

7 Development and flood considerations

In this chapter, the Commission deals with the flood considerations relevant to various types of development including: residential uses, community infrastructure, commercial development, industrial development (considering hazardous materials in particular), river architecture, filling in the floodplain and levees. One flood consideration, the problem of isolation or hindered evacuation, which is relevant to many types of development, is given particular attention.

In the course of the chapter, the Commission refers to evidence of particular sites flooding during the 2010/2011 floods. The fact that a particular site or development did flood during the 2010/2011 floods should not be taken to indicate that there was a deficiency in the development assessment process. The results of the Commission's scrutiny of the development assessment process are contained in chapter 8 *Development assessment in practice*.

7.1 Residential uses

The Commission has heard a great deal of evidence from individuals whose homes were inundated by floodwaters during the 2010/2011 floods. Experiences varied widely: floodwaters lapped at floorboards, or left homes completely submerged. For some, the waters rose slowly; for others, like the people of Grantham, the torrent swept away homes with little or no warning, and lives were lost.

What follows is a brief discussion of how the planning system regulates future residential development and the limitations of land planning in protecting existing residential uses.

7.1.1 Existing residential uses

Many existing uses have been established historically without regard to flood or by reference to what was accepted wisdom at an earlier point in time. For example, Brisbane City Council estimates that almost 90 per cent of the residential properties in Brisbane that were affected by the 2010/2011 floods were in areas predominantly developed prior to 1978, the year in which the council adopted a defined flood level as a planning tool.¹

Planning systems do not operate retrospectively. Improvements in land planning regulation are only realised when development applications are assessed against the improved regulation. Where residential uses have been established historically, there is little the planning system can do to mitigate their risk of flooding.

Councils can, however, take steps to limit further residential development occurring in areas that flood. Generally, this involves 'down-zoning' such areas so that the planning scheme provisions discourage future approvals for residential development. For example, Ipswich City Council, in response to the January 2011 floods, considered which parts of its region should be rezoned, having been affected by flooding in January 2011.² Ipswich City Council's temporary local planning instrument also contains 'special opportunity areas', in which the council is encouraging

the transition of existing residential precincts to ‘low impact, non-residential uses’.³ This is not a zone change, but rather involves reducing the level of assessment for certain non-residential uses, making it easier to obtain a development approval. For a more detailed discussion of temporary local planning instruments see section 5.2.

However, land planning measures, such as those used by Ipswich City Council, can present some difficulties. Councils may be concerned that changing their planning schemes in response to flooding – by ‘rezoning’ or ‘down-zoning’ certain areas – will result in claims for liability under the *Sustainable Planning Act 2009*. (For a detailed discussion, see section 5.5 *Compensation*.) In addition, existing residential communities in flood-affected areas may, understandably, be resistant to the introduction of non-residential land uses, with the prospect of losing the amenity of their neighbourhoods.⁴

There will be circumstances which warrant more concerted measures: when homes are frequently damaged by flooding, a government (local or state) may offer to buy the properties from their owners. This is known as a property buy-back program or a voluntary purchase scheme.⁵ Buying back residential property does not stop flooding; instead, it puts an end to the land being used for residential purposes. With similar intent, the Lockyer Valley Regional Council recently undertook a large scale land swap for the Grantham area, enabling certain eligible land owners to relocate their homes on land above the level of flooding experienced in the January 2011 floods.⁶ A description of both these programs is contained in chapter 11 *Buy-backs and land swaps*.

Existing residential development located in areas that flood will, inevitably, remain vulnerable to flood damage. This raises the question of what can be done to minimise the impact of flooding on existing residential uses. Some of the options examined by the Commission include:

- installing backflow prevention devices to prevent stormwater rising out of drains and flooding residential properties, see section 10.2 *Stormwater*
- sealing electricity conduits to prevent floodwaters entering residential buildings through basements, see section 10.3 *Electrical infrastructure*
- providing protection from flooding by way of flood mitigation levees, see section 7.7 *Levees*.

Another option (which is beyond the Commission’s terms of reference and hence is not further explored in this report) is retrofitting existing houses in areas at risk of flooding to reduce their vulnerability to flood impact. This might include renovating a house to incorporate water resistant building materials or to raise its ground floor level: a costly solution, which is not appropriate for every location or every house type and does not guarantee immunity from all floods.⁷ The use of appropriate building materials to guard against some of the damage caused by flooding is examined in more detail in chapter 9 *Building controls*. Ensuring that homeowners are provided with information about the risk of flood to their property or residence is a first step in enabling them to make decisions about whether the use of resilient building materials is necessary and useful. The communication of information about flooding to purchasers of property is discussed in section 2.9.2 *Flood information for dealing with property*.

7.1.2 An acceptable level of risk for proposed residential uses

The Standing Committee on Agriculture and Resource Management report, *Floodplain Management in Australia: Best Practice Principles and Guidelines*, states that residential development should be located in areas of low hazard, or medium hazard where justified by careful planning, design and construction which takes account of the potential flood damage and provides safe evacuation.⁸ The ‘hazard’ referred to is the loss of life, injury and economic loss which may be caused by future floods.⁹

This standard is given effect, at least in part, in State Planning Policy Guideline 1/03: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide*, which provides that planning schemes should discourage residential development in areas of high or medium hazard, unless the scheme includes a clear requirement that people and property be protected from the relevant hazard.¹⁰ It contains proposed solutions in support of this aim. In particular, the guideline suggests that houses be located so that habitable floor levels are above the defined flood event level.¹¹

These solutions are mirrored in planning schemes across Queensland (and throughout Australia): flood related planning controls typically require that residential buildings be constructed so that their habitable floor levels are located at or above the level of a 1% AEP flood. An additional freeboard of (usually) between 300 millimetres and 500 millimetres may also be required.¹²

But whether the 1% AEP flood constitutes an acceptable level of risk for development, and in particular residential development, is a vexed issue.¹³ The consequences of flooding are likely to be at their most disastrous for residents and homeowners.¹⁴ *Floodplain Management in Australia* recognises this: according to it, the community must play a role in determining what level of flood risk it is prepared to live with.¹⁵

The history of Bundaberg Regional Council's 2004 planning scheme is instructive. Prior to 2004, the scheme stipulated that the floor level of residential premises be at least as high as the level of the 1942 flood in Bundaberg, which was lower than the level of a 2% AEP flood.¹⁶ The 1942 flood level was widely accepted by the community.¹⁷ When, in 2000, the council sought to introduce a new planning scheme adopting a 2% AEP flood level, the public's reaction was decidedly negative. The council's director of infrastructure and planning services reported that there were demonstrations and a 'fiery' public meeting in response to the 2% AEP flood map.¹⁸ The council has since introduced the level of the 2% AEP flood into its planning scheme to regulate development proposals affected by Burnett River flooding.¹⁹ State Planning Policy 1/03 generally proposes that a 1% AEP flood level be adopted, although it accepts that the local circumstances may warrant the use of a different level. A key feature of the Bundaberg Regional Council's justification of choosing the lower, 2% AEP level is the community's willingness to accept the concomitant higher risk of flooding.²⁰

The current review of State Planning Policy 1/03 is considering this particular issue in more detail. The Inland Flood Study – a joint project of the Queensland Government and the Local Government Association of Queensland – recommended that, as part of the review of State Planning Policy 1/03, criteria be developed to determine the circumstances in which a council should be able to adopt a defined flood event of a greater or lesser magnitude than a 1% AEP flood to regulate residential development.²¹

The Commission endorses consideration being given to this issue. To determine what amounts to an acceptable level of risk for residential development, it is necessary to understand the consequences associated with floods across the full range of probabilities.²² Only once this understanding has been gained is it appropriate to canvas what level of risk from flooding the community is prepared to tolerate.²³ To this end, the public notification period required for all major planning scheme amendments is particularly important. (For a discussion of the planning scheme amendment process see 4.1.4 *State interest review of planning schemes*. In chapter 2 *Floodplain management*, the Commission has outlined, in detail, the way in which government can conduct flood studies to measure the full range of floods, in terms of likelihood and behaviour, and how such studies can be used in floodplain management.)

7.2 Community infrastructure

Community infrastructure is development that provides services vital to the wellbeing of the community.²⁴

Under the *Sustainable Planning Act 2009*, a Minister²⁵ or a council may designate land for community infrastructure.²⁶ The kinds of development which are identified as community infrastructure for the purposes of the *Sustainable Planning Act* are contained in Schedule 2 of the *Sustainable Planning Regulation 2009*.

Much of the development which falls under the community infrastructure designation, whether so designated by the Minister or a council, is exempt development which does not require approval under a planning scheme and is not required to meet any scheme requirements.²⁷ However, development under a community infrastructure designation must comply with the requirements of the designation, which may specify, for instance, the height and location of the works on land.²⁸

Where a Minister is responsible for making the designation, he or she must consider relevant state planning policies, which include State Planning Policy 1/03: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide*, before designating the land.²⁹

State Planning Policy 1/03 also applies where a council:

- designates land for community infrastructure under the *Sustainable Planning Act*
- assesses a development application for community infrastructure under the *Sustainable Planning Act* or
- allocates land for community infrastructure in a planning scheme.³⁰

State Planning Policy 1/03 lists, in Annex 1, the types of community infrastructure development to which it applies. They are:

- police and emergency services facilities, including emergency shelters

- hospitals and associated infrastructure
- facilities for the storage of valuable records or items of cultural or historic significance
- State-controlled roads
- railway lines, stations and associated facilities
- aeronautical facilities
- communication network facilities
- works of an electricity entity under the *Electrical Safety Act 2002*
- water cycle management infrastructure.³¹

There is both overlap and divergence between the types of development identified as community infrastructure in Schedule 2 of the *Sustainable Planning Regulation* and those specified in Annex 1 of State Planning Policy 1/03. Some of the uses which are identified as community infrastructure under the *Sustainable Planning Regulation*, but which are absent from the list of community infrastructure uses in the State Planning Policy 1/03, are:

- child care facilities
- aged-care facilities
- cemeteries and crematoriums
- correctional facilities
- educational facilities
- parks and recreational facilities
- operating works under the *Electricity Act 1994*
- various types of transport infrastructure and waste management facilities.

For those types of development which are identified as community infrastructure by the *Sustainable Planning Regulation* but which are not included in the State Planning Policy 1/03 list, there is no requirement that regard be had to the policy when a Minister or council considers the suitability of the development for the proposed location.

State Planning Policy 1/03 aims to ensure that, where practicable, community infrastructure to which it applies is located and designed so as to function effectively during and immediately after floods of a 'specified level of risk'.³² The policy applies to the listed types of development anywhere in Queensland (not only within natural hazard management areas for flood).³³ If it is proposed to locate community infrastructure within a natural hazard management area for flood, its compatibility with the flood hazard of the land is assessed against Outcomes 1 and 2 of State Planning Policy 1/03.³⁴ These outcomes are discussed in chapter 4.1 *State Planning Policy 1/03*.

State Planning Policy 1/03 acknowledges that it would be unrealistic to locate and design community infrastructure so as to withstand any conceivable flood.³⁵ Accordingly, the policy, when read together with the State Planning Policy 1/03 Guideline, recommends appropriate levels of risk for specific types of infrastructure.³⁶ For example, the guideline suggests that emergency shelters be located above the level of a 0.5% annual exceedance probability flood, while hospitals and associated facilities should be located above the level of a 0.2% AEP flood.³⁷ The policy also says that the steps needed by way of design and location to enable the infrastructure to withstand flood should be weighed against the need for the infrastructure to serve the community effectively in normal circumstances, when there is no flooding.³⁸

The types of community infrastructure to which State Planning Policy 1/03 applies are those which the community needs to continue to function, notwithstanding flood. An example of such infrastructure is the Wesley Hospital, located in Auchenflower, Brisbane, and constructed in 1976. In January 2011, it was surrounded by floodwaters.³⁹ All vehicle access, including access by ambulances, to and from the hospital was cut during an almost two day period from early Wednesday, 12 January, to late Thursday, 13 January.⁴⁰ The hospital became fully operational again from Monday 17 January.⁴¹ (The difficulties the hospital experienced are discussed in greater detail in section 7.8 *Anthills: Properties isolated by flooding of low-lying access routes*.)

Not all of the development identified as community infrastructure under Schedule 2 of the *Sustainable Planning Regulation* is of the kind which the community needs to continue to function during and immediately after flood. An obvious example is parks and recreational facilities. However, some of the identified forms of infrastructure provide services important to community well-being.

The special characteristics of child care centres make the use a suitable one to be assessed against criteria requiring centres to be located and designed, wherever practicable, so as to function effectively during and immediately after floods of a specified level of risk. The closure of a child care centre is likely to cause considerable inconvenience and, possibly, expense (loss of wages or the cost of substitute casual child care) to parents using its service. In any assessment it is relevant that many of the occupants of child care centres are likely to be too young to evacuate on foot, or even to be evacuated in a motor vehicle unless fitted with appropriate car seats, increasing the required evacuation time. An ideal evacuation would likely involve children being collected by their parents or carers, but that is dependent on there being flood free evacuation routes.

The Queensland Government Planner's opinion, given in response to the description of a case where a child care centre was served by a flood free evacuation route and was required to have a flood evacuation plan in place as a term of its development approval, was that it was, nonetheless, preferable that it be located outside a flood 'risk area'.⁴² His opinion reinforces the Commission's view that child care centres should be assessed against the standard State Planning Policy 1/03 as it applies to community infrastructure, given the 'specified level[s] of risk' for community infrastructure prescribed by the State Planning Policy 1/03 Guideline tends to be set very low, generally between the 0.2% AEP and 0.5% AEP flood levels.

During hearings held at Ipswich, a witness gave evidence about the inundation of a child care centre in Goodna. The development of the centre was approved by the Ipswich City Council in August 2006, on a site which was inundated during the 1974 floods and is located within the council's '1 in 100 flood line', adjacent to an overland flow path and close to the council's '1 in 20 development line'.⁴³ The centre is able to accommodate approximately 115 children per day, including eight babies (under 15 months in age) and 20 toddlers (aged 15 months to two and a half years); on any given day about 25 staff are employed at the centre.⁴⁴ On the morning of 11 January 2011, the centre manager decided to evacuate the centre because of concern about flooding.⁴⁵ By 1.00 pm that day, all children had been collected by their parents or carers and the staff had evacuated.⁴⁶ By 5.00 am on Wednesday 12 January 2011, the water levels at the centre exceeded six feet.⁴⁷ The centre remained closed for 45 days.⁴⁸

Notwithstanding that child care facilities are not within the compass of the State Planning Policy 1/03 definition, the council assessed the development application against criteria under the Ipswich Planning Scheme 2004's community use code requiring the use (in this case, the child care centre) to be able to function effectively during and immediately after a flood.⁴⁹ This standard was plainly not achieved by the centre during the January 2011 flood. This aspect of the development approval is considered in detail in section 8.3.1 *Conditions going to acceptability of use*.

Arguably, aged-care facilities should also be assessed against criteria requiring them to be located and designed so as to function effectively during and immediately after flood. The Standing Committee on Agriculture and Resource Management report *Floodplain Management in Australia: best practice principles and guidelines* states that housing for the aged is best sited in flood-free areas because of the additional time likely to be involved in evacuation, and the dangers of slower evacuation.⁵⁰

The Commission heard some evidence about the evacuation of residents of a Yeronga retirement complex (providing aged-care, assisted living and independent living facilities)⁵¹ during the January 2011 flooding.⁵² The evacuation, for the most part, ran smoothly, but was described as being very stressful for some of the residents.⁵³ The flood inundated the basement carpark and reached a level approximately one metre above ground.⁵⁴ Only those residents fit enough to climb the fire escape stairs were permitted to return to the complex two weeks later to collect additional personal items.⁵⁵ Residents were not able to return to living in the complex until approximately two months after the inundation of the property.⁵⁶ For a fuller discussion of this example, see section 7.8 *Anthills: Properties isolated by flooding of low-lying access routes*.

A third kind of development which is identified as community infrastructure under Schedule 2 of the *Sustainable Planning Regulation*, but which is absent from the list of development which constitutes community infrastructure in State Planning Policy 1/03, is operating works under the *Electricity Act 1994*. Elsewhere in this report, the Commission recommends that the Queensland Government should consider measures to include requirements in the designation of land for community infrastructure under the *Sustainable Planning Act* to ensure that critical infrastructure for operating works under the *Electricity Act* is built to remain operational during and after a flood of a particular magnitude, with that magnitude being determined by an appropriate risk assessment. This proposition is discussed in detail in section 10.3.3 *Shared network infrastructure*.

The Commission's investigation as to the kinds of development which are included in the definition of community infrastructure under Schedule 2 of the *Sustainable Planning Regulation* but excluded from State Planning Policy 1/03 is, plainly, not comprehensive. Even this selective review, however, establishes a case for the Queensland Government to give consideration to extending the application of a state planning policy which deals with flood to the types of community infrastructure which are identified in the *Sustainable Planning Regulation* and which the community needs to continue functioning, notwithstanding flood.

The Commission otherwise endorses the criteria set by State Planning Policy 1/03 for determining the compatibility of proposed community infrastructure with a specific level of flood risk and supports the incorporation of criteria in these terms in model flood planning controls and planning schemes.

Recommendations

- 7.1 The Queensland Government should consider extending the application of a state planning policy dealing with flood to the types of community infrastructure which are identified in the *Sustainable Planning Regulation 2009* and which the community needs to continue functioning, notwithstanding flood.
- 7.2 The Queensland Government should draft assessment criteria to be included in the model flood planning controls that require community infrastructure (including the types of community infrastructure which are identified in the *Sustainable Planning Regulation 2009* and which the community needs to continue functioning, notwithstanding flood) to be located and designed to function effectively during and immediately after a flood of a specified level of risk.
- 7.3 If the Queensland Government does not include such assessment criteria in model flood planning controls, councils should include assessment criteria in their planning schemes that require community infrastructure (including the types of community infrastructure which are identified in the *Sustainable Planning Regulation 2009* and which the community needs to continue functioning, notwithstanding flood) to be located and designed to function effectively during and immediately after a flood of a specified level of risk.

7.3 Commercial uses

This part considers the location of commercial uses on land liable to flood. Industries that involve the processing or storage of dangerous goods and substances are considered separately; see 7.4 *Industrial uses and hazardous materials*.

The location of commercial uses, such as shops and offices, in areas susceptible to flood carries the risk of damage to goods, property and equipment. Many businesses across Queensland experienced such damage during, and as a consequence of, the 2010/2011 floods, as well as temporary closures and loss of power.

Nevertheless, commercial uses within the floodplain may be more appropriate than other uses.⁵⁷ The personal safety of a commercial building's occupants may still be at risk, but generally to a lesser degree than would be the case for residential or certain community infrastructure uses. Commercial buildings may also be better able to withstand flood damage because they have the advantage, in many cases, of being more structurally robust than houses, and are required to be designed to withstand other hazards such as fire.⁵⁸

Business owners may become aware of the susceptibility of a location to flood by undertaking a general flood search. The site-specific flood information which some councils make available to all members of the community is discussed in chapter 2 *Floodplain management*.

Businesses may willingly establish a commercial use in an area which floods because the location offers other commercial benefits. A Gympie real estate agent gave evidence that the company for which she worked as licensee and office manager did just that: it elected to lease a property knowing that the vicinity flooded, because of its cheaper rent.⁵⁹ The premises were completely flooded by the rising Mary River in January 2011. The real estate agency, in collaboration with the business' landlord, has refurbished with an eye to future inundation, using flood-resilient or readily removed materials and furniture: a front desk easily moved; floor tiles laid, not glued, in place of carpet; removable ceiling tiles; and corrugated iron, rather than plaster, dividing walls.⁶⁰

However, although a proprietor may be willing to balance flood risk against other advantage in establishing his or her business, councils need to consider the appropriateness of commercial development in areas liable to flooding.

A development approval granted for a car and dog wash on land approximately 600 metres from the Mary River in Gympie and below the '1 in 40 flood level' provides an example.⁶¹

The car and dog wash comprises four manual car cleaning and vacuum bays, one automated drive-through car wash and two manual dog washing bays.⁶² The buildings are permanent steel and concrete structures and the site infrastructure involved a complex plumbing network and extensive plant and equipment.⁶³ The business was inundated during the 2010/2011 floods, causing it to become inoperable for a period of eight weeks and to incur substantial financial losses through damage to the buildings and equipment and loss of trade.⁶⁴

The council's considerations, when assessing the owners' development application for a material change of use, were dictated by the assessment criteria of the Cooloola Shire Council planning scheme. Of the codes applicable, only one, the Gympie Planning Area Code, contained a provision requiring flooding to be taken into account.⁶⁵ Development within the commercial zone of the Gympie planning area is assessed against a requirement to maintain the safety of people from floods.⁶⁶ There is no requirement that seeks to protect property used for commercial purposes from the impacts of floods.⁶⁷ Nor does the scheme contain a provision which requires the potential for flood damage to commercial property to be mitigated. The council also did not consider, because it was not required to by the terms of the planning scheme, the frequency with which the site has been affected by flood, the site's proximity to the Mary River or the effects of stormwater runoff.⁶⁸

The Gympie Regional Council's manager of development and compliance agreed that the Cooloola Shire Council planning scheme's provisions could be made more detailed in regards to flooding.⁶⁹

The Council's director of planning and development gave evidence of an anomaly in the Cooloola Shire Council planning scheme's code for reconfiguring a lot, relevant to the subdivision of land. (That code did not apply to assessment of the car and dog wash development application, which involved no subdivision.) The reconfiguration of a lot code:

- requires that 'new lots intended for non-residential use maintains [sic] the safety of people and minimises [sic] the potential damage to property from flood'
- states that this specific outcome can be achieved, for example, if each lot contains a safe refuge.⁷⁰

Thus, a development could meet the criterion which requires the potential damage to property from flooding to be minimised by providing a 'safe refuge'; in other words, without doing anything to ensure the preservation of buildings or equipment.⁷¹ The planning director said that the hiatus would be addressed in the preparation of the council's new planning scheme. He regarded the resilience of non-residential buildings to flood as 'an important and a laudable outcome' in development assessment.⁷²

Councils should be required to consider the impact of flood on commercial property when assessing a development application for a commercial use on land at risk of flood. This could be achieved by including in planning schemes assessment criteria (overall outcomes, performance outcomes and acceptable outcomes) that require the impact of flood on property to be minimised. Including assessment criteria of this kind in planning schemes may also carry the incidental benefit of alerting business owners to the risks associated with establishing a commercial use on the floodplain.

Recommendations

- 7.4 The Queensland Government should draft assessment criteria to be included in the model flood planning controls that require the impact of flood on commercial property to be minimised.
- 7.5 If the Queensland Government does not include such assessment criteria in the model flood planning controls, councils should include assessment criteria in their planning schemes that require the impact of flood on commercial property to be minimised.

7.4 Industrial uses and hazardous materials

After the January 2011 floods, the Oxley Creek, and other nearby tributary creeks in Brisbane's south, were slick with contaminants and littered with industrial debris.⁷³ Much of this pollution was discharged from the many industrial and commercial facilities located within the Oxley Creek catchment.⁷⁴

Brisbane City Council quickly commenced the process of cleaning up. Due to the large amount of hazardous material discharged onto nearby land and spilled into local waterways, the council needed assistance from DERM, which was duly provided.⁷⁵

The scale of the post-flood clean up of the Oxley Creek catchment highlights what can happen when industrial premises flood. This prompted the Commission to examine the way in which the storage and manufacture of hazardous materials are regulated, and in particular whether the risk of flooding is adequately considered.

Hazardous materials

Hazardous materials were defined in the *Dangerous Goods Safety Management Act 2001* as materials that can cause harm to people, property and the environment,⁷⁶ and that definition was adopted by State Planning Policy 1/03: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide*. (The *Dangerous Goods Safety Management Act* has been repealed; the *Work Health and Safety Act 2011* now applies to the storage of dangerous goods, even if they are not in a workplace or used in the course of work.⁷⁷) In addition, the term 'hazardous materials' may have a specific meaning in council planning schemes.

Hazardous materials are often stored, used or manufactured on land associated with industrial uses. Such materials are also associated with rural land uses, such as agriculture, which can involve, for example, the use of fertilisers and petrol products. It is generally more appropriate for industrial or rural land uses to be located on land at risk from flooding, as compared to more sensitive land uses, such as residential or community infrastructure.⁷⁸

However, when floodwaters inundate land on which dangerous chemicals and other hazardous materials are located, those substances can be discharged, causing harm to people, property and the environment. Given this, it is important that regulation of the storage and location of hazardous materials takes into account the risk of flooding on sites at which these products will be stored.

7.4.1 Regulation

In Queensland, the principal state level instruments that regulate the storage and use of dangerous chemicals and hazardous materials are the *Work Health and Safety Act 2011*, the *Environmental Protection Act 1994*, and State Planning Policy 1/03: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide*. At a local government level, the storage and use of hazardous materials is addressed in planning scheme provisions.

Work Health and Safety Act 2011

Dangerous goods are defined in the *Work Health and Safety Act 2011* as meaning asbestos or anything defined under the Australian Code for the Transport of Dangerous Goods by Road and Rail as dangerous goods or goods to be transported.⁷⁹ The Act imposes duties of safe storage of substances and design of structures.⁸⁰

Protocols for the storage of hazardous materials are also informed by the Safe Storage and Handling of Dangerous Goods: Guidelines for Industry,⁸¹ which provide practical guidance on meeting the requirements of the (now repealed) legislation previously governing dangerous goods, the *Dangerous Goods Safety Management Act 2001* and its associated Regulation. The guidelines describe specific engineering controls for the storage and handling of dangerous goods and recommend that dangerous goods be stored as far as practicable above 'recorded flood levels', although no advice is provided as to the meaning of this term.⁸² Where this is not practicable, the guidelines suggest dangerous goods be stored in closed containers that are 'appropriately restrained' and impervious to the intrusion of floodwaters.⁸³

Environmental Protection Act 1994

Environmentally relevant activities

The *Environmental Protection Act 1994* regulates 'environmentally relevant activities': generally speaking, activities which may cause environmental harm through the release of contaminants.

There are four broad categories of environmentally relevant activities:

- agricultural activities which affect the Great Barrier Reef (regulated by chapter 4A of the Act)
- mining activities (regulated by chapter 5 of the Act)
- petroleum and greenhouse gas activities (regulated by chapter 5A of the Act)
- activities which are not agricultural, mining or petroleum activities, but which will, or may, cause harm as a result of contaminants being released into the environment.⁸⁴

Activities in the last category are ‘chapter 4 activities’⁸⁵ and are listed in Schedule 2 of the *Environmental Protection Regulation 2008*,⁸⁶ this list includes activities such as chemical manufacturing,⁸⁷ boilermaking,⁸⁸ motor vehicle workshop operation,⁸⁹ meat processing⁹⁰ and textile manufacturing.⁹¹ The chapter 4 activities listed in Schedule 2 are of particular relevance to this section of the Commission’s report: they are commonly associated with industrial land uses in urban areas and tend to involve the storage and manufacture of hazardous materials. The following discussion relates to chapter 4 activities alone. Mining activities are discussed at length in chapter 13 *Mining*.

Unlike other environmentally relevant activities, such as mining or agriculture, chapter 4 activities are assessable development under the *Sustainable Planning Act 2009*.⁹² A development applicant must make an application for a material change of use in order to: start a new chapter 4 activity; increase the threshold of a chapter 4 activity; re-establish an abandoned chapter 4 activity; or materially increase the intensity or scale of a chapter 4 activity.⁹³

All chapter 4 activities are assessed by DERM, except where they have been devolved to local government for assessment and enforcement.⁹⁴ Devolved chapter 4 activities include: poultry farming; asphalt manufacturing; motor vehicle workshop operation and printing; and certain other activities, such as chemical storage, which are devolved to councils if they meet specific thresholds prescribed in the regulation.⁹⁵

The ‘standard criteria’

All environmentally relevant activities are assessed against the standard criteria⁹⁶ as defined in the *Environmental Protection Act 1994*.⁹⁷ The standard criteria comprise a list of general considerations, such as ‘any applicable environmental protection policy’. They make no express reference to flooding, although in some cases such a reference may be inferred. For example, one of the criteria – ‘any applicable Commonwealth, state or local government plans, standards, agreements or requirements’ – may encompass flood related provisions in council planning schemes. Notwithstanding, the current criteria provide no basis for specific consideration of flood when assessing applications for environmentally relevant activities. They offer little guidance to Queensland Government or council officers about whether, and how, flooding should be taken into account in that assessment process.⁹⁸

The Commission reviewed ten approved applications for environmentally relevant activities in four local government areas. Each approval was granted in respect of land that flooded in 2010/2011 floods. This review disclosed that none of the assessments explicitly considered whether flooding might occur at the site, or what effects flooding would have, should it eventuate.⁹⁹

The risk of flooding, and its potential effects, should be taken into account in the assessment of environmentally relevant activities. The Commission considers that, to achieve this, a specific direction to consider the issue of flooding should form part of the assessment process under the *Environmental Protection Act 1994*.¹⁰⁰

Recommendation

- 7.6 The Queensland Government should ensure that the criteria under the *Environmental Protection Act 1994* that apply to the assessment of development applications for material change of use for environmentally relevant activities include consideration of the risk of flooding at the site on which the activity is proposed to occur.

DERM information sheets and assessment reports templates

Template documents used in the assessment of applications for environmentally relevant activities could be improved so as to promote proper consideration of the issues associated with flooding.

DERM makes available an ‘information sheet’ for use by those applying to conduct an environmentally relevant activity.¹⁰¹ The information sheet does not suggest the provision of information about flood risk, except for applications that concern activities where discharges to the environment are anticipated.¹⁰² According to an officer of the department, information about flooding is rarely provided with development applications.¹⁰³ This, of course, makes it difficult for the risk of flooding to be considered as part of the decision making process. A practical solution to this problem would be for DERM to amend its information sheet to indicate that information regarding flood risk (including confirmation, if it be the case, that there is none) should be provided routinely with development applications concerning environmentally relevant activities.

DERM officers use an assessment report template when assessing applications for environmentally relevant activities.¹⁰⁴ The template contains a development approval assessment checklist, which contains no specific reference to flooding.¹⁰⁵ This checklist could be amended to invite consideration of flooding as part of the assessment process for environmentally relevant activities.

However, checklists will not always ensure that adequate thought is given to the matter of flooding. DERM reviewed a number of completed assessments for environmentally relevant activity assessments. That review revealed that, even with the assessment report template checklist, there were inconsistencies in the approaches taken by department officers.¹⁰⁶ After completing the review exercise, DERM resolved to revise the template report to minimise divergence amongst the approaches taken.

The Commission considers that while a checklist may not ensure reference to flooding issues, a more comprehensive document would, at the very least, encourage their consideration during the assessment of environmentally relevant activities.

Recommendations

- 7.7 The Department of Environment and Resource Management should amend its information sheet about applications for a material change of use for environmentally relevant activities so that applicants are prompted to include information (if any) about the risk of flooding at the site where the activity is proposed to occur.
- 7.8 The Department of Environment and Resource Management should amend the template assessment report used to assess applications for a material change of use for environmentally relevant activities so that it prompts departmental officers to give specific consideration, as part of the assessment process, to the risk of flooding at the site where the activity is proposed to occur.

Information sharing between the Queensland Government and councils

When a decision to approve an environmentally relevant activity is made by a Queensland Government officer, the council within whose boundaries the activity is being conducted may not have automatic access to details about the location and nature of the proposed activity.¹⁰⁷ Council officers would benefit from this information: it is relevant to any subsequent decisions about land use at or near sites at which environmentally relevant activities occur.

As noted above, certain chapter 4 activities are also devolved to councils for assessment.¹⁰⁸ There appears to be no obligation for councils approving devolved environmentally relevant activities to provide DERM with the details of such approvals.

An assessment officer in the Brisbane City Council expressed the view that it would be quite simple for such an information sharing arrangement to be established between a council and DERM.¹⁰⁹ It would also seem prudent for any agency which assesses applications for environmentally relevant activities to keep a register of such activities and include in that register the details of environmentally relevant activities assessed by other agencies.

Recommendations

- 7.9 The Department of Environment and Resource Management should ensure that, when applications for a material change of use for an environmentally relevant activity are approved by the department, the details of those activities, including their nature and location, are provided to the council within whose area the activity will be conducted.
- 7.10 Councils should ensure that, when applications for environmentally relevant activities are approved by a council, the details of those activities, including their nature and location, are provided to the Department of Environment and Resource Management.

State Planning Policy 1/03

State Planning Policy 1/03 applies to certain development which involves the manufacture or storage of hazardous materials in bulk.

Hazardous materials 'in bulk', as defined in the State Planning Policy 1/03, are hazardous materials in quantities that:

- are equal to or exceed the threshold amounts which determine a 'large dangerous goods location' under the (now repealed) *Dangerous Goods Safety Management Regulation 2008*, or
- require a licence, granted under the *Explosives Regulation 1955*, for the storage of explosives.¹¹⁰

The application of State Planning Policy 1/03 to individual development proposals is only enlivened where the development is proposed on land which is identified as a natural hazard management area for flood, and where the council planning scheme does not appropriately reflect the policy.¹¹¹ State Planning Policy 1/03 requires that development which involves the manufacture or storage of hazardous materials in bulk should be compatible with the nature of the natural hazard management area for flood.¹¹² Compatibility exists where public safety and the environment are not adversely affected by the detrimental impacts of floodwater on hazardous materials manufactured or stored in bulk.¹¹³

The State Planning Policy 1/03 Guideline offers two solutions for achieving this outcome:¹¹⁴

- the manufacture or storage in bulk of hazardous materials takes place above the defined flood event flood level¹¹⁵
- structures used for the manufacture or storage of hazardous materials in bulk are designed to prevent the intrusion of floodwaters.¹¹⁶

The first solution contemplates the possibility that a site which is susceptible to flooding during a defined flood event might contain locations, such as the highest part of the site or the second storey of a building, which remain flood free.

The solutions proposed in the State Planning Policy 1/03 Guideline are alternatives; applicants can choose to locate hazardous materials above the defined flood event flood level *or* store or manufacture them in a way that prevents the intrusion of floodwaters.¹¹⁷ Framing the solutions as alternatives allows a more flexible approach to be adopted for industrial development involving the storage or manufacture of hazardous materials on land at risk from flooding.

This flexibility is important. Placing stringent restrictions on the location of industrial uses that involve hazardous materials – for example, to areas outside the 1% AEP flood extent only – may have consequences, particularly economic ones, which are not ascertainable in the absence of a proper risk based analysis. For example, parts of Brisbane that are susceptible to flooding also house large industrial precincts. If industrial development were to be restricted in these areas, the economic disadvantages might outweigh the benefits gained from reducing the risk of floodwaters discharging hazardous materials associated with such development.

The Commission agrees generally with the solutions proposed by State Planning Policy 1/03 Guideline for determining whether the storage or manufacture of hazardous materials in bulk is compatible with the natural hazard management area for flood. However, determination of the level above which hazardous materials must be located is best determined through a risk based assessment, not simply by reference to the defined flood event nominated by a council in its planning scheme.

7.4.2 Planning schemes

Planning scheme provisions

There is variation among planning schemes as to the way in which the manufacture and storage of hazardous materials are regulated. Bundaberg City Council (under the Bundaberg and Burnett planning schemes only¹¹⁸), Gympie Regional Council (under the Cooloola and Tiaro planning schemes only¹¹⁹) and the Sunshine Coast Regional Council (under the Maroochy and Noosa planning schemes only¹²⁰) include both of the solutions proposed in the current Guideline to State Planning Policy 1/03. All three planning schemes managed by the Moreton Bay Regional Council, and the Kilcoy planning scheme (administered by Somerset Regional Council) include only the first proposed solution: that materials be stored above the defined flood level.¹²¹

Brisbane City Council's planning scheme does not directly regulate development involving hazardous materials. Instead, regulation is achieved by the operation of the Subdivision and Development Guidelines, which are arrived at after consideration of several different codes.¹²²

Ipswich City Council's planning scheme requires, where industrial sites are located below the 1 in 20 development line, the 1 in 100 flood line or within the Urban Stormwater Flow Path areas, that any materials stored on site:

- are readily able to be moved in a flood event
- are not hazardous or noxious or comprise materials that may cause a deleterious effect on the environment if discharged in a flood event, and
- where capable of creating a safety hazard by being shifted by floodwaters, are contained in order to minimise movement in times of flood.¹²³

The elements of this provision are not drafted as alternatives; the effect is that materials which are hazardous, noxious or that may cause a deleterious effect on the environment, should not be located on land below the 1 in 100 flood line or in areas subject to overland flow.

Other planning schemes provide no specific guidance for the assessment of land uses involving the use or storage of hazardous materials on the floodplain.¹²⁴ For instance, the Esk Shire planning scheme (now administered by the Somerset Regional Council) contains no standards or controls relating to the storage of hazardous materials on land at risk from flooding.¹²⁵ The Central Highlands Regional Council relies on the regulatory framework provided by the previously applicable *Dangerous Goods Safety Management Act*, and the *Environmental Protection Act* (discussed above), to make decisions about the storage and use of hazardous materials.¹²⁶ Beyond these regulatory instruments, the planning scheme appears to contain no additional restrictions.

It is important that all Queensland planning schemes address the storage and manufacture of hazardous materials on land that is susceptible to flooding. The Queensland Government Planner agreed that the Queensland Planning Provisions should include an outcome, similar to that prescribed in the Guidelines to State Planning Policy 1/03 (discussed above).¹²⁷ This could be achieved by including assessment criteria in the model flood planning controls, which are intended to apply to land identified by a council as being susceptible to flooding. The model flood planning controls are discussed in detail in section 5.1 *Planning schemes*.

Recommendations

- 7.11 The Queensland Government should draft assessment criteria to be included in the model flood planning controls that require that:
- the manufacture or storage of bulk hazardous materials (as defined in State Planning Policy 1/03) take place above a certain flood level, determined following an appropriate risk based assessment, or
 - structures on land susceptible to flooding and used for the manufacture or storage of bulk hazardous materials (as defined in State Planning Policy 1/03) be designed to prevent the intrusion of floodwaters.
- 7.12 If the Queensland Government does not include such assessment criteria in the model flood planning controls, councils should include assessment criteria in their planning schemes that require that:
- the manufacture or storage of bulk hazardous materials (as defined in State Planning Policy 1/03) take place above a certain flood level, determined following an appropriate risk based assessment, or
 - structures on land susceptible to flooding and used for the manufacture or storage of bulk hazardous materials (as defined in State Planning Policy 1/03) be designed to prevent the intrusion of floodwaters.

Conditions on development approval

Where the manufacture or storage of hazardous materials *is* addressed in a planning scheme, some councils impose additional conditions on development approvals,¹²⁸ while others do not.¹²⁹ Where conditions are imposed, the approach differs among councils. For instance, the Gympie Regional Council (under the Cooloola Planning Scheme only) requires contingency plans for hazardous material evacuation as well as flood management plans.¹³⁰ Fraser Coast Regional Council, on occasion, imposes conditions that preclude the manufacture or storage of bulk hazardous materials, at or below the adopted flood level, unless approved in writing by a council assessment manager;¹³¹ it is not clear what would be taken into account by the assessment manager in deciding whether to grant approval.

Problems can arise where the condition imposed, or the outcome prescribed by the planning scheme, relies on human intervention to prevent hazardous materials escaping into floodwaters. For example, should access to a site be cut, hazardous materials could not be removed and the solution proposed would fail.¹³² While this might be rendered less likely by the prospect of a long flood warning time, the chance that individuals will be unable to reach a property to remove hazardous materials can never be entirely eliminated. Accordingly, development approval conditions which rely on evacuation plans or some other form of human intervention should not be the sole restriction placed on the storage or manufacture of hazardous materials on land at risk from flooding.

Recommendation

- 7.13 When approving applications for development which involve the manufacture or storage of hazardous materials, councils should not restrict the conditions imposed to ones which are solely reliant on human intervention to remove the materials in the event of flood.

7.5 River architecture

7.5.1 Brisbane's river architecture

The Commission uses the term 'river architecture' in this report as referring to structures built for public or private use in rivers and waterways, but it has focussed its attention on those structures built along the Brisbane River, such as the New Farm Riverwalk (a floating walkway), the CityCat terminals (docks for the larger catamaran ferries), the CityFerry terminals (docks for the smaller ferries) and private pontoons.

In the January 2011 floods, Brisbane's river architecture was severely damaged, and in some cases became a danger to river navigation as detached pieces became waterborne debris. This debris posed a danger to other pieces of river architecture and to the structural soundness of any bridge it collided with.

Brisbane's image as the 'River City' is built, in part, upon its impressive river architecture. The amenity provided by these facilities must be balanced against the potential for their becoming a hazard in any future flood: a risk which must be considered in the design of new structures.

7.5.2 Regulation of river architecture as 'prescribed tidal work'

River architecture is classified as 'prescribed tidal work' under the *Coastal Protection and Management Act 1995*¹³³ and requires a development approval for its construction.¹³⁴ Applications for river architecture were previously approved by the Queensland Government. On 18 November 2005, the 'code for development applications for prescribed tidal work'¹³⁵ was introduced, and councils became responsible for approving those development applications.¹³⁶

The code has a number of purposes, one of which is to ensure prescribed tidal work is structurally sound.¹³⁷ It also stipulates 'specific outcomes' that need to be met by the development and 'probable solutions' that identify ways in which the 'specific outcomes' may be achieved.¹³⁸

One specific outcome requires prescribed tidal work to be designed and constructed to ensure it is structurally sound, having regard to relevant engineering standards, the location of the work, the purpose of the work and the impact of flooding, tide and hydrodynamic changes.¹³⁹

The code suggests that in order to satisfy this 'specific outcome', one 'probable solution' is for the development to be consistent with all relevant Australian standards,¹⁴⁰ and with relevant planning scheme standards, if they are more stringent than the relevant Australian standard.¹⁴¹

7.5.3 New Farm Riverwalk

The New Farm Riverwalk was a floating walkway that ran parallel to the bank of the Brisbane River from New Farm to the Story Bridge.¹⁴² In the January 2011 flood, the walkway suffered significant damage from the impact of debris, and the downstream section of the walkway was washed away.¹⁴³ As the flood levels rose, other support structures that comprised the Riverwalk also failed.¹⁴⁴

Authorities became concerned a 300 metre section of the Riverwalk that had detached and floated down the river posed a threat to the structural integrity of downstream bridges if a collision were to occur. On 13 January 2011, tug boats guided the detached section of the walkway away from bridges and other infrastructure, preventing any collision occurring.¹⁴⁵

The force of the flooded river on the pontoon at the mid-section of the structure led to the walkway's failure.¹⁴⁶ Brisbane City Council maintenance records do not contain any evidence to suggest that any earlier incidents, such as the impact from large debris or any deterioration of the building materials before the January 2011 flood, contributed to the Riverwalk's failure.¹⁴⁷



Flood damage to New Farm Riverwalk (photo courtesy Stephen Knight)

Design standards

The Riverwalk was built in 2003 for Brisbane City Council by contractors, following a tender process that began in early 2001.¹⁴⁸ The Riverwalk was designed to survive at least a 1% AEP flood, which meant that although damage might be sustained in such a flood, the walkway should remain intact.¹⁴⁹

The identification of appropriate design standards for flood resilience at the time of the Riverwalk's construction was a matter for the design engineer applying relevant Australian standards and professional judgment.¹⁵⁰ There was no requirement for the flood resilience standards and design for the Riverwalk to be assessed by any third party, and there was no evidence that any review of this kind had taken place.¹⁵¹

Following the January 2011 floods, a hydraulic study was undertaken to determine the velocity of the water and flood levels at the Riverwalk structure. This study found that the 1% AEP flood level for the Riverwalk was 3.52 metres, whereas the actual flood level in January 2011 reached 4.0 metres.¹⁵²

A study carried out to determine the cause of the Riverwalk's failure indicated that its design standard may have been intended for use in river architecture built in a typical marina situation along a coast. In a setting such as the Brisbane River at New Farm, flood levels can be significantly greater than the tidal range.¹⁵³ This study recommended that an analysis of the 0.05% AEP flood be undertaken for the design of any future Riverwalk.¹⁵⁴

Reconstruction of the Riverwalk

Brisbane City Council has indicated that it intends to rebuild the Riverwalk, at an estimated expense of around \$70 million.¹⁵⁵ Plainly, such a structure needs to be designed and built to a higher standard than the previous one, with measures put in place to ensure that if it does fail in any future flood, all parts that detach can be quickly and effectively secured.

Given the unique character of such a project, the risk involved in any failure, and the value of the work required, it would be prudent to ensure that any design is reviewed by an independent expert.¹⁵⁶

7.5.5 CityCat and CityFerry terminals

The terminals used by Brisbane's ferries, the CityCats and the CityFerries, suffered significant damage in the January 2011 flood. Of the 24 CityCat and CityFerry terminals across Brisbane:

- ten terminals were categorised as useable with minor works (they could be reinstated for use within a short time frame by cleaning and replacing electrical components)
- seven terminals were categorised as useable with moderate works (they required repairs to pile brackets, removal of broken balustrades, repairs to roof structures and removal of debris)
- the remaining seven terminals were categorised as requiring major repairs (they suffered extensive damage to, or destruction of, piles, pontoons, gangways and/or waiting areas).¹⁵⁷

The terminals in the minor and moderate damage categories were reinstated relatively quickly after the flood event (except one, River Plaza, which was subsequently reclassified as requiring major repairs). Brisbane City Council decided to reinstate the terminals that suffered major damage (including River Plaza) on a temporary basis, pending their replacement with new terminals constructed to different flood design standards. The temporary replacement of the West End terminal was not carried out, as there were pre-existing plans to replace the entire terminal.¹⁵⁸

In 1995 and 1996, the CityFerry terminals¹⁵⁹ were upgraded to accept CityCat vessels. These terminals were originally designed and built between the early 1920s and 1996. Brisbane City Council was not able to tell the Commission whether they were originally constructed in accordance with the relevant Australian standards or what, if any, standards and policies were used for their design and construction.¹⁶⁰ Nor was the council able definitively to inform the Commission as to what flood the terminals were built to withstand during the upgrade.¹⁶¹

In 1995 and 1996, four new CityCat terminals were also built.¹⁶² Brisbane City Council was able to indicate with more certainty that these terminals were designed to withstand a 1% AEP flood.¹⁶³ From 2001, a number of the terminals were upgraded progressively to withstand a 1% AEP flood.¹⁶⁴

All of the works undertaken to repair the damage caused to the terminals in the January 2011 floods are now complete. Brisbane City Council indicated that it intends to replace the terminals that suffered major damage¹⁶⁵ with new structures built using design criteria developed in light of what was learnt from the January 2011 flood and using more advanced three dimensional modelling.¹⁶⁶ The new designs will incorporate a deflection structure at the upstream end of the pontoon and the pontoon itself will be streamlined to reduce drag forces. They will include a retractable gangway that can be removed from the path of the flood flow.¹⁶⁷ The new designs are expected to result in terminals that are more resilient to flood than the previous designs.¹⁶⁸

7.5.6 Private pontoons

During the January 2011 floods, over four hundred private pontoons in the Brisbane River were dislodged from their moorings, including the floating restaurant 'Drift'. These pontoons ultimately ended up in the lower reaches of the river, creating serious navigational hazards for boats and shipping in the river and at the Port of Brisbane. On their journey down the river some of these pontoons may have caused damage to other infrastructure in the river, including Brisbane City Council's CityCat and CityFerry terminals.¹⁶⁹

7.5.7 Response to the floods

Ordinarily, the repair or replacement of damaged structures in tidal areas requires a development approval from council. However, following the 2010/2011 floods, DERM granted an exemption (which applies between 14 February 2011 and 31 January 2013) to allow the repair of structures, without further approval, provided they are replaced on a like-for-like basis and in the same location.¹⁷⁰ The exemption was issued to allow for faster reconstruction of previously approved maritime structures.¹⁷¹

For private pontoons rebuilt under this exemption, Brisbane City Council has, in conjunction with DERM and Marine Queensland, developed a voluntary code of practice setting out the design, construction and maintenance standards that should be applied. The code is only intended to apply during the exemption period.¹⁷²

Brisbane City Council believes that the code for development applications for prescribed tidal work in the *Coastal Protection and Management Regulation 2003* should be reviewed to ensure the design and construction provisions for all river architecture are adequate.¹⁷³ The Commission agrees that the Queensland Government and councils

having responsibility for river architecture such as that in the Brisbane River should review development standards to ensure the most up to date and appropriate standards are applied.

Recommendations

- 7.14 The Queensland Government should review the code for development applications for prescribed tidal work in the *Coastal Protection and Management Regulation 2003* to consider whether the design and construction standards should be made more stringent than the existing standards.
- 7.15 Councils (particularly Brisbane City Council) should consider including in their planning schemes more stringent standards for the design and construction of prescribed tidal work than those in the code for development applications for prescribed tidal work in the *Coastal Protection and Management Regulation 2003*.

7.6 Placement of fill and development in a floodplain

Most towns and cities in Queensland are built on floodplains. A common solution to this constraint has been to import fill onto low-lying land, to build it up and reduce its flood risk. That measure can result in the diversion of floodwater to properties up and downstream, and can exacerbate flooding of those properties. Compensatory earthworks are often needed to prevent or minimise these consequences.¹⁷⁴

The following diagram from the ‘Compensatory Earthworks Planning Scheme Policy’ in Brisbane’s planning scheme depicts compensatory earthworks.¹⁷⁵

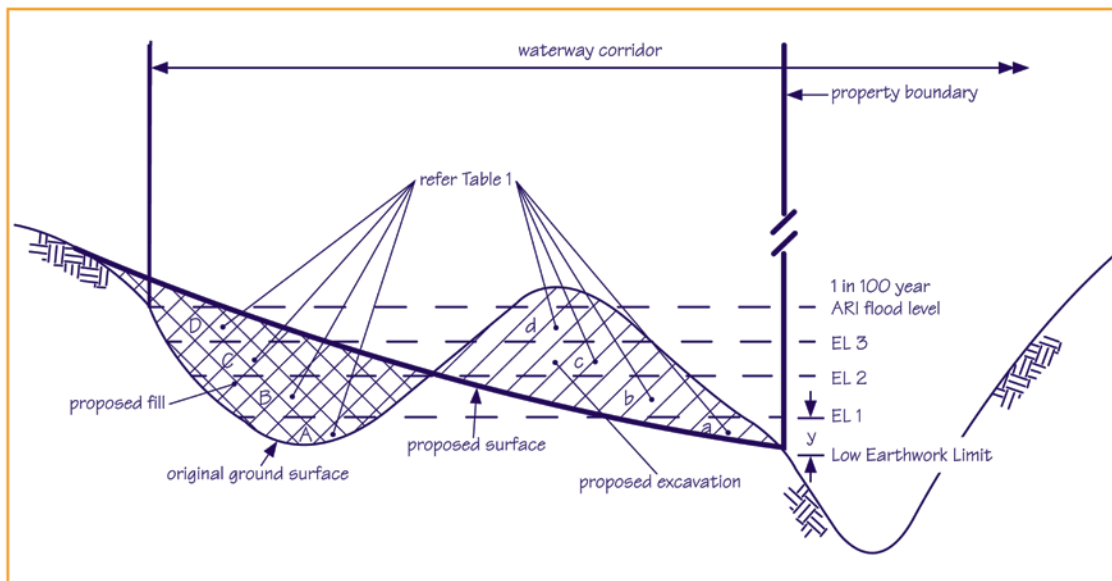


Figure a Calculating Compensatory Cut and Fill Volumes – Cross Section

Source: Compensatory Earthworks Planning Scheme, Brisbane City Plan 2000, Volume 2, Appendix 2: Planning Scheme Policies

In some limited circumstances, filling in the floodplain does not adversely affect surrounding properties, even without compensatory earthworks; for example, placing fill in backwater or low flow velocity areas may not have any consequence for properties up or downstream.¹⁷⁶

A number of witnesses expressed their concern to the Commission that development in their areas exacerbated the flooding of their properties. Although the Commission is not in a position to determine whether or not the fill did worsen flooding in any particular instance, it is useful to refer to some cases which demonstrate public concern about the adverse flooding effects that filling in the floodplain can have.

Graceville

One of the clearest examples of the issue was raised by two witnesses, one residing at, and one near, Graceville Park, a multi-level complex containing 90 townhouses. The land on which the development was built is low lying, part of the Oxley Creek and Brisbane River floodplains, and traverses a natural waterway.¹⁷⁷ Prior to development, the site was a horse paddock with a creek running through the middle.¹⁷⁸ Images depicting the 1974 flood level at the site show that water covered most of the land upon which the townhouse complex is now located.¹⁷⁹

In January 2011, 81 of the 90 townhouses on site were flooded; 60 of these suffered total inundation.¹⁸⁰ Nearby residences were also heavily affected. A neighbouring land owner, whose property is bordered on one side and at the rear by the townhouses of Graceville Park,¹⁸¹ gave evidence that the floodwaters reached the eaves of his house.¹⁸² He expressed concerns that the Graceville Park development changed the topography of the land and, given its proximity to his residence, increased the potential for his property to flood.¹⁸³

A number of approvals were required from Brisbane City Council before construction on Graceville Park could begin, including a rezoning approval, a town planning consent permit, and two group title subdivision approvals.¹⁸⁴

In 1991, the land was officially rezoned to a residential use, following the submission and approval of a rezoning application.¹⁸⁵ The rezoning did not itself authorise the construction of town houses; a town planning consent permit was required for this purpose.¹⁸⁶ When the town planning consent permit application was initially submitted, the developer was advised that the topographical features and drainage problems of the site rendered it unsuitable for the development of town houses at the proposed density.¹⁸⁷

Council records indicate that the resolution of flood issues proved difficult.¹⁸⁸ Problems were identified with the hydraulic study provided in support of the town planning consent permit application; before approval was granted, the developer made several attempts at providing a flood study that was satisfactory to the council.¹⁸⁹ The study had contained insufficient information to enable the council to assess the possible impacts of the proposal on adjacent land in terms of flooding, ponding of water and overland flow.¹⁹⁰ The developer undertook to recalculate the flood levels of the site using more accurate information.¹⁹¹ Ultimately, the various issues identified were resolved to the satisfaction of the council, and approval was granted.¹⁹²



Flood damage in Graceville back yard, neighbouring Graceville Park complex visible over fence (photo courtesy Rob Clements)

For the developer to achieve compliance with some of the conditions of the development approval, filling was required. The precise amount of filling undertaken is not known, although it appears as though it must have been at least 0.8 metres across the site.¹⁹³

The planner responsible for assessment of the rezoning application and the town planning consent permit application indicated that if the development were assessed under today's standards, some aspects of the approval would be different. This is unsurprising; the application was made under an earlier planning scheme and before the State Planning Policy had been adopted. By way of example, the witness indicated that fill levels on the site would likely have been increased to allow higher floor levels, with a greater distance required between the townhouses and adjoining properties; the number of townhouses would probably have been reduced by five or ten units; and access roads into the site might have been required to be built to a higher level.¹⁹⁴

Emerald

An Emerald resident whose house, built in 2004, was inundated in the 2010/2011 floods told the Commission that she was concerned about the possible impact of future developments approved nearby. Two new businesses have been approved to be built on land filled up to and above the 2008 flood level; one is a concrete batching plant to be located 60 metres from her home.¹⁹⁵ The resident's view was that such developments would affect drainage for the area, restrict water movement and increase the depth of floodwater.¹⁹⁶

Karalee

Residents of Karalee in Ipswich have expressed concerns about the extent of fill deposited on the Citiswich Industrial Estate, a large scale development (315 hectares in size) located approximately seven kilometres east of the Ipswich central business district.¹⁹⁷ The developer has chosen to undertake the project in seven stages, or areas, of construction and development work.¹⁹⁸

A Karalee resident informed the Commission that, although she was not personally affected by the January 2011 flood, several houses in her neighbourhood were inundated.¹⁹⁹ When she moved into her present home in 1993, the land on the opposite side of the Bremer River was pasture with cattle grazing and the natural floodplain was unaltered.²⁰⁰ At the time of purchasing her property, she checked the 1974 flood maps for the area and saw that her house had not been inundated.²⁰¹ Because of this, she was surprised at the level the 2011 floodwaters had reached in her area.²⁰²

This Karalee resident said that during the past decade, the land on the opposite side of the Bremer River has been progressively developed as part of the Citiswich development.²⁰³ Over the last three years there had been dramatic increases in the earthworks on the area between the Warrego Highway and the Bremer River, known as stage seven of the Citiswich project. She had observed large amounts of soil being cut away from hills and placed onto the floodplain, as well as truckloads of dirt being transported into the development site.²⁰⁴ She and another Karalee home-owner who gave evidence said that the fill brought in for this stage of the development built the land levels up to as much as 10 metres higher than the natural ground level in the floodplain.²⁰⁵

The second of the Karalee witnesses said that his house was completely inundated during the January 2011 flood.²⁰⁶ He believed that the floodwaters which immersed his property came from the direction of the Citiswich development and the Warrego Highway bridge,²⁰⁷ that the 10 metre high earth fill on the Citiswich site acted as a dam and pushed the floodwaters back onto his property, and that the effect of the Citiswich development was to increase the height of the flood.²⁰⁸

The engineering and environment manager for Ipswich City Council acknowledged that infill works occurred on stage seven of the Citiswich site before the 2010/2011 floods²⁰⁹ and that in some respects, the description provided by the residents about the extent of fill was accurate.²¹⁰ However, the ten metres of fill spoken of by the Karalee residents was isolated to a small depression on the site,²¹¹ approximately half a hectare in size.²¹² Most filling conducted on this stage was more likely to have been at a height of two to three metres, covering an area approximately one to two hectares in size.²¹³ He explained that some of the filling in the stage seven area at the Citiswich site was exempt development and consequently did not require a development approval.²¹⁴ The issue of exempt development of this kind is discussed further at section 7.6.2 *Exemption where fill is carried out by a public sector entity*.

The development application for the preliminary approval for the Citiswich site included a 'Masterplan Flooding Investigation', which addressed both river and local flooding concerns.²¹⁵ The study included a cumulative flooding impact assessment, which set out the proposed filling extent for the whole of the Citiswich site. The assessment concluded that the proposed filling would 'not adversely impact on the flood levels external to the site' and that 'the flood immunity of the Warrego Highway has not been reduced'.²¹⁶ A preliminary approval overriding the planning scheme for operational works was granted; it had the effect that subsequent earthworks applications for filling on the Citiswich development were assessed by reference to the Masterplan Flooding Investigation.²¹⁷

The Ipswich City Council did not expect there would be any impact from the exempt fill on stage 7, even though there had been no compensatory earthworks (such as excavation) to offset the volume of soil imported to the site.²¹⁸ This was because the amount of fill being placed on the site accorded with the Masterplan Flooding Investigation, which indicated that flood levels external to the site would not change if filling was conducted without any compensatory cut.²¹⁹ This perceived lack of impact was attributed to the particular floodplain characteristics at that locality, such as its location outside high flow areas.²²⁰

It is apparent from the evidence received by the Commission that the Bremer River in the vicinity of the Citiswich site was not fully contained in the waterway and did break out across the floodplain in the January 2011 floods.²²¹ The Commission makes no finding as to the extent to which the fill on the Citiswich site resulted in loss of flood storage capacity, if at all, or whether there were consequential impacts to surrounding properties.

7.6.1 Treatment of fill in State Planning Policy 1/03 and Guideline

Given the potential for adverse consequences to surrounding areas, the placement of fill in a floodplain should be assessed against criteria which consider its impact on surrounding land. The importance of maintaining the flood storage function of floodplains is recognised in State Planning Policy 1/03.²²²

Outcome 5 of the State Planning Policy, which applies when councils are making or amending a planning scheme, encourages councils to include planning strategies in planning schemes which 'prevent development from materially increasing the extent or the severity of natural hazards'.²²³

In Appendix 5 to the State Planning Policy 1/03 Guideline, there are example criteria which give councils a basis for devising performance outcomes to be incorporated into a code in a planning scheme.²²⁴ They include criteria that stipulate:²²⁵

- 2.1 Works do not involve:
 - a) any physical alteration to a watercourse or floodway including vegetation clearing; or
 - b) net filling exceeding 50 cubic metres.
- OR
- 2.2 The development complies with any applicable development criteria set out in a floodplain management plan.
- OR
- 2.3 Where a floodplain management plan does not exist, the proposed works either:
 - a) avoid any reductions of on-site flood storage capacity and contain within the subject site any changes to depth/duration/velocity of floodwaters of all floods up to and including the DFE [defined flood event]; or
 - b) do not change the flood characteristics at the DFE 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 Commission does not have sufficient evidence to comment on whether a criterion that permits filling up to 50 cubic metres is appropriate. However, in the Commission's view, it is essential that councils assess applications for filling or development in a floodplain against criteria which seek to protect surrounding land from any increases in flood risk, or resulting changes to flood behaviour.

Recommendations

- 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 mechanisms)
 - 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.
- 7.17 If the Queensland Government does not include such assessment criteria in the model flood planning controls, councils should consider including assessment criteria in their planning schemes 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 acceptable defined flood event by measures taken within the subject site (for example, use of compensatory works, detention basins or other engineering mechanisms), and
 - 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 process of assessing development applications for fill may be assisted by the creation and maintenance of a model. The Bundaberg Regional Council has developed, and maintains, a model which assists it to assess the impact of fill on local flooding from overland flow when an application is submitted. It regards the model as critical in managing stormwater issues.²²⁶ The benefit of such models is dealt with in further detail in section 10.2 *Stormwater*.

7.6.2 Exemption where fill is carried out by a public sector entity

There is no requirement to obtain a development permit for filling if the works constitute exempt development.²²⁷ Such works include ‘operational work or plumbing or drainage work (including maintenance and repair work) if the work is carried out by or on behalf of a public sector entity authorised under a state law to carry out the work’.²²⁸ This could include placing fill onto a site in the floodplain. As indicated previously, some of the fill placed on the Citiswich site falls within this category of development.

In addition to fill placed on the Citiswich site, members of the public have raised concerns with Ipswich City Council about the depositing, without approval, of fill taken from the Ipswich Motorway Upgrade Project.²²⁹ The project, being overseen by the Department of Transport and Main Roads, is an upgrading of the Ipswich Motorway in three locations: the Ipswich/Logan Interchange, from Wacol to Darra and from Dinmore to Goodna.²³⁰ The Ipswich City Council observed that fill sourced from the project had not necessarily been placed by the Department of Transport and Main Roads, but may have been deposited by some of its contractors.²³¹ It is unclear, from the council’s perspective, whether the exemption afforded to public sector entities under the legislation protects the activity in this respect.²³²

Ipswich City Council provided a statement to the Commission about the difficulties experienced in Ipswich in consequence of the exemption afforded to public sector entities. The exemption can result in fill’s being placed in

stormwater flow paths and areas that are susceptible to flood without any technical assessment by council of the impacts.²³³ There are associated difficulties in taking compliance action against receiving landowners, and problems with distinguishing what is exempt.²³⁴ Ipswich City Council believes that it should have an opportunity to assess the impact of any proposed filling in a floodplain, regardless of the identity of the entity undertaking the fill.²³⁵

In the Commission's view, given the potential impact on other properties through the diversion of floodwaters, public sector entities should not be exempt from obtaining development approvals for filling where the filling is to be deposited away from the site of its extraction and in a floodplain.

Recommendation

7.18 The Queensland Government should consider amending the *Sustainable Planning Regulation 2009* so that operational work or plumbing or drainage work (including maintenance and repair work) carried out by or on behalf of a public sector entity authorised under a state law to carry out the work is not exempt development under the *Sustainable Planning Act 2009* if the development has the potential to reduce floodplain storage.

7.6.3 Examples of problems from fill associated with infrastructure

In addition to the evidence concerning fill placed in commercial development projects and fill extracted from major infrastructure projects and deposited elsewhere, the Commission heard evidence from members of the public who expressed concerns about the impact of public infrastructure on flooding.

An Emerald resident believed that the railway line running parallel to the Capricorn Highway caused floodwaters to back up in the 2010/2011 floods.²³⁶ His opinion was based on the facts that the flood peaked at different levels and times on each side of the railway line; the southern side was approximately 600 millimetres higher than the northern side;²³⁷ and the rail line has only a limited number of small culverts where water can drain away.²³⁸

Concerns about the effect of local railway lines on flood behaviour were also raised by the Jondaryan District Residents Association. The association expressed the view that the Western Railway line raised water levels in homes on the northern side of the line at Jondaryan during floods, and that this was a consequence of lack of adequate drainage points under the railway.²³⁹ According to the association, the resulting pressure build-up caused the railway line to 'blow out' at points between Doctor's Creek and Jondaryan, washing ballast from the line onto the Warrego Highway.²⁴⁰

One resident of Male Road in Caboolture raised concerns that the Bruce Highway exacerbated local floodwater levels.²⁴¹ A report commissioned by the Moreton Bay Regional Council on the cause of regular flooding in Male Road concluded that regular flooding of the area was attributable primarily to the fact that the land is low lying and located within the floodplain of King John Creek.²⁴² The Bruce Highway was found to contribute to the increase in upstream flood levels at Male Road, although it was not possible to state with certainty how this increase affected the flooding of houses in the area.²⁴³

Upgrades to the Ipswich Motorway, in particular the Monash overpass construction works, were also the subject of evidence heard by the Commission. Residents of a nearby townhouse complex believed these works created a damming effect which increased the height of floodwaters.²⁴⁴ The Department of Transport and Main Roads acknowledged that the Monash overpass construction works involved a significant road embankment which would remove the existing overland flow path for the catchment, and accordingly required the construction of a culvert.²⁴⁵

It is not appropriate or feasible for the Commission to undertake the factual and technical investigations necessary to reach a conclusive view in each of these cases about whether the construction of the infrastructure worsened the flooding conditions experienced by nearby residents. However, the examples provided serve to identify that there is community concern about the effects of infrastructure development on flood levels. The possibility of impact on flooding should be considered by the Queensland Government when designing and constructing infrastructure. (See also section 10.5 *Roads and rail*.)

7.7 Levees

A levee is a raised embankment.²⁴⁶ Flood mitigation levees are located so as to provide protection from water breaking out of rivers and creeks. An embankment built, for example, alongside a river to protect a town on the floodplain will mitigate flooding, up to a point, in that town. It might, though, increase flood heights on the other side of the river. By protecting the town, the levee removes a portion of the storage volume on the floodplain; logically, the water that would have inundated the town must go elsewhere. On some floodplains and for some levees, the effect may be minimal. In other places, it may be significant.

Levees have other drawbacks: if they are overtopped, the damage caused by the water's breakout can be considerable. A levee may hold floodwater at a damaging height for longer by constraining its escape. There is also a risk that individuals or a community protected by a levee will become complacent, assuming that the levee will protect against all floods:²⁴⁷ a dangerous mindset.

The Commission has not set out to establish whether any particular levee caused harm in the 2010/2011 floods; individual hydraulic studies would be required to form such conclusions and are beyond the scope of the Commission's investigation. What has attracted the Commission's attention are systemic questions of inconsistency in the approach to the control of the development of levees and disputes as to who should impose that control. The potential impact of levees on flooding means that those issues should be resolved.

7.7.1 Levees in the 2010/2011 floods

The Commission heard evidence about towns with levees in the Goondiwindi and Balonne Regional Council areas. In Goondiwindi, an 11 metre high embankment²⁴⁸ built in 1957 successfully protected the town from the 2010/2011 floods:²⁴⁹ the highest floods on record.²⁵⁰ A temporary levee constructed in St George prior to flooding protected most of the town in 2010/2011: the flood peak of 13.2 metres was more than a metre below the crest of the embankment.²⁵¹ Thallon, Mungindi and Dirranbandi also employ levee banks which successfully protected those towns from the nearby Balonne River during the 2010/2011 floods.²⁵²

Evidence was received of various types of levees used to protect rural properties during the 2010/2011 floods. In the St George region, channel irrigation systems on cotton farms, primarily used to deliver water to the farms,²⁵³ acted as levee banks to protect properties from the floodwaters of the Balonne River.²⁵⁴ In north-east Emerald, a large levee, kilometres long, had been built along the side of two creeks.²⁵⁵ In Bundaberg, small dirt banks had been constructed on a farm.²⁵⁶ Owners of properties near each of those levees raised concerns that their effect was to worsen the flooding nearby.²⁵⁷

Possibly the largest levee banks in Queensland are those at the Ensham mine near Emerald, built 30 metres high to withstand the level that would be reached by a flood with an average recurrence interval of 1000 years.²⁵⁸ Those levees were built after previous, smaller banks were overtopped²⁵⁹ by flooding in 2008, leading to inundation of mine pits and a loss of production.²⁶⁰ The current levee banks were approved in 2009 and withstood the major flooding of the Nogoa River in 2010/2011.²⁶¹

7.7.2 Post-flood consideration of levees in urban areas

Following the 2010/2011 floods, Brisbane and Ipswich city councils have taken steps to explore using levees as a flood mitigation measure in high density urban areas.²⁶²

There are currently no levees within the Ipswich City Council boundaries.²⁶³ The council engaged external consultants to investigate the feasibility and cost effectiveness of levees in specific areas that were seriously affected by the 2010/2011 floods. Particular attention is being given to an area of the central business district where inundation was the result of water's making its way through a railway underpass from the Bremer River.²⁶⁴

Brisbane City Council engaged experts to prepare a report identifying engineering options that could provide flood mitigation for Brisbane;²⁶⁵ it listed a number of possible structural flood mitigation measures for Brisbane, including levees.²⁶⁶ The report acknowledged the complexity of assessing whether levees would be suitable in such an urban environment, and suggested that they would not be suitable along waterways. However, the report considered that levees might be a feasible solution to protect critical infrastructure such as the cold stores at the Brisbane Markets at Rocklea.²⁶⁷

These considerations have been taken into account by Brisbane City Council in developing an interim framework for the management of levees in areas of strategic importance as part of its Flood Action Plan of January 2011.²⁶⁸ The framework is designed for assessing levees' prospects of success, with specific criteria to assist the council or private owners considering the building of a levee.²⁶⁹ It remains for this framework to be given legal effect, either by a local law or an amendment to the Brisbane planning scheme.²⁷⁰

7.7.3 Controlling the construction of levees

Current regimes

Planning schemes

Councils can control the conditions under which levees are built through their planning schemes. For example, the construction of levee banks in the Ipswich City Council area requires development approval under the council's planning scheme.²⁷¹ However, the construction may be exempt from requiring development approval under the Ipswich planning scheme if the levee bank is insignificant; for example, if it is not greater than 1000 square metres in area or more than 50 centimetres in height.²⁷²

Local laws

During the 2010/2011 floods, seven councils²⁷³ had local laws²⁷⁴ concerning levees. Two councils let their local laws expire on 31 December 2011;²⁷⁵ three councils have indicated their intention to repeal them²⁷⁶ and one council has provided no indication as to the future of its local laws.²⁷⁷ The seventh council, Goondiwindi Regional Council, is considering the inclusion of levees as assessable development in its next planning scheme, which would have the effect that no levee bank could be built without the approval of council.²⁷⁸ In the interim, the council proposes to enact a local law for the regulation of levee banks for the whole council region.²⁷⁹

A catchment wide floodplain board

The former Emerald and Peak Downs shire councils formed the Nogo River Flood Plain Board in 1996,²⁸⁰ with authority to assess levees within the boundaries of a defined floodplain area.²⁸¹ The board was empowered as a 'joint local government' under the *Local Government Act 2009*.²⁸² It followed an assessment process outlined in the relevant local law.²⁸³ On receiving an application for construction of a levee, the board would invite the public and nearby landholders to make submissions on the application.²⁸⁴ Applications were required to be accompanied by a hydraulic report advising on the impact of the levee on the catchment and neighbouring properties.²⁸⁵ SunWater Limited²⁸⁶ provided the board with further hydraulic analysis and advice in respect of the applications it received.²⁸⁷

The board voted to dissolve itself in 2011. The Central Highlands and Isaac regional councils approved its abolition. The board said it had taken such drastic action because it was unable to regulate the floodplain efficiently; its preference was for the Queensland Government to assume responsibility for floodplain regulation.²⁸⁸ The magnitude of the issues it was dealing with, including multi-million dollar mining operations, were matters of state and national importance, and it lacked the technical and financial means to address the possible ramifications of coal mining developments on the floodplain; it was created to deal with farming levees.²⁸⁹

The board's concern was borne out in its dealings with Ensham Resources in 2009 regarding the latter's proposed mine levees: after Ensham complained of difficulty obtaining flood levee construction permits from the board, the Minister for Infrastructure and Planning declared the levee construction project a 'prescribed project' under Part 5A of the *State Development and Public Works Organisation Act 1971*, with the ultimate result that the Coordinator-General made the decision to issue permits for the levee banks.²⁹⁰ An explanation of prescribed projects is provided at section 6.3.3.

Department of Environment and Resource Management

The Assistant Director-General of DERM gave evidence that DERM has no overarching role or responsibility in respect of flood mitigation levees;²⁹¹ in fact, he was not aware of any significant regulatory role of any Queensland Government department.²⁹² He outlined four narrow areas in which DERM does exercise regulatory control over levees:²⁹³

- diversion of a watercourse approved under the *Water Act 2000* as part of mining activities authorised by the *Environmental Protection Act 1994*²⁹⁴

- activities authorised by the *Environmental Protection Act 1994* (flood protection levees for mining activities and bunding for the containment of hazardous materials)²⁹⁵
- within a drainage and embankment area designated under the *Water Regulation 2002*²⁹⁶ (only three areas have been designated drainage and embankment areas under the Regulation)²⁹⁷
- the construction and use of infrastructure, including dams and associated works intended to take overland flow water, including floodwater, for water supply purposes.²⁹⁸

There might be an argument that DERM's role in fact extends beyond those four situations. Some instances of 'taking or interfering with water' (which is likely to capture most, if not all, levees) require a development permit under the *Sustainable Planning Regulation*, while others do not.²⁹⁹ Where a development permit is required, DERM may be the assessment manager.³⁰⁰

In addition to its legislative responsibilities, DERM provides information, on request, to councils to assist them to assess flood mitigation levees.³⁰¹ DERM does not collate or hold comprehensive information on all levees in Queensland, as it does not consider itself responsible for them.³⁰²

Need for regulation

Structural measures, such as levees, are one of the four main threads of best practice floodplain management outlined in *Floodplain Management in Australia*;³⁰³ see section 2.1 *Principles of floodplain management* above. If it is appropriate that levees form part of a council's floodplain management plan, it is also appropriate that levees be regulated. The fact that levees affect watercourses makes them a necessary part of any consideration of flooding in a catchment. It does not assist floodplain management for landholders to have, as they do in some areas of Queensland, free rein to build levees on their properties.

Levees may cause damage far from their location. As an adjustment to the natural watercourse, they can affect the entire catchment in which they are located. That propensity to cause damage to other property supports the argument for consistent and state-wide regulation.

The patchwork of DERM and council approvals, and in some areas, a complete absence of regulation, is not conducive to consistent decision-making. Uniform regulation of the construction of levee banks would ensure that applications to build them are judged against the same standards, no matter where they are built and for what purpose. Mining levees in Central Queensland assessed by DERM would be required to meet the same criteria as farming levees near the New South Wales border. Consistency holds advantages for landholders who wish to build a levee, or who live near a proposed one.

Options for controlling the building of levees

The Commission considered two options for controlling the construction of levee banks within the land use planning regime: the designation of levees as assessable development, or local laws. If the former is chosen, either councils or the Queensland Government could act, in effect, as regulator; if the latter, the regulators must be councils.

Levees are a type of development under the *Sustainable Planning Act 2009*.³⁰⁴ They are not specifically designated, by name, as 'assessable development' in the *Sustainable Planning Regulation 2009*, although they may be assessable as 'interfering with water': see the section *Department of Environment and Resource Management* above. The regulation of levees in a planning scheme prepared under the *Sustainable Planning Act 2009* is not compulsory. Levees are not dealt with in regional plans, state planning regulatory provisions, any state planning policy or the Queensland Planning Provisions.

The Queensland Government could, by legislation, ensure that building a levee requires a development permit by:

- designating it as assessable development in Schedule 3 of the *Sustainable Planning Regulation 2009*, or
- requiring, by way of a state planning policy or mandatory provision in the Queensland Planning Provisions,³⁰⁵ that councils nominate the construction of a levee as 'assessable development' in their planning schemes.³⁰⁶

If a council's current planning scheme is not made under the *Sustainable Planning Act 2009*, and does not regulate levees, the council can make a local law for that purpose.³⁰⁷ The Queensland Government could encourage councils in that position to adopt such a local law by proposing a suitable model local law. But any such local law will only

apply until the time that a council decides to prepare its next planning scheme under the *Sustainable Planning Act 2009*; after that, the council may only regulate levees through its planning scheme. Consequently, this option would be an interim measure at best.

The Queensland Government should consult councils to determine the most effective way to regulate the construction of levees consistently across Queensland.

The appropriate regulator

The two candidates to regulate levees are the Queensland Government and councils.

Many councils, and their representative body, the Local Government Association of Queensland, submitted that the Queensland Government should be responsible for regulating all levees.³⁰⁸ (In New South Wales and Victoria, floodplains are managed at a state government level.³⁰⁹) They maintain that councils do not have the necessary technical expertise and financial means to conduct the scientific studies necessary for proper assessment of a proposal to build a levee bank,³¹⁰ and refer to the catchment wide implications of levees³¹¹ and interstate issues in the border region as reasons for the Queensland Government to be in charge.³¹²

The Queensland Government does not consider it is best placed to consider applications to build levee banks. It points to council expertise in approving development applications under planning legislation, and the importance of local knowledge of the area in which a levee is proposed. The government suggests that it could assist councils by providing expert advice as a referral agency during the assessment process.

Both arguments have merit. The evidence is that neither councils nor the Queensland Government are immediately capable of assessing applications for permits to build levee banks: both would require the devotion of more resources to that task.³¹³ Depending on the method of regulation chosen, both could be involved, in different capacities, in assessing applications. The Queensland Government and councils should reach a decision as to which will regulate the construction of levee banks. The Commission's concern is that a state-wide, consistent process be put in place for that regulation.

Recommendations

7.19 Levees should be regulated.

7.20 The Queensland Government should consult with councils to determine an effective method for the regulation of the construction of levees in Queensland.

In particular, the Queensland Government should consider:

- requiring a development permit for the construction of a levee by designating levees as assessable development in the *Sustainable Planning Regulation 2009*, or
- requiring, by way of a state planning policy or mandatory provision in the Queensland Planning Provisions, that councils nominate the construction of a levee as assessable development in their planning schemes.

7.7.4 Types of levees to be regulated

A uniform definition is essential to consistency of decisions about where and how levees are built across Queensland. There is no widely accepted definition of 'levee' as a term for the purpose of regulation. There are, however, a number of definitions in Australian, and indeed Queensland, literature on the subject, which could be considered in determining how best to define the term so as to identify what is to be regulated.³¹⁴ One matter that should be considered in defining 'levees' is whether some embankments are so small, or have such insignificant effect, that they should be excluded from regulation. Another is whether any definition should extend to emergency works carried out to protect properties against an immediate threat of flooding.

Recommendation

- 7.21 The Queensland Government should consult with councils to formulate a definition of ‘levee’ to identify what should be regulated.

7.7.5 Process and criteria for approving the construction of a levee

There is no common process or agreed list of relevant considerations used in different areas where levees are regulated. Having common standards would assist in a uniform approach across Queensland.

In terms of process, it is important that any decision about a levee be made after public consultation and obtaining relevant scientific studies.

One important factor in assessing a proposed levee is its effects across the whole catchment in which it is located, which may include effects across local government or state borders.³¹⁵ The assessor must determine whether the proposal strikes the appropriate balance between the persons and property it seeks to protect and those it may adversely affect. Increased flood risk in neighbouring properties may be justified if the levee protects infrastructure vital to the whole community, such as a hospital or a state emergency service shed. The adverse impacts of a levee which protects a significant part of a community might be mitigated by setting higher minimum floor levels or building new evacuation routes for affected areas. Structural measures, including other levees and detention basins, could also be considered to offset the impact of a proposed levee.

The considerations applicable in determining whether to allow the building of a proposed levee should be set out in publicly available documentation. Guidance might be gained from Floodplain Management in Australia and other publications.³¹⁶ If it is decided that councils will grant development permits for the construction of levees, these considerations might usefully form part of model flood planning controls: see section 5.1 *Planning schemes*.

Recommendations

- 7.22 There should be a consistent process for the determination of applications to build levees. That process should include:
- consulting landholders who may be affected by the proposed levee
 - obtaining or commissioning appropriate hydrological and hydraulic studies to assess the impacts of the proposed levee.
- 7.23 There should be a common set of considerations in the decision whether to approve an application to build a levee, including:
- the impacts of the proposed levee on the catchment as a whole
 - the benefits of the proposed levee to the individual or entity applying to build the levee and to any nearby community as a whole
 - any adverse impacts on other landholders, including the risk of levee failure
 - the implications of the proposed levee for land planning and emergency management procedures
 - whether any structural, land planning or emergency management measures can be taken to mitigate the adverse impacts of the proposed levee.

7.8 Anthills: Properties isolated by flooding of low lying access routes

Some properties did not suffer inundation during the 2010/2011 floods, but were isolated by rising floodwaters. This problem largely occurred where properties were developed on land higher than access roads. That circumstance caused difficulties of two kinds: evacuation became necessary, but routes were cut; or evacuation was not necessary, but people were isolated from essential services.³¹⁷

The Commission heard evidence about a number of properties that suffered such difficulties in the 2010/2011 floods. One of the clearest examples was in the Brisbane suburb of Bellbowrie. Three properties situated at Allard Close were built on land filled to a height above the 1% AEP flood level, which was separated from the rest of the suburb by a former golf course to the east and a low-lying gully to the west.³¹⁸

On 11 January 2011, some residents of Allard Close were isolated from the suburban road network because their shared driveway across the gully was covered by a metre of floodwater.³¹⁹ One of those residents described how, unable to get his vehicle across the water, he could not drive his family to safety or remove belongings from his house.³²⁰ On 12 January 2011, the Brisbane River filled up the gully, creating a body of water approximately 150 metres wide between his house and the rest of Bellbowrie.³²¹ His family had to evacuate that day by walking across the former golf course behind their house to Weekes Road, from where the SES ferried them across floodwaters.³²²

The construction of housing in an area susceptible to isolation in floodwaters creates a number of risks for its occupants. The artificial peninsula on which the Allard Close resident's house was constructed provided little opportunity for conventional evacuation once the floodwaters began to rise. While he was aware of the risk that his property would be isolated,³²³ by the time he realised that he might need to evacuate, the evacuation route was cut.³²⁴

The Wesley Hospital in the Brisbane suburb of Auchenflower also experienced a serious loss of access during the January 2011 floods. Situated on a steep hill (and very close to the Brisbane River), the hospital is bordered on two sides by the low lying Moorlands Park and Coronation Drive.



Wesley Hospital, January 2011 (photo courtesy *The Courier-Mail*)

Floodwaters closed all usual forms of access to the hospital from the early hours of Wednesday 12 January 2011 to late on 13 January 2011.³²⁵ Any patients who could be discharged safely were advised to leave before the hospital became isolated, if their personal circumstances allowed.³²⁶ All elective, non-acute services were cancelled for the remainder of the week and patients who would normally have been admitted to the hospital were directed to other hospitals.³²⁷ A large number of staff members volunteered to remain on site to maintain patients' care.³²⁸ Linen, pharmacy and food supplies had to be delivered using the nearby Auchenflower Railway Station pedestrian overpass; staff either carried or pushed the supplies to the hospital.³²⁹ This remained the only access route for the hospital until late on Thursday 13 January 2011. No ambulances were able to reach the hospital, although ambulance officers were able to transfer emergency patients, on foot, across the railway station overpass bridge.³³⁰ One patient was moved across the bridge on an ambulance trolley, with great difficulty.³³¹ At one point, the electricity supply to the hospital was at risk of being cut, which would have necessitated the evacuation of all patients.³³² Fortunately this did not occur, and the hospital was able to perform most fundamental services.

Since the January 2011 flood, the hospital executive has reviewed the question of access to the hospital during flood and is considering investing in a helicopter pad. It has also reviewed the hospital's communications with the State Health Emergency Control Centre and the local district disaster management group, with a view to obtaining better information during a crisis about the availability of access routes and the supply of essential services, particularly electricity.³³³

The fact that such an important piece of community infrastructure was effectively isolated for two days is of concern. Planning considerations for community infrastructure generally are discussed elsewhere in the Commission's report (see section 7.2 *Community infrastructure*).

The issue of access roads was also highlighted in the suburb of Yeronga, in south Brisbane. 'The Village', a multi-level aged care facility situated at Cansdale Street, was built on land zoned as a light industrial area, and developed in 2007 and 2008. The Brisbane City Council considered that the site presented a number of attractive features for aged care accommodation: its proximity to services and public transport, the uncontaminated nature of the site, its amenity (with parkland on three sides) and the fact that it enabled elderly residents to remain in the community, rather than having to move to the outer suburbs of Brisbane.³³⁴

It was apparent from an early stage of the assessment process for this development that the site had flood-related constraints. The preliminary development assessment for the facility included a series of pre-lodgement meetings in late 2004 and early 2005 where issues relevant to flooding on the site were identified by the developer and Brisbane City Council.³³⁵ One such issue was the location of the site in a waterway corridor.³³⁶ Throughout the development application assessment process, the Brisbane City Council raised concerns with the developer regarding the management of floodwaters from both the Brisbane River and overland flow.³³⁷ The developer's initial hydraulic reports required extensive re-analysis³³⁸ before the Brisbane City Council eventually approved the development, with conditions, on 3 October 2006.³³⁹

Although the site was known to be affected by flooding from two sources (a 1% AEP flood from the Brisbane River, or a 1% AEP overland flow flood³⁴⁰), no conditions were imposed on the development in relation to access or evacuation routes in the event of flooding.³⁴¹ The driveway crossover into 'The Village' is at the 1% AEP flood level;³⁴² however, the heights of the two access roads relevant to the site, Cansdale Street and Venner Road, have lower flood immunity levels. Cansdale Street is built to withstand floods with an average recurrence interval of 50 years, whereas Venner Road is built to withstand floods with an average recurrence interval of 20 years.³⁴³ When the aged care use was approved by Brisbane City Council, these road heights were seen as acceptable, because they accorded with the specified flood immunity levels for existing roads contained in the Subdivision and Development Guidelines in force at the time.³⁴⁴

During the January 2011 flood, the entire site was surrounded by floodwaters. On 11 January 2011, the residents of 'The Village' had to evacuate in order to escape the imminent flooding.³⁴⁵ Evacuation was carried out prior to the floodwaters reaching the premises. The basement of the building was flooded and the ground floor was submerged in approximately one metre of floodwater.³⁴⁶ Access roads to and around the site were inundated.³⁴⁷

There are obvious difficulties in residents of advanced age with mobility problems having to evacuate when surrounding roads are flooded. In some circumstances, there may not be enough warning time available for evacuation to occur before access roads begin to flood. Currently, the Brisbane City Council Subdivision and

Development Guidelines require that existing access roads be built to a height that will withstand floods with an average recurrence interval of 50 years.³⁴⁸ They do not require access above the height of the 1% AEP flood level.³⁴⁹ Nor is there any express requirement that in assessing applications for developments where the intended residents are likely to experience difficulty in evacuating quickly, regard be had to the height of the access roads into the site. The Regional Manager of the Development Assessment South Team in Brisbane City Council, expressed the view that there ought to be criteria requiring consideration of the site's proposed occupants, as well as the particular characteristics of the proposed use.³⁵⁰

In Maryborough, residents of Granville experienced loss of access to essential services as a consequence of the closure of the Granville Bridge and the major thoroughfares leading into the city. The bridge crosses the Mary River, providing the only entry point to the Maryborough central business district for the residents of Granville and other suburbs.³⁵¹ Problems also arose when low lying sections of the access roads leading off the bridge (Kent Street, Tiger Street and Mary Street) were inundated by floodwaters. The combination of the closure of these roads and of the Granville Bridge effectively closed off Granville residents' access into Maryborough from the morning of 8 January 2011 to the evening of 14 January 2011.³⁵² Similar problems were experienced by residents of Bellbowrie when that suburb was isolated and its main shopping centre inundated.³⁵³

Residents of the Tennyson Reach development also lost road access during the January 2011 flood. Situated on the banks of the Brisbane River, the ground floors of the residential towers at Tennyson Reach are built to a height above the level of the 1% AEP flood. However, problems arose during the flood when access roads to the Softstone and Lushington buildings were inundated by floodwater well before the buildings were affected. One witness estimated that the main access road on the site, King Arthur Terrace, was cut off approximately six hours before the units began to flood.³⁵⁴ Residents attempting to evacuate had to wade or swim through water to reach their vehicles.³⁵⁵

7.8.1 Current provisions in State Planning Policy 1/03

Outcome 1 of State Planning Policy 1/03 requires that in the assessment of applications for development within specified³⁵⁶ natural hazard management areas, regard must be had to the compatibility of the development with the nature of the natural hazard, except where the development proposal is a development commitment; or where there is an overriding need for the development in the public interest and no other site is suitable and reasonably available for the proposal.³⁵⁷

Under Outcome 2, if the development is not compatible with the nature of the natural hazard, but there is an overriding need for it in the public interest (and no other site is suitable and reasonably available), the aim is to minimise as far as practicable the adverse impacts from natural hazards, and to ensure the development does not result in unacceptable risk to people or property.³⁵⁸ The policy specifies that Outcome 2 will be achieved when the development is brought as near as practicable to the level required to comply with the specific outcomes in Annex 4, and does not result in an unacceptable risk to people or property.³⁵⁹ The specific outcomes in Annex 4 are:

1. Development maintains the safety of people on the development site from all floods up to and including the DFE [defined flood event].
2. Development does not result in adverse impacts on people's safety or the capacity to use land within the floodplain.
3. Development minimises the potential damage from flooding to property on the development site.
4. Public safety and the environment are not adversely affected by the detrimental impacts of floodwater on hazardous materials manufactured or stored in bulk.
5. Essential services infrastructure (for example, on-site electricity, gas, water supply, sewerage and telecommunications) maintains its function during a DFE.

Assessment of 'unacceptable risk' requires consideration of on-site and external impacts of the proposed development.³⁶⁰ Annex 5 specifies that the minimum required to avoid an unacceptable risk is achievement of 1, 2 and 4 above.³⁶¹ But State Planning Policy 1/03 does not expressly require consideration of:

- the potential for land not susceptible to flooding to be adversely affected by flood through isolation

- the impact of isolation: this may involve consideration of characteristics of the flood such as the rate of rise and duration, and how those characteristics affect a proposed use, having regard to factors such as warning times, evacuation routes and access to essential services during periods of isolation.³⁶²

The examples provided earlier in this section demonstrate the utility of such considerations.

Recommendations

- 7.24 The Queensland Government should draft assessment criteria to be included in the model flood planning controls that address:
- the prospect of isolation or hindered evacuation
 - the impact of isolation or hindered evacuation.
- 7.25 If the Queensland Government does not include such assessment criteria in the model flood planning controls, councils should consider including assessment criteria in their planning schemes that address:
- the prospect of isolation or hindered evacuation
 - the impact of isolation or hindered evacuation.

(Endnotes)

- 1 Exhibit 506, Flood Response Review Board, Brisbane Flood January 2011: Independent Review of Brisbane City Council's Response 9-22 January 2011, May 2011 [p3].
- 2 Second submission of Ipswich City Council, 28 April 2011 [p68: para 23.1].
- 3 Exhibit 911, Statement of John Adams, 2 September 2011, JA-10 [p2: para 7.3].
- 4 Second submission of Ipswich City Council, 28 April 2011 [p63: para 20.8].
- 5 Exhibit 1007, Standing Committee on Agriculture and Resource Management (SCARM), Floodplain Management in Australia: best practice principles and guidelines, SCARM Report 73, 2000 [p7: para 2.3.2.1].
- 6 Exhibit 602, Lockyer Valley Regional Council, Grantham Relocation Policy, 11 May 2011 [p2: para 1.1].
- 7 See, for example: Exhibit 561, Statement of Peita McCulloch, 15 September 2011 [p7: para 21].
- 8 Exhibit 1007, Standing Committee on Agriculture and Resource Management (SCARM), Floodplain management in Australia: best practice principles and guidelines, SCARM Report 73, 2000 [p19: para 3.6.2]; State Planning Policy 1/03 Guideline: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* [p 22: para 7.9].
- 9 Exhibit 1007, Standing Committee on Agriculture and Resource Management (SCARM), Floodplain management in Australia: best practice principles and guidelines, SCARM Report 73, 2000 [p97].
- 10 State Planning Policy 1/03 Guideline: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* [p22: para 7.9].
- 11 State Planning Policy 1/03 Guideline: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* [p55 and 58].
- 12 Exhibit 666, Statement of Glen Brumby, 15 September 2011, Attachment 19, Annexure 4; Exhibit 666, Statement of Glen Brumby, 15 September 2011, Attachment 5 [p7].
- 13 Exhibit 967, Managing Flood Risk through Planning Opportunities: Guidance on Land Use Planning in Flood Prone Areas, June 2006 [p69]; Exhibit 1007 Standing Committee on Agriculture and Resource Management (SCARM), Floodplain management in Australia: best practice principles and guidelines, SCARM Report 73, 2000 [p4: para 1.8].
- 14 Exhibit 967, Managing Flood Risk through Planning Opportunities: Guidance on Land Use Planning in Flood Prone Areas, June 2006 [p50, 53].
- 15 Exhibit 1007, Standing Committee on Agriculture and Resource Management (SCARM), Floodplain management in Australia:

- best practice principles and guidelines, SCARM Report 73, 2000 [p4: para 1.8].
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- 16 Exhibit 766, First statement of Andrew Fulton, 1 September 2011 [p10-11: para 3.1.1.2].
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- 17 Exhibit 766, First statement of Andrew Fulton, 1 September 2011 [p10: para 3.1.1.2].
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- 18 Transcript, Andrew Fulton, 11 October 2011, Bundaberg [p3911: line 10].
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- 19 Exhibit 766, First statement of Andrew Fulton, 1 September 2011 [p11: para 3.1.1.2.2 – 3.1.1.2.3]; Transcript, Andrew Fulton, 11 October 2011, Bundaberg [p3912: line 21].
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- 20 Exhibit 534, Statement of Gary Mahon, 2 September 2011, Attachment GLM-21 [p5-6].
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- 21 Exhibit 534, Statement of Gary Mahon, 2 September 2011, GLM-39 [p2]; Transcript, Gary White, 19 September 2011, Brisbane [p2761: line 18].
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- 22 Exhibit 966, Paul Grech, *Report to Queensland Floods Commission of Inquiry Addressing Town Planning Issues*, 15 October 2011 [p7: para 7.3]; Exhibit 968, Floodplain Development Manual: the management of flood liable land, April 2005 [p2].
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- 23 Exhibit 966, Paul Grech, *Report to Queensland Floods Commission of Inquiry Addressing Town Planning Issues*, 15 October 2011 [p7: para 7.3]; Exhibit 968, Floodplain Development Manual: the management of flood liable land, April 2005 [p2].
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- 24 State Planning Policy 1/03: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* [p13: para A1.2].
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- 25 For section 200 of the *Sustainable Planning Act*, 'Minister' includes any Minister, see: Schedule 3, *Sustainable Planning Act 2009*.
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- 26 Section 200, *Sustainable Planning Act 2009*.
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- 27 Section 203, *Sustainable Planning Act 2009*.
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- 28 Section 202, *Sustainable Planning Act 2009*. Use of designated land contrary to a requirement is an offence under section 582(b)(ii) of the *Sustainable Planning Act 2009*.
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- 29 Section 207(2)(d), *Sustainable Planning Act 2009*.
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- 30 State Planning Policy 1/03 Guideline: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* [p19: para 6.39].
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- 31 State Planning Policy 1/03: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* [p13: para A1.2].
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- 32 State Planning Policy 1/03: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* [p5: para 5.2; p8: Outcome 3]. Throughout this section, including in the recommendations, the phrase 'specified level of risk' should be construed to have the same meaning as the phrase does in Outcome 3 of State Planning Policy 1/03.
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- 33 State Planning Policy 1/03: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* [p3: para 2.2; p13: Annex 1].
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- 34 In brief, Outcome 1 requires, subject to some exceptions, such as where there is an overriding need for the development in the public interest and no other site is suitable and reasonably available for the proposal, that a development be compatible with the severity of the flood hazard. Outcome 2 provides that, where a proposed development is not compatible with the severity of the flood hazard, it must minimise as far as practicable the adverse impacts from flood and not result in an unacceptable risk to people or property. See State Planning Policy 1/03: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* [p6-7].
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- 35 State Planning Policy 1/03: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* [p8: para 6.15].
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- 36 State Planning Policy 1/03: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* [p8: para 6.15]; State Planning Policy 1/03 Guideline: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* [p38].
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- 37 State Planning Policy 1/03 Guideline: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide*, Appendix 9 [p70].
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- 38 State Planning Policy 1/03: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* [p8: para 6.15].
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- 39 Transcript, Luis Prado, 21 September 2011, Brisbane [p2946: line 19 and p2946: line 39].
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- 40 Transcript, Luis Prado, 21 September 2011, Brisbane [p2946: line 44].
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- 41 Exhibit 580, Statement of Luis Prado, 8 September 2011, Annexure 1 [p4].
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- 42 Transcript, Gary White, 7 November 2011, Brisbane [p4639: line 37].
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- 43 Exhibit 858, Statement of Timothy Foote, 7 October 2011, TCF-10; Exhibit 830, Major Flood Information Map 42 marked to show 45 Alice Street, Goodna; Exhibit 831, PD Online Map of 45 Alice Street, Goodna.
- 44 Transcript, Krystal Wilson, 18 October 2011, Ipswich [p4101: line 47; p4102: line 24].
- 45 Exhibit 829, Statement of Krystal Wilson, 14 October 2011 [p2: para 8 – p3: para 9].
- 46 Transcript, Krystal Wilson, 18 October 2011, Ipswich [p4104: line 30].
- 47 Transcript, Krystal Wilson, 18 October 2011, Ipswich [p4104: line 54].
- 48 Transcript, Krystal Wilson, 18 October 2011, Ipswich [p4105: line 32].
- 49 Exhibit 858, Statement of Timothy Foote, 7 October 2011, TCF-1, JB Goodwin Midson & Partners Assessment Report – 45 Alice Street Goodna [p17].
- 50 Exhibit 1007, Standing Committee for Agriculture and Resource Management (SCARM), Floodplain Management in Australia: best practice principles and guidelines SCARM Report 73, 2000 [p20].
- 51 Exhibit 639, Seventh statement of Rory Kelly, 21 September 2011, Attachment RJK-106 [p BCC.061.4797].
- 52 Transcript, Kenneth Smith, 21 September 2011, Brisbane [p2886: line 40].
- 53 Transcript, Kenneth Smith, 21 September 2011, Brisbane [p2886: line 49]; Exhibit 567, Statement of Kenneth Smith, 13 September 2011 [p2: para 6].
- 54 Transcript, Kenneth Smith, 21 September 2011, Brisbane [p2887: line 17].
- 55 Transcript, Kenneth Smith, 21 September 2011, Brisbane [p2887: line 35].
- 56 Transcript, Kenneth Smith, 21 September 2011, Brisbane [p2887: line 47].
- 57 Hawkesbury-Nepean Floodplain Management Steering Committee, Managing Flood Risk through Planning Opportunities: Guidance on Land Use Planning in Flood Prone Areas, April 2007 [p113].
- 58 See generally: Hawkesbury-Nepean Floodplain Management Steering Committee, Managing Flood Risk through Planning Opportunities: Guidance on Land Use Planning in Flood Prone Areas, April 2007 [p119]. For the fire safety requirements which apply to commercial building in Queensland, see *Building Fire Safety Regulation 2008*.
- 59 Exhibit 815, Statement of Emily Lang, 2 September 2011 [p5: para 21].
- 60 Exhibit 815, Statement of Emily Lang, 2 September 2011 [p5: para 20].
- 61 Transcript, Rosleys Blaich, 13 October 2011, Gympie [p4014: line 39; p4023: line 34]; Exhibit 804, Statement of Rosleys Blaich, 27 September 2011 [p1: para 1; p3: para 4]; Exhibit 806, Property Search for 34 Violet Street, Gympie, 29 March 1996.
- 62 Exhibit 804, Statement of Rosleys Blaich, 27 September 2011 [p2: para 2].
- 63 Exhibit 804, Statement of Rosleys Blaich, 27 September 2011 [p5: para 9].
- 64 Exhibit 804, Statement of Rosleys Blaich, 27 September 2011 [p3: para 4].
- 65 Transcript, Tania Stenholm, 13 October 2011, Gympie [p4028: line 44; p4031: line 36].
- 66 Exhibit 811, Statement of Tania Stenholm, 28 September 2011 [p3: para 15].
- 67 Transcript, Tania Stenholm, 13 October 2011, Gympie [p4030: line 42].
- 68 Transcript, Tania Stenholm, 13 October 2011, Gympie [p4031: line 17].
- 69 Transcript, Tania Stenholm, 13 October 2011, Gympie [p4031: line 9].
- 70 Transcript, Michael Hartley, 13 October 2011, Gympie [p4071: lines 1-56]; Exhibit 820, Statement of Michael Hartley, 25 August 2011 [p 3: para 6], see SO-18 and PS-18f.
- 71 Transcript, Michael Hartley, 13 October 2011, Gympie [p4071: lines 46-56].
- 72 Transcript, Michael Hartley, 13 October 2011, Gympie [p4072: line 21].
- 73 Exhibit 545, Memorandum Brisbane City Council to DERM, Department of Community Safety and Department of Infrastructure and Planning, 25 January 2011 [p2: para 1].
- 74 Exhibit 545, Memorandum Brisbane City Council to DERM, Department of Community Safety and Department of Infrastructure and Planning, 25 January 2011 [p1]; Exhibit 546,

- Brisbane City Council Internal Memorandum, 27 January 2011 [p1].
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- 75 Exhibit 546, Brisbane City Council Internal Memorandum, 27 January 2011 [p1]; Exhibit 546, Brisbane City Council Internal Memorandum, 27 January 2011 [p3].
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- 76 Section 12, *Dangerous Goods Safety Management Act 2001*.
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- 77 The *Work Health and Safety Act 2011* replaced the repealed *Dangerous Goods Safety Management Act 2001* from 1 January 2012. For storage of dangerous goods, see Section 12, *Work Health and Safety Act 2011*; Schedule 1, section (1)(1).
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- 78 State Planning Policy 1/03: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* [p11]. See, for example, State Planning Policy 1/03 Guideline: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* [p38: para A2.31].
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- 79 Section 12, *Work Health and Safety Act 2011*; Schedule 1, section (1)(6).
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- 80 Sections 19(3)(a) and 22(2), *Work Health and Safety Act 2011*.
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- 81 Department of Emergency Services, *Safe Storage and Handling of Dangerous Goods: Guidelines for Industry*, March 2002.
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- 82 Department of Emergency Services, *Safe Storage and Handling of Dangerous Goods: Guidelines for Industry*, March 2002 [p96].
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- 83 Department of Emergency Services, *Safe Storage and Handling of Dangerous Goods: Guidelines for Industry*, March 2002 [p96].
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- 84 Section 18, *Environmental Protection Act 1994*.
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- 85 Schedule 4, *Environmental Protection Act 1994*.
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- 86 Section 17, *Environmental Protection Regulation 2008*; Schedule 2, *Environmental Protection Regulation 2008*.
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- 87 Schedule 2, Section 7, *Environmental Protection Regulation 2008*.
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- 88 Schedule 2, Section 18, *Environmental Protection Regulation 2008*.
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- 89 Schedule 2, Section 21, *Environmental Protection Regulation 2008*.
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- 90 Schedule 2, Section 25, *Environmental Protection Regulation 2008*.
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- 91 Schedule 2, Section 40, *Environmental Protection Regulation 2008*.
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- 92 Section 10, *Sustainable Planning Act 2009*.
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- 93 Section 10, *Sustainable Planning Act 2009*.
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- 94 Section 101, *Environmental Protection Regulation 2008*. DERM has also delegated responsibility to the Department of Employment, Economic Development and Innovation for the administration of two particular environmentally relevant activities: intensive animal feedlotting and pig keeping. The activities administered by the Department of Employment, Economic Development and Innovation are not generally associated with industrial land uses, and are not addressed further in this section.
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- 95 Section 101, *Environmental Protection Regulation 2008*.
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- 96 Section 73A, *Environmental Protection Act 1994*.
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- 97 *Environmental Protection Act 1994*, Schedule 4 definition of ‘Standard Criteria’, para (c).
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- 98 Exhibit 624, Statement of Jonathan Womersley, 19 September 2011 [p12: para 74, and 75]; Transcript, Rory Kelly, 27 September 2011, Brisbane [p3249: line 40].
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- 99 Exhibit 624, Statement of Jonathan Womersley, 19 September 2011, Annexures JCW-10 – JCW-14.
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- 100 Transcript, Rory Kelly, 27 September 2011, Brisbane [p3249: line 21].
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- 101 Exhibit 624, Statement of Jonathan Womersley, 19 September 2011, Annexure JCW-03.
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- 102 Exhibit 624, Statement of Jonathan Womersley, 19 September 2011, Annexure JCW-03 [p2-3: para 3.1].
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- 103 Transcript, Jonathan Womersley, 26 September 2011, Brisbane [p3172: line 54].
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- 104 Exhibit 624, Statement of Jonathan Womersley, 19 September 2011 [p14: para 85].
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- 105 Exhibit 624, Statement of Jonathan Womersley, 19 September 2011, Attachment JCW-09.
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- 106 Transcript, Jonathan Womersley, 26 September 2011, Brisbane [p3173: line 27].
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- 107 Transcript, Rory Kelly, 3 October 2011, Brisbane [p3491: line 21].
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- 108 Section 101, *Environmental Protection Regulation 2008*.
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- 109 Transcript, Rory Kelly, 3 October 2011, Brisbane [p3491: line 48].
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- 110 State Planning Policy 1/03: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide*, 2003 [p11]; Annexure 1 [p13: para A1.1].
- 111 State Planning Policy 1/03, *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* [p4: para 3.3]; Annexure 1 [p13: para A1.1]. For the purpose of State Planning Policy 1/03, the definition of hazardous materials in the *Dangerous Goods Safety Management Act* applies, excepting radioactive and infectious substances.
- 112 State Planning Policy 1/03: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* [p6].
- 113 State Planning Policy 1/03, *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide*, Annexure 4 [p18: para A4.2].
- 114 State Planning Policy 1/03, *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* [p59].
- 115 State Planning Policy 1/03, *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* [p59: para 4.1].
- 116 State Planning Policy 1/03, *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* [p59: para 4.2].
- 117 State Planning Policy 1/03, *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* [p59].
- 118 Exhibit 766, Statement of Andrew Fulton, 1 September 2011 [p18: para 5.1 – p19: para 5.4].
- 119 Exhibit 820, Statement of Michael Hartley, 25 August 2011 [p10: para 27, 29].
- 120 Statement of Julie Edwards, undated [p10: para 4.6-4.7].
- 121 Statement of Christopher Warren, 12 September 2011 [p11: para 5.8]; Exhibit 1005, Statement of Bradley Sully, 7 September 2011 [p2: para 5].
- 122 Specifically the Industrial Design Code and the Industrial Amenity and Performance Code. These codes ‘call up’ the Stormwater Management Code. With respect to flooding, the Stormwater Management Code lists, as an acceptable solution, compliance with the Subdivision and Development Guidelines. The Subdivision and Development Guidelines prescribe minimum floor levels for certain types of building, and certain types of flooding (that is, Brisbane River flooding, local flooding, waterway flooding, and storm tide). The Guidelines also allow a risk management approach to be applied, in lieu of compliance with prescribed minimum floor levels.
- 123 Statement of John Adams, 2 September 2011 [p25: para 54].
- 124 Exhibit 1005, Statement of Bradley Sully, 7 September 2011 [p3: para 1]; Exhibit 766, Statement of Andrew Fulton, 1 September 2011 [p19-20: para 5.4-5.7]; Exhibit 796, Statement of Michael Ellery, 29 August 2011 [p5: para 31]; Statement of Hendrik Christian du Plessis, 6 October 2011 [p11: para 17]; Statement of Luke Lankowski [p5: para 5.2]; Exhibit 820, Statement of Michael Hartley, 25 August 2011 [p10: para 28].
- 125 Exhibit 1005, Statement of Bradley Sully, 7 September 2011 [p3: para 1].
- 126 Statement of Luke Lankowski, 1 September 2011 [p5: para 5.1 – p6: para 5.6].
- 127 Transcript, Gary White, 19 September 2011, Brisbane [p2751: line 57].
- 128 Exhibit 820, Statement of Michael Hartley, 25 August 2011 [p11: para 30]; Statement of Christopher Warren, 12 September 2011 [p12: para 6.3]; Exhibit 796, Statement of Michael Ellery, 29 August 2011 [p5: para 32-33]; Exhibit 544, Statement of Martin Reason, 1 September 2011 [p26: para 84]; Exhibit 1005, Statement of Bradley Sully, 7 September 2011 [p3-4]; Statement of John Adams, 2 September 2011 [p25: para 55].
- 129 Exhibit 766, Statement of Andrew Fulton, 1 September 2011 [p20: para 6.1]; Transcript, Andrew Fulton, 11 October 2011, Bundaberg [p3921: line 14]; Statement of Hendrik Christian du Plessis, 6 October 2011 [p11: para 17]; Statement of Julie Edwards [p11: para 5.2]; Exhibit 770, Statement of Robert Savage [p9: para 36-37].
- 130 Exhibit 820, Statement of Michael Hartley, 25 August 2011 [p11-12: para 30].
- 131 Exhibit 796, Statement of Michael Ellery, 1 September 2011 [p5: para 32-33].
- 132 Transcript, Rory Kelly, 27 September 2011, Brisbane [p3245: line 40].
- 133 ‘Prescribed tidal work’ is defined in sections 14 and 15 of the *Coastal Protection and Management Regulation 2003*.
- 134 See Schedule 3, *Sustainable Planning Regulation 2009*.
- 135 Schedule 4A, *Coastal Protection and Management Regulation 2003*.

- 136 See Schedule 6, *Sustainable Planning Regulation 2009*. The Department of Transport and Main Roads, the Department of Employment, Economic Development and Innovation and DERM may also be involved in the assessment of prescribed tidal work as referral agencies (see schedule 7, *Sustainable Planning Regulation 2009*).
- 137 Schedule 4A, Part 1, Clause 2(b), *Coastal Protection and Management Regulation 2003*.
- 138 ‘Specific outcomes’ and ‘probable solutions’ work in a similar way to ‘performance outcomes’ and ‘acceptable outcomes’ which are described in section 4.3 *Queensland Planning Provisions*.
- 139 Part 3, Item 12.1, Schedule 4A, *Coastal Protection and Management Regulation 2003*.
- 140 For example, Australian Standard (AS 4997-2005) *Guidelines for the design of maritime structures* and Australian Standard (AS 3962-2001) *Guideline for the design of marinas*.
- 141 Part 3, Item 12.1, Schedule 4A, *Coastal Protection and Management Regulation 2003*.
- 142 The floating pontoon section of the Riverwalk was between Howard Smith Wharves and Merthyr Road. This floating pontoon comprised one section of the Riverwalk which also includes ground and elevated walkways, which run parallel to both sides of the Brisbane River. These other sections of the Riverwalk performed well (apart from localised damage) in the January 2011 flood and remain in service (see Exhibit 535, Statement of Christopher Beckley, 9 September 2011 [p3: para 8]).
- 143 Exhibit 535, Statement of Christopher Beckley, 9 September 2011, Attachment CJB-9 [p11].
- 144 Exhibit 535, Statement of Christopher Beckley, 9 September 2011, Attachment CJB-9 [p11].
- 145 Exhibit 376, Statement of Captain Richard Johnson, 18 April 2011 [p12].
- 146 Exhibit 535, Statement of Christopher Beckley, 9 September 2011, Attachment CJB-9 [p11].
- 147 Exhibit 535, Statement of Christopher Beckley, 9 September 2011, Attachment CJB-9 [p11].
- 148 Exhibit 535, Statement of Christopher Beckley, 9 September 2011 [p3: para 9].
- 149 The 1% AEP flood loads were adjusted to obtain an anticipated 0.05% AEP flood load applying a load factor of 1.4 (see Exhibit 535, Statement of Christopher Beckley, 9 September 2011 [p7: para 14]). The data to determine the 1% AEP flood was supplied by Brisbane City Council to the design consultant by supplying one and two dimensional modelling information and the consultant then used three dimension modelling to give a more specific answer (Transcript, Christopher Beckley, 20 September 2011, Brisbane [p2855: lines 1-10]).
- 150 As far as Brisbane City Council is aware, while there were at the time statutory requirements relating to authorisation of the carrying out of works like the New Farm Riverwalk in tidal areas, the standards for flood resilience for structures were a matter for the design engineer applying professional judgment in the design, and relevant Australian standards to the extent they applied (see Exhibit 535, Statement of Christopher Beckley, 9 September 2011 [p7: para 15]).
- 151 Exhibit 535, Statement of Christopher Beckley, 9 September 2011 [p7: para 16].
- 152 Exhibit 535, Statement of Christopher Beckley, 9 September 2011, Attachment CJB-9 [p15].
- 153 Exhibit 535, Statement of Christopher Beckley, 9 September 2011, Attachment CJB-9 [p12, 13].
- 154 Exhibit 535, Statement of Christopher Beckley, 9 September 2011, Attachment CJB-9 [p18].
- 155 Brisbane City Council, Riverwalk Replacement Project, www.brisbane.qld.gov.au/traffic-transport/roads-infrastructure-bikeways/bikeway-and-pathway-projects/Riverwalk-replacement/index.htm, accessed 17 January 2012.
- 156 Transcript, Christopher Beckley, 20 September 2011, Brisbane [p2856].
- 157 Exhibit 556, Statement of Ashley Horneman, 9 September 2011 [p7: para 30].
- 158 Exhibit 556, Statement of Ashley Horneman, 9 September 2011 [p7:para 32 – p8: para 34].
- 159 The terminals were: Apollo Road, Bulimba; Brett’s Wharf, Hamilton; Commercial Road, Teneriffe; Oxford Street, Bulimba; Hardcastle Park, Hawthorne; Merthyr Road, New Farm; Wynnum Road, Norman Park; New Farm Park, New Farm; Park Avenue, Mowbray Park; Sydney St, New Farm; Eagle Street/Riverside, Brisbane City; Holman Street, Kangaroo Point; Thornton Street, Kangaroo Point; QUT-Gardens Point, Brisbane City; Cultural Centre/Southbank, South Brisbane; Orleigh Park, West End; University of Queensland, St Lucia; and TJ Doyle Memorial

- Drive, Dutton Park (see Exhibit 556, Statement of Ashley Horneman [p3: para 11]).
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- 160 Exhibit 556, Statement of Ashley Horneman, 9 September 2011 [p3-4: para 12]. Australian Standard AS 3962-2001 *Guidelines for the Design of Marinas*, which contains standards relevant to the design of ferry terminals, was first published in 1992 and therefore ferry terminals designed prior to this would not have used this Australian Standard as a basis for design: Exhibit 556, Statement of Ashley Horneman, 9 September 2011 [p4: para 13].
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- 161 The design notes for the terminal upgrades state the flood velocity adopted was 2.5 metres per second. However, the design notes do not indicate to what flood event the flood velocity applies: Exhibit 556, Statement of Ashley Horneman, 9 September 2011 [p4: para 15].
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- 162 The terminals were: a new site at University of Queensland; Guyatt Park, St Lucia; North Quay, Brisbane City; and South Bank, South Brisbane: Exhibit 556, Statement of Ashley Horneman, 9 September 2011 [p4: para 16].
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- 163 Brisbane City Council indicated the design velocity for these new terminals was 3 metres per second, which, Brisbane City Council told the Commission, is 'almost certainly' a velocity that would be experienced in a 1% AEP flood: Exhibit 556, Statement of Ashley Horneman, 9 September 2011 [p4: para 15; p5: para 17].
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- 164 Exhibit 556, Statement of Ashley Horneman, 9 September 2011 [p5: para 20 – p6: para 26].
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- 165 These seven terminals are: University of Queensland; Regatta; North Quay; Queensland University of Technology; Maritime Museum (formerly River Plaza); Holman Street; and Sydney Street (see Exhibit 556, Statement of Ashley Horneman, 9 September 2011 [p7-8: para 33]).
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- 166 Exhibit 556, Statement of Ashley Horneman, 9 September 2011 [p7: para 36].
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- 167 Exhibit 556, Statement of Ashley Horneman, 9 September 2011 [p9: para 40-43]. See also Brisbane City Council's Ferry Terminal Design Specification: Exhibit 556, Statement of Ashley Horneman, 9 September 2011, Attachment ASH-11.
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- 168 Exhibit 556, Statement of Ashley Horneman, 9 September 2011 [p9: para 44].
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- 169 Exhibit 535, Statement of Christopher Beckley, 9 September 2011, Attachment CJB-12.
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- 170 The repair must comply with the conditions of DERM Exemption Certificate (permit no. CSCE019518811) dated 14 February 2011.
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- 171 See section 120C, *Coastal Protection and Management Act 1995*. There is also provision within section 585 of the *Sustainable Planning Act 2009* to allow for construction of tidal work without approval if the council is of the view that the works are necessary to ensure public safety or to protect the structural integrity of an existing structure. However, a development application for the works would need to be made as soon as reasonably practicable following commencement of the emergency work.
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- 172 Correspondence from Brisbane City Council, 18 January 2012 [p2].
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- 173 Transcript, Christopher Beckley, 20 September 2011, Brisbane [p2857]; Exhibit 535, Statement of Christopher Beckley, 9 September 2011, Attachment CJB-12.
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- 174 Transcript, Gary Ellis, 19 October 2011, Ipswich [p4260: line 26]; Exhibit 1007, Standing Committee on Agriculture and Resource Management (SCARM), Floodplain management in Australia: best practice principles and guidelines, SCARM Report 73, 2000 [p57: para G.5.2]; Report of Tony Loveday, Flood Commission – Review of Evidence – Citiswch Development, 7 November 2011 [p5].
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- 175 Brisbane City Plan, Appendix 2 [p64c].
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- 176 Transcript, Gary Ellis, 19 October 2011, Ipswich [p4259: line 22]; Report of Mr Neil Collins, Response Report to Floods Commission – Review of Evidence Report on Citiswch Development by Tony Loveday (Bremer Business Park Masterplan) [p6-3, para 7(c)].
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- 177 Transcript, Rory Kelly, 3 October 2011, Brisbane [p3517: line 20].
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- 178 Transcript, Rory Kelly, 3 October 2011, Brisbane [p3517: line 27]; Statement of Neil Fitzpatrick, 13 September 2011 [para 10].
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- 179 Exhibit 647, Statement of Robert Clements, 13 September 2011 [p7: para 29]; Transcript, Robert Clements, 27 September 2011, Brisbane [p3266: line 5].
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- 180 Transcript, Rory Kelly, 3 October 2011, Brisbane [p3518: line 33]; Exhibit 647, Statement of

- Robert Clements, 13 September 2011 [p7: para 29; p8: para 31]; Annexure 1 [p6].
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- 181 Exhibit 647, Statement of Robert Clements, 13 September 2011 [p7: para 29]; Transcript, Robert Clements, 27 September 2011, Brisbane [p3262: line 57].
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- 182 Transcript, Robert Clements, 27 September 2011, Brisbane [p3262: line 5].
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- 183 Transcript, Robert Clements, 27 September 2011, Brisbane [p3265: line 48]; Exhibit 647, Statement of Robert Clements, 13 September 2011 [para 29-30]; Annexure 1 [p6].
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- 184 Further approvals for building works and operational works may have also been required; however the Commission did not conduct an examination of these applications. See Exhibit 638, Sixth Statement of Rory Kelly, 21 September 2011 for a description of the approval process.
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- 185 Exhibit 638, Sixth Statement of Rory Kelly, 21 September 2011 [p6: para 13].
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- 186 Exhibit 638, Sixth Statement of Rory Kelly, 21 September 2011 [p6: para 14].
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- 187 Exhibit 638, Sixth Statement of Rory Kelly, 21 September 2011 [p9: para 16(b)]; Annexure RJK-77. The initial application was for 110 townhouses, a shop and a caretakers flat: Exhibit 638, Sixth Statement of Rory Kelly, 21 September 2011 [p7: para 15].
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- 188 Transcript, Rory Kelly, 3 October 2011, Brisbane [p3526: line 2].
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- 189 Transcript, Rory Kelly, 3 October 2011, Brisbane [p3525: line 39].
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- 190 Exhibit 638, Sixth Statement of Rory Kelly, 21 September 2011 [p8: para 16(b)]; Annexure RJK-77.
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- 191 Exhibit 638, Sixth Statement of Rory Kelly, 21 September 2011 [p9: para 16(c)]; Annexure RJK-78.
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- 192 Further information was provided to address drainage concerns and the proposed density of the development was reduced from 110 townhouses and a shop down to 90 townhouses. See Exhibit 638, Sixth Statement of Rory Kelly, 21 September 2011 [p8: para 16(a) – p12: para 16(p)].
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- 193 A memorandum from the Acting Director of the Planning Branch of the Department of Works to the Manager of that Department observes that the surrounding properties had ground levels ‘ranging from RL 4.5 to RL 10 m AHD and drain towards the subject site.’ The effect of the conditions imposed were such as ‘to set fill levels for access and building sites at R.L 5.3m AHD’ at Exhibit 638, Sixth Statement of Rory Kelly, 21 September 2011, Annexure RJK-69; Annexure RJK-73 [second schedule: p2].
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- 194 Transcript, Rory Kelly, 3 October 2011, Brisbane [p3520: line 8 – p3522: line 26; p3523: line 56 – p3525: line 30].
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- 195 Transcript, Cresta Richardson, 29 September 2011, Emerald [p3368: line 42]. Exhibit 673, Statement of Cresta Richardson, 15 September 2011 [p4: para 17].
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- 196 Exhibit 673, Statement of Cresta Richardson, 15 September 2011 [p4: para 17].
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- 197 Exhibit 860, Statement of Natalie Plumbe, 12 October 2011 [p3: para 12]; Transcript, Natalie Plumbe, 19 October 2011, Ipswich [p4231: line 1].
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- 198 Exhibit 860, Statement of Natalie Plumbe, 12 October 2011, Annexure NP-16; Transcript, Natalie Plumbe, 19 October 2011, Ipswich [p4232: line 23].
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- 199 Exhibit 862, Statement of Carol Richards, 29 August 2011 [para 6].
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- 200 Exhibit 862, Statement of Carol Richards, 29 August 2011 [para 12].
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- 201 Exhibit 862, Statement of Carol Richards, 29 August 2011 [p1: para 9].
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- 202 Exhibit 862, Statement of Carol Richards, 29 August 2011 [p3: para 33].
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- 203 Exhibit 862, Statement of Carol Richards, 29 August 2011 [p2: para 13; p3: para 29].
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- 204 Exhibit 862, Statement of Carol Richards, 29 August 2011 [p3: para 29-30].
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- 205 Exhibit 862, Statement of Carol Richards, 29 August 2011 [p3: para 30]; Exhibit 842, Statement of Julian Chambers, 20 September 2011 [p2: para 4].
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- 206 Exhibit 842, Statement of Julian Chambers, 20 September 2011 [p2: para 5]; Transcript, Julian Chambers, 18 October 2011, Ipswich [p4142: line 2].
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- 207 Exhibit 842, Statement of Julian Chambers, 20 September 2011 [p2: para 6].
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- 208 Exhibit 842, Statement of Julian Chambers, 20 September 2011 [p2: para 7]; Transcript, Julian Chambers, 18 October 2011, Ipswich [p4140: line 18; p4141: line 1].
- 209 Transcript, Gary Ellis, 19 October 2011, Ipswich [p4258: line 42].
- 210 Transcript, Gary Ellis, 19 October 2011, Brisbane [p4258: line 6].
- 211 Transcript, Gary Ellis, 19 October 2011, Ipswich [p4258: line 12].
- 212 Transcript, Gary Ellis, 19 October 2011, Ipswich [p4258: line 32].
- 213 Transcript, Gary Ellis, 19 October 2011, Ipswich [p4258: line 37].
- 214 Transcript, Gary Ellis, 19 October 2011, Ipswich [p4261: line 13, p4258: line 42]. Transcript, Natalie Plumbe, 19 October 2011, Ipswich [p4236: line 52].
- 215 Exhibit 861, Statement of Gary Ellis, 13 October 2011 [p12: para 22(b)].
- 216 Exhibit 861, Statement of Gary Ellis, 13 October 2011 [p13: para 22(g)]; Annexure GE-4 [p14].
- 217 Exhibit 861, Statement of Gary Ellis, 13 October 2011 [p14: para 24]; Transcript, Gary Ellis, 19 October 2011, Ipswich [p4255: line 29].
- 218 Transcript, Gary Ellis, 19 October 2011, Ipswich [p4259: line 1].
- 219 Transcript, Gary Ellis, 19 October 2011, Ipswich [p4259: line 17].
- 220 Transcript, Gary Ellis, 19 October 2011, Brisbane [p4259: line 17].
- 221 Exhibit 844, Queensland Reconstruction Authority Map of Disaster Affected Properties, Drawing Number LGA3960-0015-2, May 2011 [Citiswich marked].
- 222 State Planning Policy 1/03: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* [p9: para 7.5].
- 223 State Planning Policy 1/03: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* [p9].
- 224 State Planning Policy 1/03 Guideline: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* [p53: para A5.5].
- 225 State Planning Policy 1/03 Guideline: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* [p57].
- 226 Transcript, Andrew Fulton, Bundaberg, 11 October 2011 [p3916: line 49].
- 227 Section 235, *Sustainable Planning Act 2009*.
- 228 Section 231(2), *Sustainable Planning Act 2009*; Regulation 10 and Schedule 4, Table 4, Item 1 of the *Sustainable Planning Regulation 2009*.
- 229 Exhibit 912, Statement of John Adams, 25 October 2011 [p7: para 10].
- 230 For more information, see the Department of Transport and Main Roads website: www.tmr.qld.gov.au/Projects/Name/I/Ipswich-Motorway-Upgrade.aspx.
- 231 Transcript, John Adams, 28 October 2011, Brisbane [p4594: line 25; p4600: line 1].
- 232 Transcript, John Adams, 28 October 2011, Brisbane [p4602: line 51; p4603: line 1].
- 233 Exhibit 912, Statement of John Adams, 25 October 2011 [p7: para 12].
- 234 Exhibit 912, Statement of John Adams, 25 October 2011 [p7: para 12]; Transcript, John Adams, 28 October 2011, Brisbane [p4602: line 51; p4603: line 1].
- 235 Transcript, John Adams, 28 October 2011, Brisbane [p4594: line 41]; Transcript, Natalie Plumbe, 19 October 2011, Ipswich [p4239: line 4].
- 236 Exhibit 685, Statement of Geoffrey Jago, 17 August 2011 [p2: para 4].
- 237 Transcript, Geoff Jago, 29 September 2011, Emerald [p3426, line 40].
- 238 Exhibit 685, Statement of Geoffrey Jago, 17 August 2011 [p2: para 4].
- 239 Submission of Jondaryan District Residents Association Inc, 7 July 2011 [p1].
- 240 Submission of Jondaryan District Residents Association Inc, 7 July 2011 [p1].
- 241 Exhibit 610, Statement of Lola Worthington, 24 August 2011 [p2: para 9.3].
- 242 Statement of Anthony Martini, 2 December 2011 Annexure AM-2 [p19].
- 243 Statement of Anthony Martini, 2 December 2011, Annexure AM-2 [p19].
- 244 Transcript, Sharron Campbell, 5 October 2011, Brisbane [p3684: line 10]; Exhibit 718, Statement of Sharron Campbell, 7 September 2011 [p9: para 27]; Transcript, Jeanenne Wilkinson,

- 5 October 2011, Brisbane [p3725: line 42]; Exhibit 733, Statement of Matthew Morgan, 11 September 2011 [p2]; Transcript, Matthew Morgan, 5 October 2011, Brisbane [p3722: line 16].
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- 245 Exhibit 920, Statement of Derek Millar, 17 October 2011 [p4: para 21].
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- 246 The Commission's interim report included the following definition of 'levee': 'Levee is a raised embankment or earthworks along the floodplain that reduce the frequency of inundation of areas adjacent to the waterway. They are designed to withstand certain river heights, and will be overtopped if floodwaters exceed this level (Office of the Chief Scientist, 2011, Understanding floods: questions and answers [p vii]).' This definition serves only to lend a certain context to the structures that are being discussed in this chapter; the question of what is a levee for the purpose of regulation is an issue that is not settled and is discussed at section 7.7.4 *Types of levees to be regulated*.
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- 247 Exhibit 1007, Standing Committee on Agriculture and Resource Management (SCARM), Floodplain management in Australia: best practice principles and guidelines, SCARM Report 73, 2000 [p23: para 3.10].
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- 248 Transcript, Gregory Morrow, 3 May 2011, Goondiwindi [p1140: line 19].
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- 249 Transcript, Gregory Morrow, 3 May 2011, Goondiwindi [p1162: line 20]; Transcript, Gregory Morrow, 3 May 2011, Goondiwindi [p1140: line 16].
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- 250 Bureau of Meteorology, 'Flood Summary for the Macintyre River at Goondiwindi – December 2010 and January 2011' accessed 28 December 2011, www.bom.gov.au/hydro/flood/qld/fld_reports/goondiwindi_fact_sheet_2011.pdf.
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- 251 Exhibit 270, Statement of Scott Norman, 1 April 2011 [p2: para 2(a)].
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- 252 Exhibit 270, Statement of Scott Norman, 1 April 2011 [p2: para 2].
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- 253 Transcript, Cleave Rogan, 4 May 2011, St George [p1238: line 47].
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- 254 Transcript, Cleave Rogan, 4 May 2011, St George [p1239: line 5].
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- 255 Exhibit 676, Submission of Robert Anderson, 24 May 2011 [p1].
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- 256 Exhibit 752, Statement of Neville Cayley, 31 August 2011 [p3: para 8].
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- 257 Transcript, Kylie Kilroy, 4 May 2011, St George [p1254: line 46]; Transcript, Robert Anderson, 29 September 2011, Emerald [p3396: line 47]; Transcript, Robert Anderson, 29 September 2011, Emerald [p3399: line 20]; Exhibit 676, Submission of Robert Anderson, 24 May 2011 [p1]; Exhibit 752, Statement of Neville Cayley, 31 August 2011 [p3: para 8].
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- 258 Exhibit 941, Statement of Pier Westerhuis, 2 November 2011 [p8: para 19].
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- 259 For a definition of overtopping, refer to *Appendix 6, Glossary*.
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- 260 Exhibit 1018, Statement of Pier Westerhuis, 12 May 2011 [p2: para 9].
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- 261 Exhibit 1018, Statement of Pier Westerhuis, 12 May 2011 [p1: para 6].
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- 262 Transcript, Colin Jensen, 10 November 2011, Brisbane [p4911: line 29]; Transcript, Carl Wulff, 19 October 2011, Ipswich [p4194: line 22].
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- 263 Transcript, Carl Wulff, 19 October 2011, Ipswich [p4194: line 18].
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- 264 Transcript, Carl Wulff, 19 October 2011, Ipswich [p4194: line 28].
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- 265 Exhibit 954, Statement of Colin Jensen, 8 September 2011 [p2: para 2.1].
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- 266 Exhibit 954, Statement of Colin Jensen, 8 September 2011 [p2: para 2.1; CDJ-51: p11].
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- 267 Exhibit 954, Statement of Colin Jensen, 8 September 2011 [CDJ-51: p11].
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- 268 Exhibit 954, Statement of Colin Jensen, 8 September 2011 [p5: para 2.7].
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- 269 Transcript, Colin Jensen, 10 November 2011, Brisbane [p4911: line 30].
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- 270 Transcript, Colin Jensen, 10 November 2011, Brisbane [p4911: line 51].
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- 271 Exhibit 911, Statement of John Adams, 2 September 2011 [p28: para 64 – p29: para 66]; Ipswich City Council, Ipswich Planning Scheme, Part 12, Division 15, Earthworks; Ipswich City Council, Ipswich Planning Scheme, Schedule 8 - Exempt Earthworks.
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- 272 Ipswich City Council, Ipswich Planning Scheme, Schedule 8 – Exempt Earthworks.
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- 273 Central Highlands Regional Council, Goondiwindi Regional Council, Lockyer Valley Regional Council, South Burnett Regional Council, Toowoomba Regional Council, Western Downs Regional Council and Paroo Regional Council.
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- 274 The means of regulating through local laws is discussed further at section 7.7.3 *Controlling the construction of levees*.
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- 275 Exhibit 976, Statement of Luke Lankowski, 2 November 2011 [p1: para 4]; Exhibit 979, Statement of Ken Gouldthorp, 2 November 2011 [p1: para 4].
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- 276 Exhibit 974, Statement of Hendrik Du Plessis, 4 November 2011 [p1: para 2]; Exhibit 981, Statement of Phil Berting, 3 November 2011 [p1]; Exhibit 983, Statement of Ian Flint, 3 November 2011 [p1: para 2].
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- 277 Exhibit 977, Statement of Mark Watt, 20 September 2011.
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- 278 Exhibit 646, Statement of Graeme Scheu, 12 September 2011 [p3: para 7].
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- 279 Exhibit 646, Statement of Graeme Scheu, 12 September 2011 [p3: para 6].
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- 280 Exhibit 680, Statement of Philip Brumley, 6 September 2011 [p1: para 1].
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- 281 Exhibit 681, Statement of Philip Brumley, 22 September 2011 [p2: para 7(b)].
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- 282 It was originally empowered under the *Local Government Act 1993*, but after this legislation was repealed, its status was preserved under the *Local Government Act 2009* and *Local Government Reform Implementation Regulation 2008*; Exhibit 680, Statement of Philip Brumley, 6 September 2011 [p1: para 1, 4].
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- 283 Exhibit 681, Statement of Philip Brumley, 22 September 2011 [p1: para 3].
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- 284 Exhibit 681, Statement of Philip Brumley, 22 September 2011 [p1: para 3-4].
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- 285 Exhibit 681, Statement of Philip Brumley, 22 September 2011 [p1: para 5].
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- 286 For a description of SunWater, see: Queensland Floods Commission of Inquiry, *Interim Report*, Section 2.1.5, 2011 [p34].
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- 287 Exhibit 681, Statement of Philip Brumley, 22 September 2011 [p2: para 6].
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- 288 Exhibit 681, Statement of Philip Brumley, 22 September 2011 [p2: para 7(b); Attachment A].
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- 289 Exhibit 681, Statement of Philip Brumley, 22 September 2011 [p2: para 7(b)].
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- 290 Exhibit 921, Statement of Keith Davies, 2 September 2011, Annexure 3 [p2: para 6-8; p3: para 13; p3: para 18-19].
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- 291 Exhibit 943, Statement of Michael Birchley, 22 September 2011 [p2: para 10].
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- 292 Exhibit 943, Statement of Michael Birchley, 22 September 2011 [p3: para 12].
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- 293 Exhibit 943, Statement of Michael Birchley, 22 September 2011 [p2: para 8].
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- 294 Exhibit 943, Statement of Michael Birchley, 22 September 2011 [p2: para 8].
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- 295 Exhibit 943, Statement of Michael Birchley, 22 September 2011 [p2: para 8].
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- 296 Section 61 and Schedule 9, *Water Regulation 2002*.
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- 297 Haughton River, Major Creek and Tully/Murray Rivers; Exhibit 943, Statement of Michael Birchley, 22 September 2011 [p2: para 8].
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- 298 Exhibit 943, Statement of Michael Birchley, 22 September 2011 [p2: para 8].
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- 299 Schedule 3, Part 1, Table 4, item 3, *Sustainable Planning Regulation 2009* cf Schedule 3, Part 2, Table 4, item 1, *Sustainable Planning Regulation 2009*.
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- 300 Schedule 6, Table 3, item 3, *Sustainable Planning Regulation 2009*.
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- 301 Exhibit 943, Statement of Michael Birchley, 22 September 2011 [p8: para 35]; Transcript, Michael Birchley, 9 November 2011, Brisbane [p4806: line 8].
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- 302 Exhibit 943, Statement of Michael Birchley, 22 September 2011 [p2: para 7].
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- 303 Exhibit 1007, Standing Committee on Agriculture and Resource Management (SCARM), Floodplain Management in Australia: best practice principles and guidelines, SCARM Report 73, 2000 [p8, 23].
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- 304 Sections 7 and 10, *Sustainable Planning Act 2009*.
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- 305 These two mechanisms are preferred over the use of state planning regulatory provisions or regional plans. See section 5.1 *Planning schemes*.
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- 306 It may also be necessary to amend Schedule 4, Table 5, Items 1-5, *Sustainable Planning Act 2009*, to ensure levees can be made 'assessable development'.
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- 307 Section 37 of the *Local Government Act 2009* provides that a local law cannot duplicate a development process in the *Sustainable Planning Act*. Since levees would appear to fall within the definition of 'operational work' (as things constructed that allow interfering with water: section 10), carrying out their construction is 'development' (section 7) and is either assessable or self-assessable under the Act. Section 37(4) of *Local Government Act 2009* excludes local laws relating to levees from the prohibition on duplicating *Sustainable Planning Act* processes until such time that a local government decides to prepare its next planning scheme under the *Sustainable Planning Act*.
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- 308 Transcript, Peter Maguire, 29 September 2011, Emerald [p3458: line 18]; Exhibit 977, Statement of Mark Watt, 20 September 2011 [p2: para 7]; Exhibit 976, Statement of Luke Lankowski, 2 November 2011 [p1: para 4]; Exhibit 646, Statement of Graeme Scheu, 12 September 2011 [p2: para 5]; Supplementary Submission of the Local Government Association of Queensland, September 2011 [p3: para 2.12].
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- 309 Supplementary Submission of the Local Government Association of Queensland, September 2011 [p3: para 2.12]; Exhibit 646, Statement of Graeme Scheu, 12 September 2011 [p2: para 5].
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- 310 Exhibit 977, Statement of Mark Watt, 20 September 2011 [p2: para 7]; Transcript, Phillip Brumley, 29 September 2011, Emerald [p3416: line 21].
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- 311 Exhibit 982, Statement of Scott Norman, 6 September 2011 [p2: para 14]; Exhibit 977, Statement of Mark Watt, 20 September 2011 [p3: para 8]; Exhibit 684, Statement of Bryan Ottone, 27 September 2011 [p2: para 6]; Exhibit 681, Statement of Phillip Brumley, 22 September 2011 [p2: para 8].
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- 312 Exhibit 646, Statement of Graeme Scheu, 12 September 2011 [p1: para 3].
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- 313 Exhibit 977, Statement of Mark Watt, 20 September 2011 [p2: para 7]; Transcript, Phillip Brumley, 29 September 2011, Emerald [p3416: line 21]; Transcript, Michael Birchley, 9 November 2011, Brisbane [p4808: line 50].
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- 314 Exhibit 1007, Standing Committee on Agriculture and Resource Management (SCARM), Floodplain Management in Australia: best practice principles and guidelines, SCARM Report 73, 2000; Exhibit 238, Goondiwindi Regional Council Urban Levee Bank Policy, 23 February 2011 [p1: para 1]; Department of Sustainability and Environment, 'Victorian floods January 2011: Levees' (2011), www.water.vic.gov.au/environment/floodplains/victorian-floods-january-2011/levees.
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- 315 For example, an informal arrangement surrounded levee development in the Goondiwindi region. Landholders building new levees on one side of the Macintyre River gave notification to owners of properties where the levee was likely to affect the flow of water in the river, see: Exhibit 646, Statement of Graeme Scheu, 12 September 2011 [p1: para 3].
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- 316 Exhibit 1007, Standing Committee on Agriculture and Resource Management (SCARM), Floodplain Management in Australia: best practice principles and guidelines, SCARM Report 73, 2000 [p8, 23].
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- 317 See, for example, the description of the dangers contained in: New South Wales Government, Floodplain Development Manual: the management of flood liable land, April 2005, Appendix L [para L6.8].
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- 318 Exhibit 537, Statement of Anthony Leighton, 6 September 2011 [p1: para 2]; Transcript, Anthony Leighton, 19 September 2011, Brisbane [p2793: line 56].
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- 319 Transcript, Anthony Leighton, 19 September 2011, Brisbane [p2795: line 30]; Exhibit 537, Statement of Anthony Leighton, 6 September 2011 [p2: para 71].
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- 320 Transcript, Anthony Leighton, 19 September 2011, Brisbane [p2795: line 36].
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- 321 Transcript, Anthony Leighton, 19 September 2011, Brisbane [p2796: line 57].
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- 322 Transcript, Anthony Leighton, 19 September 2011, Brisbane [p2796: line 25]; Exhibit 537, Statement of Anthony Leighton, 6 September 2011 [p2: para 9].
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- 323 Transcript, Anthony Leighton, 19 September 2011, Brisbane [p2801: line 15; p2808: line 12].
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- 324 Transcript, Anthony Leighton, 19 September 2011, Brisbane [p2808: line 27].
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- 325 Transcript, Dr Luis Prado, 21 September 2011, Brisbane [p2946: line 19; p2946: line 39].
- 326 Exhibit 580, Statement of Dr Luis Prado, 8 September 2011, Annexure 1 [p4]; Transcript, Luis Prado, 21 September 2011, Brisbane [p2945: line 33].
- 327 Exhibit 580, Statement of Luis Prado, 8 September 2011, Annexure 1 [p3].
- 328 Exhibit 580, Statement of Dr Luis Prado, 8 September 2011, Annexure 1 [p1, 3-4].
- 329 Exhibit 580, Statement of Dr Luis Prado, 8 September 2011, Annexure 1 [p2]; Transcript, Dr Luis Prado, 21 September 2011, Brisbane [p2946: line 23].
- 330 Transcript, Luis Prado, 21 September 2011, Brisbane [p2946: line 47 – p2946: line 1].
- 331 Transcript, Dr Luis Prado, 21 September 2011, Brisbane [p2946: line 47].
- 332 Exhibit 580, Statement of Dr Luis Prado, 8 September 2011, Attachment 1 [p2].
- 333 Transcript, Luis Prado, 21 September 2011, Brisbane [p2947: line 18].
- 334 Transcript, Rory Kelly, 10 November 2011, Brisbane [p4946: line 24].
- 335 Exhibit 639, Seventh Statement of Rory Kelly, 21 September 2011 [p3: para 9-10; p4: para 11]; Transcript, Rory Kelly, 3 October 2011, Brisbane [p3495: line 22].
- 336 Exhibit 639, Seventh Statement of Rory Kelly, 21 September 2011 [p3: para 10(a)].
- 337 Exhibit 639, Seventh Statement of Rory Kelly, 21 September 2011 [p6: para 17; p8: para 24; p10: para 32]; Annexure RJK-114 [p3]; Annexure RJK-120; Annexure RJK-128 [p5].
- 338 Exhibit 639, Seventh Statement of Rory Kelly, 21 September 2011 [p5: para 13, 14; p6: para 17, 18; p7: para 22, 23; p10: para 32]; Annexure RJK-112; Annexure RJK-113 [p1]; Annexure RJK-114 [p3]; Annexure RJK-115 [p7]; Annexure RJK-120; Annexure RJK-128 [p5].
- 339 Exhibit 639, Seventh Statement of Rory Kelly, 21 September 2011 [p11: para 34, 35]; Annexure RJK-131; Annexure RJK-132.
- 340 Exhibit 639, Seventh Statement of Rory Kelly, 21 September 2011 [p5: para 14; p10: para 32, p11: para 37]; Annexure RJK-113 [p1]; Annexure RJK-128 [p5].
- 341 Exhibit 639, Seventh Statement of Rory Kelly, 21 September 2011 [p12: para 41]; Transcript, Rory Kelly, 3 October 2011, Brisbane [p3512: line 12].
- 342 Transcript, Rory Kelly, 3 October 2011, Brisbane [p3512: line 42].
- 343 Exhibit 639, Seventh Statement of Rory Kelly, 21 September 2011 [p16: para 45].
- 344 Transcript, Rory Kelly, 3 October 2011, Brisbane [p3508: line 26].
- 345 Transcript, Ken Smith, 21 September 2011, Brisbane [p2886: line 35].
- 346 Transcript, Ken Smith, 21 September 2011, Brisbane [p2887: line 17].
- 347 Exhibit 566, QRA Map of Yeronga, 21 September 2011.
- 348 Brisbane City Council, Subdivision and Development Guidelines 2008, Part A Hazard Management, Chapter 1 'Flood Affected Land' [p10: Table A1.6].
- 349 Transcript, Rory Kelly, 3 October 2011, Brisbane [p3508: line 26].
- 350 Transcript, Rory Kelly, 3 October 2011, Brisbane [p3514: line 4].
- 351 Exhibit 782, Statement of Graham Wode, 29 September 2011 [p1: para 3]; Transcript, Graham Wode, 12 October 2011, Maryborough [p3952: line 6].
- 352 Exhibit 782, Statement of Graham Wode, 5 September 2011 [p1: para 3]; Transcript, Graham Wode, 12 October 2011, Maryborough [p3952: line 3].
- 353 Transcript, Bruce Flegg, 5 May 2011, Brisbane [p1345: line 15].
- 354 Exhibit 631, Statement of David Dunworth, 27 September 2011 [p3: para 8]; Transcript, David Dunworth, 27 September 2011, Brisbane [p3222: line 1; p3224: line 16].
- 355 Transcript, David Dunworth, 27 September 2011, Brisbane [p3222: line 50]; Exhibit 572, Statement of Julie Savage, 21 September 2011 [p4: para 15]; Transcript, Julie Savage, 21 September 2011, Brisbane [p2898: line 1].
- 356 The areas are specified in A1.1 of Annex 1 of State Planning Policy 1/03: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* [p13].

- 357 State Planning Policy 1/03: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* [para 6.3].
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- 358 Outcome 2 of State Planning Policy 1/03: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* [p7: para 6.12].
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- 359 State Planning Policy 1/03: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* [p7: para 6.13].
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- 360 State Planning Policy 1/03: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* [p7: para 6.13].
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- 361 State Planning Policy 1/03: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* [p7: para 6.13].
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- 362 The State Planning Policy Guidelines recognise the existence of evacuation routes as a consideration relevant to assessing flood hazard. See State Planning Policy Guidelines: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* [p37: para A2.28].
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