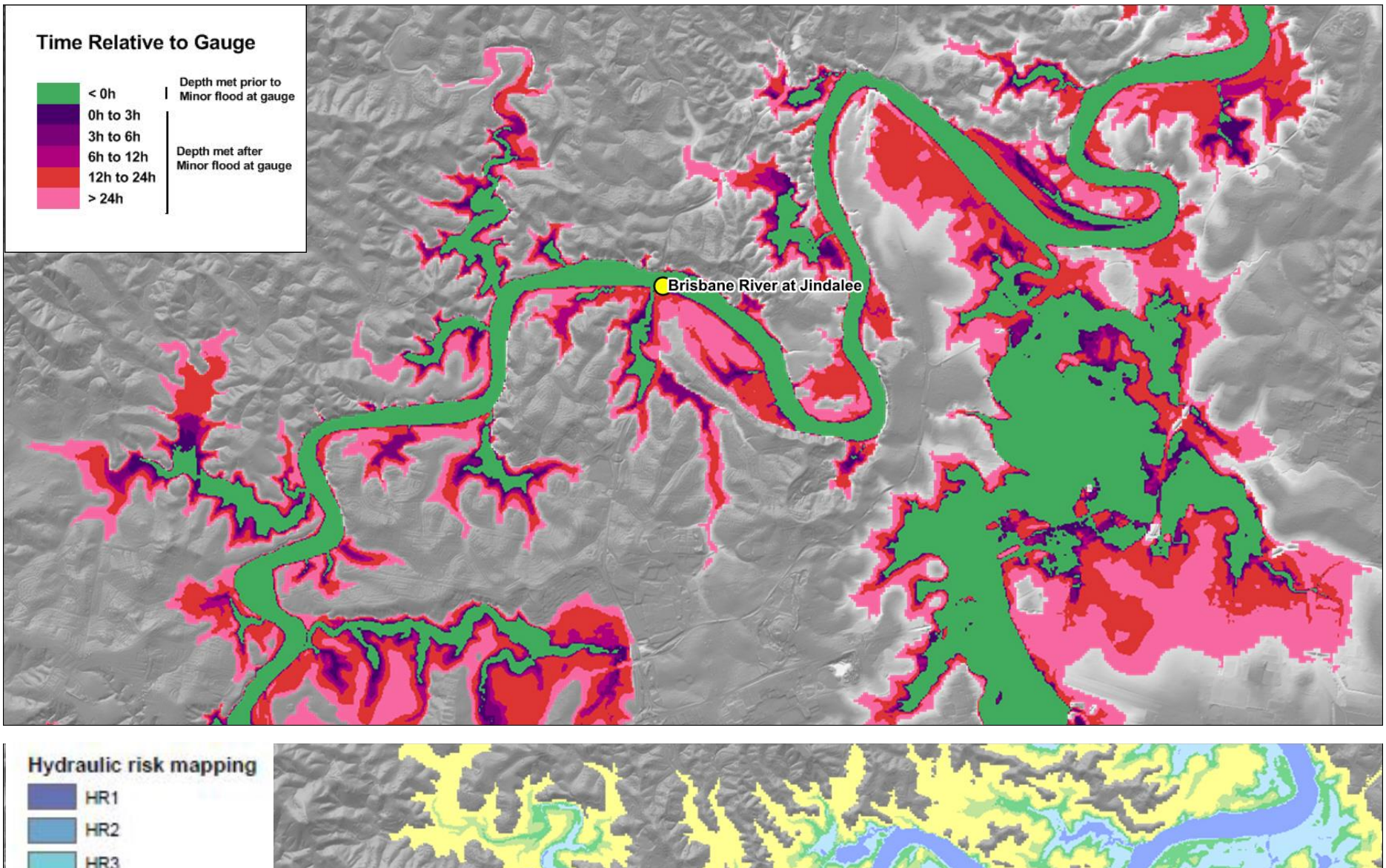
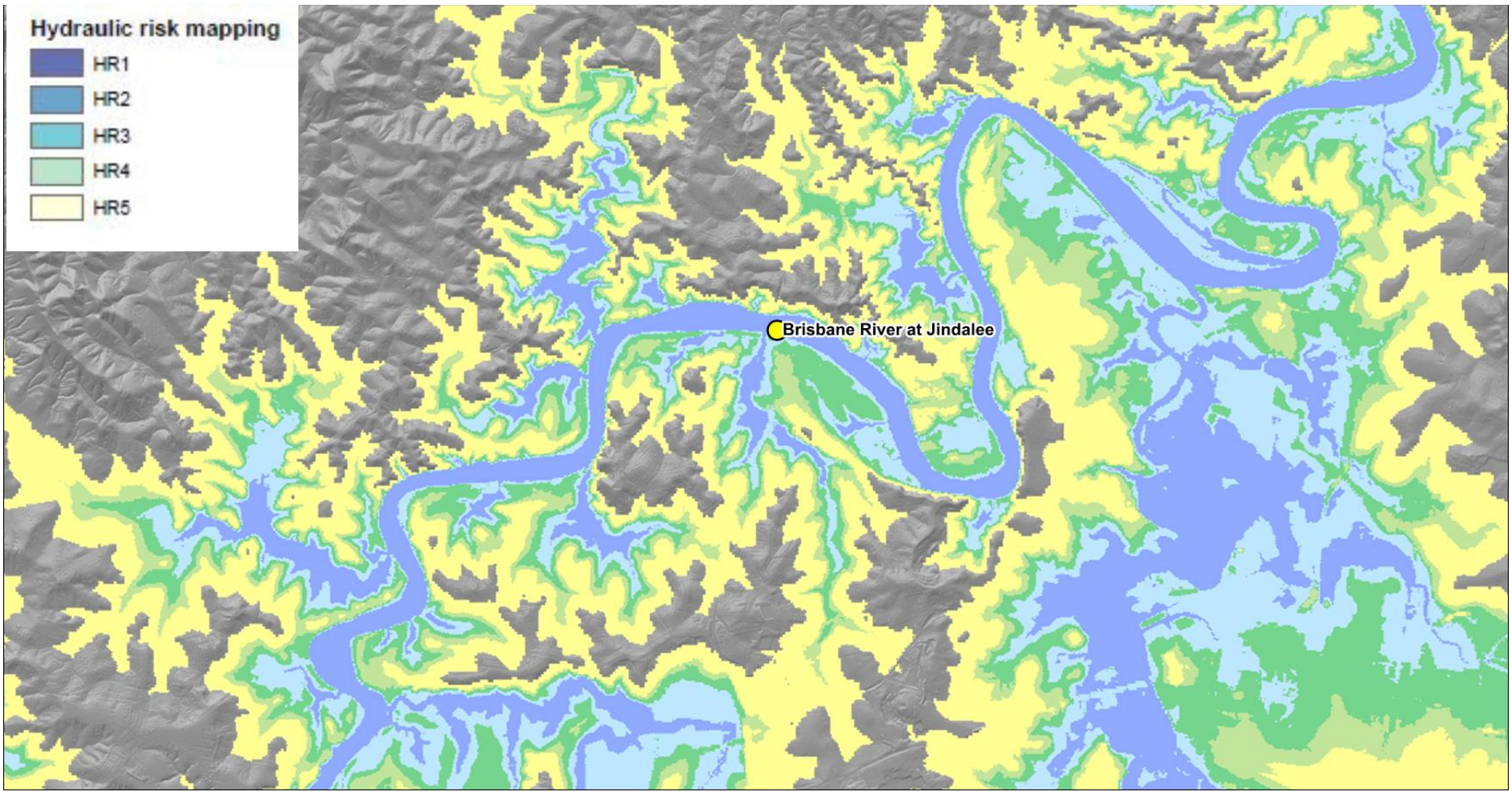
3h to 6h
6h to 12h
12h to 24h
> 24h
Depth met prior to Minor flood at gauge
Depth met after Minor flood at gauge
Brisbane River at Moggill

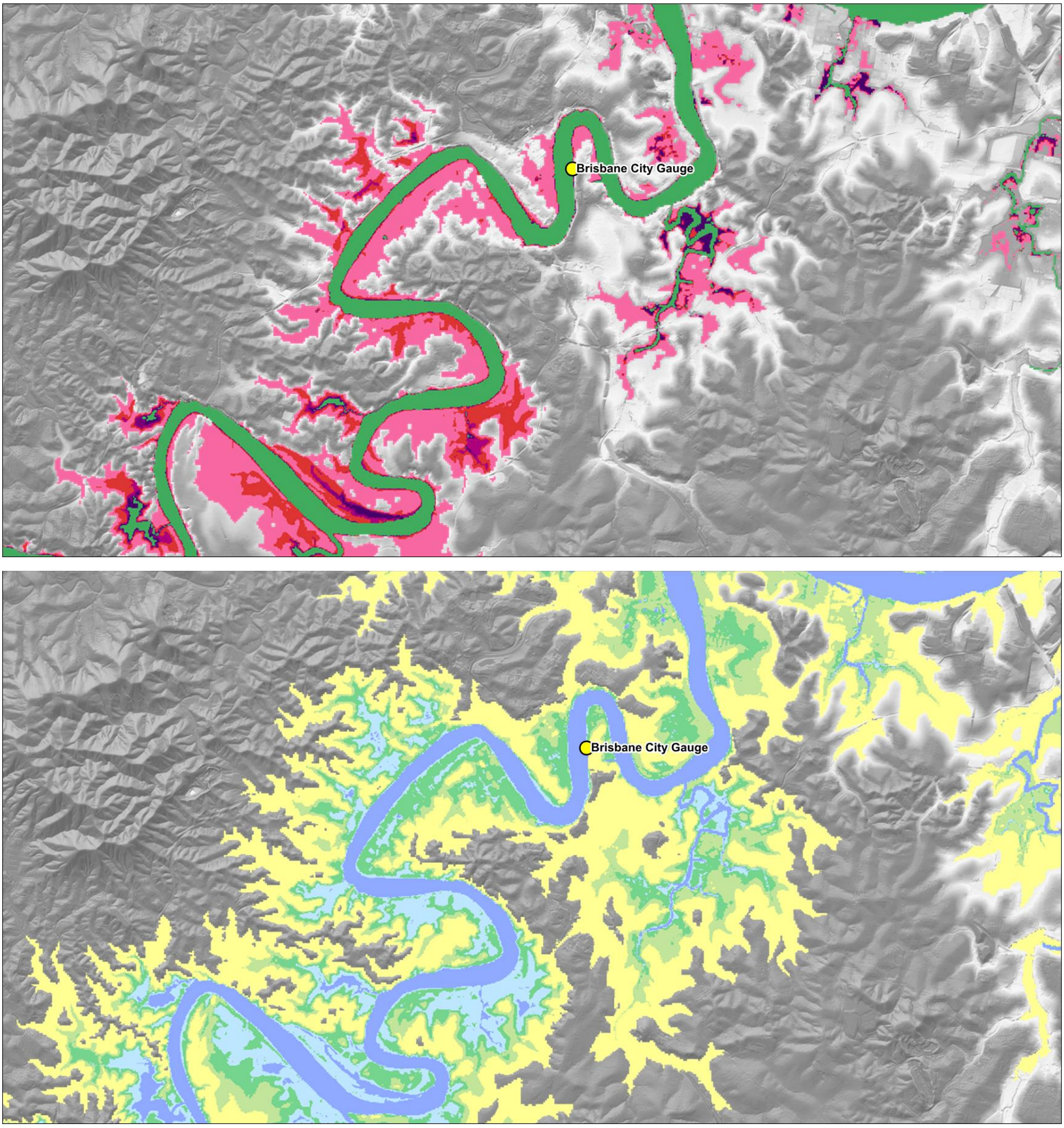

Hydraulic risk mapping
HR1
HR2
HR3
HR4
HR5
Brisbane River at Moggill

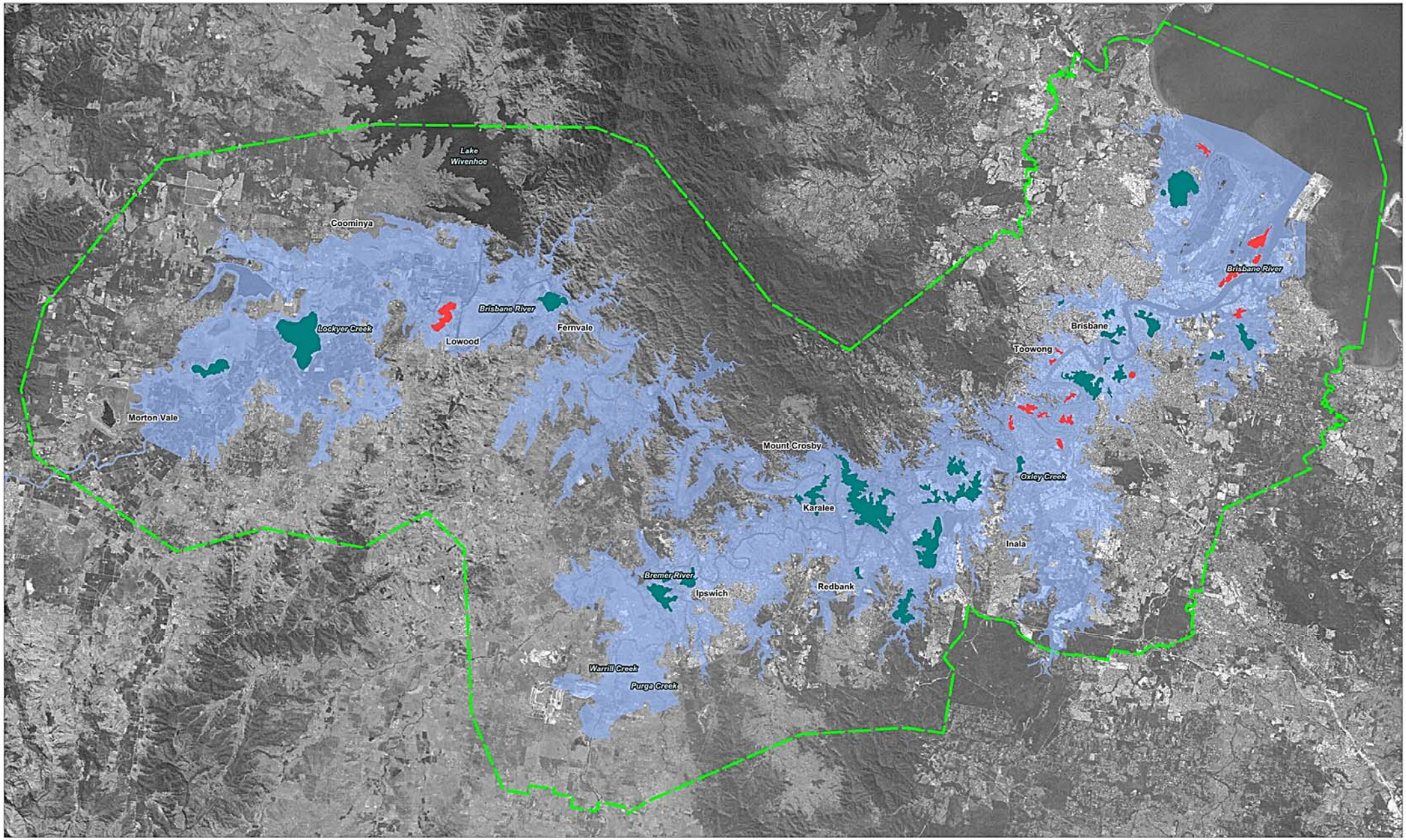
Jindalee


Time Relative to Gauge
< 0h
0h to 3h
3h to 6h
6h to 12h
12h to 24h
> 24h
Depth met prior to Minor flood at gauge
Depth met after Minor flood at gauge
Brisbane River at Jindalee


Hydraulic risk mapping
HR1
HR2
HR3
HR4
HR5
Brisbane River at Jindalee

Brisbane City





LEGEND

- Strategic Floodplain Management Study Area
- High Flood Island
- Low Flood Island
- 1 in 100,000 AEP Flood Extent

Brisbane River Catchment Flood Study

Study Partners

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Lockyer Valley Regional Council
Somerset Regional Council
Seqwater

Queensland Government

Title:

Low and High Islands: Study Area

Figure: **Fig 6-7**

Rev: **A**

0 7 14
Kilometers

Map Grid of Australia 1994, Zone 56

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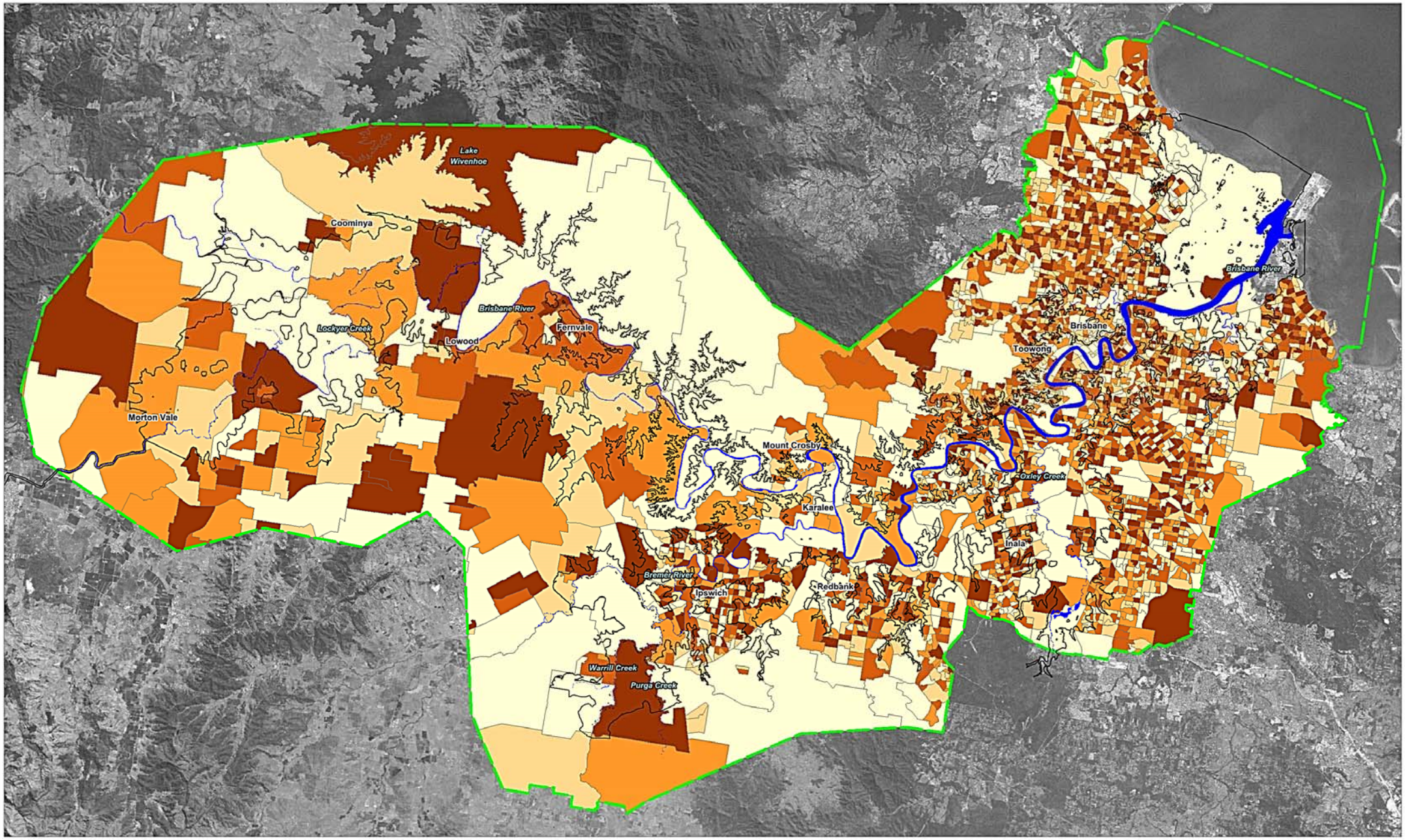

LEGEND

- Study Area Boundary
- Waterways
- 1 in 100,000 AEP Flood Extent

Vulnerability Quintiles

- Less Vulnerable
- More Vulnerable

Brisbane River Catchment Flood Study

Study Partners

Brisbane City Council
Ipswich City Council
Lockyer Valley Regional Council
Somerset Regional Council
Seqwater

Queensland Government

Title:

Physical Vulnerability

Figure: Fig 7-1

Rev: A

0 7 14
Kilometers

Map Grid of Australia 1994, Zone 56

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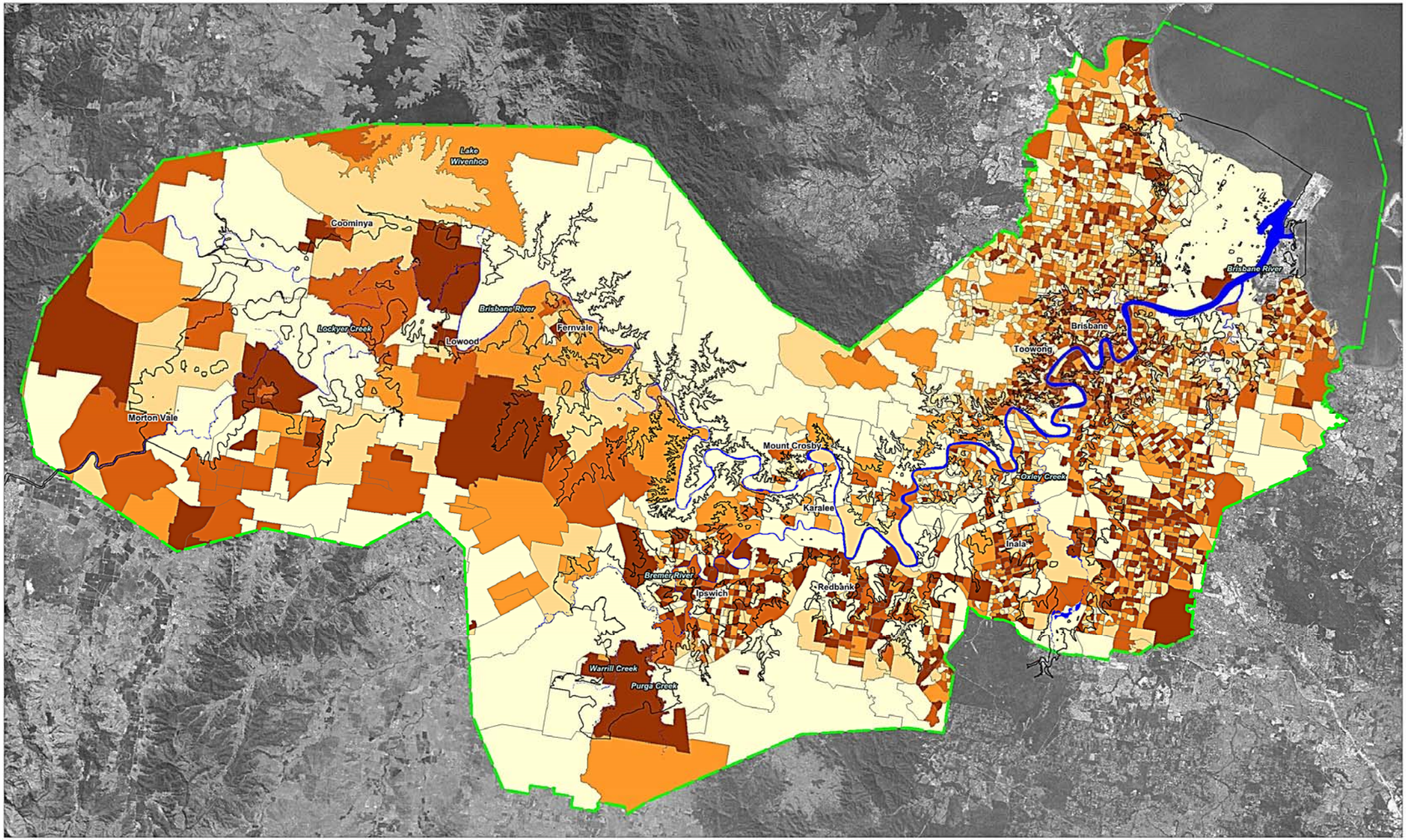

LEGEND

- Study Area Boundary
- Waterways
- 1 in 100,000 AEP Flood Extent

Vulnerability Quintiles

- Less Vulnerable
- More Vulnerable

Brisbane River Catchment Flood Study

Study Partners

Brisbane City Council
Ipswich City Council
Lockyer Valley Regional Council
Somerset Regional Council
Seqwater

Queensland Government

Title:

Social and Economic Vulnerability

Figure: **Fig 7-2**

Rev: **A**

0 7 14
Kilometers

Map Grid of Australia 1994, Zone 56

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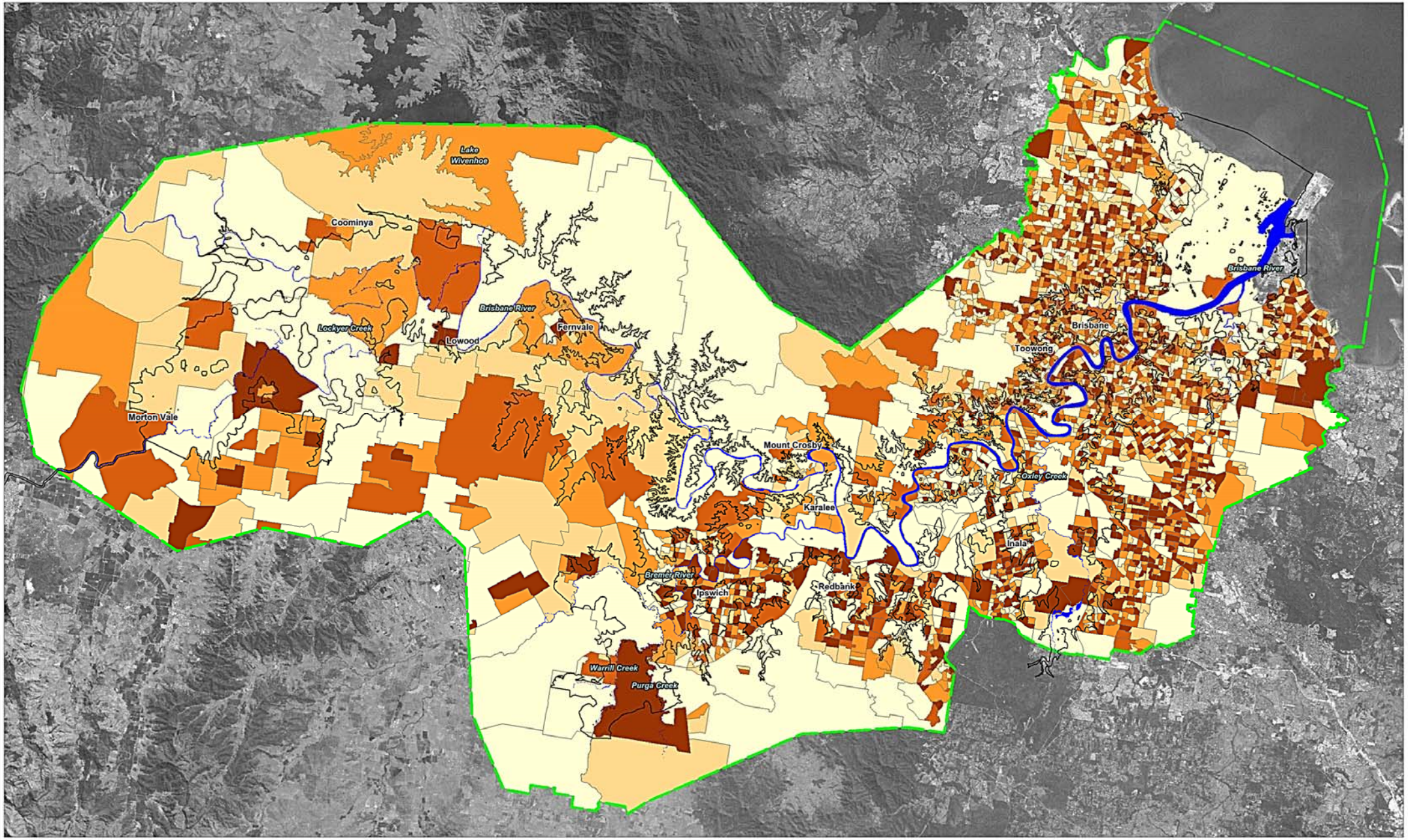

LEGEND

- Study Area Boundary
- Waterways
- 1 in 100,000 AEP Flood Extent

Vulnerability Quintiles

- Less Vulnerable
- More Vulnerable

Brisbane River Catchment Flood Study

Study Partners

Brisbane City Council
Ipswich City Council
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Somerset Regional Council
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Queensland Government

Title:

Mobility Vulnerability

Figure: Fig 7-3

Rev: A

0 7 14
Kilometers

Map Grid of Australia 1994, Zone 56

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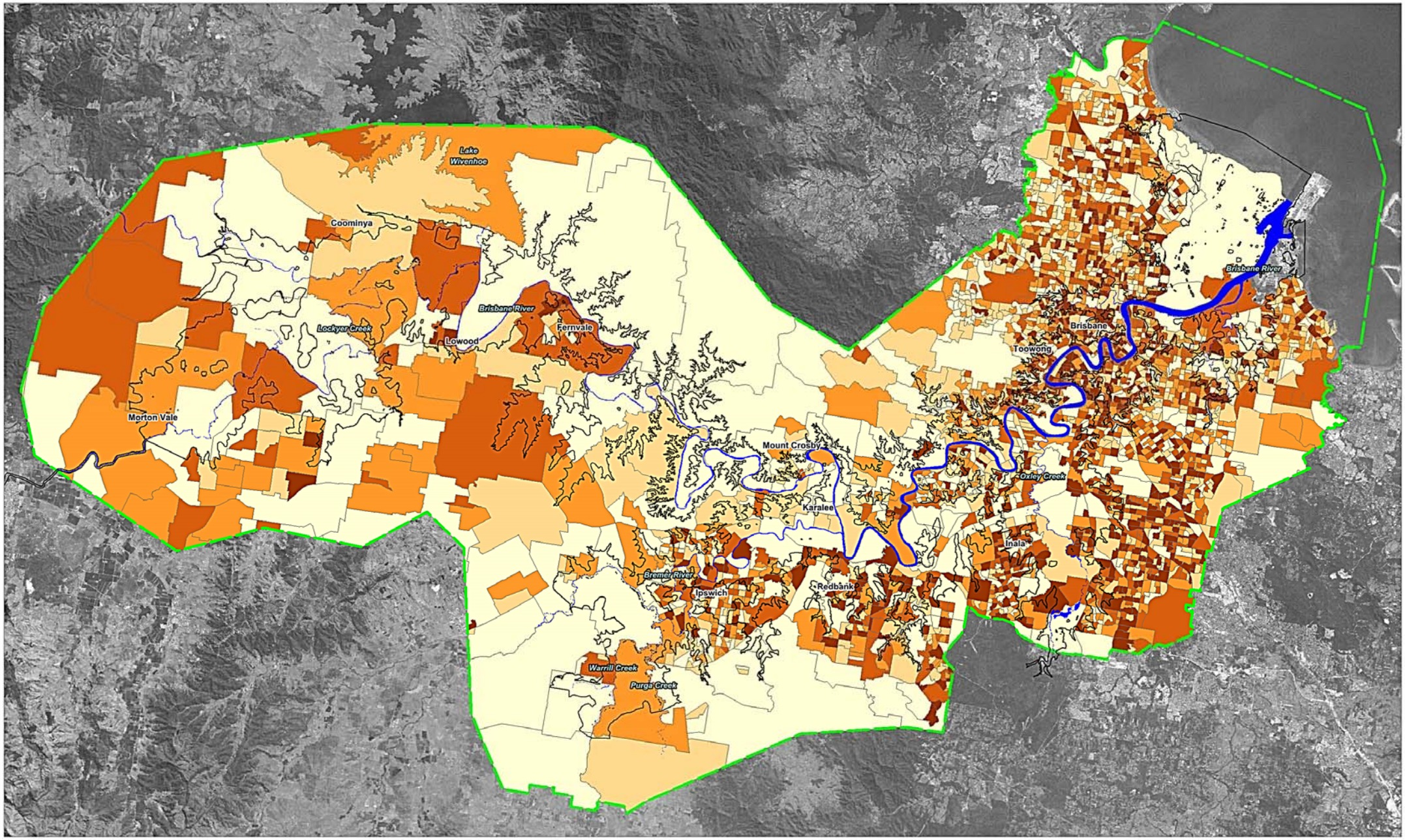

LEGEND

- Study Area Boundary
- Waterways
- 1 in 100,000 AEP Flood Extent

Vulnerability Quintiles

- Less Vulnerable
- More Vulnerable

Brisbane River Catchment Flood Study

Study Partners

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Lockyer Valley Regional Council
Somerset Regional Council
Seqwater

Queensland Government

Title:

Awareness Vulnerability

Figure: **Fig 7-4**

Rev: **A**

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Kilometers

Map Grid of Australia 1994, Zone 56

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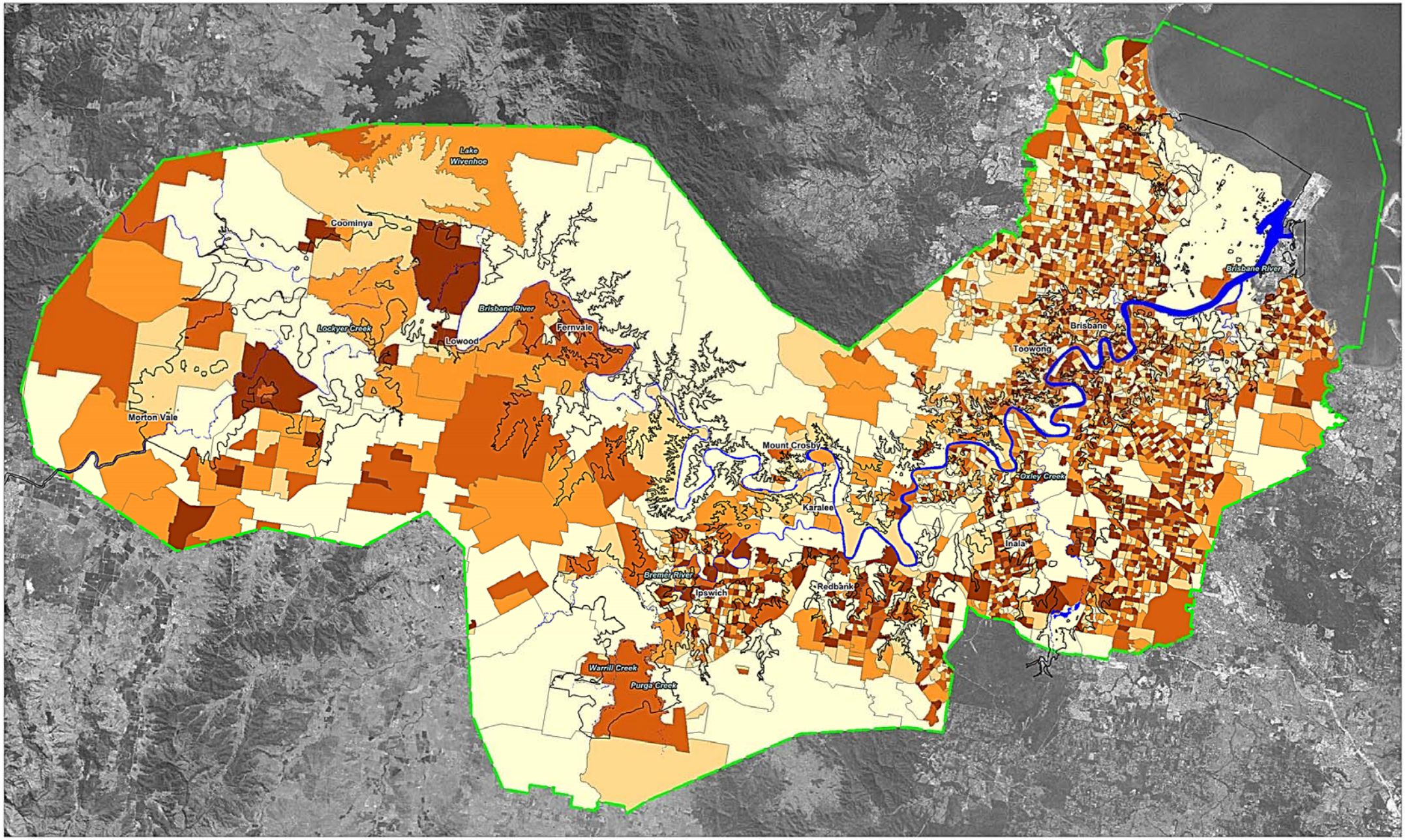

LEGEND

- Study Area Boundary
- Waterways
- 1 in 100,000 AEP Flood Extent

Vulnerability Quintiles

- Less Vulnerable
- More Vulnerable

Brisbane River Catchment Flood Study

Study Partners

Brisbane City Council
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Queensland Government

Title:

Combined Vulnerability

Figure: **Fig 7-5**

Rev: **A**

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Kilometers

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Appendix E: Example of translation of Potential Hydraulic Risk categories into overlay mapping

Translating potential hydraulic risk mapping into overlay mapping – Example 1 (3 risk categories)

Potential hydraulic risk categories

Possible overlay mapping categories

HR1

HR2

HR3

HR4

HR5

Extreme/High risk area

Medium risk area

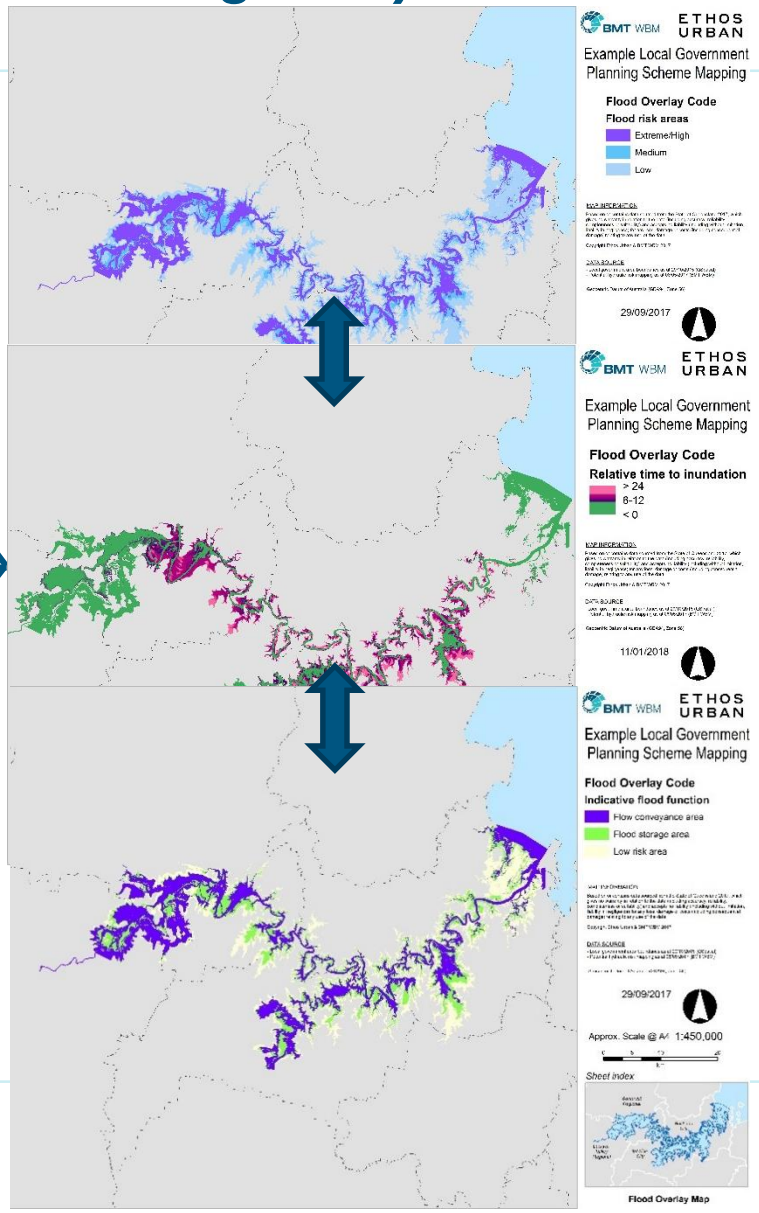
Low risk area

+

Relative time to inundation

+

Indicative flood function



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Translating potential hydraulic risk mapping into overlay mapping – Example 2 (4 risk categories)

Potential hydraulic risk categories

Possible overlay mapping categories

HR1

HR2

HR3

HR4

HR5

Very high risk area

High risk area

Moderate risk area

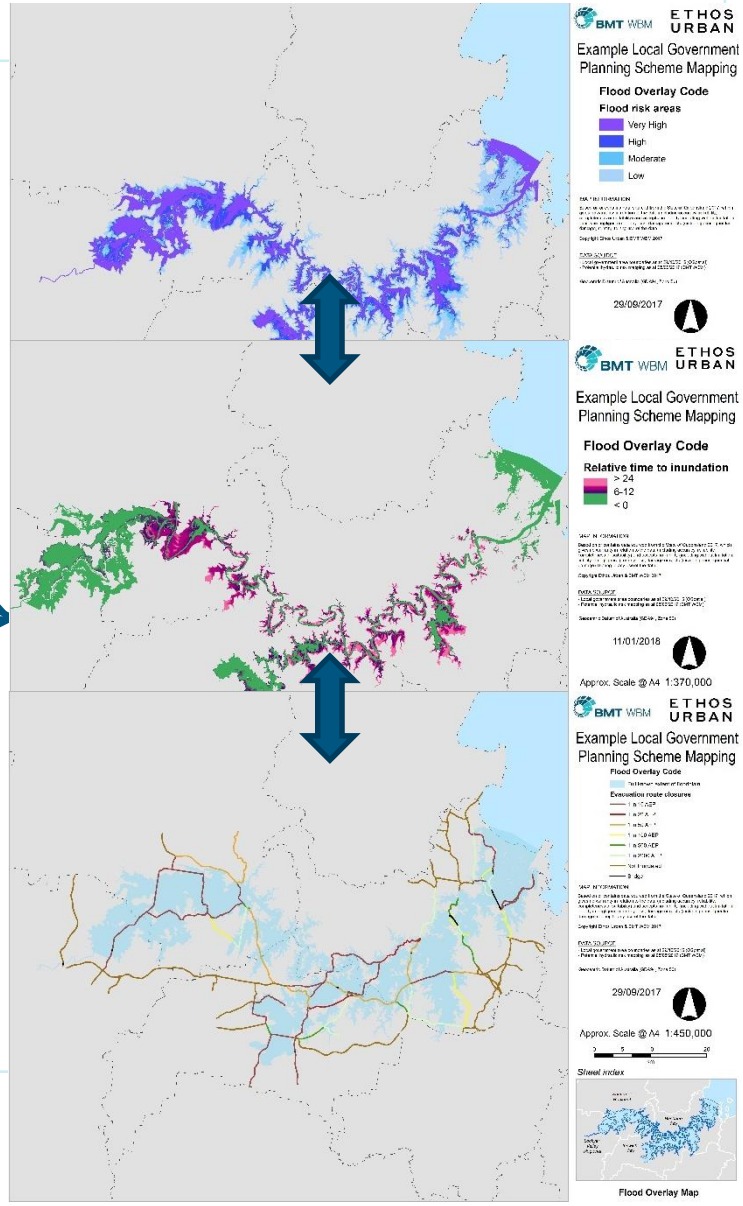
Low risk area

+

Relative time to inundation

+

Evacuation routes



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