In the matter of the *Commissions of Inquiry Act 1950*Commissions of Inquiry Order (No.1) 2011

Queensland Floods Commission of Inquiry

Second Witness Statement of Peter Baddiley

Annexure "PB2-5"

Hydrology Ptd-. Peter Baddilery

URBAN FLOODING IN QUEENSLAND-A REVIEW

by David Ingle Smith, CRES, ANU, Canberra





February 1998





URBAN FLOODING IN QUEENSLAND A REVIEW

David Ingle SMITH

Prepared for the Department of Natural Resources, Queensland

February 1998

Centre for Resource and Environmental Studies Australian National University CANBERRA ACT 0200

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ACKNOWLEGEMENTS

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Executive Summary

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The aims of the study are to:

- assess the size of the urban flood problem in Queensland;
- to advise on deficiencies in floodplain management; and
- to recommend how to overcome the shortcomings.

The major source of information was from an extensive questionnaire circulated to all local councils in Queensland. The total number is 125 and questionnaires were returned from 103 of these. Discussions with State and federal agencies established that 18 of the non-respondents did not have an urban flood problem, defined as a minimum of ten buildings at risk from the 1 in 100 year flood event.

Visits were made to five councils, Brisbane, Cairns, Logan City, Carpentaria and the Gold Coast. The last of these, is thought to have more flood prone buildings than any other local authority in Australia. Detailed accounts are presented for Brisbane and the Gold Coast.

Size of the Problem

Assessment of the size of the problem, in terms of number of buildings at risk, is handicapped by the lack, for many councils, of reliable information on flood hydrology. The best estimate of the total number of buildings liable to flooding to the level of the 1 in 100 year flood event is 65,000. This is very similar to the number for New South Wales, estimated in Smith (1996) to also be 65,000. Queensland and New South Wales together account for over 80% of flood prone buildings in Australia. A ranked list of the 12 Queensland councils with the largest number of buildings at risk to the level of the 1 in 100 year flood event is presented below, these account for at least two-thirds of the State total. The poor quality of the data does not allow further sub-division into residential, commercial and industrial buildings.

Local Government Authority	Number of buildings
Gold Coast	Half of this 16,650
Mackay	8,500 evel
Brisbane	8,000 -
Dalby	3,300 shallow
Ipswich	3,000 - Short (200)
Logan	3,300 shallow 3,000 - Short lack 2,375
Hinchinbrook	2 175
Charleville	1,350
Rockhampton	1, 200
Burdekin	1,000
Cairns	728
Caboolture	455
TOTAL	48,733

It is not possible to provide reliable estimates of those buildings at risk from floods that have recurrence interval between that for the 1 in 100 year event and the probable maximum flood, i.e., the worst flood that could occur. Only 11 councils in Queensland have such information and, of those, only 8 have the information in map form. The number of buildings liable to flooding at the level of the probable maximum flood could be in excess of 200,000.

The need for hydrological information to the level of the probable maximum flood is stressed throughout the report. This is necessary in order to assess potential flood damages, the risk of building failure and to provide a basis for effective emergency management at times of flood. For localities with a high flood range, a measure of the depth of flooding, there is a very real risk of the failure of lightweight structures (such as detached weatherboard dwellings) at time of extreme flood.

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Because of the limited data on flood hydrology and vulnerability, ie. what is at risk from flooding, it is not possible to provide reliable estimates of flood losses. However, a guesstimate for the average annual actual damages (AAAD) for tangible losses to the residential, commercial and industrial sectors, to the level of the 1 in 100 year flood, is close to \$100m (at 1990 values). The corresponding AAAD, if the damage estimates are extended to the level of the probable maximum flood, would be very much higher perhaps by a factor of two.

The report has established that Queensland has the highest AAAD for any State in Australia. The number of buildings at risk are comparable to those in New South Wales but there, the steadfast application of effective urban floodplain management has progressively reduced the AAAD for many flood prone urban localities and dramatically slowed the construction of new buildings in areas subject to the 1 in 100 year flood. In contrast, Queensland has not reduced flood vulnerability and for many urban flood prone communities the lack of land use controls or building regulations is such that potential damages increase year by year. A report, in 1978 by a National Committee investigating a National Scheme for Natural Disaster Insurance reached virtually the same conclusions.

It needs to be stressed that some of the major flood prone communities were greenfield sites at the time of the extensive floods of 1974. It is not possible from the questionnaires to give any firm data on the increase of the size of the urban flood problem since then, but there is no doubt that it is has been significant. The Gold Coast is a prime example but undoubtedly the expansion of developments, many of which are dominantly residential, onto flood prone sites has been a State-wide phenomenon.

Mitigation measures

The use of structural mitigation measures is limited. Although not necessarily a recommended procedure, only 13 councils in Queensland report the use of levees to reduce flood losses. Other strategies, some of which can be applied to individual buildings are rarely used. Examples are flood proofing, the raising of weatherboard dwellings above flood level or the purchase of especially hazardous buildings Compared to other states, this restricted use

of structural measures is thought to reflect paucity of funds, lack of background information and of urban flood policy.

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The provision of flood forecasts, in part based on local instrumentation, is of a comparatively high standard. Exceptions are for some remote inland communities, the coastal settlements of the Gulf of Carpentaria are examples. Analyses, provided by the Bureau of Meteorology, indicate that the warning times for flood forecasts for 100 flood prone urban locations (about 70% of the total) are less than 12 hours. Thus, the best possible preparedness and response are necessary if the benefits of the forecasts are to be fully captured. Improved information on flood hydrology and the availability of flood maps are required together with the provision of flood markers at the local level. Only 25% of councils report that such flood markers are in place, their use should be obligatory.

Need for a State Policy

Only 35 of the council responses indicated that they had an 'urban flood policy' and in many cases these fall short of being 'state of the art'. This number is unacceptably small and often, where such a policy exists, the information on which it is based in inadequate.

Queensland is unusual among the Australian States in that it does not have a State-wide policy for urban floodplain management. Action is left to individual councils and the 35 responses that provided information on the under-pinning legislation, demonstrate that the institutional arrangements are unclear. The burden of costs, both for the necessary flood studies and for possible subsequent mitigation, have been frequently borne solely by local councils. This is marked contrast to New South Wales, where the contribution of state funding is close to 40% of the total costs, normally matched by similar federal funding.

The need in Queensland is for a co-operative, locally-based approach to urban floodplain management that is formulated to accord with an established State policy. This would require the provision of technical advice and a contribution to council funding from State sources (especially for assistance with flood studies).

Steps towards these aims would be for the State government to produce a flood manual specifically designed for use by local governments. This should present guidance to all aspects of best practice floodplain management. It should include guidance to all relevant planning legislation in order that floodplain management by local government is integrated into the State's overall planning policy.

A clear statement on the legal liability of council decisions that allow building in flood prone areas may aid improved floodplain management. Indemnity from such liability for councils following accepted procedures (as indicated in the proposed manual) is a strategy that could be investigated.

Until Queensland adopts an acceptable policy for new urban developments in flood prone areas, the damage bill will continue to escalate. It is important to note that Commonwealth contributions to flood relief, under the Natural Disaster Relief Arrangements, have decreased over recent years. This places additional burdens on the State Treasury and it is surprising that this has not resulted in greater pressure to reduce future flood losses by way of improved planning. Many mitigation measures would have favourable benefit-cost ratios and would

therefore indicate medium to long-term advantages. In addition, the Commonwealth government has indicated that future payments for flood relief will be evaluated against improvements in floodplain management.

Storm Surge

The questionnaire also provides background information of coastal inundation for storm surge (alternatively referred to as 'storm tide'). A total of 25 councils replied that they had a storm surge problem which equates to virtually all coastal LGAs in Queensland. These are listed below with the date of the last occasion on which buildings were damaged.

Local Government Authority	Location affected	Date of most recent damaging event
Bowen	(Queens Beach)	1980
Burnett	(Bundaberg Point)	1942
Caboolture	(Several locations)	
Cairns	(City and Northern Beaches)	1979
Calliope	(Tannum Sands, Boyne Is.)	
Caloundra	(Kawana Waters)	
Cardwell	(Tully Heads, South Mission Beach)	
Carpentaria	(Karumba)	1976
Cook	(Ayton, Cooktown)	
Douglas	(Port Douglas)	
Gladstone		
Gold Coast		1974
Hervey Bay		1992
Hinchinbrook	(L. Tully)	
Johnstone 1996		
Livingstone		
Mackay	(City and North Mackay)	1918
Noosa		1992
Pine Rivers		1993
Redcliffe		1994
Redland	(Bay Island)	
Sarina	(Several locations)	1918
Thuringowa		1971
Tiaro		
Townsville	(City)	1971

Information on storm surge risk is generally poor, the study estimates that between 40,000 and 50,000 buildings may be at risk from extreme surge events. This problem is compounded

by the fact that it is unusual for councils to have any restrictions on development in areas liable to the storm surge.

Unlike river flooding, the problem of surge is concentrated in Queensland and therefore, there is not the same opportunity for the transfer of methodologies and experience between States. Succinctly, inundation of urban areas from storm surge is a Queensland problem. Surge flooding requires similar land use planning regulations to those for river flooding, the major difference is that the occurrence of a major surge event could cause, at a single urban locality, the structural failure of several hundred dwellings.

The responses to this question indicate that to date effective development controls have been lacking and that there is an urgent need to better define the areas at risk, to introduce appropriate land use and building regulations and for improved arrangements for emergency management.

The Future

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Actions to improve current practices are necessary to prevent the occurrence of major disasters with extensive damage and loss of life.

Section 11, Towards Better Urban Floodplain Management, outlines the steps that are required to improve urban floodplain management in Queensland. The essential first step is the provision of detailed studies, for flood hydrology and vulnerability, for all urban flood prone communities liable to flood. Without such information further progress is severely handicapped.

Overall, the current state of knowledge of flood risk in Queensland is poor and far below the standard of that elsewhere in Australia.

Conclusions

- (i) Reliable estimates of the number of localities and the number of buildings subject to urban flooding in Queensland are severely hampered by the paucity of information on flood hydrology.
- (ii) It is best estimated that the number of buildings (residential, commercial and industrial) at risk from the 1 in 100 year flood event is 65,000.
- (iii) The majority of councils in Queensland have no information available on the risks associated with extreme floods, i.e. those in excess of the 1 in 100 year flood event. Only eight councils have such information available in map form.
- (iv) The tangible annual average urban damage in Queensland, to the level of the 1 in 100 year flood event, is thought to be about \$100m. The paucity of information on flood hydrology and vulnerability is such that that this estimate should be regarded as tentative; the data base for commercial and industrial losses is especially poor.

- (v) Notwithstanding the quality of the background data, Queensland has the highest average annual urban flood damage of any State in Australia.
- (vi) Continued development in flood-prone areas is of special concern, this leads to an ever-increasing escalation in vulnerability and flood damage.
- (vii) The warning time that can be provided for some 70% of urban floodplain locations within Queensland is less than 12 hours.
- (viii) In comparison to other Australian States, Queensland is unusual in that there is no clear or comprehensive State-wide policy to guide urban floodplain management.
- (ix) Only thirty-five councils have a policy for urban floodplain management and, in many cases, these do not meet national or international best practice.
- (x) Twenty-three councils report that they have urban areas at risk from storm surge (storm tide).
- (xi) Overall, information available on liability for damage from storm surge, and the potential for catastrophic losses (including widespread building failure) are even less well developed than even those for riverine flooding. A guesstimate is that some 40-50,000 buildings in the State are at risk from the 1 in 100 year storm surge event.
- (xii) Urban inundation from storm surge is essentially a Queensland problem, the risk likely exceeds that of the combined total for all other Australian States.

Recommendations

Flood studies

- (i) There is an urgent need for information on flood hydrology for all flood-prone urban locations. The ranked list of flood liable locations could be used to prioritise such studies. Attention should also be given to providing information on flood hydrology for areas likely to be developed in future years.
- (ii) Studies of flood hydrology should include information of the areal extent of the probable maximum flood and give, at least, a semi-quantitative assessment of overfloodplain velocities.
- (iii) When studies of flood hydrology are complete they should be used to assess vulnerability, flood damage and be integrated into emergency management.
- (iv) The resultant flood studies (combining hydrology, vulnerability and damage) should then be used as a basis for comprehensive urban floodplain management including evaluation of the full range of mitigation measures structural and non-structural.

Forecasting and awareness

(v) There is a need to better use flood forecasts to capture the full benefits for all forms of loss reduction. One simple measure would be to make it obligatory for councils to

install flood markers in order that forecasts of flood height could more readily used to give an indication of the extent and severity of flooding. Such measures are cheap and effective.

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Policy and legislation

- (vi) There is an urgent need for the Queensland government to clarify, and ideally to revise, legislation relevant to the implementation of effective urban floodplain management.
- (vii) A clear statement of the legal liability of councils that allow development in flood-prone sites should be provided by the State government.
- (viii) To assist with the recommendations outlined above, the State government should fund and distribute a comprehensive urban floodplain manual specifically designed for use by local councils in Queensland. This should provide guidance on how to undertake studies of flood hydrology, vulnerability and damage together with information on mitigation options and the appropriate legislative basis for locally-based flood policy.
- (ix) Analysis of the risks of catastrophic damage in urban areas from storm surge (storm tide) should be a given a high priority. Policy for the planning, and for the reduction of damage to existing structures, in storm surge areas should be integrated into that for riverine flooding.

Introduction

The study was commissioned to review all aspects of the urban flood problem throughout Queensland.

Specific aims included:

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- the design, distribution and analysis of a questionnaire survey to all local government authorities (LGAs) in the State;
- estimates of the size of the urban flood problem;
- a review of the current state of urban floodplain management, including flood warning systems, mitigation measures etc.
- a prioritised list of flood prone communities for future detailed study;
- a review of best practice methods to assess urban flood losses;
- recommendations on how State agencies can assist and encourage LGAs to attain more effective flood management.

An outline consideration of inundation from storm surge was also included, as this is considered to represent an extension of riverine flood policy.

It is clear that many of the respondents to the questionnaire expended valuable time to complete the extensive range of questions. The author would like to thank all those involved for their cooperation. Special thanks are also due to senior staff of the following councils: Brisbane, Cairns, Carpentaria, Gold Coast and Logan, who, in addition to completing the questionnaire, were willing to discuss urban flood problems face to face.

Peter Baddiley and Terry Malone of the Hydrological Section of the Brisbane Regional Office of the Bureau of Meteorology, and Doug Angus and the staff of Queensland Emergency Services, willingly gave advice at all stages of the project.

Dr Darryl Muller of the Department of Natural Resources was responsible for assembling the questionnaire while Russell Cuerel, and other staff at the Department were responsible for the circulation of the questionnaire and chasing up recalcitrant respondents. Their diligence resulted in a remarkably high rate of return from local government officials who are undoubtedly over-worked and over-questionnaired.

Finally, my personal thanks to Katie Ellis in CRES, who skills, assistance and good humour at all stages of the project have been exemplary. These ranged from organising the computer data base for replies to the questionnaire, to proof reading and lay-out of the final report.

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Background and Definitions

1.1 Definitions

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A key factor in assessing the susceptibility of urban areas to flooding is the number of buildings liable to inundation. However, in order that urban flood locations can be ranked in terms of need for further study or for flood mitigation priority, this simple statement requires further definition. Necessary definitions are:

- how to define flood prone?
- what is an urban locality?
- how to classify the buildings and infrastructure at risk?

1.2 How to define flood prone?

Theoretically, a building or installation would be classified as flood prone if it is at risk from inundation by the probable maximum flood, this can be regarded as statistically the largest possible flood. 'Inundation' also presents a definitional problem with a choice between water over-ground on the property block, or restricted to a flood that exceeds floor level. For the various forms of infrastructure, the definition is more complex with the choice between over-ground inundation or the flood level that corresponds to a critical level that interferes with normal service provision, i.e., over roadbed level, or at a critical height for an electricity transformer.

However, data on the magnitude of the probable maximum flood is rarely available and the number of flood prone buildings is usually reported in terms of over-ground inundation for the 1 in 100 year event. This convention will be followed in this report except that, wherever possible, additional data will be given for liability to the level of the probable maximum flood.

1.3 What is a flood prone urban locality?

For the purposes of this study it was necessary to define what constitutes a flood prone urban locality. The decision was made to include all urban localities for which at least 10 buildings were liable to flooding from the 1 in 100 year flood event or were inundated by the flood of record. In practice, this refers to buildings that would have over-ground inundation, i.e., not necessarily over-floor level.

Any definition of this kind is arbitrary but the selection of a lower limit of 10 buildings corresponds to the criterion used in the first national survey of urban flooding undertaken by Devin and Purcell (1983).

1.4 How to classify the buildings and infrastructure at risk?

It is common practice for urban flood studies to report risk in terms of the number of buildings liable to inundation. Many studies do not differentiate between residential buildings (in Australia normally detached dwellings) and those that are commercial or industrial. Other

accounts sub-divide business enterprises into 'commercial and 'industrial'. In many Australian flood studies these are defined on the basis of likely flood damages and the commercial sector is restricted to the more commonly occurring buildings used for retail or office functions with 'industrial' used for larger enterprises (sometimes incorporating a number of individual buildings) often engaged in some form of manufacturing. An example that occurs relatively frequently in small urban centres is the regional milk factory. These finer divisions are usually related to studies that are designed to assess potential flood losses.

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Thus the most frequently used definition of buildings in flood studies recognises residential and commercial sectors with a possible further sub-division to recognise large industrial concerns. Some flood damage surveys recognise an additional category, often termed 'public buildings'. Examples in this category are schools, hospitals and council offices.

In Australia and overseas, studies of urban flood risk are normally limited to the analysis of buildings, however defined. In recent years more emphasis has been placed upon the susceptibility of 'lifelines' to flooding. 'Lifelines' are usually restricted to services of which roads, bridges, water supplies, sewerage and electricity form critical elements. A limited number of surveys of actual floods give descriptions of such infrastructure damage and sometimes these are included in estimates of flood damage. Even more recent studies, often based on the use of Geographical Information Systems (GIS), have begun to analyse the significance of the potential damage to lifelines in order to better plan for emergency management.

However, such studies are relatively uncommon and it standard practice in Australia and overseas to evaluate urban risk in terms of building damage. This approach forms the main thrust of this report although additional descriptions are given to the problems of infrastructure where such information is available.

To a large extent the detail and definition of buildings used in flood studies reflects the purpose of the investigation. If the aim is to assess flood damage, often as a basis for cost benefit analysis of flood mitigation options, the classification of buildings into residential, commercial and industrial is necessary. If the aim is to provide the background for emergency management, the emphasis is upon the safety of the inhabitants and this focuses attention on the residential sector and upon lifelines.

1.5 What is a designated flood?

It is near universal practice for floodplain management, in Australia and overseas, to select the level of the 1 in 100 year event as the designated (or standard) flood. Once established the designated flood forms the basis for new developments which for residential buildings are usually related to the habitable floor level. This is usually set at the 1 in 100 year level plus extra 'freeboard' which is typically a foot or 300 mm. Some jurisdictions permit floor levels for commercial and industrial establishments at lower levels, with higher levels for especially vulnerable buildings such as hospitals, police stations etc.

The adoption of a designated flood is the key step in introducing land use zoning to control the growth of new developments on flood prone land. A detailed hydrological study is required in order to satisfactorily establish the position of the 1 in 100 year flood line, as a temporary measure LGAs sometimes substitute the flood of record for the design flood. It is common practice for the extent of the design flood to be shown on large scale maps or orthophotos. This however, is not universal and in New South Wales there is a reluctance to produce flood maps. The background to this unusual stance lies with community

dissatisfaction with such maps in the mid-1980s, a detailed account of this hiatus is given in Handmer (1985).

The widespread adoption of the 1 in 100 year flood as the designated flood, however, represents an imperfect solution to the definition of 'flood prone'. There are three reasons why it is often unsatisfactory. They are:

- the large variation in flood height range between locations
- the possibility of building failure from extreme events
- the problems posed by the probable maximum flood.

Each of these is outlined below.

1.5.1 Flood height range

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The flood height range (FHR) is a term frequently used in the USA to provide a measure of the difference in stage (height) between the 1 in 10 (or 1 in 20) and 1 in 100 year events. The FHR can differ markedly from one location to another, a range from a metre or so to ten metres is not unusual. Figure 1.1 demonstrates the variation in stage for two locations. In Case A the FHR is less than a metre and in case B is about four metres. Many inland locations in Queensland would be similar to Case A, this is because when the river exceeds bankfull there are extensive flat floodplains that provide very large natural storage's for the flood waters. Case B is commonly associated with sites upstream of river gorges so that flood flows back up to considerable depths during floods.

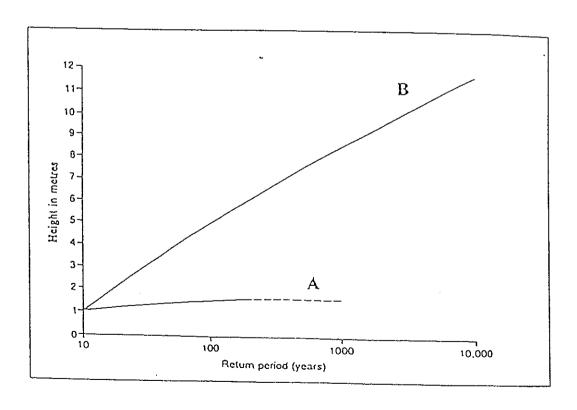


Figure 1.1 Low and high flood height range

The significance of the FHR is that buildings located close to the 1 in 100 year line in Case A would only experience limited over-floor inundation from floods greater than the 1 in 100 year, while for Case B water could be several metres over floor level. For locations similar to case B there is an additional risk of building failure (see below) and loss of life.

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Data on flood height range is relatively poor for many locations in Queensland but there is little doubt that there is a wide range of values.

A surrogate for FHR can be obtained from the Flood classification for Queensland flood warning river height stations, compiled by the Hydrological Section of the Brisbane office of the Bureau of Meteorology. This lists flood warning heights for several hundred flood gauges distributed throughout the State. It is not designed to give FHR per se but it does report minor, moderate and major warning heights for each station. The classification of the level of risk is given as an aid to emergency management. For example, 'moderate' corresponds to '... inundation of low lying areas requiring the removal of livestock and the evacuation of isolated houses' and 'major' is defined as major disruption ... 'evacuation of many houses and business premises may be required'.

For many urban settlements the Bureau of Meteorology also produces booklets describing key aspects of the flood warning system, notes on the flood history etc. In the absence of detailed hydrological studies such information forms an invaluable guide to urban flooding. The major limitation is that the 'major' flood heights are often well below the level of the 1 in 100 year flood or the flood of record. Table 1.1 illustrates the problem of FHR for a selection of flood prone urban communities.

Table 1.1 Flood height range and flood warning levels for a selection of Queensland towns, all heights are in metres

	Flood	l warning le	vels	Flood height range	Flood of record
	Minor	Moderate	Major		
Brisbane City gauge	1.7	2.6	3.5	4.0	5.45 (1974)
Ipswich City gauge	7.0	13.0	15.5	10.0	20.73 (1974)
Rockhampton City gauge	5.0	6.0	7.0	1.75	10.1 (1918)
Ingham City gauge	10.0	11.0	15.0	1.5	16.4 (1967)
Logan River, Macleans Bridge	10.0	13.5	16.0	8.0	21.67 (1974)

All values in metres. Estimate based on limited information

The data demonstrate both the variations in the FHR and the relationship of the flood of record to the warning levels. The flood height ranges given in Table 1.1 are the best estimates of the range between the 1 in 10 and 1 in 100 year flood events; the minor, and major flood warning levels are related to the effects upon those at risk and not to flood recurrence intervals.

Interpretation is further blurred by local factors. For instance for Ingham the height difference between the 1 in 2 and the 1 in 10 year floods is 4.5 m but only a further 2.0 m between the 1 in 10 and 1 in 100 year. In many cases the hydrology is imperfectly known and the data given in Table 1.1. should be regarded as indicative of high or low flood height ranges rather as precise estimates.

1.5.2 Building failure

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Data that present critical combinations of flood depth and velocity that lead to building failure are available. These are based on studies from the USA, for instance Black (1975), but the results are also relevant to a range of Australian building styles. A more accessible review of these relationships and their importance for damage and emergency management is given in Smith (1991). Examples of these relationships are reproduced here as Figure 1.2.

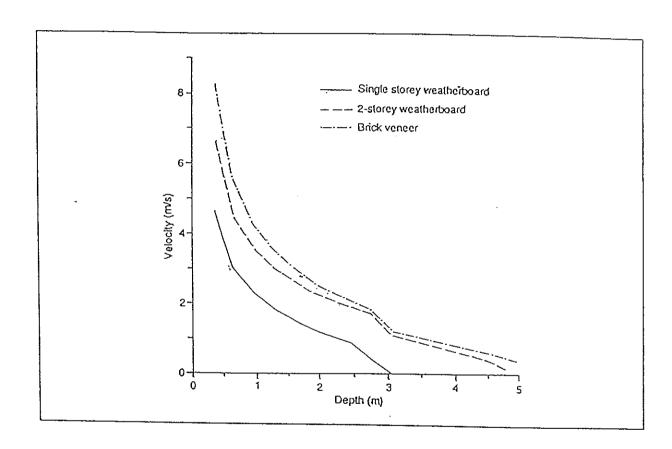


Figure 1.2 Critical flood velocity and depth for residential building failure

Detached, single storey weatherboard houses, a style common throughout Queensland, are particularly susceptible to failure which is often related to their buoyancy in flood water causing the building to 'float off its stumps'.

To use these failure relationships it is necessary not only to know the flood depth but to also have reliable estimates of the velocity of the flood waters. The velocities are those for over-floodplain discharges, not in-channel flows. Such data are rarely available in Queensland.

It should be obligatory for any future hydrological flood studies to estimate over-floodplain velocities for flood flows. This should not be difficult to achieve as many contemporary computer-based hydrological models have the capacity to estimate such velocities. In many areas, especially where the FHR is small, the chances of building failure are remote. However, for other sites the risk can be considerable and may well be judged to be unacceptable. The significance of potential building failure for emergency management and for damage estimation is large. The possibility of building failure should be a key factor in the selection of the designated flood.

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1.5.3 Less frequent floods including the probable maximum flood (PMF)

The worst flood that could occur is termed the probable maximum flood (PMF). This is clearly a very rare and extreme event and it could be replaced by estimates of the 1 in 5,000 or 1 in 10,000 year flood. In any new hydrological study it should be obligatory to provide estimates of the full range of floods including the PMF although it is accepted that, for the less frequent events, the estimation error bands will always be large.

The major reason for estimating the PMF is to use it in conjunction with Figure 1.2 in order to assess the potential for building failure from rare events. All too often the perception of the 1 in 100 year (or other) design flood is that this divides areas that are considered as flood prone from those (erroneously) thought to be flood free. However, residual risk from the PMF (and the other large events) is not only due to building failure. An additional reason for assessing the less frequent events is to ensure that emergency measures to deal with the residual flood risk (like access for evacuation and refuge points) can be implemented as part of a flood disaster response plan

It would be economically unacceptable to prohibit all new development below the level of PMF but if there would be widespread building failure from such extreme events this should be recognised in any land use zoning restraints. Knowledge of this worst case flood should be fully understood by the emergency services, the problem of isolation of flooded areas as islands is of special concern.

Such risks of failure are generally greatest for locations where the flood height range is large. Although precise hydrological data are not available, dwellings close to the 1 in 100 year at Ipswich would have several metres of water over floor level for a near PMF which, in many cases, would result in widespread building collapse.

The risk of failure for existing developments below the level of the 1 in 100 year flood line can be very severe. For Ipswich, with the high FHR shown in Table 1.1, it is likely that several hundred buildings would be totally submerged by such extreme floods. The loss of more than thirty dwellings in the 1974 flood demonstrates that this risk is very real. The fact that similar houses were re-built on the sites is an example of very poor urban floodplain management.

1.6 Definitions – a summary

In this account a flood prone urban location is defined as a place at which at least 10 buildings would be subject to the 1 in 100 year flood event. Buildings are regarded as flood prone if their grounds are within the limits of the 1 in 100 year flood. Wherever possible the buildings are sub-divided into residential and commercial. For many localities hydrological studies that define the extent of the 1 in 100 year flood are lacking, in such cases the flood of record is substituted.

Such definitions are used because:

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- they give comparability between places
- they represent the most commonly available data
- it is common practice for floodplain management to use the 1 in 100 year (or flood of record) flood line as the basis for building and land use controls

The questionnaires used in the study were designed to provide this basic information but also provided the opportunity to report more detailed information where it is available, ie properties liable to flooding from the probable maximum flood, susceptibility of infrastructure etc.

It needs to be stressed that, although the 1 in 100 year event is very widely used as the basis for floodplain management, it is far from an ideal standard for universal application. Further, for emergency management and flood damage assessments over-floor flooding is much more critical than over-ground inundation.

For the purposes of floodplain management it is necessary to select a designated flood which forms the basis for controls on new developments. Although the 1 in 100 year flood line is often used, this is not necessarily a good choice due to large variations in flood height range which have, in extreme cases, the potential to cause structural failure especially for lightweight buildings.

Hydrological studies of flood prone areas should always include estimates of the magnitude and extent across the full range of floods to the level of the probable maximum flood. This is especially important because of its implications for emergency response planning.

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Urban Flooding in Queensland: Early Estimates of Size

2.1 Early estimates

Any estimates of the number of properties at risk from flooding made in Australia prior to the mid-1970s are little more than guesses. The impetus to flood studies from the widespread flooding of 1974 resulted in the first systematic attempts to assess the magnitude of the problem. These estimates were hampered by the lack of flood maps, which are essential to define the urban areas at risk. The first estimates based upon a growing data base were made by a Technical Committee of the Australian Government Actuary (AGA, 1978) which reported its findings in 1978. In 1976 Douglas, in a paper at the National Hazards Symposium held in Canberra (available as Douglas, 1979), presented a review of flooding in Australia. This suggested that some 5 per cent of dwellings in Australia were liable to river flooding, the information base for this estimate was derived from the information gathered by the Technical Committee.

Irish and Devin (1978) discussed methods to estimate mean annual damage to dwellings. Their account gave estimates of the number of dwellings exposed to damage from the 1 in 100 year flood for 135 urban areas throughout the Commonwealth. These included all major urban centres plus smaller urban areas known to have a significant flood risk.

Irish and Devin, commented, in comparing the estimates for Queensland and New South Wales, that:

... Mean annual flood damage for New South Wales was estimated to be much less than for Queensland despite the disparity in State populations. This is thought to be due to the flood mitigation program which has been carried out in many NSW towns over the last two decades, the tighter town planning controls and the absence of major flood hazards in Sydney, Newcastle and Wollongong (Irish and Devin, 1978: 106).

A recent review of urban flooding in Australia is also given in Smith (1996).

2.2 Estimates by Australian Water Resources Council (AWRC)

The study undertaken by Water Studies Pty Ltd, and reported in *Floodplain management in Australia* (AWRC, 1992), provides the most recent nationwide flood estimates. These include information on the numbers of buildings at risk, together with estimates of annual average damage (AAD) for rural and urban sectors for both mainstream and stormwater flooding. The background data were assembled after discussions with the responsible agencies in each State and Territory. The survey is comprehensive but reflects the deficiencies outlined in Section 1.

The major limitation is that all the estimates are restricted to the 1 in 100 year flood event, the additional losses that could be expected from extreme floods and building failure are omitted. To an extent the two are linked, building failure would be a much larger factor for the rarer

extreme events. The reasons for these omissions are the paucity of available data and the restricted approach taken by most State agencies to the definition of flood.

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2.2.1 Number of properties at risk in Queensland

A convenient starting point for the present study is to consider the data on the number of properties at risk in Australia from the 1 in 100 year flood as reported in Appendix D of the AWRC (1992) report. These are given in Table 2.1.

Table 2.1 Number of properties, by State, at risk from 1 in 100 year mainstream flooding, from AWRC, see Appendix D (1992)

	Protected	Unprotected	Total
New South Wales	21,800	36,100	57,900
Northern Territory		2,000	2,000
Queensland			21,000
South Australia	1,350	1,350	1,350
Tasmania		715	715
Victoria ·	3,600	10,600	14,200
West Australia	4,440	1,350	5,750
Total	29,800	73,115	102,915

Table 2.1 also divided properties into 'protected' and 'unprotected'. The protected are those where structural mitigation measures lessen the impacts of the flood events, such protection is dominantly provided by levee systems. These are of major significance in New South Wales, Victoria and Western Australia, but much less so for Queensland. Protected residences pose problems for damage estimation, this is because the levees have a design limit and when this is exceeded, severe flooding can result. An additional complication is that such levees can fail at heights below the design (i.e. overtopping) level.

The AWRC report (1992) gives the official estimates of flood prone properties, as provided by the former Queensland Water Resources Commission (now part of the Department of Natural Resources) as 17,000. Of these 14,600 were urban and 2,400 rural. These were known to be under-estimates and they were revised in the AWRC report to a state-wide total of 21,000. This too, was undoubtedly a major underestimate. Reliable estimates of the numbers will not be available until the areas subject to flood are delimited on the basis of good quality flood studies.

2.3 The Insurance Council of Australia (ICA)

A more recent unpublished study was undertaken for the Insurance Council of Australia (ICA), this included estimates of the number of residential buildings at risk from flooding for each State and Territory (Smith, 1996). The results are summarised in Table 2.3, with the exception of Queensland, the numbers of residential buildings are similar to those in AWRC (1992), given in Table 2.2.

Table 2.2 Revised State estimates of residential buildings at risk from 1 in 100 year mainstream flooding, from Smith (1996)

	Inland	Coastal	Protected	Total
New South Wales	9,700	27,800	27,500	65,000
Northern Territory	2,000	0	0	2,000
Queensland	10,000	40,000	0	50,000
South Australia	0	1,500	0	1,500
Tasmania	375	375	1,000	1,750
Victoria	4,150	7,200	3,650	15,000
Western Australia	0	1,350	4,440	5,750
Total	26,225	78,225	36,550	141,000

NOTE: The Queensland data reported in AWRC (1992) does not differentiate between 'protected' and 'unprotected' buildings, however the number of protected buildings is small.

The ICA report acknowledged that the data base for Queensland is poor but suggested a working estimate of 50,000 residential buildings, i.e. those subject to over-ground inundation from the 1 in 100 year flood event.

2.4 Summary

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Regardless of the imperfections of the estimates the overall conclusion of the existing surveys is that the combined buildings at risk in New South Wales and Queensland account for over 80% of the national total. In terms of both buildings and damage (assessed in terms of average annual loss) the magnitude is similar in both States.

These earlier accounts are all restricted to inundation from mainstream flooding, ie urban storm drainage surcharge is excluded, although the AWRC (1992) report separately assessed flood risk from storm water drainage. These earlier studies also excluded inundation from storm surge which is limited to those areas of northern Australia exposed to risk from tropical cyclones.

In practice, storm surge inundation is dominantly a Queensland problem, this is because there are only a few small urban settlements in Western Australian and the Northern Territory that are at risk from major surge events. The major urban surge locality in these other northern States is Darwin but zoning to exclude new developments from areas liable to surge was undertaken in the late 1970s, ie after Cyclone Tracey. Although the current study is focussed on urban mainstream flooding in Queensland a preliminary account of urban exposure to storm surge will be included.

Detailed studies of flood hydrology, vulnerability and loss are well-advanced in New South Wales but are only known with any precision for a few localities within Queensland. The risk of urban flood in Queensland is undoubtedly large but how large, and which localities have the major risks, provides the impetus for the present study.

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The Questionnaire: The Size of the Problem

3.1 Questionnaire distribution and response

The questionnaire, *Urban flood risk in Queensland*, was distributed to all LGAs throughout the State over the period September to November 1996. The number of LGAs totalled 125, a list is given in Table 3.1. Responsibility for circulation, the collection of returns and contacting recalcitrant respondents was undertaken by staff of the DNR. By April 1997 completed questionnaires had been received from 102 LGAs, 15 of which provided information for more than one flood prone location within their area of jurisdiction, these are also indicated on Table 3.1. Of the completed forms, 15 LGAs did not meet the criteria used to define a flood prone community, i.e. more than 10 flood prone buildings at a single locality. These are also shown on Table 3.1.

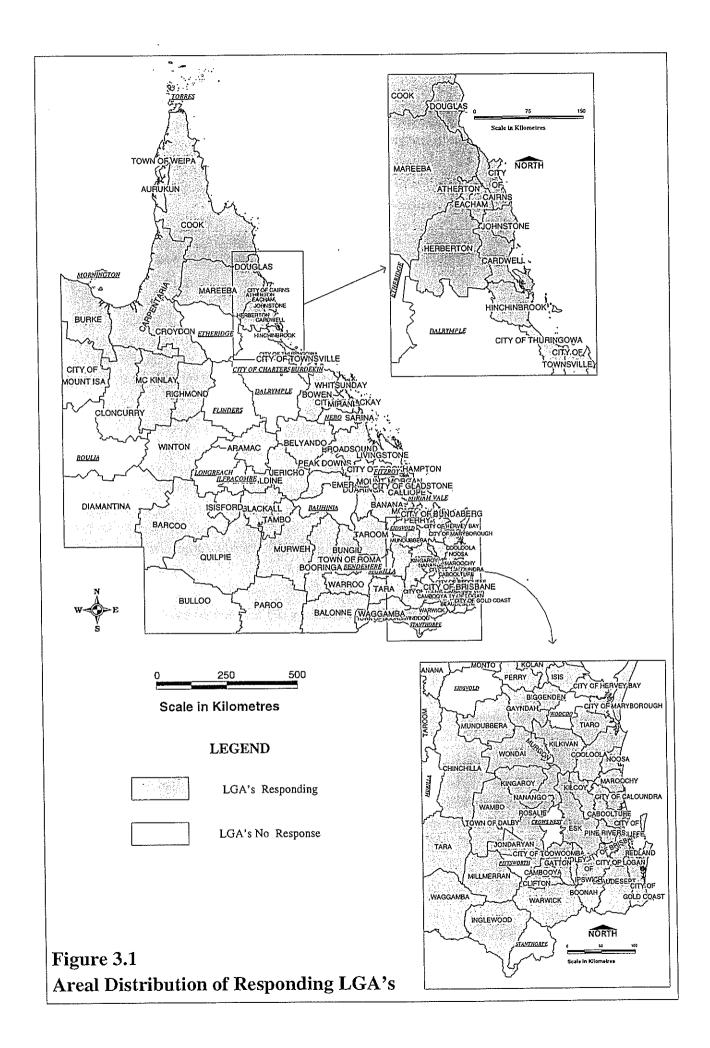
The areal coverage of LGAs who responded, also including those with an insignificant urban flood problem, are given in Figure 3.1.

In order to obtain this degree of participation, the DNR repeatedly contacted those LGAs who had not sent in completed questionnaires. In reviewing progress in early 1997, it was decided not to further harry those non-responding LGAs who were considered not to have an urban flood problem. The decision on LGAs in this category was based upon discussions with the Hydrological Section of the Bureau of Meteorology and with staff of Queensland Emergency Services. The 18 LGAs in this category are indicated on Table 3.1 and as a result of their elimination, there were only 4 LGAs of interest who did not respond.

In total, responses were received from 102 LGAs covering 133 localities.

A further modification to the original intention of the questionnaire, that it should be completed for each flood prone location within single LGAs, was for Brisbane and Gold Coast City Councils. This is because for both of these the size of the urban flood problem, in terms of numbers of buildings at risk, was especially large and because flood prone buildings were distributed over a number of catchments. The detail for Brisbane and the Gold Coast are outlined in Section 4.

Overall, the level of response and detail given by those LGAs that have a risk of urban flooding was good. Where known, separate estimates of the size of the urban flood problem for these, and for respondents who did not complete individual questions, are included in the discussion of the results.



Queensland LGAs, responses to the questionnaire Table 3.1.

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1.	Aramac Shire		43. Diamantina Shire	*(2)	85. Monto Shire	*
2.	Atherton Shire	*	44. Douglas Shire		86. Mornington Shire	1
3.	Aurukun Shire		45. Duaringa Shire	*	87. Mount Isa City	
4.	Balonne Shire	(5)	46. Eacham Shire		88. Mt Morgan Shire	
5.	Banana Shire	(4)	47. Eidsvold Shire	1	89. Mundubbera Shire	
6.	Barcaldine Shire		48. Emerald Shire		90. Murgon Shire	*
7.	Barcoo Shire	(3)	49. Esk Shire		91. Murilla Shire	1
8.	Bauhinia Shire	ì	50. Etheridge Shire	1	92. Murweh Shire	(2)
9.	Beaudesert Shire		51. Fitzroy Shire		93. Nanango Shire	
10.	Belyando Shire	*	52. Flinders Shire	1	94. Nebo Shire	1
11.	Bendemere Shire	1	53. Gatton Shire		95. Noosa Shire	
12.	Biggenden Shire		54. Gayndah Shire		96. Paroo Shire	
13.	Blackall Shire		55. Gladstone City		97. Peak Downs Shire	*
14.	Boonah Shire		56. Gold Coast City		98. Perry Shire	*
15.	Booringa Shire		57. Goondiwindi Town		99. Pine Rivers Shire	
16.	Boulia Shire	1	58. Herberton Shire		100. Pittsworth Shire	1
17.	Bowen Shire		59. Hervey Bay Shire	(2)	101. Quilpie Shire	
18.	Brisbane City		60. Hinchinbrook Shire	:	102. Redcliffe City	
19.	Broadsound Shire	*	61. Ilfracombe Shire	1	103. Redland Shire	(2)
20.	Bulloo Shire		62. Inglewood Shire		104. Richmond Shire	
21.	Bundaberg City		63. Ipswich City		105. Rockhampton City	
22.	Bungil Shire	*	64. Isis Shire	₩.	106. Roma Town	
<i>23</i> .	Burdekin Shire		65. Isisford Shire		107. Rosalie Shire	(2)
24.	Burke Shire - received b	nit	66. Jericho Shire	(2)	108. Sarina Shire	(5)
	not included		67. Johnstone Shire		109. Stanthorpe Shire	1
	Burnett Shire		68. Jondaryan Shire	(2)	110. Tambo Shire	
	Caboolture Shire	(8)	69. Kilcoy Shire		111. Tara Shire	
27.	Cairns City	(2)	70. Kilkivan Shire	*	112. Taroom Shire	
	Calliope Shire		71. Kingaroy Shire		113. Thuringowa City	
29.	Caloundra City		72. Kolan Shire	*	114. Tiaro Shire	
	Cambooya Shire		73. Laidley Shire		115. Toowoomba City	
31.	Cardwell Shire		74. Livingstone Shire		116. Torres Shire	I
32.	Carpentaria Shire	(2)	75. Logan City		117. Townsville City	
<i>33</i> .	Charters Towers City	1	76. Longreach Shire	I	118. Waggamba Shire	
	Chinchilla Shire		77. Mackay City		119. Wambo Shire	
	Clifton Shire	*	78. Mareeba Shire		120. Warroo Shire	
36.	Cloncurry Shire	*	79. Maroochy Shire		121. Warwick Shire	
37.		(3)	80. Maryborough City		122. Whitsunday Shire	*
	Cooloola Shire		81. McKinlay Shire		123. Winton Shire	
	Crows Nest Shire	1	82. Millmerran Shire	*	124. Wondai Shire	*
40.	•		83. Mirani Shire		125. Woocoo Shire	1
	Dalby Town		84. Miriam Vale Shire			
42.	Dalrymple Shire	ı			}	

Italic = no response received

1 = not chased up - believed to have no problem

Bold = response received

^{* =} no obvious problem

^{(#) =} multiple responses received

3.2 Discussion of the questionnaire

Responses to the questionnaire are used as a basis for discussion throughout the remainder of this report.

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This Section (Section 3) concentrates on the size of the problem, Section 5 on Hydrological information, mapping, damage studies, mitigation and policy, Section 6 on Flood warning systems and counter disaster plans and Section 7 on The largest known flood - the effects on lifelines.

An overall summary to the questionnaire results is given in Section 10.

Appendix 1 provides detail on responses from each LGA. This omits qualifying comments. The original forms and a spreadsheet of responses with included comments are held by the Department of Natural Resources.

Appendix 2 is a copy of the questionnaire with, where appropriate, indications of the responses to each question.

3.3 Interpreting questionnaire responses

Before presenting an analysis of the responses it is important to the note difficulties in designing a questionnaire to cover LGAs that differ in size from Brisbane City Council to remote locations in the north and west of the State that cover areas of several thousand square kilometres but have populations of only a few hundred. There are also difficulties in that the questions were designed to obtain information from LGAs that had undertaken hydrological and vulnerability studies as well as those that had no detailed information whatsoever.

The analysis presented below does not give detailed quantitative information for each section of each question on the questionnaire. However, Appendices 1 and 2 to the report present a summary of all questions from each questionnaire received.

Because of the comprehensive nature of the questionnaire, it was not possible for all respondents to provide answers to each question and sub-question. Therefore, the number of answers to each question varies. This is indicated by presenting the results to individual questions in the form of '55 of the 101 respondents'.

A limited number of questions were included that allowed LGAs to comment on whether they had a risk from storm (tide) surge. This was not intended to be a detailed survey but to gain some overall indication of the perceived size of the storm surge problem which has much in common with overland mainstream river flooding. The results for storm surge are discussed in Section 9.

3.4 Size of the urban flood problem

Ideally the first step in analysing the size of the urban flood problem in Queensland would be to present data on the numbers of buildings at risk from overground (or over-floor) inundation from both the designated flood (usually that associated with the 1 in 100 year event) and the probable maximum flood. The latter is rarely available in Australia or elsewhere and it is standard practice to use the 1 in 100 year flood to define numbers of buildings, see Section 1.2. However, in Queensland only a limited number of LGAs have undertaken the detailed

hydrological studies necessary to define this level, in such circumstances the best estimate (although far from ideal) can sometimes be obtained by considering the flood of record.

3.4.1 Definitions used to define the number of flood prone buildings

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The questionnaire was designed to obtain information on numbers of buildings for both the Largest recorded event (Questions 4.4 to 4.7) and the Total number of buildings flooded by the adopted designated event (Questions 6.8 to 6.11). Where possible the respondents were requested to classify the number of buildings into residential, commercial, industrial and caravans (including mobile homes). In both cases information was requested from the best available data. In a limited number of cases this aspect of vulnerability was known in detail, eg. for Mackay and Charleville both based on detailed GIS studies of individual buildings, but for many other locations the size is often that of an educated guess.

In order to preserve comparability, the number of flood prone buildings are in terms of over ground flooding. This is because it is the simplest, and most commonly used procedure, to estimate the number of buildings located below the level of the 1 in 100 year flood. The numbers of buildings that would experience over-floor inundation would be considerably less. The importance of this distinction will be illustrated in section 4 with data from the Gold Coast.

There are also difficulties in whether the data are expressed in terms of 'buildings' or 'properties'. The questionnaire was quite deliberately worded in terms of 'buildings'. This was because the use of the word 'property' is often interpreted at local government level to represent a building block, with or without a building on it. The other problem is that in the residential sector a 'building' can sometimes contain more than one dwelling unit, for example when the building is divided into flats or apartments. For much of Queensland this is a not a serious problem. However, for some localities (the Gold Coast is a prime example), they can be a significant difference between the number of residential buildings and dwelling units. The difference is important both for assessment of potential flood losses and for the emergency services, i.e. in converting residential buildings to numbers of people in order to plan for emergency evacuation.

For consistency, the numbers below are expressed in terms of flood prone buildings liable to <u>over-ground</u> flooding and with no allowance for the conversion of residential buildings into dwelling units. Similar assumptions are made in comparable flood studies in Australia and elsewhere, and in the AWRC (1992) report. For floodplain and emergency management at local level the details of numbers of buildings flooded over-floor and the number of individual dwelling units are however, important.

To provide even a provisional estimate of the numbers of flood prone buildings in Queensland is a difficult task. Using the survey responses to arrive at a total figure involved assessing the following components:

• numbers of buildings given in direct response to Questions 6.8 to 6.11, i.e. where the flood problem was relatively easily described by a number in the questionnaire answer box (these are described in Section 3.4.2 and summarised in Table 3.2)

• numbers of buildings for LGAs that did not provide a direct answer to Questions 6.8 to 6.11; these were in two groups:

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- a) more complex responses where the flood problem was large or involved numerous catchments typically the larger LGAs (responses for these are included in Section 3.4.3 and summarised in Table 3.4)
- b) estimates for councils known to have large numbers of buildings at risk that did not respond to Questions 6.8 to 6.11, these are also given in Section 3.4.3 and summarised in Table 3.4,
- allowance for missing data (i.e. those not considered in Sections 3.4.2 and 3.4.3), these are given in Section 3.4.4.

For many of the authorities with a small number of flood prone buildings the estimates are taken directly from the questionnaire, the totals for these are given in Table 3.2. The detail can be obtained from the precis of the individual questionnaires given in Appendix 1. Those with a larger number of buildings at risk fall into two categories. Some have information based on detailed hydrological and vulnerability studies, others base their estimates on very poor quality data. The councils with larger numbers of buildings at risk, with either poor or good quality data, are listed in Table 3.4.

Thus, Table 3.4 lists those authorities with a substantial urban flood problem for which the numbers of buildings at risk were not given directly in response to Question 6.8 to 6.11. For many of the authorities in this category, numbers were not given because the information was too complex for a simple answer. For the two councils with the largest numbers of flood prone buildings, Brisbane and the Gold Coast, the problems of providing estimates are described in detail in Section 4. Where the number of flood prone buildings is poorly known this is indicated in Table 3.4. For these larger authorities a short description is given for each in Section 3.4.3.

Care has been taken not to double count estimates from the responses, given in Table 3.2, with those listed in Table 3.4. Attention however, is drawn to the number of flood prone buildings in the Nerang catchment of the Gold Coast. Initial, and provisional, Council estimates were given on the questionnaire but more detailed information was made available to the study at a later stage. In this instance, the initial estimate of 5,000 flood prone buildings given on the questionnaire has been omitted from the totals in Table 3.2 and the new estimate (of 16,650) added to Table 3.4.

Table 3.5 presents a consolidated ranked list, based on the information given in the questionnaire responses and from the data in Table 3.4. Of the twelve councils in Queensland that have the largest number of buildings at risk from urban flooding to the level of the 1 in 100 year flood event.

3.4.2 Numbers of flood prone buildings - reported in the questionnaire

The response to Questions 6.8 to 6.11, which requested the best estimates of the number of buildings at risk from flooding to the level of the designated flood, provided direct information for 34 urban locations from 23 LGAs. The totals for these locations are given in Table 3.2.

Table 3.2 Total number of buildings at risk from flooding to the level of the designated flood, direct responses to Questions 6.8 to 6.11

Number of buildings				
Residential	Commercial	Industrial	Caravans (mobile homes)	Total
7,189	345	217	474	8225

The provisional estimate for the Nerang Catchment given in the questionnaire response by the Gold Coast City Council has been omitted from Table 3.2.

The poor number of direct responses to this question is perhaps not surprising, this is because only 43 out of the 108 locations reporting to have carried out a 'flood' study in the questionnaire (Question 6.1), have designated flood levels.

There is also a difficulty in converting these data to number of buildings liable to flood from the 1 in 100 year event. This is because there are variations between the locations in the definition used for the designated flood. These variations are summarised in Table 3.3.

Table 3.3 Definitions of the designated flood, based on Question 6.5

Designated floods (numbers of LGAs)				
1 in 100 year	1 in 50 year	Below 1 in 50 year	Flood of record	
27	11	4	2	

The four locations that used a value below that of the 1 in 50 year have a variety of levels for the designated flood. For example, Ipswich uses the 1 in 20, Mt Isa the 1 in 15, Townsville the 1 in 10 and Hinchinbrook the 1 in 3 year level. Such criteria would not be acceptable by those States and nations that have urban floodplain management guidelines or regulations. Beaudesert and Mirani use the flood of record.

A further complication is that for some councils the designated flood level varies, for instance different criteria for mainstream and creek flooding. Examples of this kind are provided by Laidley and Logan.

There is also a problem in distinguishing between 'commercial' and 'industrial' buildings and for the overall State summary it is recommended that the two are combined into a single class. Any subsequent survey should aim to list major flood prone industrial complexes.

An example from Gladstone indicates that much of the large port complex is at risk from flooding, and for Brisbane industrial flood damage would be large.

3.4.3 Estimates of the number of buildings NOT included in the direct responses to Questions 6.8 to 6.11 and for which information is known to exist

The most significant feature of the response to the questions that describe the number of buildings at risk from the designated flood is that many of the LGAs with a known flood risk

provided no information (ie did not complete Question 6.8 to 6.11, by reporting the number of buildings flooded to the level of the adopted designated flood). Table 3.4 lists estimates from other sources for many of the missing LGAs known to have a significant number of buildings at risk.

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Also included in Table 3.4 are figures for those LGAs, such as Gold Coast and Brisbane, which were unable to provide a response by simply entering a number in answer to Question 6.8 to 6.11 but did however provide detailed data.

Table 3.4 Estimates of the number of buildings at risk for LGAs not completing Question 6.8 to 6.11

Local Government Authority	Number of buildings to 1 in 100 year level	
Mackay	8, 500	
Brisbane (Brisbane River and Creeks)	8,000	
Gold Coast Nerang catchment Other catchments	$14,650 \\ 2,000 \pm 1,000$	
Dalby	3, 300	
Ipswich (All catchments) Charleville	*3,000 1,350	
Rockhampton	1, 200	
Burdekin	*1,000	
Total	43,000	

^{*} Poor quality estimates

An outline to the sources for each of the locations listed in table 3.4 is given below.

Gold Coast

Revised estimates for the Gold Coast based on detailed studies for the Nerang catchment (available after the questionnaire was completed) are discussed in detail in Section 4. The figure used in the estimates of numbers of buildings at risk in Table 3.4 (i.e. 14,650) is for 400 commercial and 14,250 'residential properties'. The Gold Coast is unusual in the large number of 'residential properties' (this equates to buildings) that contain a number of individual 'dwellings', i.e. multi-occupancy as flats or apartments, are relatively common. The number of 'dwellings' is estimated to be $28,600 \pm 2,000$. For reasons of consistency, the figure of 14,650 has been used in Table 3.4.

Other catchments in the area administered by the Gold Coast City Council also contain urban flood prone land, studies for these is less complete than for the Nerang catchment The Council provisionally estimates a combined total of $2,000 \pm 1,000$ flood prone buildings for the remaining catchments.

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A study of storm surge for south and north Mackay (the latter was then in the Pioneer Shire) also provided a building by building data base that could be used to estimate the numbers liable to flood from the Pioneer River, see Smith and Greenaway (1994). The problem for the estimation of mainstream flooding is that precise definition of the 1 in 100 year flood is not available (i.e. extent and slope). Despite this limitation, the combined estimate for south and north Mackay for residential, commercial and industrial buildings is 8,500 (to the level of the 1 n 100 year flood).

Brisbane

Details of the estimates for the main Brisbane River (post-Wivenhoe Dam) and for the various creek catchments in the area administered by the Brisbane City Council are given in Section 4. The favoured official figure is about 8,000 (all types of buildings) although there are reasons to consider that this may be an under-estimate. There is no doubt that some very large industrial enterprises are included. With the completion of a revised hydrological study, currently in progress, for the Brisbane River and the impending AGSO Cities Project study of vulnerability these estimates will be greatly improved.

Ipswich

Information for Ipswich is poor, although detail is known for Bundamba Creek, one of the sub-catchments. Based on the 1974 flood, 2,500 buildings were flooded. Although this would come close to a 1 in 100 year event such data are over twenty years old and with a 1 in 20 year designated flood level it is certain that the current number of buildings at risk would be larger, hence an estimated total of 3000 has been adopted.

Dalby

A Flood Management Study was commissioned by Dalby Town Council, after a series of major floods in the early 1980s. That study forms the basis for the estimation of the number of urban buildings at risk. Of the total of 3,300, about 400 are used for commercial or industrial purposes.

Charleville

Extreme floods occurred over a wide area of western Queensland in April 1990 and this led to detailed studies of the flood hydrology and of the vulnerability of the community affected. The study is reported in the *Western Queensland Flood Study*, Camp, Scott and Furphy (1991) The largest of the urban communities was Charleville which was estimated to have 1350 buildings within area subject to the 1 in 100 year flood. Of these, 1225 were residential and 125 commercial.

Rockhampton

Detailed consultant studies are available for the City of Rockhampton and these include estimates of the number of buildings, see Camp, Scott and Furphy (1992). However, these were not reported in the questionnaire and a provisional figure of 1,200 is used. Further detail could be obtained from the flood studies available to the council.

Burdekin

Unfortunately questionnaire information from Burdekin is lacking. Urban locations within the area administered by the council are thought to have a significant flood problem, especially for low probability flood events. The number of 1,000 is merely indicative of the size of the problem.

Combining the questionnaire results, consolidated in Table 3.2, with those in Table 3.4 gives a provisional estimate for the number of flood prone urban buildings in Queensland at the 1 in 100 year flood level. The total is close to 51,000, this combines residential, commercial, industrial and mobile homes. A ranked list of the twelve most flood prone LGAs, based on the questionnaire and Table 3.4, is presented in Table 3.5.

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Estimates of the number of buildings liable to inundation for floods of greater severity than the 1 in 100 year event are discussed in Section 3.5 and summarised in Section 3.6.

Table 3.5 A list of the twelve LGAs with the largest number of buildings at risk from the 1 in 100 year flood

ocal Government Authority	Number of buildings ¹
Gold Coast	16,650
Mackay	8, 500
Brisbane	8, 000
Dalby	3, 300
Ipswich	3,000
Logan	2, 375
Hinchinbrook	2, 175
Charleville	1, 350
Rockhampton	1, 200
Burdekin	1, 000
Cairns ²	728
Caboolture	455
TOTAL	48,733

Includes residential, commercial, industrial and caravans

3.4.4 Missing data

The total of 51,000 buildings at risk from flooding at the 1 in 100 year level is not fully inclusive. As indicated, some of the questionnaire responses are for a designated flood that is lower than the 1 in 100 year flood level (and as a consequence are an underestimate of the

Limited to the extent of the former Mulgrave Shire, riverine flooding in the area of the former Cairns City is, in comparison, limited (refer Section 9 for surge inundation estimates for Cairns and other coastal centres)

number of properties at risk from the 1 in 100 year flood). It should be noted however, that the estimates in Table 3.4 are for the 1 in 100 year flood.

There remains the problem of LGAs who did not complete Ques 6.8 - 6.11 (Table 3.2) and for which estimates are not given in Table 3.4. It is unlikely that, to the level of the 1 in 100 year flood, any of the missing LGAs have exceptionally large numbers of flood prone buildings, say more than 500 at any single location. Even this statement needs caution as the very large numbers for the Gold Coast were unknown until recently, the size of flood risk at Mackay was not appreciated until the storm surge study undertaken in 1991 and Charleville was not thought to have a serious flood risk until the floods of 1990.

Further, the floods of early 1997 drew attention to a number of relatively small urban locations that had previously been considered, erroneously, as flood free. It is also salutary to note that whenever detailed, building by building, surveys are undertaken, the size of the problem increases over that for earlier estimates! This certainly was the case for New South Wales as building by building surveys replaced the original estimates provided by Councils. Undoubtedly, future floods will provide similar surprises.

3.4.5 Overall estimate of the number of flood prone buildings in Queensland

The estimate, given above, of 51,000 buildings at risk from the 1 in 100 year flood need modification to account for the missing and incomplete data indicated above.

A cautious estimate would be 60,000 but it is considered more likely that, if and when local urban flood studies are complete, that the number could be nearer to 65,000. It is also pertinent, to stress that without basic hydrological information and designated floods for planning purposes that the number is increasing year by year.

3.5 Probable maximum flood

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Comprehensive studies of urban flood damage should consider the potential impact of the probable maximum flood (PMF). This is not in order that the limits of the PMF should be used as a designated flood for planning purposes but it is necessary in order to evaluate: potential flood damage, the risks of building failure and to provide the emergency services with information to enable reduction in flood losses, especially the risk to life. The need is to estimate PMF although it is stressed that for many localities the increased risks could be relatively small, the significance is that for other locations the risks could be high. The background to the need for PMF information is given in Section 1.5.3.

3.5.1 PMF and the questionnaire

The lack of hydrological studies for most prone locations in Queensland is such that data on the extent of extreme events are often lacking. Only about 20% of responses (23 out of 108) indicated that they have data on the discharge of the flood of record. Such information is of course, invaluable for the subsequent estimation of the PMF.

Ques 6.3 specifically asks '... has the PMF discharge been estimated', less than 10% of the respondents (11 out of 109 replies) indicate that they had; examples of those that have such information are St George, Bowen, Gladstone and Rockhampton. Only 8 of the 10 with PMF discharges have converted the data into map form, LGAs that have include Cairns (Mulgrave), Noosa, Pine Rivers and Redland.

The questionnaire did not ask whether hydrological studies had included estimates of over-floodplain velocities, but it is extremely unlikely that this has been undertaken by more than a handful of authorities. Logan is one example that has information on velocity which has been used to assess the likelihood of building failure.

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It is clear that, with few exceptions, information on the PMF or extreme floods (i.e. those in excess of the 1 in 100 year event) is not normally available. To follow best practice, estimates of flood discharges up to and including the PMF, their areal extent and over-floodplain velocities should be incorporated into all hydrological studies for flood prone urban locations.

This applies to existing urban developments and, equally important, for those yet to be developed above the level of the designated flood. It is crucial that the community perception does not consider that areas above the designated flood, regardless of its annual recurrence interval, are flood free. The PMF and velocity information are of significance for the emergency services and are necessary to establish comprehensive flood loss data for use in any form of cost benefit analysis. Often insurance companies are one of the few institutions to take cognisance of the risks involved from such extreme events.

Although detailed data are uncommon, there is little doubt that a near PMF for locations with a high flood range would result in structural building failure especially for many existing residential developments. Ipswich is one such example, some 30 dwellings failed during the 1974 flood and an event of greater magnitude would dramatically increase the number of such failures. This would clearly, pose a very real risk for loss of life.

3.5.2 Probable maximum flood - buildings at risk

Precise estimates of the number of buildings at risk from flooding to the level of the PMF are rarely available in Australia or overseas. Such studies in Australia are restricted to a limited number of urban flood prone communities in New South Wales.

Currently there are no detailed estimates of the numbers of buildings at risk from PMF or extreme floods for any location in Queensland.

Thus, evaluation of the risk to buildings above the level of the 1 in 100 year flood is essentially unknown. The account below attempts to describe the problem and its likely significance.

3.5.3 Increases in the number of flood prone buildings at the level of the probable maximum flood

The AWRC (1992), and earlier reports, specifically limit the numbers of flood prone buildings to those at risk from the 1 in 100 year event. This is done for the very good reason that few maps exist that show flood lines for events that exceed the 1 in 100 year level. Indeed, the only examples that consider this problem in any detail have been produced by CRES at ANU, see Smith (1991). A detailed account of these studies is given in Appendix 3.

For the case studies discussed in Appendix 3, (the Hawkesbury-Nepean region of western Sydney, the Georges River and Prospect Creek in Sydney, Queanbeyan in inland New South Wales and Canberra) the number of buildings subject to inundation at the level of the PMF are three to six times greater than the number for the 1 in 100 year flood event. The increases in flood height from the 1 in 100 year flood to the PMF for these localities are in the range from about 3 metres to greater than 10 metres. The larger the flood height range, the larger

the increase in the number of buildings at risk when compared to those for the 1 in 100 year flood event.

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Table 3.6 lists a selection of flood prone locations in Queensland known to have large height ranges. Although local site factors are significant, it is likely that increases in the number of buildings subject to inundation from a PMF would be comparable to those for the examples listed above in New South Wales and the ACT.

Table 3.6 Increases in flood height from the 1 in 20 to 1 in 100 year flood for a selection of Queensland towns

Ipswich, Brisbane-Bremner River	15.0+m
Kenilworth, Mary River	7.0 m
Gympie, Mary River	12.0 m
Taroom, Fitzroy River	7.0 m

The increases are related to the valley topography but are exacerbated by development guidelines that use the 1 in 100 year event as the definition of flood prone. This is because once floods exceed the 1 in 100 year level a large number of buildings, located just above the 1 in 100 year line to conform with development regulations, are inundated.

Of significance for urban locations with large flood ranges is the depth of inundation experienced by buildings that are located at, say, the 1 in 50 year level. These will have water over their rooves for near PMF events. It is this factor which is largely responsible for structural failure.

It is important to stress that all the case studies in Appendix 3 and in Table 3.6 are for locations which have relatively high flood level ranges. Such effects are not universal or even widespread. For example, they would be insignificant for most inland locations in New South Wales, along the Murray, in Adelaide and for most of Tasmania and Western Australia. However, high flood ranges occur in Ipswich, much of Brisbane and for some of the coastal flood locations in New South Wales and Queensland.

Attempts to allow for the markedly increased damage for locations with high flood ranges will be made in Section 8. Suffice it to say that such effects must be considered if the aim is to obtain realistic damage estimates on which to base flood mitigation strategies and their cost benefit ratios.

3.6 Probable maximum flood – summary

The responses to the question 6.3 illustrate the paucity of PMF data for Queensland, less than 10% had estimates of the PMF discharge and even fewer had converted this to maps showing the extent of the PMF event. There is clearly, an urgent need to consider the impacts of extreme floods to the level of the PMF. This is necessary to improve both the effectiveness of the emergency services to reduce all forms of loss from such extreme events and as a basis for

acceptable and comprehensive cost benefit analyses of flood mitigation measures to lessen the losses to existing flood prone developments, especially those below the level of the 1 in 100 year flood.

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Background data from New South Wales for locations with moderate to high flood height ranges, have been used to illustrate the nature of the problem (see Appendix 3). As a preliminary (and conservative) value it is not unlikely that the number of buildings in Queensland liable to inundation from the PMF are up to three times the number at risk from the 1 in 100 year flood event, i.e. close to 200,000 buildings.

Given the overall lack of PMF data for Queensland, it would be necessary to prioritise those LGAs with the major risk, ie those with a moderate or high flood ranges. The most significant of these is Ipswich, other locations include Brisbane River, Logan River, Mary River, and Taroom with others selected in consultation with the Bureau of Meteorology. Once the discharge and areal limits of the PMF are available, ideally with estimates of over-floodplain flow velocities, the risk of building failure could be assessed.

The selection of designated flood levels for urban floodplain management should incorporate the analysis of the effects of extreme floods especially for those localities that are known to have a high flood range. In some cases it would be inadvisable, if only on the grounds of safety, to use the 1 in 100 year flood for such purposes.

Brisbane and the Gold Coast

4.1 Brisbane and the Gold Coast

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Brisbane City and Gold Coast City Councils completed the questionnaire circulated to all Queensland LGAs. However, in both cases the responses were limited to individual river catchments, the main Brisbane River and (for the Gold Coast) the Nerang catchment. As both councils have particularly large and complex urban flood problems interviews were held with senior staff to gain further information on the other flood prone catchments in their areas of jurisdiction. This section reports on the overall problem for both councils, first for Brisbane and then for the Gold Coast.

For Brisbane, the current study had access to an extensive series of reports of flood studies undertaken for the Creek catchments over many years. The section below combines this information with that given in the questionnaire for the main Brisbane River.

The Gold Coast also has a number of separate catchments, many of which contain major flood prone urban developments. Until the last year or so information on flood risk and vulnerability was not known in any detail, however comprehensive studies for the Nerang catchment were made available after the completion of the questionnaires. For the other catchments similar studies are not yet fully complete and the information reported below is limited to an outline of the likely situation. The flood studies for the other Gold Coast catchments, have yet to be finalised.

4.2 The flood problem for Brisbane

The Brisbane floods of the Australia Day week-end of 1974 still represent the most severe example of urban flooding in Australia, with an estimated damage bill of at least \$200m at 1974 values. It is important to note that this widely quoted figure, based upon the SMEC (1975) flood study does not include the severe flooding of the Bremer River or of the Brisbane creek catchments. Even before the 1974 flood, inundation maps were available for parts of Brisbane and subsequent to the event Brisbane City Council embarked on a major series of flood studies for the creek catchments followed, in many cases, by the construction of flood mitigation works. Flood information on flood hydrology for the Brisbane Creeks is likely the best for any major metropolitan area in Australia. From the late 1970s, the City Council has progressively imposed land use controls and building regulations for new developments in flood prone areas.

The flood problem in Brisbane has two major components, flooding along the main stream of the Brisbane River and flooding in the smaller catchments, many of which are tributaries to the Brisbane River. This second category is often referred to as 'Creek flooding', some 26 separate creek catchments are recognised although many of these are conveniently grouped into larger catchments. The relationships between the Brisbane River and the Creeks are illustrated in Figure 4.1.

The questionnaire completed by Brisbane City Council, and the data reported in the Tables in other sections, relate solely to flooding along the main channel of the Brisbane River. The Creek catchments that pose major flood threats to buildings and infrastructure are named on Figure 4.1.

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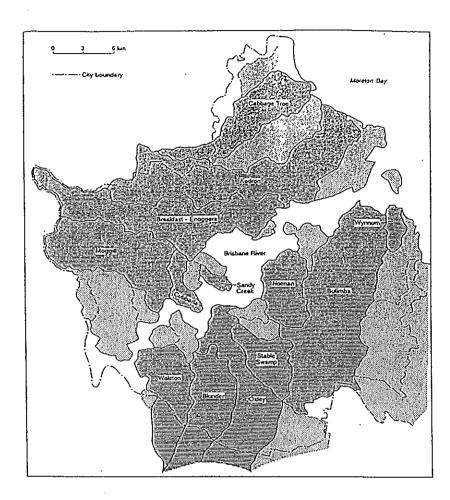


Figure 4.1 The Brisbane River and creek catchments in the area administered by Brisbane City Council

The nature of the flood risk differs markedly between the main river and the Creeks. The most significant difference is in the time interval between rainfall and downstream flooding. Oxley Creek is the largest of the Creek catchments with a length of about 53 km, the corresponding values for the other major Creeks are Bulimba at 41 km, Kedron 27 km, Breakfast/Enoggera 24 km, Cabbage Tree 23 km, Moggill 22 km and Norman 13 km. Carroll (1991), in a study of the warning times and flood forecasting in the Brisbane region, estimated that the time between rainfall and downstream flooding is about 18 h for Oxley Creek with all the other creek catchments having times of nine hours or less. Carroll estimates the effective warning time for Oxley Creek to be about 11 hours, for all the other catchments the effective warning times are 5 h or less. For Wynnum, one of the smaller creeks, the effective warning time is less than an hour.

These relatively short warning times contrast to the main Brisbane River where the warning times are in the range 12 - 24 h, for the 1974 floods the Creeks peaked more than 24 h before

the main river. The differences between the times for the main Brisbane River and the Creeks is significant for measures designed to reduce risk of life and contents damage to dwellings and to commercial and industrial enterprises.

4.2.1 Problems with the assessment of flood vulnerability

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Hydrological information for the Creeks is excellent and is used to define flood regulation lines on which land use and building controls are based. The only shortcoming is that detailed information on the number of buildings at risk from flooding is not known. This stems from the problem that, although both flood data and property boundaries are combined into a long established and well designed GIS for the whole of the region administered by the Brisbane City Council, there is no differentiation between those blocks on which there is a building and those that have not been developed. It is likely that this deficiency will be addressed in the near future as a part of the Australian Geological Survey Organisation (AGSO) Cities Project. Once such building information is incorporated into the GIS, the ability to use the data base for emergency management will be greatly enhanced.

This restriction on information on the type and number of flood prone buildings applies to both the Brisbane River floodplain and to the Creeks. For the main river, and for some of the Creeks, the earlier flood studies estimated the number of buildings at risk. For the main river these were based on the data collected by the SMEC (1975) study, those for the Creeks were much less precise although some have been revised on the basis of additional field studies. This is the case where economic assessments were undertaken in order to evaluate the costs and benefits of a range of floodplain mitigation options many of which were of a structural nature. To undertake such analyses it was necessary to assess flood damage under current conditions and this required data on the number and type of existing buildings. However, progressively the Creek studies were restricted to assessment (or re-assessment) of the flood hydrology and the evaluation did not include assessment of structural mitigation options.

Thus, information on the numbers of buildings at risk from flooding in Brisbane is not consistent across the catchments. This has been further complicated by other factors. These include:

- increases in upstream flood storage after the completion of the Wivenhoe Dam in 1985, this decreased downstream flood risk for the floodplain of the Brisbane River,
- in several of the Creek catchments structural works have lessened the flood risk
- the possibility of construction of new developments in flood prone locations.

Each of the factors is considered below.

4.2.2 The effects of the Wivenhoe Dam

The extra flood storage provided by the Wivenhoe Dam undoubtedly reduced downstream risk but the widespread community perception that it eliminated the flood problem is false. Data reported in CRCE Water Studies (1986), reproduced here as Table 4.1, provide estimates of the changes in risk for the Brisbane River floodplain due to enhanced upstream dam storage and compares the 1974 flood data to that for a re-run of that event under post-Wivenhoe conditions. These data suggest that the mainstream flooding for a 1974 event (close to the 1 in 60 year event) under current conditions would affect 4,900 dwellings and 1,600 commercial and industrial enterprise. It is estimated that the peak height of the 1974 flood in central Brisbane would be reduced by 1.45 m.

Table 4.1 Effects of Wivenhoe Dam on 1974 flood levels and damages for the Brisbane and Ipswich areas. From CRCE Water Studies (1986)

	1974 Flood Pre-Wivenhoe	1974 Flood Post-Wivenhoe
Flood height (AHD) Brisbane City gauge	5.45	4.00
Flooded houses	9,800	4,900
Flooded commercial/industrial enterprises	2,700	1,600
Total damage (\$106 at 1974 values)	180	80

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A re-assessment of flood hydrology for the Brisbane River is listed as a priority by Brisbane City Council and is currently in progress. Studies are also in progress to re-assess the flood hydrology of Oxley and Wynnum Creeks. It is Council policy to re-assess the hydrology of the Brisbane Creeks on a 15-year cycle. This enables the effects of developments to be incorporated, offers the opportunity to utilise additional runoff and rainfall data and ensures that best practice techniques are employed. It needs to be stressed that developments that effect urban runoff are not restricted to buildings within the flood prone parts of the catchments but include a wide range of changes to land use modifications throughout the Creek catchments.

The policy of a 15-year rolling cycle of hydrological studies is to be commended and is not generally practised elsewhere in Australia or overseas.

4.2.3 Effects of structural works

The Creek catchments contain residential, commercial or industrial buildings constructed before floodplain management policies were introduced to regulate development in flood prone locations, in some cases before susceptibility to flood risk was known. Post-1974 flood mitigation studies were undertaken for these catchments, and where economic and physical factors allowed, a range of structural measures were undertaken to reduce flood risk. Thus, early estimates of the number of buildings at risk from a re-run of the 1974 event have now been reduced. Precise information on the numbers of buildings involved are not known but locally these could be substantial.

An evaluation of the reduction of flood risk due to structural mitigation works is available for the Norman Creek catchment. The initial study, entitled the *Norman Creek Flood Mitigation Report* was undertaken by Brisbane City Council (BCC, 1984). This noted that some 300 dwellings and 300 commercial enterprises were liable to flooding for a 1 in 100 year flood, the definition of flooding was over-ground level. On the basis of this study structural works were undertaken. A further study to assess the changes in hydrology due to the works was reported in the *Norman Creek Flood Study* (Connell Wagner, 1995). This study concluded that the estimated reductions in flood height due to the implementation of the works recommended in the BCC (1984) report were attained. The reductions in the height of the flood peaks vary throughout the catchment but in some locations achieved values in the range of 0.8 to 0.9 m. The 1995 study did not attempt to convert these changes in flood magnitude and frequency to economic gains but the original study in 1984 considers that these could amount to approximately half of the pre-works average annual damage.

Studies of this kind, i.e. that compare reality against original design, are unusual and this example for Brisbane is testimony to the high standard of the flood studies over the last twenty years.

4.2.4 Possibility of new flood prone buildings

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, 32 (10) The standard of flood hydrology in Brisbane is matched by the implementation of regulations to restrict development in areas of known flood risk. However, there is always the possibility that some developments have escaped enforcement of such regulations, particularly in the early years, if only because the limits of flooding were imperfectly known for the Creeks. Overall it is unlikely that there have been significant increases in the numbers of flood prone buildings in the area administered by the Brisbane City Council over the last twenty years or so. The reply to the questionnaire by Brisbane City Council, restricted to the main Brisbane River, lists a total of 6,027 buildings to the level of the designated flood (1 in 100 years) but comments, 'based on 1975 data – could be more houses affected now'.

4.3 Estimates of flood prone buildings in the floodplains of Brisbane river and creek catchments

The lack of information on the number of flood affected buildings and the problems of change with time, outlined above, restrict the provision of quantitative data on the size of the flood risk. A summary of the estimates is presented in Table 4.2, together with an indication of the date of the assessment. The details of the flood studies for the creek catchments are given in Appendix 4, they are <u>not</u> reported in the list of references. These present a complex picture which is discussed below.

First, Table 4.2 demonstrates the familiar problems associated with such estimates. They are limited to the risk from either the 1 in 100 year event or the flood of record (in this case the 1974 event) and it is not always clear if the numbers refer to above ground or above floor flooding. In recent years, the studies of flood hydrology commissioned by Brisbane City Council have included estimates of the magnitude of the probable maximum flood and overfloodplain velocities. Thus, when the data for the flood free buildings are fully combined with the City's GIS it will be a relatively simple matter to define precisely the vulnerability to flood in terms of ground or floor level and in terms of any flood frequency from 1 in 5 year to that for the probable maximum flood. It will also be possible to assess liability to potential structural failure of buildings in response to flood depth and velocity, information that is often lacking elsewhere. A listing of many of the major hydrological studies for the Brisbane Creek Catchments undertaken over the last 15 to 20 years is given in Appendix 4.

The official estimates supplied by the Brisbane City Council in the early 1990s, as a contribution to *Floodplain management in Australia* (AWRC, 1992, p.145), are described as follows:

There are some 3,800 properties in Brisbane and Ipswich subject to flooding from the Brisbane River by the current 100 year ARI event. Brisbane City Council also estimate that there are some 6,000 properties in Brisbane (5,000 residential, 1,000 other) subject to major creek flooding. Some properties may be subject to both major creek flooding and Brisbane River flooding. It was assumed that 8,000 properties in the Brisbane metropolitan area were subject to 100 year flooding by either the Brisbane River or major creeks.

These data should be regarded as presenting a very general picture and are likely to be underestimates.

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Table 4.2 Estimates of number of flood prone buildings in the Brisbane region

	Residential	Commercial and Industrial	Total
Brisbane River* (SMEC, 1975) Pre-Wivenhoe 4.0 m (1 in 28 yrs) 6.0 m (1 in 60 yrs)	4941 11614	1569 (+206)+	6716
Brisbane River* (Water Studies CRCE, 1986) Post-Wivenhoe	4900	3125 (+515) ⁺	15284 6500
Brisbane Creek catchments (BCC, 1977) Oxley Enoggera/Breakfast Kedron Bulimba Norman Other creeks less than 50 buildings		1500 1100 1100 50 50	1500 1100 1100 50 50
Creek catchments from flood mitigation studies Oxley (BCC 1981)		1500	1500
Norman (BCC, 1987) Cabbage Tree (Kinhill, 1991) Bulimba (Connell Wagner, 1992	300 617 475	300 105 25	600 722 500
Brisbane (BCC estimates from AWRC 1992)			
Brisbane River (Post-Wivenhoe Dam)		3800	3800
Brisbane Creek catchments	5000	1000	6000
Brisbane overall (allowing for Brisbane Rivers and Creeks)		8000	8000

^{*} Brisbane River and lower reaches of creeks, includes estimate for Ipswich

4.3.1 The SMEC flood study

The SMEC (1975) study of the Brisbane floods was the first study of its kind in Australia to accurately assess the number of buildings at risk from flooding and to combine this with stage-damage curves to provide an assessment of flood damage. A summary table from that report (SMEC, p.65, 1975) is reproduced here as Table 4.3. It is important to note that this relates only to flooding from the main Brisbane River although the numbers include buildings located in the lower reaches of the Creek catchments that would be flooded from the main river as well as from any separate floods from the upper reaches of the Creek catchments (at a slightly different time). The flood height (at the City gauge) for the 1974 flood was 5.5 m which gives approximately 15,000 buildings that experienced inundation over ground level,

^{*} Miscellaneous buildings

with most flooded above floor level. For an 8.0 m (1 in 110 year) flood the corresponding number is about 23,500.

Table 4.3 Numbers of buildings affected by various heights of flooding of the Brisbane River, from SMEC (p.65, 1975)

Flood height m	Recurrence interval	Commercial buildings	Industrial buildings	Residential buildings	Miscellane ous buildings	Total
2.0	l in 11 yrs	165	64	208	32	469
4.0	1 in 28 yrs	708	861	4,941	206	6,716
6.0	1 in 60 yrs	1,230	1,925	11,614	515	15,284
8.0	1 in 110 yrs	1,664	2,615	18,461	786	23,526
9.0	1 in 150 yrs*	1,883	2,879	21,403	889	27,054

^{*} Approximate, interpolated from data in SMEC (1975).

NOTE: Flood frequencies are post-Somerset Dam but pre-Wivenhoe Dam

The flood peaks correspond to the pre-Wivenhoe Dam situation although the flood peak was lower than under pre-1950s conditions due to the flood storage effects of the Somerset Dam. The data which correspond to a re-run of the 1974 event (post Wivenhoe dam), are a city gauge height of 4.0m, and total buildings of 6,716 (see Table 4.2).

There are other features of Table 4.2 which require additional comment. These include:

- all the estimates for flood prone buildings in the Creek catchments that have been updated with field studies show very significant increases from those based on earlier generalised information
- the problem of numbers of flood prone buildings for Ipswich

4.3.2 Increases with detailed field studies

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Detailed field estimates of the number of buildings at risk for the Creek catchments are available for Norman (BBC, 1981), Cabbage Tree (Kinhill, 1991) and Bulimba (Connell Wagner, 1992). These all report significantly larger numbers that those in the provisional data of 1977. For example, the early estimates for Bulimba and Norman for the 1 in 100 year flood were both for 50 buildings but the detailed studies increase the listing to 600 and 500 buildings with over-ground flooding respectively. For Cabbage Tree the provisional estimate was for less than 50 buildings but with a field survey this increased to 722.

These discrepancies match experience elsewhere in Australia, that is provisional estimates seem always very much smaller than those found from field surveys of buildings.

Part of the discrepancy in Table 4.2 stems from the difficulty that the lower reaches of the Creek catchments are also subject to inundation from the main Brisbane River, further complicated by tidal and possibly storm surge associated with tropical cyclones which would, in many cases, be the trigger for severe rainfall and flooding. The effects of tides and surge

have been incorporated into all recent hydrological studies commissioned by the Brisbane City Council but these rarely list the number of buildings at risk.

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4.3.3 Numbers of buildings in Ipswich

Ipswich is inundated by floodwater from the Bremer River catchment but the flood height is effected by the height of the of the flood in the Brisbane River. The relationship between the two is complex and varies considerably from flood to flood, see SMEC (1975, p.25). For Ipswich, in contrast to Brisbane, there are no detailed hydrological studies or assessment of the number of flood prone buildings, although it is understood that such studies are currently in progress.

Chamberlain et al. (p. 9, 1981) report that for the flood of 1974:

Ipswich City Council records show that over 1,800 buildings in that city, residential and commercial, were completely or partially inundated. Forty-one dwellings were swept away, 620 were completely submerged, and 974 partly submerged. Water entered about 200 other properties, though the buildings were not flooded [indicating over-ground but not over-floor flooding].

Thus, for the 1974 flood (close to a 1 in 100 year event for Ipswich) the number of buildings of all kinds flooded over ground was about 2,000.

These figures are now over twenty years old and, because Ipswich City Council regulations only prohibit new developments below the level of the 1 in 20 year flood event, the number of buildings currently at risk is likely to be much larger. The effect of Wivenhoe Dam at Ipswich would be restricted to the effects of the lowered tail water levels where the Bremer River joins the Brisbane River

4.4 Summary - number of flood prone buildings for Brisbane

Notwithstanding the generally excellent standard of the flood hydrology for both the Brisbane River and the Creek catchments, there are problems in providing detailed estimates for the number of buildings at risk from flooding. These are outlined above and include changes to flood risk due to mitigation works which vary in size from the Wivenhoe Dam to numerous minor structural works on many of the Creeks and lack of detail for developments described in section 4.2.4.

There are grounds for considering the official AWRC (1992) number of 8,000 buildings as given in Table 4.2 to be underestimates. The actual number could be considerably larger, based on supposition, perhaps by a factor of two.

The AGSO Cities Project, which commenced in late 1996, will focus on Brisbane as its major case study and will provide much improved information of the flood risks to buildings and infrastructure. As outlined above, the hydrological data base for the area administered by the Brisbane City Council is excellent but the need is to link this to GIS data for buildings and infrastructure. Such information will be of major value for emergency management and will also enable the further flood mitigation options, especially those of a non-structural nature, to be evaluated. The application of detailed regulations for the development of buildings and structures within the known flood prone areas have been in place for many years.

4.5 The flood problem for the Gold Coast

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In this report the Gold Coast region equates to the area administered by the Gold Coast City Council and includes urban areas located in the catchments of the Logan, Albert, Coomera, Pimpama and Nerang Rivers together with a number of small catchments that drain directly into the Pacific Ocean. Prior to amalgamation in 1995 the region was under the jurisdiction of two local government authorities, namely Albert Shire and Gold Coast Council. As is commonly the case in Australia the river catchment boundaries are not coincident with those for local government and for the Logan and Albert Rivers upstream portions of the catchments remain the responsibility of other councils. For the Gold Coast region, this posed particular problems prior to recent amalgamation. An outline map of the major catchments and their relationship to the boundaries of the Gold Coast City Council are illustrated in Figure 4.2.

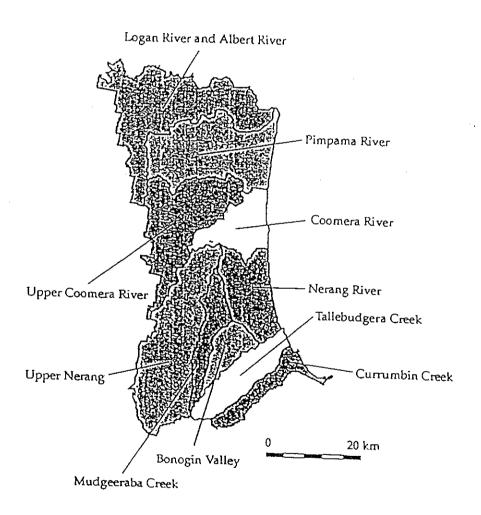


Figure 4.2 Gold Coast catchments

Based upon existing State government modelling, flooding for the Gold Coast region, in terms of the number of buildings, represents one of the largest single concentrations of urban flood risk in Australia. It is also noteworthy that the risk to the residential sector is exceptionally large.

There is abundant historical evidence of the stage height and extent of flooding in the Gold Coast region. A summary of these events is given in the *Logan and Albert Rivers Flood Warning System* (BOM, 1992). The floods of January 1887 and January 1974 represent the largest floods of record although for the former information is less detailed especially as regards the areal extent of inundation. The gauge height and extent of the 1974 flood, which was a major event throughout much of Queensland and New South Wales, is however well recorded and was subsequently mapped in detail for the Albert and Logan River floodplains by the Queensland Water Resources Commission. Maps of inundation for the 1974 flood also exist for the Pimpama, Coomera and Nerang Rivers as well as Tallebudgera and Currumbin Creeks, although the detail is less precise.

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For the Nerang River system the January 1974 flood is estimated to have an annual recurrence interval of about 1 in 65-70 years. For the Coomera, Logan and Albert Rivers the 1974 flood is considered to be greater than the 1 in 100 year flood. It is pertinent to note that the 1887 flood was of greater magnitude and, although there is no available estimate of the annual recurrence interval, the gauge heights on the Logan River at Wakefield and Maclean's Bridge were between 0.6 and 0.8 m higher than for the peak of the 1974 flood.

Given this historical information of flood risk for the Gold Coast region it is surprising that data on the number of buildings at risk was not included in any of the earlier State surveys of flood risk; the numbers reported for Queensland are summarised in Section 2.2.1. Whilst there were land use controls provided by planning schemes which usually required compliance with a hydraulic study, individual developments have produced some afflux. It would appear that the cumulative effect of these developments would have significantly aggravated flooding problems if Council had not provided some additional flood mitigation benefit with the raising of Hinze Dam in the Nerang River catchment (the dam is primarily a reservoir to service the region's water supply needs). Developments had to show no adverse impacts in terms of afflux and floor levels were required to have either 150 mm or 300 mm freeboard above 1974 flood levels (former Albert Shire and Gold Coast City respectively). However, the last few years have witnessed major changes in the compilation of information on flooding and the implementation of land use and building regulations on the floodplains. An outline of these changes is given below.

4.6 Current status of Gold Coast urban floodplain management

The 1974 flood is estimated to have directly affected at least 1,000 dwellings in the Gold Coast region which at that time had a population of less than 100,000 people (today's population is about 350,000). Since that time major and widespread residential development has occurred in the area inundated by the 1974 event. The 1974 floods acted as a spur to undertake hydrological studies and, in addition to the map showing the 1974 flood limits, a physical model was developed for the Nerang River in the early 1980s. This was replaced, in 1989 by the production, of a one-dimensional computer model, by the Queensland Department of Primary Industries (now DNR).

In 1996 Council approved the development of two dimensional hydraulic and environmental models which have yet to be commenced. By 1997 a more sophisticated two-dimensional (MIKE 21) model which incorporated 130,000 grid points had been developed by a consultant acting for a landowner.

The overall situation in the Gold Coast region is similar to that described for the Brisbane City Council, i.e. there are a number of individual catchments each with their own hydrology. Each catchment requires detailed hydrological studies before reliable estimates of the number of buildings at risk, potential flood damages and possible flood mitigation options can be assessed. Projects to achieve these aims are actively in progress and the Gold Coast City Council in recent financial years has budgeted in excess of \$1 m annually to meets these ends. The current status for the various catchments, provided by the City Council in response to the present study, is reproduced below.

Table 4.4 Localities affected by flooding in the Gold Coast Region

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Catchment	Locality	Affected
Logan River	Waterford	Floodplain & Valley flooding
	Bethania	Floodplain & Valley flooding
	Beenleigh	Floodplain & Valley flooding
•	Alberton	Floodplain & Valley flooding
	Woongoolba	Floodplain & Valley flooding
	Steiglitz	Floodplain & Valley flooding
Albert River		Valley flooding
Pimpama River	Norwell	Low lying areas and roads affected
Coomera River	Hope Island	Low lying areas flooding
	Upper Coomera	Valley flooding
Nerang River System	Area 65 sq km from Chevron Island in North to Burleigh Waters in South, West of Gold Coast Highway to Mudgeeraba in South West and to Nerang in North West.	Floodplain depths to 3.5 metres, residential areas affected
Nerang River	Upstream of Nerang	Valley flooding
Mudgeeraba-Bonogin Valley	No data available but some houses affected at Q5	Valley flooding
Tallebudgera Creek	Palm Beach	Floodplain
Currumbin Creek	Currumbin Waters	Floodplain

^{&#}x27;Floodplain' indicates extensive inundation across the floodplain, 'Valley flooding' corresponds to flooding of more limited areal extent.

The current situation and stage of analysis is as follows:

Logan/Albert Rivers Flood study by AWE for SOUTHROC has been recently completed. Flood inundation lines for various floods will be prepared and this data can be used to quiz Council's land use map and cadastre electronically. Pimpama River No flood study is available, however an approximate 1974 flood inundation line is available and an electronic quiz is possible. Coomera River Flood study by Kinhill Engineers has been undertaken, but inundation lines have not been prepared. An approximate 1974 flood inundation line is available for electronic quiz. Nerang River System Flood study is complete and inundation maps using early topographic data have been prepared by the Department of Natural Resources' Surface Water Assessment Group. New inundation maps are being prepared using photogrammetric data, and a flood damage study is in progress for Q20,

> At Q100 it is estimated there will be about 8,000 properties inundated and about 14,000 flood affected, with a private property damage bill of some \$200 million.

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Q50, Q100 and Q200 floods.

Currumbin and Tallebudgera Creeks

Flood study is nearing completion and inundation maps will be prepared.

4.6.1 The hydrology

The hydrology of the of the catchments in the Gold Coast region poses particularly difficult problems: These include:

- the tidal nature of the rivers and creeks,
- the widespread changes to the catchment characteristics,
- surge associated with cyclonic conditions.

The lower sections of the larger rivers, namely the Logan and Albert, and the floodplains of the smaller rivers and creeks are all at low elevations and are therefore, affected by tidal influences. It is these areas that contain the major concentrations of residential growth, in part because of their appeal for water-based canal developments.

The construction of canal estates is but one example of the human-induced changes to the natural fluvial environment. Another is that the natural storage of the low-lying floodplains

has been reduced due to fill to provide mounds on which dwellings are constructed. The network of canals for recreational vessels has also modified the original stream network. In addition to these problems the region shares the universal problem that there are very poor historic records of discharge and stage height for such small catchments.

One of the most probable scenarios for severe flooding in the Gold Coast region is linked to the effects of intense and heavy rain from tropical cyclones. This would be enhanced by the triggering effect of high ground that would cause heavy rainfall in the upper catchments of the rivers and creeks that flow across the floodplains in the Gold Coast. Such flooding could be compounded by the effects of storm surge (alternatively termed 'storm tide') associated with such cyclones. The direct effects of storm surge inundation are thought to be limited, ie in no way comparable with Cairns or Mackay, but the indirect effects could be considerable. These indirect effects would cause the rivers and creeks, especially in the tidal areas, to increase flood levels. The magnitude of the additional inundation depends on a range of meteorological factors and is also related to whether the peak surge and flood flows occur at high or low tide.

It is important to acknowledge the severe technical hydrological problems of the Gold Coast region. However, hydrological information now available, currently in progress and planned, is of a high order and attempts to incorporate the problems outlined above. In addition, the studies provide information on the magnitude of the very low probability floods (including estimates of the probable maximum flood), over-floodplain velocities and changes to flow paths. The Gold Coast Council is also aware of the possible changes (likely to be adverse) of greenhouse climate change.

The current stage of hydraulic information is described in the study undertaken by the DNR in 1992 (DNR, 1992). Such information is an essential first step to assess the vulnerability of existing floodplain developments. The approach is to use a geographical information system (GIS) to link the hydrology and land use (including the built environment). Flood maps showing the extent of flooding and the property boundaries are available in draft form for some of the catchments (the Nerang River catchment for example) and in progress for others. The amalgamation of Albert Shire and the Gold Coast Councils into a single authority has had positive outcomes in that it allows a more comprehensive whole of catchment planning but has also required the blending of two previously separate data sets.

4.6.2 Planning regulations and guidelines

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The large number of residential flood prone buildings in the Gold Coast region, the majority of which have been built in the last twenty years, suggests that acceptable floodplain management regulations for land use, the floor height of habitable buildings, the use of fill etc, were poorly applied and enforced. However, the situation has, in the last few years, dramatically changed and comprehensive development assessment criteria for flood plain studies for developments in floodplains. For instance, the Nerang Hydraulic Master Plan was adopted in 1997.

Council requirements for inclusion in a Terms of Reference of any Environmental Impact Study usually include a statement along the following lines:

'The Environmental Impact Study shall include a hydraulic study investigating 10, 20, 50 and 100 year ARI, critical duration and the 1974 historical flood events, prepared by a suitably qualified consulting engineer at the applicant's

cost. The hydraulic study is to investigate the base case (undeveloped case) and the developed case. In relation to the design of the development, the following development objectives are desirable:

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- 1. No net loss of floodplain storage any increase in floodplain storage is an advantage.
- 2. No net increase in flood level except perhaps locally within the development site.
- 3. No significant change to flood flow direction.
- 4. No significant change in flood velocity unless it can be proven that either velocities are lower or will be to the advantage of neighbours. (A "neighbour" in this context is the owner of any property that can be demonstrated to be affected by this proposed development).
- 5. No net increase in inundation duration where inundation could damage private assets.
- 6. No loss or adverse change to emergency services access.
- 7. No net shortening of the warning time from declaration of emergency so as to maintain the ability of neighbours to provide protection to their assets or evacuation.

Should any of the above objectives not be achieved, then the applicant shall lodge a schedule of non-compliance with the design objectives together with an explanation of why the objectives cannot be achieved, and propose measures that would remedy any problems'.

The design flood will be the 1 in 100 year event or the largest recorded flood whichever is the higher. Developers are required to use approved hydrological modelling techniques and such analysis must extend to the level of the 1 in 200 year flood for reasons such as counter disaster planning.

Future floodplain management will be based on best practice hydrological assessment combined with GIS analysis of vulnerability and stringent regulations will be formulated and applied to any form of new development, building or other, that is proposed within the limits of the 1 in 100 year flood. Urban floodplain management will also include whole catchment planning and greater community involvement. An example of the former is the Joint Flood Plain Management Group for the Logan River, established in March 1996, which reports to the Logan River Management Co-ordinating Committee which has representatives from the Gold Coast, Beaudesert, Logan and Redland Councils. Community involvement is evident in such groups as the Merrimac/Carrara Floodplain Advisory Committee, established in August 1996 to consider the future of this portion of the Nerang River catchment. The Committee is composed of a wide range of stakeholders from community representatives to State government officials.

4.6.3 The problem of numbers of buildings and dwellings

Data from the 1997 Nerang River Flood Study, made available by the Gold Coast City Council in late 1997, provide an excellent illustration of the problem of basing flood assessment solely on the number of buildings (or properties). This is because many of the

residential buildings in the Gold Coast region are designed for multi-occupancy, as flats or apartments. In such cases it is better to use the term 'residential dwellings', i.e. a residential dwelling unit is a single household in a multi-occupancy building. The data in the Nerang Study also illustrates the differences in the number of dwellings situated in the flood prone zone and the numbers liable to over-floor inundation. For example, for the 1% (1 in 100 year flood) there are 14,250 residential properties in the flooded area. These equate to 28,600 residential dwellings. Of these, only 8,000 would likely experience over-floor flooding for the 1 in 100 year flood. In part, the large difference in the number of dwellings in the flood zone with an without over-floor flooding is because many are multi-storey buildings.

The number of multi-occupancy and multi-storey residential properties in the Nerang River floodplain, in comparison to most other urban areas in Queensland, is exceptionally large. However, the data outlined above illustrate the necessity for detailed studies in order to adequately assess vulnerability, estimate flood damage or provide good quality information for emergency management. These aspects of the Nerang Flood Study could well be used as an example of how to undertake comparable detailed studies for urban floodplain management elsewhere in Queensland.

4.7 Summary

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Notwithstanding the provisional nature of some of the estimates of the number of buildings, the size of the existing flood risk presents a massive problem. Estimates, supplied by the Gold Coast City Council, for direct damage (building structure, internal and external, contents) to residential developments for a re-run of the 1974 event in the Nerang catchment alone is of the order of \$200m at current prices. In addition there would be direct and indirect losses in the commercial sector, widespread infrastructure damage and untold intangible losses due to the fall in tourist numbers.

The Gold Coast City Council is faced the management of the largest concentrations of flood prone residential buildings of any local government authority in Australia. The Council is currently addressing this issue by improving its flood information and modelling systems and by ensuring that flood risk forms a central component of its urban flooding policy. The Gold Coast situation provides a salutary lesson for other Queensland councils..

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Hydrological Information, Mapping, Damage Studies, Mitigation and Policy

5.1 Introduction

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The design and implementation of acceptable urban floodplain management policy for flood prone LGAs requires a sound hydrological base. Information on the extent of inundation from floods of differing magnitudes and frequency is an essential step in this process. Normal practice is for such information to be obtained from rainfall/runoff modelling techniques but the accuracy of these depends on the availability of historical data. A less precise procedure is to base policy on information from the flood of record. Ideally, hydrological information is combined with damage studies in order to select effective flood mitigation options from which local policy is formulated.

An assessment of the current situation in Queensland can be obtained from the responses to the questionnaire, especially parts of Question 5, 6, 7 and 8.

Question 5 specifically addresses the information available on past flood events,

Question 6 asks for detail on hydrological studies,

Question 7 enquires if flood damage studies have been undertaken,

Question. 8 deals with the details of flood policy and mitigation measures.

The responses to each of these is addressed below.

5.2 Information on past flood events

Question. 5.1 asks '... is historical flood data available?' Two thirds (68 out of 102 responses) of localities reported that it was. The negative responses include those that do not consider they have a serious urban flood problem, but there are others that give the reasons for the lack of data as 'apathy', or 'no engineer' and a number replied that they considered that the responsibility lay with the DNR (or the former Water Resources Commission) or the Bureau of Meteorology. Those who consider that the responsibility lies elsewhere include LGAs who indicated (or thought) that the data were held by those agencies.

The responses on historical data closely match those locations which have a town flood gauge, a little over half of the localities (53 out of 101) are in this category. The length and quality of flood records are, of course, variable. For some locations the records extend back for over a hundred years, eg. Brisbane City 156 years, Rockhampton 137 years, Taroom 133 years, Gympie 128 years and Ipswich 100 years. Conversely, many LGAs have only short records, i.e. less than 10 years. ALERT flood warning installations provide an excellent opportunity to gather more precise rainfall and runoff data although there is a need for inhouse LGA expertise to fully capture such information.

For the flood gauge records to be of real value, it is necessary for these to be expressed in terms of the areal extent of inundation. Question 5.10 asks if '... flood limits for the largest known flood are available in map form?' Exactly half (53 out of 106) of the localities have the records available in this form. Question 5.11 seeks further detail on the '... historical flood mapping method.' Most are available in paper map form but for 17 locations the information is also stored as GIS data and about 10 also have the flood limits superimposed on air photographs. The relatively high proportion who have converted the largest known flood into GIS format is encouraging and this will undoubtedly assist future flood policy design and implementation.

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5.3 Hydrological flood studies

Question 6.1 asks if a '... hydrological/hydraulic flood study has been carried out for this community?' A positive response indicates that some form of modelling has been undertaken, using the historic flood data and regional rainfall statistics. The latter are much more numerous, and have longer records, than for flood or river discharge. Only 40 out of 108 of localities have undertaken hydrological studies although in some cases (i.e. Brisbane River) these are currently being re-assessed. Those with such studies include the majority of the major flood prone LGAs within the State although in some instances the data are of a relatively poor standard. Ipswich is in the process of undertaking such studies and the Gold Coast has recently completed studies for the Nerang catchment and is in the process of undertaking them for other catchments in their area of jurisdiction.

Question 6.2 invites LGAs with such flood studies to indicate the floods that '... were studied'. For the 40 responses the floods studied were to a variety of levels, in many cases the lowest probability flood also formed the designated flood. The lowest probability levels in the flood studies are summarised in Table 5.1.

Table 5.1 Flood studies, lowest probability event for which information is available, based on Question 6.2

Above 1 in 100	1 in 100	l in 50	Below 1 in 50
4	24	6	6

In urban flood studies, it is common practice for the 1 in 100 year event to be the lowest probability event studied, although the recommended procedure is for such studies to extend to the probable maximum flood. In Table 5.1, the LGAs who extended the study to levels above that of the 1 in 100 year event include Brisbane (including the creek catchments), Logan (in part), Warwick and Rockhampton. An example which reported limits below the 1 in 50 year event was Mt. Isa. Studies at 1 in 50 and below are too limited to form the basis for acceptable urban floodplain policy. However, some of the LGAs with 1 in 50 year information do have other more limited data available, eg. for the flood of record. Some LGAs vary the level of study by catchment, examples are Laidley, Logan and Pine Rivers.

The situation for the probable maximum flood is separately assessed in Section 3.5. Only 8 localities have maps that show the extent of the PMF, among these are Gladstone, Redland, River, Rockhampton, Roma and Warwick.

Question. 6.5 requests information on the "... adopted designated flood". The number of responses and level of adoption are given in Table 3.3. In summary, of the 44 responses 27 used the 1 in 100 year event, two the flood of record and the remainder the 1 in 50 year or even more frequent event.

Question 6.6 indicates that for 42 localities, a large proportion of those that answered Question. 6.5, have maps that show the designated flood line and nearly all of these also have the information in GIS format.

5.4 Damage studies

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Question 6.12 enquires '... has a damage study been carried out?' There were only 11 (out of 98) positive replies. Such studies are not only critical to the assessment of the costs and benefits of floodplain mitigation options but, since they are based on field surveys of all buildings, provide an invaluable aid to all facets of emergency management.

Table 5.2 lists all the positive responses to this question. The majority are known to be of a high standard although for the Brisbane River the damage study is stated to be 'very old - 1976', i.e. after the 1974 flood. It is noteworthy that many of the damage studies were prompted by the occurrence of a major flood event that served to highlight the need for such information. Examples are given in Table 5.2 and include Rockhampton, Murweh (Charleville and Augathella) and Jericho. For the Gold Coast and Warwick such studies are actively in progress and Ipswich (omitted from the positive response data) has such information for the Bundamba catchment. The situation for the Brisbane Creeks is discussed separately, see Section 4.2, and not included in the questionnaire responses.

The poor coverage of flood damage studies for known flood prone urban locations in Queensland is regarded as a major barrier to the formulation of acceptable floodplain management policies.

5.5 Summary - past events, hydrological and flood damage studies

Historic data on flood events is available for a large number of flood prone locations but only about 40% have undertaken detailed hydrological studies. These include most of the major flood prone localities and 42 have the information available in map or GIS form. However, only 27 localities have used this information to define designated floods to the level of the 1 in 100 year event. Information on the PMF is rarely available and even rarer in map or GIS format. The greatest lack however, is for damage studies which only exist for 11 localities and are absent for many of the most flood prone LGAs.

5.6 Policy and mitigation

Question 7 specifically addresses LGA flood policy, and Question 8 flood mitigation measures. The analysis of responses to several of the questions on policy is reported by LGA and not by flood prone locality.

5.6.1 Policy

There were 79 responses, by LGA, to Question. 7.1 which asked '... has a flooding policy been developed?' Of these, 37 reported that there was such a policy and 42 that there was not. It is important to note that there are likely large variations in what is interpreted as

constituting such a policy. However, it is thought that in all cases there are restrictions on new developments in areas below the level of the designated flood. Most of the LGAs with significant urban flood problems indicated that they had a flood policy, exceptions included Bundaberg, Dalby and Emerald.

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Table 5.2 LGAs reporting that flood damage studies have been undertaken, based on Question 6.12

LGA and locality	Comment	
Brisbane	For Brisbane River based on 1976 data.	
Dalby		
Gold Coast	Completed for Nerang Catchment, in progress elsewhere.	
Hinchinbrook (Ingham)	For Ingham.	
Ipswich	Only for Bundamba catchment.	
Jericho	After 1990 flood.	
Mackay .		
Murweh	Charleville and Augathella, After 1990 flood.	
Noosa	,	
Rockhampton	After 1991 flood.	
Roma		
Warwick	In progress.	

Question 7.2 requested information on the '... hydraulic basis for flooding policy.' Two thirds (24 out of 79 LGAs) indicated that they use a designated flood with the remainder basing their policy on historic flood data. In some cases physical models had been employed to assist with flood policy, Caloundra and Mackay are examples. In many cases the policy is based on a combination of historic data and hydrological modelling.

However, attention is drawn to Section 5.2 which shows that for many locations, information on the extent of floods is limited.

Question 7.3 enquires '... is the designated flood for residential buildings the same as the designated flood for commercial buildings?' Of the 41 LGAs that replied, 36 used the same designated floods for both residential and commercial and 5 have different levels. There was only a single reply to Question. 7.4 which requested reasons for the differences. Gympie (Cooloola Shire) commented that it was '... deemed acceptable for commercial to flood', i.e. there were no restrictions for commercial developments in flood prone locations. Caboolture uses the 1 in 100 year as the designated flood for residential buildings and the 1 in 50 year for commercial.

Question 7.5 requests information on the '... difference between allowable floor levels and designated flood levels'. This is an example of obtaining more detailed information on the

nature of the flood policy. A total of 22 LGAs provided data, the range was from zero to 1,000 mm. However, approximately half of the LGAs require a minimum difference of 300 mm (likely converted from earlier regulations of '1 foot'). Several LGAs vary the designated flood/floor level by location, e.g. Logan uses 150 mm for the main Logan River and 300 mm for the tributary creeks. Such variations usually reflect the quality of the available hydrological data which is invariably more precise for the main rivers than for the smaller tributary catchments. For this reason, Beaudesert requires a floor height of at least 1,000 mm above the designated flood in some locations.

5.6.2 Fill requirements

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Some jurisdictions in Australia and overseas prohibit any new building within the flood prone area as delimited by the designated flood. Others use floor level restrictions, similar to those described above for Queensland, but have restrictions on the building methods employed to obtain the required level. In Queensland many of the regulations are related to fill, in order to form a mound on which to construct the buildings, elsewhere regulations often restrict 'raising' of the building to the use of columns or stumps, similar in form to the traditional high set Queensland dwelling. The reason for such restrictions is to avoid the afflux problems posed by using fill to produce the mound. In Queensland the use of fill is much more widespread and Question 7 was designed to gain further information on this.

Question. 7.6 asks '... if allowable filling requirements are:

- a. ad hoc individual approvals,
- b. filling policy determined on the basis of hydraulic studies,
- c. individual approvals based on the developer demonstrating impacts,
- d. other.

The 34 LGAs who responded indicated that there is variation both between LGAs and sometimes within the area administered by individual councils. Nine councils rely solely on the ad hoc approach, 4 on policies based on hydraulic studies and 13 on developers demonstrating impacts acceptable within the overall flood policy. The remainder use combinations of these requirements, often these differ in relation to the detail available from existing hydraulic studies. In such cases the developer is required to provide a detailed analysis to demonstrate whether the development is acceptable or not. The reply from Redcliffe to this question is noteworthy because the council does not allow fill under any circumstances.

If consistently applied, such variations are acceptable and there is often more consultation and detailed analysis where a major development is proposed. However, the continued use of ad hoc or poorly supervised requirements for fill can, and does, lead to significant increases in afflux and therefore, to increased flood risk.

There is a strong case for State guidelines and perhaps, regulation to clarify the arrangements for fill, if only to overcome the problems posed by differing requirements by councils in the same catchment.

Over-use of fill by one council can cause adverse effects for others on the floodplain. A Joint Flood Plain Management Group was established for the Logan River in March 1996 with elected and professional staff from the four LGAs that share the Logan River catchment. One

of the terms of reference is to develop '... an agreed protocol to be followed by the each Local Government in assessing development applications'.

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5.7 Legislative mechanisms

To achieve effective local floodplain management there is a need for the policy to have a sound institutional base. It is widely accepted that this is not the case for many Australian States, Queensland is no exception. The situation for the eastern mainland States is reviewed in National Landcare publication, *Issues in floodplain management – a discussion paper* (Smith *et al.*, 1996). To clarify the situation Question 7.7 sought information on the 'legislative mechanisms used' in Queensland.

LGAs were asked to indicate which of four Queensland Acts were used as a basis for their flood policy. The four were:

The Local Government Act (abbreviated to LG)

The Local Government (Planning and Environment) Act, hereafter LG (P & E)

The Water Resources Act (WR)

The River Improvement Trust Act (RIT)

Other

There were 37 responses, the results are given by LGA and not by locality. There was considerable variation between LGAs, some employing a single act and other combining one or more. A summary is given in Table 5.3.

Table 5.3 Legislative mechanisms used to underpin flood policy (Question 7.7)

	LG only	LG(P&E) only	LG/LG(P&E) combined	LG/WR combined	LG/LG(P&E)/WR combined
Number of LGAs	5	16	12	1	3

LG = Local Government Act

LG (P&E) = Local Government (Planning and Environment) Act

WR = Water Resources Act

The LGA and LG(P & E) Acts are the most widely used, either singly or in combination; 33 LGAs fell into this grouping. Neither the WR nor RIT Acts were used as the sole institutional underpinning but were used in combination with the two most frequently used Acts by six LGAs. Warwick is the only LGA to use all four Acts. There were no examples of the use of 'other' legislation as an institutional base for flood policy. From the survey results it would appear that the institutional arrangements are unclear.

5.8 Mitigation

It is standard practice to divide flood mitigation measures into two separate classes, namely structural and nonstructural. In detail there are definitional problems but the structural class normally involves engineering measures which are often costly. In contrast, non-structural measures generally have little direct cost (resumptions and rezoning compensations are two

examples of expensive 'non-structural' measures) to LGAs and typically incorporate features such as zoning and building regulations. Question 8 invites LGAs to indicate any structural measures used for mitigation and Question 7 for non-structural. Although flood warning systems are included as a nonstructural measure (Question 8.2), much fuller information is requested in Question 10 with the results discussed in detail in Section 6. The flood mitigation options are discussed in terms of locality.

5.8.1 Structural mitigation measures

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Question. 8.1 invites respondents to indicate '... flood mitigation measures used to reduce [the] effects of flooding on [the] community'. Four categories were given with the request to list any additional measures that had been used. The categories listed were:

Levees
Flood control dams
Retention basins
Flood proofing of buildings
Other

Structural measures, often of more than one type, were reported as used at 29 localities. Thirteen localities (out of the 29) use levees, in 6 instances in conjunction with one or more other structural measures. Although the respondents were not specifically asked, many report that the levees are only used locally, ie to protect a relatively small number of buildings or only apply to part of the flood prone locality, Brisbane and Balonne are examples. For two localities, Goondiwindi and Mackay, the levee systems are known to be extensive. At Goondiwindi the levee system has been in place for many years and affords a relatively high level of protection, that for Mackay is much more recent and has a level of protection for floods in the 1 in 30 to 1 in 40 year class.

A fuller list of localities reporting levees, excluding those already mentioned, includes Bundaberg, Emerald, Hinchinbrook (Ingham), Johnstone (Innisfail), Paroo (Cunnamulla) and Thuringowa. In comparison to New South Wales or Victoria, the number of major urban levee systems is relatively small.

Flood control dams are mentioned for only four locations. These are the Somerset and Wivenhoe Dams on the Brisbane River, the Ross River Dam upstream of Townsville and the Hinze Dam in the upper catchment of the Nerang in the Gold Coast. In all of these cases the primary purpose of the dams was water supply, irrigation or urban, with flood control as an additional feature.

Flood detention basins are smaller structures than flood control dams and are specifically designed to retard and decrease flood peaks that could cause downstream damage. They are usually constructed on small catchments in major urban areas. They are specifically mentioned for six localities, these include the Brisbane Creeks, Cairns, Maryborough and Townsville.

Flood proofing of buildings can be considered as a special case of structural mitigation, it differs from most other forms of structural mitigation as it can be undertaken for individual buildings (residential or commercial), only 8 localities report its use. These are Bowen, Dalby, Ingham, Maryborough, Logan, Murweh (Charleville) and Rosalie. This small number is perhaps surprising, in part because the traditional high Queensland detached dwelling provides a ready-made example of flood proofing. Although data are not requested of the

numbers of buildings that are flood proofed, usually undertaken well after construction and in response to a known flood risk, the measure is only used in a minor way. This contrasts with some communities in New South Wales where house raising (the most common form of flood proofing) is widespread. For central Lismore over 1500 weatherboard houses have been raised, some to 3.0 m or more, over the last 60 years or so specifically to reduce flood losses.

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'Other measures' are reported for a small number of locations. These include clearing vegetation from channels (Boonah), channel improvement and diversion (Bowen) and the use of flood gates (to lessen the tidal effects on river flooding) at Ingham. Logan also reports a program of acquisition for a small number of dwellings exposed to high velocity flood waters.

5.8.2 Non-structural mitigation measures

Question 8.2 lists three categories of non-structural measures, plus 'others', these are:

Building controls Land use controls Flood warning systems Other

There are 66 responses, by locality, that list non-structural measures, that is more than double the number that report the use of structural measures (29). Some 55% of the localities (36 out of 66) combine building and land use controls. This indicates that some form of designated flood is used and that the buildings within the designated limits are subject to regulation which usually requires the floor levels to be at a specified height above that of the designated flood, see Question 7.5 (Section 6.1) for detail. Ten localities rely solely on building regulations and 8 on land use controls.

Exactly half (33 out of 66) list flood warning systems as a nonstructural measure, in 22 cases employed in conjunction with other measures.

'Other' measures are limited. Cairns reports that a program of acquisition for dwellings that are below the 1 in 10 year flood; interestingly Logan considers such a measure to be structural.

Two features of the replies need comment. The first is that only 36 localities have combined building and land use controls and the other is the relatively large number that report the use of flood warning systems. It was not possible from the survey to consider the details of the mitigation measures or, in the case of building and land controls, the degree of compliance.

5.9 Funding for flood studies and structural works

Flood studies are an essential prerequisite for the formulation of building and land use controls. Question 8.3 asks for information on the source of '... funding for flood studies' and Question 8.4 for the source of funding '.... for structural works'. In both questions the categories are given as:

Commonwealth government State government Local government Other It is important, for two reasons, to separate funding for flood studies and structural works. First because flood studies should be basic to any form of structural works and are comparatively, less expensive. Secondly, the various funding schemes between the three tiers of government vary for the two types of activity.

It is understood that State authorities in Queensland rarely provide financial assistance for studies (unless subsidisable capital works are involved). Commonwealth funding has traditionally been available for both studies and for works - indeed, without acceptable flood studies, assistance with funding for structural measures would not be provided. The difficulties of joint assistance from State and Commonwealth sources are outlined in Section 11.2.3.

5.9.1 Flood studies

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Of the 52 responses, 49 indicate at least a contribution to the costs of flood studies from the appropriate LGA.

In some 60% of the localities (32 out of the 52 responses) funding for flood studies was borne solely by the LGAs.

Ten localities reported that funding was shared by all three tiers of government, examples are Logan, Paroo, Rockhampton and Mirani. Only 5 indicated that funding was shared between State and local government.

Assistance with funding from other (non-government) sources was limited. Cairns reports assistance from the Cairns Port Authority and in other cases the costs were partly re-couped from developers in the form of fee for service. Caloundra, Thuringowa and Caboolture specifically mention such contributions. For Caboolture, an LGA with a fast rate of growth and development, the costs of the flood study was recovered in two or three years by the sale of the appropriate part of the flood study (i.e. in the form of a computer model) to developers who were then required to demonstrate that their proposals were in accord with the council's flood policy.

5.9.2 Mitigation

In most cases the costs of structural works are very much greater than for flood studies. For example, levee schemes to protect even relatively small numbers of buildings often cost in excess of \$1 m. They also require the LGA to take on substantial future costs for maintenance and repair. Thus, for many of the LGAs in Queensland, and elsewhere in Australia. The construction of such structural measures are dependent on assistance from higher tiers of government.

There were 30 responses, by locality, to the question of the funding for structural works. The combinations of funding are several and are summarised, with examples, in Table 5.4.

Table 5.4 Combination of funding sources for structural works (Question 8.4)

	C'wealth only	State only	LGA only	C'wealth/ State	C'wealth, State and LGA
Number of Locations	0	4	14	6	6
Examples		Blackall	Caboolture	Tara	Brisbane Logan Mackay Mirani Paroo Warwick

A small number of responses listed funding from other sources. For Mackay and Wambo these include local River Trusts and Thuringowa specifically mentions developer contributions. Again, the dominance of council contributions in funding is apparent. However, for many of the responses, which include those based solely on local funding, it is likely that the structural works were of a minor type. For example, the eight separate localities listed by Caboolture.

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5.10 Summary – flood studies and mitigation measures

Councils play the major role in funding of both structural and non-structural mitigation measures, in many cases without any assistance from either State or Commonwealth sources. This contrasts to New South Wales where, for the early years of the 1990s, the combined annual expenditure on flood studies and works was well in excess of \$20 m. The major difference between Queensland and New South Wales was that the latter was prepared to match, dollar for dollar, Commonwealth funding provided under FWRAP or, in later years, from the National Landcare Program. Queensland, with few exceptions was not prepared to match the Commonwealth contribution, exceptions involving major amounts of funding for capital works were Rockhampton and Mackay.

It is likely, although not subject to rigorous proof, that the relatively poor coverage of flood studies and mitigation measures in Queensland, in comparison to New South Wales, is a result of this difference in the approach to funding

Queensland has relatively few major structural flood mitigation works, although such works, (nearly all constructed to reduce flood damage to existing flood prone developments), are not in themselves a major plus for floodplain management. However, in New South Wales the construction of such mitigation measures was closely linked to the adoption of comprehensive land use and building controls usually related to a 1 in 100 year designated flood. This strategy has greatly reduced the potential for flood damage from new developments. For many parts of Queensland this has not been the case and the potential for fluture losses increases year by year.

Flood Warning Systems and Counter Disaster Plans

6.1 Introduction

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A flood warning system encompasses the flood forecast, its dissemination and response by the emergency services and the community at risk. It is an essential component of urban flood mitigation both for communities with and without structural mitigation measures. For those with structural measures it is necessary because the majority of these are constructed to a specific design limit (often the 1 in 100 year flood or less) which can be exceeded. Structural measures also have some risk, albeit often small, of failure. If levee protection is used as an example, flood warning systems are necessary to cope with situations where the levee may be overtopped, i.e. the design limit exceeded, or is at risk from other forms of failure. In all cases, structural measures should be accompanied by an emergency plan. Although outside the direct scope of this study, this also applies to downstream inundation from the failure of all hazardous, i.e. large dams.

The Bureau of Meteorology, for Queensland this is the Brisbane Regional Office, has overall responsibility for the provision of flood warnings and forecasts of river heights. There is however, an important qualification which relates to 'flash' flooding. This is defined as flooding for which the time between rainfall and downstream inundation is less than six hours.

The responsibility for flash flooding lies elsewhere, in practice with local government.

With the exception of flash flooding, for those areas with the necessary field instrumentation to provide input data on rainfall and runoff the Bureau provides quantitative forecasts of flood height. This is normally presented as a forecast of river height and time for a specific flood gauge, often located in flood prone urban areas. The gauge heights are usually combined with a forecast expressed in terms of minor, moderate or major flood. These terms have agreed definitions and are available for several hundred gauges throughout the State. They are often related to the inundation of road crossings, overtopping of bridges, initial flooding of buildings etc. An extract from the Bureau's River height stations flood classifications is given in Table 6.1. The forecast to the public is issued after discussions between the Bureau staff and local agencies for key river height locations (towns, cities etc.) particularly those which involve urban flood inundation.

The Bureau is not primarily responsible for the dissemination of the forecast to the local community or for the response components of the flood warning system but in practice it works closely with LGAs and the emergency services to facilitate best warning practice and to give advice on response. Although Commonwealth policy affirms the Bureau's responsibility for flood warnings, it also calls on State and local governments to share in the upgrading and maintenance of monitoring networks. The Bureau is responsible for the rainfall network, and State/local governments for river height stations.

Table 6.1 An example of the Bureau of Meteorology river height stations flood classifications

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Quee	nsland fl	ood warnin	g river he	ight statio	ons flood clas	sifications	
Station Name	First report	Bridge height	Minor flood	Crops grazing	Moderate flood	Town houses	Major flood
Leichhardt The 16m waterhole TM			3.0		4.0		5.0
Floraville TM		3.0	3.0		5.0		7.0
Flinders Hughenden (SYN)	1.0 h	4.00	2.5	4.0	4.0 d/s	4.9	6.0 d/s
Marathon	2.0 h		6.0	!	8.0		9.0
Richmond (SYN)	3.0 h	5.80	5.0	6.0	6.0		8.0
Richmond TM			5.5		6.5		8.2
Hulberts Bridge	2.0 h	3.90	7.0	10.0	10.0	12.2	12.0
Cloncurry	2.0 h	10.30	3.0		5.0	11.0	7.0
Cloncurry TM		11.00	3.5		5.2	11.0	7.0
Carsland	1.0 h		2.0	2.0	3.0 d/s		5.0
Canobie	3.0 h		3.0		4.0		5.5
Walkers Bend	3.0 h	5.40	6.0	6.0	9.0		12.0
Walkers Bend		5.40	6.0	6.0	9.0		12.0
Norman Yappar River Normanton	1.6 h 2.5 h	0.60 5.50	1.6 3.5	2.0 3.5	2.5 4.0	3.8 7.0	3.8 6.5

All lengths in metres

6.1.1 Flash flooding

Flash flooding is subject to different arrangements, by definition the time between rainfall and downstream flooding is limited. Thus, in order to provide forecasts with sufficient lead time to reduce losses to life and property, the analysis needs to be undertaken locally. For maximum effectiveness such systems require telemetric rainfall and river gauges that can transmit data to a locally based receiving station, ideally linked to a computer system that can convert the information into a forecast for downstream flood prone locations. A commercially available system, normally referred to as an ALERT system, fulfils these requirements. The funding and maintenance of such systems for flash flooding is usually the responsibility of LGAs, not the Bureau. However, the Bureau provides technical assistance with siting, installation, calibration and use and, in return, has access to the output. The majority of

ALERT systems used in Australia were based on a model tested and adapted by the Bureau. A few years ago Brisbane City Council installed a comprehensive flood warning system known as PROPHET, based on the ALERT concept, this is described by Carroll (1993).

6.1.2 Flood warning systems and flood mitigation

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Until the late 1980s flood warning systems in Australia were handicapped by intergovernmental disagreement over the responsibility for future funding of the service. A background to this and to the general principles of flood warning systems is given in Smith and Handmer (1986). After that date it was agreed that the Bureau of Meteorology was responsible (with the exception of flash flooding) and additional staff and resources were allocated to the regional offices to provide the forecasting service. As a result there have been major improvements in the instrumentation, areal coverage and quality of the forecasts throughout Australia. The Brisbane Office of the Bureau has been to the fore of these developments.

Flood warning systems however, directly involve LGAs assisting with the process of data collection as an essential input into the forecasts, for interpretation of expected areas of inundation, for local dissemination and, together with the emergency services, for the appropriate response. Where the risk is from flash flooding they also have the responsibility for providing the forecast. This outline is necessary in order to understand the responses to the questions concerning flood warning systems in the questionnaire.

An understanding of flood warning systems is important as they assist with the definition of flood risk and thereby, assist with the prioritisation of future floodplain management needs of LGAs within Queensland. This is because the risk for all forms of damage is much greater for those LGAs that have only short warning times, say less than 12 hours, in contrast to others that have several days.

6.2 The questionnaire responses

The questionnaire responses are designed to obtain a picture of how LGAs contribute to, and gain from, the overall flood warning system.

Question 8.2 asks if LGAs use flood warning systems, assumed to be locally based, as a form of nonstructural flood mitigation measure. Approximately half (33 out of 67) of the responses report that flood warning systems are so used. As the total includes localities that do not have a significant urban flood risk this can be considered as a satisfactory result.

Four specific questions (10.1 to 10.4) were asked in the section of the questionnaire concerned solely with flood warning systems. These were:

Question 10.1 requests information on the type of forecast provided by the Bureau.

Question. 10.2 asks if the Bureau forecasts are further interpreted for use by specific local communities.

Question. 10.3 enquires if the LGA maintains a local flood warning system.

Question. 10.4 invites further detail on the methods used to disseminate the information to the community where a local system is maintained.

6.2.1 Question 10.1. Form of forecast supplied by the Bureau

Two thirds (65 out of 102) of localities receive quantitative forecasts from the Bureau in the form of river gauge heights and in terms of minor, moderate and major flooding. The majority of LGAs and localities that do not receive such forecasts are located in remote areas of the State and/or have only minor urban flood problems. The former, Carpentaria is an example, are in regions with a poor coverage of river gauges.

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6.2.2 Question 10.2. Is the forecast further interpreted by the LGA?

Where quantitative forecasts are supplied by the Bureau, approximately 40% (28 out of 67) relay the information unchanged and 60% (38 replies) further interpret this for use by local communities.

6.2.3 Question 10.3. Does the LGA maintain a local flood warning system?

Forty-five localities have information based on local flood warning systems of the ALERT type. Such a high proportion is, to date, only found in Queensland. This is undoubtedly one of the major positive features of urban floodplain management in the State. However, it is worthy of note that the preliminary draft of the *Victorian flood strategy 1997 - 2007*, proposes 29 additional centres for flood warning systems for that State.

As noted, Brisbane City Council maintains its own comprehensive flood warning system and the south-east of Queensland now has a coverage of ALERT-type installations unmatched elsewhere in Australia. A number of systems originally designed for water resource management have been integrated into this coverage. One outcome of this detailed cover is that LGAs with ALERT systems for their local area have the capacity to interrogate or directly receive data from other systems in the region and thereby gain information on the approach of storm cells before they reach their catchments.

6.2.4 Question 10.4. How is the information from locally based systems relayed to the community at risk?

There were 49 replies to this question and the respondents could tick boxes to indicate door knocking, radio, television or loudspeakers as the method(s) used, respondents were also invited to add additional categories. Forty-two of the respondents (about 85%) indicated that they used more than one method to disseminate the forecast. This is particularly important as all analytical accounts of the effectiveness of flood warning systems stress the need for more than one method to be used in order to obtain community acceptance and thereby an effective response.

6.3 Flood warning time

The time that a community has between receiving a quantitative forecast and the inundation of buildings and infrastructure is an important element in defining susceptibility to flood. It ranks with the number of buildings and flood height range in outlining a priority list of communities in most urgent need of comprehensive floodplain management. However, it is difficult to define, with any precision, what is a flood warning time? There are a range of possible definitions, e.g. from the start of rainfall to time of flood rise, time of peak rainfall intensity to flood peak etc. In addition, the relationships between timing and intensity of rainfall to the subsequent downstream flood can vary considerably between events, e.g. it often depends on which sub-catchments received the maximum rainfall.

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However, at a broad scale, there are clearly major recognisable differences in flood warning time between LGAs and localities in Queensland, the full range is from an hour or so to several weeks.

6.3.1 Flood warning time - questionnaire responses

LGAs were asked, in Question 4.15, for differing localities in their area, to give estimates for the flood warning time. In this case between '... commencement of rainfall and initial inundation of the urban area'. There were 71 responses and these are tabulated in Table 6.2.

Table 6.2 Flood warning time, responses to Question 4.15

	< 12	12 to < 24	24 hours to	2 to 7	8 to < 14	> 14
	hours	hours	< 2 days	days	days	days
Number of localities	26	14	18	6	3	4

Overall, 55% of the responses indicated a time of less than 24 hours.

At the other extreme 20% (13 replies) indicated a time of 2 days or more. A warning time of this length should be sufficient to enable maximum reduction of damage to take place and for the risk to life to be small.

6.3.2 Flood warning time — Bureau of Meteorology

A separate analysis was undertaken by the Brisbane Office of the Bureau as a specific contribution to the current study. This was to classify, for 143 (mainly urban) locations throughout the State, the flood warning time into three classes. These were less than 12 hours, 12 hours to less than 24 hours and greater than 24 hours. The information from the Bureau is presented in full in Appendix 5.

The analysis by the Bureau was based upon the lead times for the forecast of river flood heights that could be provided with reasonable accuracy for downstream locations using existing '... climatological factors and/or flood monitoring networks and prediction tools'. It is stressed that the classification represents an average case and lead times could vary for specific floods. The results are presented in Table 6.3.

Table 6.3 Flood warning times – the Bureau's analysis

	A	В	С
·	< 12 hours	12 - 24 hours	> 24 hours
Number of locations	100	25	18

Tables 6.4 Questionnaire and Bureau estimates of flood warning time for a selection of flood prone Queensland LGAs

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Local Government/ Locality	No. of Buildings at Risk from 1/100yr Flood	Bureau of Meteorology A<12 hrs;B 12-24 hrs, C>24 hrs	Questionnaire Question 4.15
Gold Coast Overall total	16,650	A	24 hrs
Mackay	8,000	A	6 - 12 hrs
Brisbane Brisbane River Brisbane Creeks	8,000	B A	48 hrs < 12 hrs
Dalby	3,300	A	7 hrs
Ipswich	3,000	A	24 hrs
Logan Logan River Scrubby Creek	2,375	B A	48 hrs 6-8 hrs
Hinchinbrook Ingham	2,175	A	36 hrs
Murweh Charleville Augethella	1,350	B A	24 hrs < 24 hrs
Rockhampton	1,200	С	up to 14 days
Burdekin Hume Hill/Ayr	1,000	A	
Cairns City Mulgrave	728	A A	2 hrs 30 hrs
Caboolture Burpengary	455	A	6 hrs
Blackall	N/A	В	72 hrs
Cooloola Gympie	N/A	В	varies
Johnstone Innisfail	N/A	. A	4 hrs
Carpentaria Normanton	N/A	С	10 days +
Mt Isa	70	A	

N/A Detailed estimates not available

Using the Bureau's definition, 87% of the localities fall into the '24 hours or less' category and 77% of the total have less than 12 hours between prediction and arrival of the flood.

The LGAs completing question 4.15 and the localities analysed by the Bureau are not identical and there are differences in the definition of flood warning time. However it is clear that a very high proportion of urban locations in Queensland have warning times of less than 24 hours.

Table 6.4 repeats the list of LGAs with the highest numbers of buildings at risk from the 1 in 100 year flood (see Table 3.5) together with the warning times from the Bureau and, where available, from the responses to the questionnaire. Table 6.4 is also extended to list a selection of other flood prone urban LGAs, for these detailed estimates of the number of properties at risk are not known but the numbers are relatively small.

6.3.3 Why are the flood warning times so short?

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The relatively short leads given in Tables 6.2, 6.3 and 6.4 are perhaps surprising, given the length of many of the major rivers systems in Queensland. The reasons for the short times and forecasts include:

- many flood prone communities are liable to flooding from relatively small catchments that are tributaries to the major rivers. Examples are the Brisbane Creeks, the Scrubby Creek catchment in Logan, and Townsville.
- for locations situated on major rivers, damaging floods are often from rainfalls in the lower parts of the catchment, not necessarily in the more remote headwaters. Examples are Johnstone and Cairns (Mulgrave).
- often the Bureau's forecasts are, in part, based on river gauges which, for very good reasons, are not situated in the upper parts of major catchments.

Whatever the reasons, it is very clear that most of the major flood prone urban communities have lead times that are less, often very much less, than 24 hours. Given that rain and floods can occur at night, at week-ends or on public holidays, a time of even 24 hours requires best practice dissemination and response to significantly reduce flood losses.

6.4 Counter Disaster Plans

Counter disaster plans are a requirement for all LGAs in Queensland and throughout Australia. For many areas these include responses to flood events and therefore, are the component of the flood warning system most concerned with loss reduction, of which reduction to loss of life is predominant. Question 11 (11.1 to 11.6) was specifically designed to obtain information on the Counter Disaster Plans at LGA level. As the effectiveness of such plans is related to aspects of community awareness, the responses to Question 9 are also reported in this section.

6.4.1 Question 11. Counter Disaster Plans

Some of the component questions of Question 11 were difficult for respondents to answer. For example, 11.4 and 11.5 ask if the flood plan was activated during the last major flood and for comments on its effectiveness. The difficulties were that, in many cases, the 'last flood' was before the Counter Diaster Plan was developed and comments on effectiveness are subjective. In addition, it was not feasible for the questions to ask for details of the flood section of the Plan. It is suspected that often this is relatively meagre, if only because of the lack of hydrological information on the size and areal extent of the floods which should be basic to such a Plan. These caveats should be remembered in interpreting the responses summarised below.

Question 11.1. Is there a Counter Disaster (Flood) Plan for this community?

Approximately 90% (90 out of 101) of respondents report that there was a flood plan. All of the 10% with a negative response are for localities with only a small number of buildings at risk.

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Question 11.2. Is the Counter Disaster (Flood) Plan linked to flood warning systems?

Some 60% (52 out of 88) replied that there was such a link. It would seem surprising that 40% (36) did not link the flood warning system to the disaster plan. Among these LGAs who did not have such a link were Caboolture, Goondiwindi and Mackay. Goondiwindi has levee protection from all but the most extreme flood events, it is therefore an example where a flood warning system should be required to deal with potential overtopping or failure. The recently constructed levee at Mackay, with a much lower level of protection, is a further instance.

Question 11.3. Was the Plan activated for the last major flood?

The responses were confused as the 'last major flood' could be before the plan was implemented. As this question was poorly worded discussion of the responses are omitted.

Question 11.4. Was the plan effective after the last major flood?

The answers were more satisfactory. Out of the 63 responses for localities that had experienced a flood since the Plan was implemented, 80% (51) replied that the plan was effective. Although this is often based on self-assessment, the level of favourable responses is good.

Question 11.5. Was the Plan revised after the last major flood?

Of the localities for which the question was applicable, 75% (50 out of 66) reported that a review had taken place.

Question 11.6. Does the Plan use or contain information from flood studies?

Approximately half of the replies (43 out of 83) are based on information from flood studies and half (40) are not. This confirms the overall lack of flood studies for much of Oueensland.

Overall, for most localities with an urban flood problem, LGAs include a consideration of flooding within the Counter Disaster Plan. Although based on self assessments, most LGAs regard the Plans as effective and they are revised after flood events. It is disturbing however, that only half of the Plans are based on information from flood studies, taken to mean hydrological studies of the magnitude and extent of floods and the vulnerability of the flood prone communities. The frequent lack of links to flood warning procedures also warrants improvement and there are undoubtedly examples where flood studies have not been incorporated in the Counter Disaster Plan.

6.4.2 Awareness

Questions 9.1 to 9.5 requested information on the level of community awareness.

Notwithstanding that such responses are subjective, they form an important component of overall urban floodplain management.

Question 9.1. Is the community aware it is located on a floodplain?

Some 90% (91 out of 102) of locations are considered to have such awareness, exceptions include Biggenden, Caboolture and Herberton.

Question 9.2. Is the community aware that it can be flooded?

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Approximately 98% (98 out of 102) replied that they were so aware. Toowoomba and Mt Morgan were examples of a negative response.

Question 9.3. Are past flood levels indicated locally (e.g. flood markers)?

About 25% (24 out of 102) replied that there were such flood markers. Among these were Brisbane, Dalby, Eacham, Emerald, Jericho, Isisford, Maryborough, Roma and Taroom.

It is especially significant that many of the communities with a larger number of buildings at risk do not have flood markers.

This is common throughout much of Australia, and although there are no national statistics it is likely that the situation reported for Queensland is better than for some other flood prone States. However, this may represent an over-optimistic interpretation of 'flood markers', for effectiveness in a large flood prone community there should be a series of such markers throughout the area at risk from inundation. It should be a requirement that flood markers are installed for all localities with a flood risk. This is because they are an essential and inexpensive mechanism which give meaning to the forecasts of river gauge heights for individual buildings. Although not requested in the questionnaire, the lack of markers is usually due to the perceived adverse effects on house prices or for future development.

Question 9.4. Are public awareness/education programs conducted?

Only a little over 20% (21 out of 96) communities would appear to have such programs. In a number of instances, especially for coastal communities, it was commented that such programs are associated with seasonal awareness campaigns for tropical cyclones rather than those solely related to flood. Among those LGAs with awareness programs are Brisbane, Ipswich (but qualified as 'limited'), Logan, Mirani, Rockhampton, Taroom, Townsville (linked to cyclone programs) and Warroo. Again there would seem to be a problem with the lack of such programs for many of the more flood prone communities. Finally, the effectiveness of such programs remains an unknown.

Question 9.5. Community awareness of counter disaster arrangements?

Approximately two thirds (64 out of 96) of localities replied that the community is aware of counter disaster arrangements. However, in retrospect this was not a well worded question.

In general, the level of awareness of flood threat would appear to be high among communities at risk. However, the use of flood markers and of programs to promote flood awareness would appear to be limited especially for many of the communities most at risk.

6.5 Summary

Flood forecasts, directly from the Bureau or from local systems, are widely available throughout the State. A notable feature is the growth in recent years of ALERT-type systems for locations liable to flash flooding. It is also clear that many of the LGAs with urban flood

problems have developed a variety of methods to disseminate the forecast to the community at risk.

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However, the lack of hydrological studies that define the extent of flooding for many LGAs poses problems for forecasting. Firstly, this limits the usefulness of the forecast as it is unclear what area is actually at risk for a forecast gauge height and secondly, the Bureau's staff can often only add to the list of flood prone locations after a major flood has occurred. There are also problems with the provision of installations in the remote and sparsely populated areas of the State.

A significant feature of flood warnings is that a very large proportion of flood prone communities have lead times that are less than 12 or 24 hours. This emphasises the need for locally based, ALERT-type, systems. The costs and expertise to install and maintain such systems pose very real problems, especially for those LGAs with small populations and thereby limited finance and technical resources. Overall, the provision of flood forecasts and their dissemination in Queensland, relative to the other States, is good. However, as these components of the flood warning system improve the spotlight turns to community response. The question then becomes how to capture the benefits offered by the forecasts and dissemination.

The majority of communities would appear to be aware of their flood risk but few of the Counter Disaster Plans specifically incorporate flood warnings. There is also a lack of flood markers and flood awareness programs, especially for many of the communities with large numbers of buildings at risk. Such issues should form a focus for future enhancement of the flood warning systems in Queensland.

The Largest Known Flood Events – The Effects on Lifelines

7.1 The largest known flood

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The importance of the probable maximum flood, and the difficulties in its estimation, are discussed in Section 3.5. Questions 4.1 to 4.3 are concerned with the largest known flood event and this is used as a bench mark against which to evaluate the effect on lifelines. There remain two aspects that are worthy of comment, these are the duration of flood inundation and the date of its occurrence. Duration can be assessed in variety of ways and the term is not easy to define with any precision. However it can be used as an indication of the severity of the disruption to the community and is of significance for the provision of services and emergency management.

Analysis of the responses to the date of the largest event are not conducive to statistical analysis, in part because the length of records varies from well over a hundred years to less than five. But the pattern has interest for floodplain management.

7.1.1 Date of the largest known flood

Question 4.1 asks 'for the date of the largest known flood', for the locality. There were 95 responses and the results are tabulated in Table 7.1. As would be expected the most recent decades have the larger numbers, this reflects the increasing number of flood gauges over time.

Table 7.1 shows that there is a tendency for some earlier decades to have a particularly high frequency of 'largest known events' and for others to be of low frequency. The 1890s and 1970s are examples of the former and the 1920s and 1930s of the latter. The significance of the data, with all their imperfections, is that major flooding would appear to be a sporadic event and therefore, there is a need for the collection of data over long periods. Massive floods, such as the Brisbane flood of February 1893 did not provide the stimulus for care in floodplain siting, however the floods of January 1974 (less severe than in 1893) resulted in Australia's most costly flood event. Despite such reluctance to learn from experience, knowledge of the levels of earlier floods is a key factor for the estimation of even greater floods and for emergency management. For some localities in inland Queensland the floods of early 1997, some reported in the questionnaire some not, achieved 'flood of record' status.

7.1.2 Duration

There were 69 replies to Question 4.3 which asked for estimates of the 'duration of flood inundation' for the largest known flood. The number of responses is less than for the date of the event (Question 4.1) as in a number of cases information on duration was not known. The duration estimates are tabulated in Table 7.2.

Overall, despite uncertainty over definition, duration's of 3 days or more are reported for approximately half of the locations (35 out of 69). It needs to be stressed that Table 7.2 refers

to the largest known event, for lesser floods the duration would be considerably less. For example, the Brisbane River duration in 1974 was reported as 4 days.

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Table 7.1 Year of the largest known flood by decade (Question 4.1)

Decade	Number ⁺	
1890 - 1900	10	
1901 - 1910	0	
1911 - 1920	4	
1921 - 1930	1	
1931 - 1940	0	
1941 - 1950	9	
1951 - 1960	10	
1961 - 1970	4	
1971 - 1980	29	
1981 - 1990	10	
1991 - early 1997	18	

⁺ Creek catchments for Brisbane are excluded.

Table 7.2 Duration of inundation for the largest known flood (Question 4.3)

	< 24 hours	1-2 days	3-7 days	8-14 days	> 15 days
Number of locations	20	14	23	7	5

As a guide, duration is related to warning time, i.e. the longer the warning time, the longer the period of inundation. Indications of duration of flood inundation can therefore, be obtained from Section 6 and Appendix 5. There are exceptions to this relationship and locally, low lying areas can remain inundated for much longer periods. However, such sites are usually of greater significance for agriculture rather than for urban flooding.

7.2 Lifelines

Questions 4.8 to 4.14 request information on the '... effects of the largest known flood on lifelines'. Individual questions address the following categories:

- Roads
- Rail
- Airports
- Water supply
- Sewerage
- Electricity
- Other (e.g. fire, ambulance, hospital)

There are variations in the degree of severity indicated for the various lifelines, e.g. for roads impacts are described as 'no access roads affected', 'some access roads cut' or 'all access roads cut'. The results are presented by locality.

7.2.1 Transport links

It is important to note that disruption, especially to transport links, can severely effect communities that do not experience inundation of buildings. This is especially true for remote settlements in the sparsely populated parts of the State. There were a number of replies to this question for localities that do not fulfil the study's definition for urban flooding, i.e. more than 10 flood prone buildings.

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Close to 75% (70 out of the 93 responses to this question) had all road access cut for the highest known flood, all but 2 of the remaining 23 had some access roads cut. The question did not ask for the length of disruption but for some remote localities this is measured in weeks, eg. Burke and Normanton.

Rail

For the largest known flood, over two thirds (40 out of the 59 reporting) indicated that all rail links were cut. For the larger urban centres, such as Brisbane, such closures were usually for a short duration, for remote localities with rail links the duration of disruption would be very much longer. There are also significant adverse effects on the handling of coal and minerals although these fall outside the scope of this report.

Airports

These vary in size from international airports to outback landing strips. The availability of air strips is especially important for emergency management in remote areas; for evacuation, for the supply of food and other assistance. Of the 56 replies, i.e. those with nearby air services, approximately half remain unaffected by even the largest known flood.

7.2.2 Water, sewerage and electricity

Major disruption to these services can have significant consequential indirect effects, for instance risks to health. These vary from the spread of disease due to contamination of drinking water to the lack of electricity for refrigeration and cold stores. It is also necessary to stress that key installations for water and sewerage are often located close to rivers and creeks and, if precautions are not taken, may be especially liable to disruption and damage by flood. A problem with the responses was that for many smaller communities there is, or was at the time of the largest known flood, no reticulated supply for these services!

Water

Perhaps surprisingly, close to 70% (62 out of 88) of the responses indicate that water supply was not affected by the largest flood.

Sewerage

Approximately 60% (38 out of 66) of localities with sewerage experienced disruption.

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Electricity

About half (44 out of 87) of the responses indicate that electricity supplies were disrupted.

Other significant disruption to services

This question invited comment on disruption to other lifelines. A number of localities reported that the communities were isolated from fire, ambulance or hospitals, these include Blackall, the Gold Coast (fire and ambulance), Ingham (fire) and Laidley is isolated from its hospital. In some cases the service buildings are inundated and for others, access was cut. Many other responses commented that the disruption, especially to the road network, hampered the provision of the full range of emergency services.

7.3 Summary

As a general statement, it is not possible to flood proof the transport links. Indeed, a large proportion of the payments under the Natural Disaster Relief Arrangements are too small, but areally extensive, LGAs to repair their extensive road network, including bridges, culverts etc that are usually unsurfaced and therefore, particularly liable to flood damage. However, there is a case to locally provide upgraded transport links especially where these form evacuation routes for the communities at risk. This has special significance for those exposed to storm surge where evacuation is critical and also applies to the siting of all key emergency service installations and buildings, especially police, fire, ambulance, hospitals and communication buildings for emergency management. Special consideration should also be given to the siting of dwellings that house especially vulnerable groups such as the elderly and infirm.

For service provision, water etc, flood proofing of key installations is of importance. Throughout Australia, measures to flood proof especially vulnerable points of all infrastructure should have a high priority. This subject has been highlighted by Emergency Management Australia (EMA) and many of the corresponding State agencies for special attention in the coming years. It needs to be stressed that many individual service providers have well formulated emergency procedures although there is a need to integrate the individual services to take account of consequential effects. For instance, the supply of electricity is often critical to the provision of water and sewerage.

The Implication for Estimates of Flood Damage

8.1 Background to flood damage

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The questionnaire circulated to all LGAs in Queensland did not include questions that asked for estimates of flood damage in dollar values. This was a conscious decision as such estimates are only of use if they are based on a consistent methodology and definitions of what constitutes damage. Contemporary estimates, say of the kind given in newspapers, are little more than anecdotal and do not represent any form of sound economic appraisal. In order to formulate best practice urban floodplain management it is necessary to undertake detailed assessment of flood losses for a community on a consistent basis. Such assessments require:

- detailed hydrological studies to define the risk
- data on what is at risk the vulnerability.

This report has demonstrated that hydrological studies of this kind (with information on the magnitude, frequency and extent of all floods to the level of the PMF, with floodplain velocities for flood flows etc.) are only available for a limited number of localities in Queensland. Information on what is at risk (buildings, lifelines etc) is only known for a handful of these.

The paucity of the background information necessary to assess flood losses in economic terms is such that any attempt to evaluate these at the State level is little more than a guess. However, the data from the questionnaire on the number of buildings does enable some comment on losses relative to other States.

8.2 Queensland – estimates of urban flood damage

This section will comment on the likely size of the State's flood losses and is followed by discussion on how this could be improved.

8.2.1 AWRC (1992)

The AWRC report provided estimates at State level for urban damage in Australia. Following normal practice these are most usefully expressed for comparative purposes in terms of average annual actual damage (AAAD). In this context, 'actual' refers to losses after allowance has been made for the reduction to contents loss by the actions of the residents, ie. by lifting or removing items so that they are not inundated. The estimates given below are for tangible losses, ie. they combine direct and indirect losses but do not include any allowance for intangible effects.

The AAAD values given in the AWRC report:

- are at 1990 values.
- only include damages to the level of the 1 in 100 year event,
- do not include losses to lifelines.

With these definitions and qualifications, the AWRC (1992) AAAD values for Queensland, and the number of buildings at risk used in their estimation, are given in Table 8.1.

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Table 8.1. AWRC estimates for tangible annual average actual damage (AAAD) for Queensland (AWRC, 1992)

	AAAD in \$m	Number of Properties to 1 in 100 year level
Residential	16.4	21,000
Commercial	6.0	2,000
Industrial	7.1	750
Public	4.5	750
Total	34.0	24,500

The AAAD estimates in Table 8.1, which total \$34 m, are based on accepted practice for damage estimation. Indeed, in many respects the methodology ranks among the best available in the literature. The major shortcoming is the poor data base for the number of buildings at risk (to the 1 in 100 flood level), the estimates used by the AWRC were provided by Queensland State agencies.

8.2.2 Flood damage estimates Insurance Council of Australia (Smith, 1996)

In 1996 the Insurance Council of Australia (ICA) commissioned a study to provide estimates of residential flood damage for Australia. The report (Smith, 1996) is unpublished but the following extracts indicate the results for Queensland. The methodology, with the exceptions summarised below, followed that used in the AWRC study.

The major change to the AWRC report was that total number of residential buildings at risk to the level of the 1 in 100 year flood was increased to 50,000. The revised AAAD, restricted to the residential sector, was \$31 m, at 1990 prices to allow direct comparisons to the AWRC value.

The ICA study also made a tentative attempt, based on extremely limited information, to estimate the AAAD to the level of the probable maximum flood. The AAAD value to the PMF for Queensland was given as \$75 m for the residential sector alone. Most of this additional damage was due to the potential losses from building failure for such extreme events, for example for Ipswich.

8.2.3 Revised AAAD for Queensland.

The revised estimate for the total number of flood prone buildings in Queensland (residential, commercial and industrial etc) to the level of the 1 in 100 year flood is given in Section 3.4.4 as 65,000.

Thus, a very provisional guesstimate of the AAAD for tangible flood losses in Queensland, for all buildings to the level of the 1 in 100 year event, is of the order of \$100 m. This is obtained by scaling up the 50,000 estimate given in Smith (1996) and making some estimate for commercial and industrial damage (for purposes of comparability the AAD is in 1990 values).

If the AAAD is extended to include events to the level of the probable maximum flood, these estimates would be very much higher, perhaps by a factor of two.

The possible doubling of AAAD, when estimated to the PMF, is due both to the increased number of buildings at risk and to the increased risk of failure under extreme flood conditions. The changes to the AAAD should not be confused with the increased number of buildings at risk, estimated to be a factor of three (see Section 3.8). This is because AAAD takes into account event damages and their frequency.

There are grounds for considering that the damages could still be underestimates. This is because there may still be flood prone communities that, on the basis of the questionnaire, are inadequately assessed in terms of the numbers of buildings at risk. Further, the ratio of residential to commercial/industrial buildings in the AWRC report and the inadequate questionnaire responses for building type suggest that the overall losses may be too small. This is because unit losses for commercial/industrial concerns are much higher than for residential buildings.

What is now certain is that the Queensland has the highest AAAD for any State in Australia. Numbers of buildings at risk in New South Wales are comparable but more than twenty years of steadfast application of urban floodplain management has reduced the AAAD for some communities and halted the increase in flood prone developments for the majority of LGAs. At State level, Queensland has not reduced the risk and for many major flood prone urban communities the lack of effective land use controls or building regulations is such that the potential damages increase year by year.

8.3 Assessment of urban flood damage

Need to define direct and indirect costs in this section

Hydrological techniques and models are widely available for the estimation of the magnitude, frequency and extent of flood events, this is now equally true for methods to assess urban flood damage. These are based on the use of stage-damage curves for differing classes of buildings, a technique first described in the USA by White (1945), these methods subsequently became the basis for the Federal Flood Insurance Program in the late 1960s. Refinements of the stage-damage technique, based on work in the UK, are given in Penning-Rowsell et al (1977). One of the first applications in Australia of such methods was to assess the damage after the Brisbane floods of 1974, see SMEC (1975). A study of the flood damages for Lismore in New South Wales (Smith et al, 1979), also prompted by the 1974 floods, led to the development of a commercially available computer package, ANUFLOOD, to assess urban flood losses and as a method to evaluate the costs and benefits of a range of flood mitigation measures.

ANUFLOOD is described in detail in the *User's manual* (Taylor *et al.*, 1983) and the accompanying *Field guide* (Smith and Greenaway, 1983), both have been revised on a number of occasions. The program combines spatial information on flood hydrology (magnitude, frequency and extent), a building data base and stage-damage curves appropriate for the classes of buildings. Together these can provide estimates of flood damage in a variety

of forms, for example as event damages (say for the 1 in 70 year flood) or as average annual damage. Subsequent modifications to ANUFLOOD can (if flood velocity data are available) assess the additional costs due of building failure. The program has been modified, to ANUSURGE, for use to assess damage from storm surge (Smith and Greenaway, 1994). It is also possible to link ANUFLOOD (or ANUSURGE) to existing geographical information systems to produce output in terms in spatial information. This is essentially the basis of the AGSO Cities Program which is currently underway in Queensland.

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Although ANUFLOOD and ANUSURGE are convenient packages, the principles are those accepted internationally as best practice for the assessment of flood damage, eg. White (1945), Penning-Rowsell *et al.* (1977). ANUFLOOD has been widely used by consultants and government agencies in New South Wales as a component of flood studies and as a foundation for floodplain management for well over fifteen years. More recently it has been used by consultants for studies in Queensland, for example the studies by Camp, Scott and Furphy for Rockhampton and Charleville, and ANUFLOOD is currently used as a basis by the DNR for flood studies in progress at Warwick.

In short, there are no technical barriers to the assessment of best practice flood damage estimates. A critical prerequisite however, is the availability of good quality hydrological data for the area under study.

The output of ANUFLOOD, and of similar computer-based programs, is usually in terms of direct, actual or potential, flood damage. The estimation of indirect damage is often undertaken outside the program. Indirect effects are much more difficult to define and are often assessed as a proportion of the direct losses. A more detailed discussion of the evaluation of indirect losses is given in Parker *et al.* (1986), a recent Australian account is available in Handmer and Thompson (1996).

Direct damage are those that result from the contact of flood water (and included sediment) with building structures and building contents. Indirect losses are essentially due to disruption caused by the flooding. For instance, a major category for the residential sector is the cost of alternative accommodation. For the commercial and industrial sectors indirect losses include loss of trading profit due to closure as a result of flooding. Indirect losses in the commercial and industrial sectors can be substantial and are relatively much larger than residential indirect losses.

Care is needed with the assessment of indirect losses to the commercial and industrial sectors. The choice is between financial losses (losses to individual firms comparable to insurance payments) and economic losses. The latter are usually less obvious and attempt to evaluate the losses to the regional, State or national economies. For example, if a beer bottle factory is inundated there are two possibilities to ensure continued production. One is that beer bottle production can be made up by other flood free beer bottle manufacturers, perhaps by working overtime, so that there is no overall loss to the economy; the other is that the lost capacity cannot be taken up elsewhere. In the former case the indirect losses, using economic criteria, are very small while in the latter case they are not. In the UK, the Treasury uses indirect losses defined on economic grounds, in Australia it has been the practice to use financial losses. Such questions are of significance in assessing flood damage, the differences in definition of indirect losses can have major effects on the cost benefit analysis of structural mitigation measures which are usually, in part, funded by State and/or national governments.

Direct and indirect damages are combined to give tangible losses. In many studies, especially overseas, these are usually in terms of potential losses and are not adjusted to allow for damage reduction to building contents by the residents, emergency services etc. In Australia

such measures are often incorporated into the estimates, this is the case with damage data given in the earlier part of this section.

Consideration and weighting should also be given to intangible losses, which by definition, are not (easily) converted into dollar terms. It is recognised that such effects can be important and include all forms of stress, illness and, in the extreme case, death resulting from flooding. In the commercial sector the intangible losses can include loss of business confidence, future contracts etc.

8.4 Summary

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Due to the paucity of hydrological studies it is not possible to give other than guesstimates for the magnitude of the State's flood damages.

It is however, likely that average annual damages are higher for Queensland than for any other Australian State, that the Brisbane floods of 1974 were the most damaging flood event ever to occur in Australia and that the Gold Coast has among the largest potential for flood losses of any LGA in Australia.

Techniques to assess flood hydrology and damages are available and expertise in their use is widely available in Australia. That this is the case is illustrated by Queensland LGAs that have undertaken such studies, for example Rockhampton and Murweh. However, the number is meagre especially in comparison with New South Wales. The problem becomes how to encourage such studies to be undertaken for all urban flood prone localities in Queensland.

The publication of a manual for use by LGAs in Queensland that describes methods to be used for hydrological studies and especially for damage evaluation, would be a invaluable aid to LGAs to achieve the aim of best practice urban floodplain management.

It is stressed that the available techniques to assess potential flood damage are based on the evaluation of direct losses to buildings and their contents, guidance on a consistent methods to estimate indirect and intangible losses is also required together with advice on how to assess the effects on lifelines.

The comments above apply to the assessment of losses from riverine flooding, the situation for losses from inundation by storm surge is even less satisfactory. In this case there is much less opportunity to learn from the experience of the other States as the risks of damaging storm surge are much greater in Queensland than elsewhere in Australia. State of the art studies in this field are from the southern eastern USA.

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Surge Inundation

9.1 The background

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Surge, alternatively termed storm tide, is associated with the low atmospheric pressure accompanying tropical cyclones. This causes a localised rise in sea level which is at a maximum immediately below the eye of the cyclone. When the cyclone moves into shallow coastal waters the increase in sea level can be enhanced due to wind and wave set-up. It is however, difficult to provide reliable forecasts of the height of the surge at, and landward of, the shoreline.

The magnitude of the surge near-shore is controlled by a variety of factors of which the off-shore bathymetry and the (in plan) shape of the coast are particularly significant. As a guide, extensive off-shore shallow water increases the height of the open sea surge and the effects can be further enhanced if the surge is funnelled into estuaries or embayments. Figure 9.1 taken from Hopley and Harvey (1979) provides an indication of the effects of bathometry, the diagram shows depth correction factors. The higher the correction factor the more likely that open ocean effects will be converted into enhanced coastal zone inundation. In broad terms a factor of 2.0 indicates a doubling of open ocean surge while 0.5 indicates that it would be halved. The Gulf of Carpentaria is noteworthy for its high correction factors, in contrast to the relatively low values for Brisbane, south to the Gold Coast and to the border with New South Wales.

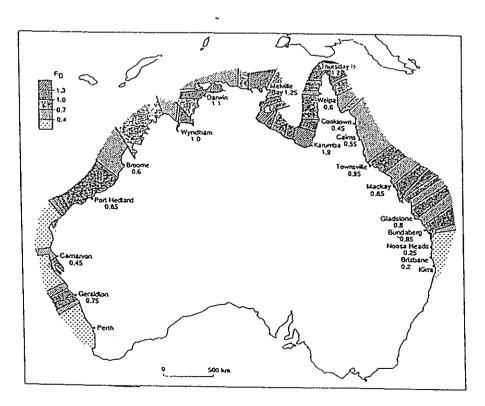


Figure 9.1 Regional variations in depth correction factors, Fd, for the Australian coast, from Hopley and Harvey (1979)

The need is for provision of estimates of surge height at specific locations but this requires detailed and complex calculations in order to translate the open sea surge into those that would apply at the coast. Such forecasts will never be precise because even small changes in the track of the approaching cyclone change the area at maximum risk. Over the last few years the Bureau of Meteorology, in part related to the Queensland-based Tropical Coastal Cyclone Impact Program (TCCIP), has undertaken 'state of the art' studies for storm surge at several east coast locations in Oueensland. Such studies have included the major coastal lowlying urban areas of Cairns and Mackay. Notwithstanding this work, problems of forecasting surge are further complicated by the timing of the surge in relation to the prevailing tide and the problems of estimating wave height. During the course of a tropical cyclone, open sea wave height can be very large, but for most practical purposes (emergency management, damage estimation etc.) wave height needs to be added to the estimates of the height of storm surge which are normally reported in terms of 'still water'. The problem is especially important where surge inundates land and buildings beyond the landward limit of the highest astronomical tide. As a working rule wave height in inundated areas can be approximated to be half the still water depth, i.e. an inundation of 3.0 m of still water surge requires the addition of a further 1.5 m to allow for wave height.

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Within the context of the present study, the focus is upon the risk of urban inundation from storm surge. To some degree, the whole Queensland coast is at risk from surge inundation associated with tropical cyclones and the urban risk applies to coastal settlements at low lying locations.

The inclusion of storm surge within a review of flooding is three-fold. This is because:

- the effects on buildings and services are similar to extreme river inundation,
- in many locations, urban areas subject to surge are also liable to river flooding,
- mitigation is best achieved by land use zoning and building regulations which are similar for riverine and surge flooding.

9.2 Surge inundation

A review of the effects of surge inundation on buildings with reference to Mackay is given in Tropical storm surge, damage assessment and emergency planning, Smith and Greenaway (1994). In summary, the effects of surge on buildings are much more severe than from river flooding, this is because of the power of wave impact on structures. In locations close to shore the best estimates, from the USA, indicate that for lightweight domestic or commercial structures there is a strong likelihood of complete failure if the depth of the surge (still water plus wave height) is in excess of 1.0 m over floor level. Severe damage could be expected for much more limited flooding over floor level. In addition, the salinity of sea water causes much greater damage to building contents than is the case for fresh water.

The implications for loss of life are therefore, extreme and far exceed those associated with river flooding.

Further, by definition, surge occurs in combination with extreme winds and rainfall associated with tropical cyclones. These factors are recognised by the emergency services in Queensland who, over the last five years or so, have been actively engaged in improving emergency response for areas liable to surge. A problem for the emergency services is that for the wind effects of cyclones, the preferred strategy is for those at risk to stay indoors, while for surge the need is for evacuation before the wind reaches velocities in excess of about 70 kph.

9.2.1 Surge and river flooding

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Many coastal settlements in Queensland were originally sited on river estuaries and subsequent growth has often led to further urban development in low lying, near-coastal locations. Such sites are often, therefore, vulnerable to both river flood and surge. The problem with such sites is that a cyclone landfall in the vicinity of an estuarine town can cause inundation by surge followed, with a variable lag time, by river flooding resulting from intense rainfall in the upstream river catchment.

Mackay, on the Pioneer River, is a prime example for which information is available. In 1918, much of the settlement was destroyed by a surge event which was followed, some 12 - 24 hours later, by the flood of record. Indeed, it is difficult to distinguish from the contemporary accounts of the disaster which buildings were destroyed by wind, surge or river flood!

The conjunction of vulnerability to surge and flood in such locations emphasises the need for mitigation to consider both hazards in an integrated fashion.

9.2.2 Land use zoning and building regulations

The analysis of the questionnaires indicates that many flood prone LGAs in Queensland have regulations that, to some degree, recognise the need to introduce zoning and floor height regulations for river flooding. Similar or linked regulations for surge are uncommon. An exception is the recognition of the threat and related regulations, for new developments, by the former Mulgrave Council which are now in the process of incorporation for the enlarged area of Cairns City Council. Mackay, with a known surge risk, has no related zoning or building regulations.

There are clearly major difficulties for an LGA in introducing regulations for surge but this deficiency is in marked contrast to many other developed countries. The USA is a leader in this field and most States in surge-prone regions have rigorous planning requirements for new developments. Typically these prohibit buildings in the zone exposed to the 1 in 100 year surge unless the floor level is above inundation level and the construction meets stringent engineering standards. In addition, there is a requirement to provide acceptable escape routes in areas liable to surge. In the USA a 'V-zone' is recognised where surge would be accompanied by significant wave height (and therefore an enhanced risk of building failure). For most of the Queensland coast, the physical setting and exposure are such that the majority of the coast would be classified as 'V-zone'. In the USA regulations for surge are similar to those used there for flooding, and stem from the National Flood Insurance Program which is subsidised by the federal government and provides cover for both river flooding and surge-provided that local government adopts planning regulations for new developments.

The occurrence of major surge events for existing urban locations in Queensland is of relatively low frequency but with a magnitude that has potential for huge damages and loss of life. The lack of State or local zoning and building regulations for most of the Queensland coast needs to be urgently addressed.

9.3 Where is the risk?

For over twenty years there have been attempts in Queensland to define the likely magnitude of storm surge, especially for the east coast. In common with overseas studies, there is little information on the vulnerability of the urban areas at risk. The Department of the Environment (notably the Beach Protection Authority) published a series of storm surge

studies, based on computer simulation, in the late 1970s, for a range of locations from Cooktown in the north to the Gold Coast in the south. The component reports include estimates of surge heights for the 1 in 100 year event and many also give estimates for the 1 in 500 year surge, these are for still water levels and do not include wave height, wind set-up etc. The Department is currently preparing a review entitled, *Storm tide threat in Queensland*.

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There is also a series of storm tide maps, published in the mid-1970s by the Queensland State Survey Office, again for a selection of east coast locations, these include Cairns, Mackay and Townsville. These are designed for use by the emergency services and are basically shaded layered contour maps.

Other useful information is given in Storm tide: warning-response systems (SCDO, 1992). This lists 'all known centres of habitation on the Queensland coast' and gives the height of 'the assumed highest tide' and highest astronomical tide (HAT), together with comments on evacuation zones (up to 1.5 m, 1.5-3.0 m, and 3.0-4.5 m). It also presents brief comments, where known, on the 'inundation of any developed area'. For some locations SCDO (1992) also provides estimates of the surge height for an event with a 1 in 500 year annual recurrence interval. Where appropriate, this is given in Table 9.1. These values for surge height are added to the sea water level current at the time of the event, i.e. allowing forthe state of the tide etc. The aim is to give a broad indication of relative surge risk rather than any kind of precise estimate. No indication is given of the wave height that should be added to the still-water levels.

9.3.1 Mackay, Cairns and Townsville

More recently detailed building-by-building surveys, suitable for use as geographical information systems (GIS) have been undertaken for Mackay and Caims. Details of the results for Mackay are available in Smith and Greenaway (1994) and Granger and Smith (1995), at both locations details of the hazard are available from recent studies. A summary of the surge data for Mackay is given in Table 9.2.

A comprehensive building data base has been prepared for Cairns by K. Granger (AGSO) and A. Zerger (CRES, supported by an IDNDR Postgraduate Scholarship). Provisional analysis for a near probable maximum surge height of 5.0 m (above HAT) indicates that a total of some 13,000 buildings would be affected with the majority experiencing over floor inundation. Of the total, approximately 10,000 are dwellings and the remainder commercial buildings including major hotels.

To date, there is no data on potential building failures but it can be anticipated that these would be large in number. The estimates are for a still water level, i.e. wave height is not incorporated. Equally important would be the damage to lifelines which would cut power, water and sewerage; road, rail and air traffic links, and thereby totally isolate the Cairns region. Full details of the analysis for Cairns should be available in the next few months.

Much of Townsville is low-lying and liable to surge but to date, to the best of my knowledge, there are no reliable estimates of the numbers of buildings at risk. However, for a low probability surge event these could likely total several thousand.

Table 9.1 LGAs reporting a surge problem, map availability and SCDO (1992) estimates of height of 1 in 500 year surge

LGA and sites listed		Map available	SCDO Surge height 1 in 500 year	
Bowen	(Queens Beach)	yes	2.6m	
Burnett	(Bundaberg Point)	yes		
Caboolture	(various locations)	yes (some locations)*		
Cairns	(City and Northern Beaches)	yes	2.5m	
Calliope	(Tannum Sands, Boyne Is.)	yes		
Caloundra	(Kawana Waters)	yes		
Cardwell	(Tully Heads, South Mission Beach)	yes	2.35m	
Carpentaria	(Karumba)	no		
Cook	(Ayton, Cooktown)	yes (simplistic)*	1.85m	
Douglas	(Port Douglas)	yes		
Gladstone		yes		
Gold Coast		no	1.45m	
Hervey Bay		yes	4.2m	
Hinchinbrook	(L. Tully)	no	3.1m	
Johnstone		yes (in part)*	2.45m	
Livingstone		yes	4.7m	
Mackay	(City and North Mackay)	yes	4.8m	
Noosa		no		
Pine Rivers		yes		
Redcliffe		yes		
Redland	(Bay Island)	no		
Sarina	(various locations)	yes	5.0m	
Thuringowa		yes (inaccurate)*		
Tiaro		no		
Townsville	(City)	yes	3.7m	

^{*}Comments as given in the questionnaire responses.

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^{+ 1} in 500 year surge height from SCDO (1992) is the still water level, i.e. no allowance for wave height, wave set-up etc. The estimate is added to the tide height predicted for the time of the surge. Given solely as an indication of relative risk.

Mackay - number of buildings at risk from inundation and failure in relation to probability of storm tide Table 9.2

	1 in 20 yr	1 in 50 yr	1 in 100 yr	1 in 1000 yr	1 in 10,000 yr	Probable maximum
TOTAL TRANSPORTED TO THE PROPERTY OF THE PROPE	4.0 m	4.70 m	5.20 m	6.60 m	7.90 m	8.50 m
Mackay residential		THE PARTY OF THE P				
No. of buildings, overground flooding	154	2879	3576	5268	6263	6531
No. with overfloor flooding	885	1877	2760	4593	5890	6256
No. of building failures	0	885	1748	3740	5299	5714
Mackay commercial No. of buildings, overground flooding	81	355	434	1040	1123	1154
No. with overfloor flooding	99	295	419	1001	1122	1150
No. of building failures	-	99	250	558	1067	1094
North Mackay residential No. of buildings, overground flooding	26	82	406	912	1104	1147
No. with overfloor flooding	2	42	207	799	1055	1112
No. of building failures	0	7	20	552	925	1055
North Mackay commercial No. of buildings, overground flooding	7	27	63	117	127	129
No. with overfloor flooding	0	26	59	117	127	129
No. of building failures	0	0	10	92	125	127
Based on ways height against	Cool with the BENA A CLOSE	(1001)				

Based on wave height assumptions given in FEMA (1986)

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It is likely that Cairns and Mackay pose the greatest threat in terms of number of buildings but comparable studies are urgently needed for other surge-prone settlements before any reliable estimate can be given as to the overall size of the problem in Queensland.

9.3.2 Gulf of Carpentaria

The quality and detail of information on the potential surge risk for the Gulf of Carpentaria is much less than for the more populous east coast. The risk is known but there is little knowledge of the magnitude, frequency and inland extent for the rarer, i.e. the low probability, events. The vulnerability of Karumba, with a resident of population of about 400, is recognised and there are established evacuation plans for the whole settlement, all of which would be inundated by even a moderate surge. Evacuation is to Normanton along 70 km of low-lying road. However, this link could easily be severed by cyclonic rains and there is a need for better designed surge refuges. Acceptable designs however, require knowledge of the height of extreme surge conditions. Further to the west, Burketown presents an equally severe risk and a number of people were drowned there by surge in 1887.

9.4 Responses to the questionnaire

Only three questions directly address the problem of storm tide.

Question 3.1 Asked '... does a storm tide problem exist?'

Question 3.2 Requests the date of the last event which caused the flooding of buildings.

Question 3.3 Enquires if a storm tide map exists.

9.4.1 Does a problem exist?

A total of 25 LGAs replied that they had a storm tide problem, in several cases this applied to several locations within their area. A list of the LGAs at risk is given in Table 9.1. This confirms that virtually all coastal LGAs in Queensland acknowledge the risk of surge. The non-respondents of Burdekin and Torres Is. are also known to have a storm tide problem. The magnitude of the risk, in terms of numbers of buildings, varies and reflects the exposure of low lying structures.

For some locations the height of likely surge events is restricted but even for these localities the indirect effects could be considerable. The Gold Coast falls in this category with the likelihood of surge having adverse effects on flood height together with the additional problem that, in some locations, it is possible that extreme surge could break through the coastal dunes and cause direct inundation.

9.4.2 Date of last damaging surge?

Some two thirds of the LGAs reporting a problem provided dates for the last surge event to inundate buildings. These are listed in Table 9.3. In four cases these were from the 1990s although for all of these the damage was relatively small. Mackay and Sarina, with catastrophic losses in 1918, have not experienced a significant surge event in the last 70 years.

9.4.3 Storm tide inundation maps?

Table 9.1 also lists whether or not LGAs have storm tide maps. Nearly three quarters (16 out of 25) report that they do, although it is significant that several of those draw attention to their limitations e.g. 'simplistic', 'only for some locations' etc. Similar reservations are also likely

to apply to others that responded that they had storm tide maps, it is suspected that in many cases they are limited to coloured-layered contour maps. Although these are of use for evacuation procedures for the emergency services, they have little scientific foundation and do not express risk in terms of frequency, i.e. they are not comparable to flood maps that show the limits of the 1 in 100 or 1 in 50 flood event.

Table 9.3 Local Governments reporting building damage from storm tides

LGA	Year of storm tide damage
Bowen	1980
Burnett	1942
Cairns	1979
Carpentaria	1976
Cook	1976
Gold Coast	1974
Hervey Bay	1992
Johnstone	1996
Mackay	1918
Maryborough	1976
Noosa	1992
Pine Rivers	1993
Sarina	1918
Thuringowa	1971
Townsville	1971

9.5 Surge in Queensland - a summary

Flooding from storm surge is a potential problem for all low lying coastal areas of northern Australia that experience tropical cyclones. In terms of urban surge risk the problem is especially significant for Queensland, a fact recognised by the majority of coastal LGAs responding to the questionnaire. However, there is a paucity of detailed information on hazard risk that is based on 'state-of-the-art' scientific methodology. Where this has recently become available, for example for Cairns and Mackay, studies have demonstrated the massive potential for damage and for loss of life. It is not possible to state with any certainty the numbers of building in Queensland that are directly at risk from extreme storm surge events but a conservative estimate would indicate a value of the order of 40-50,000.

The impact of a major storm surge on an urbanised community would result in building and infrastructure failure that is akin to that normally associated with an earthquake rather than with riverine flooding.

Only a limited range of questions concerning storm surge were included in the questionnaire. However, it is clear that more resources need to be devoted to this problem in order to assist LGAs to better define the risk. It is noticeable that much of the recent research on hazard risk and vulnerability to surge has been funded by Commonwealth agencies rather than by the State government.

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Unlike river flooding, the problem is concentrated in Queensland and therefore, there is not the same opportunity for the transfer of methodologies and experience between States. Succinctly, inundation of urban areas from storm surge is dominantly a Queensland problem.

In order to lessen further impact, better risk definition will need to be followed by the adoption of land use zoning and building regulations similar in form to those discussed for river flooding in Section 11. The implementation of such measures will not be an easy task and should ideally, be linked to changes and improvements to similar measures for river flooding. Such actions should not be delayed until their significance becomes apparent in the aftermath of the next major surge to impact upon a low lying urban coastal community. There is the need for a review of Queensland's planning and management for surge to match that underway for urban river flooding.

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The Questionnaire – A Summary

10.1 Response to the questionnaire

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This study reports on the state of urban floodplain management in Queensland and is based on a questionnaire sent all to LGAs. Responses were obtained from 103 LGAs and provided information on 133 separate locations. These do not include the flood prone creek catchments in Brisbane or those for the Gold Coast, these are discussed separately in Section 4. The majority of the non-respondents were LGAs that are unlikely to have a urban flood problem, in many cases because of their small and dispersed populations. There were difficulties in designing a questionnaire suitable for LGAs that range in population size from Brisbane City Council to areally extensive, but sparsely populated, local government areas in the west and north of the State. Despite these qualifications, the survey provides, for the first time, comprehensive State-wide data which permits comments to be made on the current state of urban floodplain management and provides a background to suggestions for State policy.

The questionnaire indicates that 92 LGAs have an urban flood problem, if non-respondents are included this becomes 96 out of a State-wide total of 125 LGAs..

10.2 Numbers of buildings at risk

The simplest, and most commonly used, indicator of size of urban flood problems is the number of buildings at risk from the 1 in 100 year flood event. Few LGAs have reliable information on the extent of such a flood and even fewer have information on the number of buildings at risk.

Based on the questionnaire, and including an allowance for non-responses, the number of urban buildings in Queensland at risk from 1 in 100 year flood event is estimated to be about 65,000. For an unknown proportion of these properties, 1 in 100 year flood inundation would not exceed building floor level.

The data are inadequate to classify the properties into separate categories, i.e. residential, commercial etc. There is some evidence that the ratio of residential to other buildings is less than in other Australian states, provisionally it could be assumed that some 25% are non-residential.

Table 3.5 provides a ranked list of the 12 most flood prone LGAs in terms of the number of buildings at risk at risk, these account for some 60 % of the State total.

The area administered by the Gold Coast has the distinction of having one of the largest number flood prone properties (dominantly residential) not only in Queensland but in Australia. The council has completed detailed assessment, including potential damage, for the Nerang catchment and has studies in progress or planned for the other catchments in its area.

It is salutary to note that, until the last year or so, there were no detailed data available for the Gold Coast on the number of properties at risk, that Charleville was not regarded as having a major flood problem until the floods of 1990, the potential magnitude of river flooding for Mackay was not known until 1994 and the size of the flood problem in Queensland was

reported to the AWRC national study, in 1990, as comprising only 25,000 properties. It is perhaps, tempting fate to suggest that as a result of the current survey that there will be no more major additions to the list of flood prone communities. However, it is thought unlikely that any major new urban centres will be added to the list given in Table 3.5.

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10.3 Extreme floods

It has been stressed throughout this report that the 1 in 100 year flood line should not be regarded as separating flood prone areas from those that are flood free. Only 1I localities had any detail of the size of the probable maximum flood, the worst case event, and of those only 8 had the information available in map form. The number of properties at risk from the probable maximum flood is much larger than for the 1 in 100 year flood and it is not impossible that the number to the limit of the probable maximum flood could be more than three times larger. Many of these additional buildings would only experience over-ground, as opposed to over-floor, flooding but the consequences for some localities is that lightweight structures at lower levels are at risk of structural failure.

10.4 Flood height range

The number of properties at risk from the 1 in 100 year event is only one indicator of flood risk, another is the flood height range which is the difference in flood depth (indicated by heights on flood gauges) between, say, the 1 in 20 and 1 in 100 year floods. There are large variations in the flood height range between localities, examples for some of the major flood prone communities are given in Table 1.1, these range from about 3m to in excess of 20m. Precise data of this kind, i.e. based on detailed hydrological studies, are uncommon in Queensland but a guide can be obtained from the levels of minor, moderate and major floods available from the Bureau of Meteorology.

High flood ranges, associated with even relatively low flood velocities, greatly increase the risk of building failure especially for lightweight structures, eg. detached single storey weatherboard dwellings. The significance of extreme floods, above the 1 in 100 year event to the level of the probable maximum flood, is especially marked for communities with a high flood range.

Table 1.1 can be used as a guide to localities where flood height range is of major concern. The situation for Ipswich, confirmed by the failure of over 30 dwellings in the 1974 flood, is the most severe example in Queensland in the last thirty years.

10.5 Flood warning systems

Much of the State, especially Brisbane and the south-east, is well provided with locally-based flood warnings, most based on ALERT installations. Quantitative flood forecasts from the Bureau of Meteorology are available for many other communities with a known urban flood risk and the situation is one of continued upgrading and extension although smaller and remote communities do not have the benefit of such services. However, the lack of basic data on what localities are flood prone has been a problem for the Bureau, all too often communities with a major urban risk have only become apparent after a major flood has occurred.

Information provided by the Bureau, and reproduced here as Appendix 5, shows that the length of the flood warning time (with the current provision of field instrumentation and techniques) is, for the majority of flood prone locations, less than 12 hours.

Such short warning times form a further indicator of flood risk. A warning time of less than 12 hours gives much less time to evacuate, reduce losses and to reduce stress and anxiety than a warning time of several days.

As is almost universally the case, improvements to flood forecasts demonstrate the need for better community response in order to more fully capture the benefits of enhanced warnings. The questionnaire responses confirm that there is scope to more fully integrate flood warnings into LGA emergency plans and flood policy. The need is now, to incorporate improved forecasts and warning times into a comprehensive flood warning system which includes better community awareness and response.

10.6 Priority listing of flood prone urban communities

The preceding sections have stressed that urban flood risk is an amalgam of the current numbers of properties at risk, the flood height range and the length of warning time that can be provided to reduce tangible and intangible losses. Hence, the three factors that together define vulnerability are:

- size of the existing problem
- flood height range

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It is not possible to rank these factors in a truly quantitative manner but qualitative guidance can be given based on an A, B, C system. This is presented in Table 10.1, where A represents a high rank for a specific factor, B is moderate and C is relatively less important. Thus, three As indicate a high priority on grounds of overall vulnerability and three Cs a much lower ranking.

The three factors provide a ranking of flood risk but do not of themselves indicate the state of information and response. For example, Brisbane has excellent hydrological background information (although currently under improvement for the main Brisbane River), local flood warning systems but relatively poor information on the buildings at risk. This handicaps measures to increase community awareness and response although it would not be a difficult matter to combine building data with existing geographical information systems. Until the last year or so, the Gold Coast (including the former Albert Shire) had only scant information on the number of properties at risk. Within a short time studies, now complete for the Nerang catchment but underway elsewhere, have completely transformed the information base. Rockhampton and Murweh (e.g. Charleville) are among the few LGAs that have close to best practice information on all aspects of vulnerability, including potential flood losses.

The ultimate test is not restricted to the availability of a full information on vulnerability but its use to formulate acceptable locally based urban floodplain management. Such management requires full data on vulnerability but such availability does not guarantee its use to establish acceptable local policy.

Table 10.1 is limited to communities that are known to have a relatively large number of buildings already at risk from flooding. There are many more small communities which would likely have a high ranking of vulnerability in terms of flood height range and flood warning time. The need here, as with those listed in Table 10.1, is for background studies in order that future developments do not increase future flood risk.

Table 10.1 A ranking of the vulnerability of major flood prone communities in Queensland

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LGA and location	Number of buildings	Flood height range	Effective warning time
Gold Coast	A	С	A
Mackay	A	В	A
Brisbane Brisbane River	A	В	В
Creeks	A	В	В
Dalby	A	A	A
Ipswich	A	A	A
Hinchinbrook (Ingham)	A	В	A
Logan Logan River Creeks	A	ВВ	B A
Murweh Charleville Augathella	B C	B B	B A
Rockhampton	В	С	C
Burdekin	В	В	В
Cairns (inc. Mulgrave)	В	С	A
Caboolture	В	?B	A
Blackall	С	В	A
Gympie	?C	A	В
Johnstone (Innisfail)	В	С	A
Balonne	С	С	A
Gulf Rivers (Normanton)	С	A	С

It needs to be stressed that some of the major flood prone communities were close to green field sites at the time of the extensive floods in 1974. It is not possible from the present information base to give any firm data on the increase in the size of the problem over the last twenty years or so but there is no doubt that it has been significant. The Gold Coast is a prime example of this but undoubtedly the expansion of developments, many of which are dominantly residential, into flood prone sites has been a State-wide phenomenon.

10.7 Background studies in hydrology and mitigation

The survey results show that hydrological studies are available for only some 40% of flood prone urban localities; note that 'localities' are sub-sets of local government areas. However, what is meant by 'hydrological studies' and the purposes to which they are put are quite different questions. It would appear that only 28 localities have used this information as a basis on which to define a designated flood that is at the level of 1 the 100 year flood (or better). A disturbingly large number of the major flood prone communities do not have a designated flood to an accepted level.

Hydrological studies are necessary to define hazard risk and the next step along the path to effective floodplain management is to investigate the potential flood damage to existing developments. This has only been undertaken by for 11 localities, see Table 5.2 for detail. Again many high priority flood vulnerable locations do not fall into this group.

Only 35 responses to the questionnaire reported that there is a 'flood policy' in place. The number of councils that have a policy for urban flooding is unacceptably small and often, where such a policy exists, the information on which it is based is inadequate.

10.8 The use of mitigation measures

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Mitigation measures are divided into structural and non-structural, the detailed responses are described in Section 5.8. Only 29 localities reported that they used structural measures. Levees are used at 13 of these although few are extensive systems designed to protect larger urban flood prone communities to the level of the 1 in 100 year event. The use of other structural measures is limited to a small number of localities. For example, dams utilised for flood control are few and in all cases are restricted to locations downstream of dams developed primarily as water resource storage's; although for Brisbane, and to a lesser extent Townsville and the Nerang catchment, they have significantly reduced future flood losses especially for minor and moderate flood events. Their smaller equivalent, flood retention basins, are rarely used to reduce the adverse effects of mainstream flooding although they are more widely used to mitigate the effects of flooding associated with stormwater drainage..

It is especially noteworthy that flood proofing, especially the raising of weatherboard dwellings, located in flood prone locations, is rarely reported and there are no reports of the flood proofing of other types of building. Channel improvements are another example of a structural measure used on a local basis although these have been used more extensively and to good effect in some of the smaller developed Brisbane Creek catchments. Voluntary acquisition of dwellings in especially hazardous locations is rarely used.

The relatively low rate of adoption of structural measures for existing flood prone developments is not necessarily an indication of poor floodplain management. Indeed, the construction of major levee systems and other structural works can have adverse implications for community awareness and behaviour and create problems for emergency management. It is probable, however, that the relative paucity of such mitigation measures in Queensland more likely reflects problems with low level State funding to assist LGAs to construct, what are often, expensive works.

Nonstructural measures, usually involving the use of land use controls and building regulations within the area delimited by the designated flood, are reported as used at some 66 locations. Some 36 of these combine land use and building controls measures although many of these lack essential hydrological information.

The use of fill, to elevate habitable floor levels above the level of the designated flood, is widely used throughout Queensland, to a much greater extent than elsewhere in Australia. For such techniques to be effective it is essential that the impact of cumulative fill decisions on flood levels is fully known. It is suspected that often this is not the case and that the widespread use of fill for new developments is not consistent with sound urban floodplain management. It is certainly necessary to carefully control the afflux effects especially when a catchment extends across a number of LGAs.

Despite the use locally of a range of mitigation measures there is scope for the experience of LGAs who have used such individual measures to share their experiences with others who

have not. This applies especially to structural mitigation. It would invaluable if examples of the successful (and even the unsuccessful) use of such measures could be used as illustrative examples in a State manual designed for use by LGAs throughout Queensland. Relative to urban floodplain management in New South Wales, the adoption rate of structural and nonstructural mitigation measures is low.

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10.9 Summary

The details of the individual responses to the questionnaire are given in Appendix 1, and an analysis of the overall pattern for the State in the preceding sections. The responses to the questionnaire have enabled a much fuller account to be presented of the urban flood problem than was previously possible. Caution is urged in placing undue weight on individual responses but the overall pattern provides a valuable background against which to assess the problem of urban floodplain management in Queensland and a basis upon which to recommend future improvements.

There is no doubt that increased contact between elected representatives and professional staff of councils, with and without adequate floodplain management policies, would lead to the sharing of information and experience. Such meetings of councils with urban flood problems have been held annually in New South Wales for over thirty years and, it is suggested, would be invaluable in Queensland

Towards Better Urban Floodplain Management

11.1 Effective floodplain management – the steps

The steps necessary to provide the information integral to effective urban floodplain management have been stressed throughout this report. In summary they are:

i. hydrological studies

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- ii. analysis of what is at risk-combined with hydrology to give vulnerability.
- iii. decision on the appropriate designated flood
- iv. flood management plans for:
- v. new developments
- vi. residual flood risk
- vii. existing flood prone developments
- viii.adoption of measures into local planning regulations.

11.1.1 Steps (i) & (ii) - hydrological and risk assessment studies

'Flood studies' incorporate the first two steps in the process. The hydrological studies define the flood hazard risk, they should use the best available modelling techniques and use all available information on historic floods. The studies should include data on all floods to the level of the probable maximum flood and information on over-floodplain velocities especially for the more extreme events.

Once the hazard is so defined, a survey should be undertaken of all buildings (and ideally infrastructure) that is at risk, this should include all buildings, residential, commercial/industrial etc. Information to be gathered should include ground and floor heights, type of construction and, for the commercial/industrial, size, use and estimates of liability to flood loss. Stage-damage curves should be constructed or obtained for each of the major building classes recognised in the field survey. Guidance to the detail is given, for example, in the ANUFLOOD manuals.

The output can be combined with geographical information systems (GIS). This forms an excellent method for storage and, for many LGAs, can be linked into GIS for other information available for the area. GIS methodology also allows for rapid appraisal of the effects of floods of differing magnitude and frequency.

The flood hydrology and what is at risk (buildings etc), are then combined to give estimates of all forms of flood damage for a range of flood events. Such analysis forms the basis for the adoption of the designated flood level. Background to damage estimation is given in Section 8.

11.1.2 Step (iii) - the designated flood

Decisions on the choice of the designated flood are the key to successful urban floodplain management, this is because the designated flood determines where future developments will be located. Worldwide the tendency has been, regardless of local circumstances, to select the 1 in 100 year flood as the designated flood. There is no scientific or economic basis for a universal selection of this kind. Throughout this report it has been stressed that the flood risk is dependant on local circumstances of which flood height range is especially significant.

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Decisions of the designated flood should, be made at the local level and consider all aspects of the flood background; hydrological, socio-economic and safety factors. For some flood prone locations the 1 in 100 year flood would form a sensible choice for the designated flood, for others it would not. In some instances, i.e. where there is a high flood range, a level approaching the 1 in 50 year is likely to be a better choice. For others, say with a lower flood range and low velocity flood flows, it could be closer to the 1 in 200 year event.

Because of the overwhelming importance of local factors and the costs and benefits of the choice of the designated flood, the local community should play a major role in the discussion. However, the decision should be made within floodplain guidelines decided by the State government. There is a case to be made that final approval for local plans should be at State level, if only to ensure that the decision has been made on the basis of best practice analysis from the flood studies.

If LGAs are reluctant or slow to comply with State guidelines, there is the option of superimposing an interim designated flood. Reluctantly, it is suggested that this could be the 1 in 100 year event although even in that case the imposition of a more severe standard for locations with a high risk should be considered.

The role given to the State government is, in part, because it is responsible for relatively large proportions of flood relief payments and for the safety of its citizens. To attain these aims, which will be considered in more detail below, the State government also has responsibility for assistance with funding the studies and mitigation measures.

11.1.3 Step (iv) - flood management plans

New developments

Once the selection of the designated flood has been made, the next step is to consider the regulations that apply to new developments. These will be based on land use zoning and building controls within the area delimited by the designated flood. They may vary from no new construction whatsoever, to controls on habitable flood levels with the possibility of different controls for different uses, eg. restricted residential but allowable commercial and industrial development. Again much will depend on the local flood hydrology. At this stage the possibility of building failure due to extreme floods may require the definition of subzones for land use and building controls. For example, especially vulnerable uses (hospitals, emergency service facilities, homes for the elderly etc) may require additional limitations on siting. It is also import to consider the location of flood free evacuation routes and available flood warning times. Locations that could become 'islands' at times of flooding need special attention.

Residual flood risk

A major problem for the formulation of flood policy for urban areas is that there are usually existing flood prone developments, often extensive, located below the level of the designated

flood. Such development frequently forms the major barrier to policy formulation. The problems are several. First, whether or not to provide mitigation measures and secondly, to agree policy for future re-development of existing buildings. Stakeholders representing existing flood prone developments will normally press for structural solutions to reduce their flood risk. Such measures are often expensive and beyond the ability of the LGA to fund and rarely produce a complete solution, i.e. most structural measures retain a residual flood risk. For some locations the upgrading of flood warning systems provides a partial response. The problem is that those at risk are reluctant to pay for the reduction of their risk, those with no risk feel equally strongly that they should not be required to contribute to the costs.

Clearly, there is no easy solution to this problem. It can be said however, that local community debate aided by clear and accessible information on the costs and benefits should be encouraged prior to a decision.

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This is of major concern to the emergency services and is an aspect of flood management that is often ignored or poorly handled. First, it is essential that the community is aware that any designated flood (apart from the probable maximum flood!) leaves a residual risk of flooding. Second, that any structural mitigation measure carries with it the risk of exceedance of the design criteria (often the designated flood) or of structural failure. It should be recognised that any structural solution needs to be accompanied by a corresponding emergency plan and that the costs of the emergency measures should be included in the overall costs and benefits.

If the flood study data are incorporated into a GIS, this offers an excellent way of demonstrating the extent and costs of the residual flood problem. A key to the reduction of the effects of residual risk is the availability, or installation, of a flood warning system which should incorporate a well formulated program for community awareness and response.

A simple and inexpensive method to improve awareness and response is the installation a series of flood markers throughout the flood prone areas. These should show the level of the flood of record and also repeat the heights given on the town's flood gauge. This is critical to give meaning to flood forecasts for the residents of the flood prone area. However, in Queensland and elsewhere such simple methods are rarely implemented because of concern of the possible adverse effect on property values. Such flood markers should be obligatory in local and State policy.

11.1.4 Step (v) – implementing a local flood policy

The final step is to implement the local flood policy and to incorporate the designated flood, land use zoning and building controls into the local planning scheme. It would appear from the questionnaire, and in Smith et al (1996), that State planning legislation to allow for effective local planning is confused. If this is the case, and discussions with many Queensland officials confirm that it is, it is necessary to clarify, and perhaps change, the situation. Without such clarification, the implementation of best practice management at LGA level will be jeopardised.

11.2 Background to hazard policy

It can be argued that relationships between national, state and local governments for hazards differ in style to those of other inter-governmental interactions. The higher tiers of government tend to place a greater emphasis on matters of safety and are concerned to establish best practice procedures for hazard management at local level. To this end they are willing, to a degree, to provide assistance to achieve these aims. Such assistance is usually

tied to the lowest tier, local government, adopting planning measures to reduce the risk. In addition to assistance for mitigation and funding emergency procedures, higher tiers of government assist with relief aid in the aftermath of a disaster.

The perception from local government is somewhat different. Frequently local government, which is directly responsible to the local community, perceive attempts to impose planning controls from above as unwarranted interference that is counter to local development. The community, all too often, regard the occurrence of a damaging disaster to be that of a very low risk which can be ignored. When the rare event occurs there are commonly two responses:

- requests for assistance to recover from the event;
- the search for a scapegoat, for example the council '... gave us permission to built here without telling us it was hazard prone'.

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This outline of the problems of hazard management and governance is not unique to flooding, to Queensland or to Australia but is common among developed nations regardless of hazard. It is for example, a major on-going problem for planning and building regulations for earthquake risk in the USA. A detailed recent account of the problem, using flood hazard as an example, is available in *Environmental Management and Governance-Inter-governmental Approaches to Hazards and Sustainability*, (May et al., 1996). This presents international comparisons between New Zealand, New South Wales and the USA.

11.2.1 Policy responses

The study by May et al. (1996) describes the public policy options available to governments for hazard management as a representing a spectrum from coercive to cooperative approaches.

Coercive policies, as used in for example Florida, are at one extreme and marked by the State government setting rigid rules and timetables to which local governments must comply. Local flood plans, follow a pattern determined by the State, and are required to be submitted by a set date. Non-compliance results in severe fines and reductions in State contributions to a range of services. It needs to be added that there is State assistance for the production of such plans and the possibility of assistance with funds for any subsequent approved mitigation measure.

At the other extreme, a co-operative approach, the State provides flood planning guidelines but leaves local government to decide on local policy within a broad framework. Again funding from the State is required for success.

11.2.2 Lessons from New South Wales

New South Wales was used in May et al. (1996) as a detailed case study and a lengthy questionnaire was completed by some 100 LGAs to provide background data. Prior to the mid-1980s New South Wales government had, for some ten years, followed a flood policy that had many elements of a coercive approach. LGAs were required to use the 1 in 100 year event as the designated flood, if they did not they were legally liable for any flood damages suffered by those to whom they gave planning approval. This policy was accompanied by the production, by State agencies, of some 70 high quality flood maps for many of the flood prone urban communities. In 1984 community concern over provisional flood maps on display for public comment for Fairfield (an inner Sydney council) at the time of a State election resulted in a major shift in policy. This event acted as a focus for widespread dissatisfaction with the coercive policy by councils statewide. In 1985 the draft of the New

South Wales flood manual was released (NSW PWD, 1986) and a new 'merits based' policy introduced.

The 'merits based' policy can be regarded as representing a cooperative approach, it has remained in force ever since. LGAs were encouraged to establish community floodplain committees to oversee the steps outlined in the preceding section of this report. Overall, the policy has met with favour from LGAs and a large number of flood prone communities have now progressed to the stage where their decisions are formalised into local planning schemes. Interestingly, virtually every LGA selected the 1 in 100 year as the designated flood, a decision that they violently opposed under a coercive policy. This is in spite of advice from State agencies to consider alternative definitions.

A unique feature of the New South Wales approach is that if LGAs follow the guidelines given in the flood manual that the council and its staff are exempted, in legislation, from future action over duty of care for flooding decisions. This was welcomed by LGAs and undoubtedly played a major role in the favourable response of LGAs to the post-1985 cooperative policy.

It is again necessary to state very clearly that the New South Wales government has been prepared, over many years, to make available financial and technical assistance to flood prone LGAs. In the early 1990s the State contribution was of the order of \$10 m annually, matched by a similar sum from the Commonwealth, LGAs in general contributed 20% of the costs. This applied to funding for flood studies and to the cost of structural measures, all of the latter were required to show a favourable cost benefit ratio based on rigorous analysis of the damage costs which were available from the flood studies. Assistance from the State government has also included analysis of flood hydrology and other technical advice on a range of flood related issues. To these ends permanent, well-staffed, well-qualified and resourced units devoted to flood management have been maintained at State level for well over twenty years.

Overall, the cooperative flood policy followed in New South Wales can be counted as a success. Precise data are not available but the rate of increase of developments in flood prone areas is very small and the potential for damage to existing flood prone developments has been reduced. The only problem with a fully cooperative approach is that LGAs, if they so wish, need not participate. Such a decision however, means that funding for mitigation measures is not available and they still face possible liability under duty of care.

11.2.3 Commonwealth assistance

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For many years the Commonwealth provided assistance on a 40:40:20 basis (Commonwealth, State, local) funding basis for approved schemes for flood studies and mitigation. This was originally part of the Federal Water Resources Assistance Program (FWRAP) and, later, the flood component was administered by the National Landcare Program. Queensland did not participate, in any major way, in this process as the State lacked information on which to promote claims for assistance.

The Commonwealth, in partnership with the States, separately contributes to flood relief under the long established Natural Disaster Relief Arrangements (NDRA). The assistance is mainly to LGAs to repair infrastructure losses (mainly related to the transport network) and for assistance with personal hardship and distress. Relief of this kind was not linked to programs to improve floodplain management and to reduce flood losses. In mid-1996 the Commonwealth indicated that in future the provision of NDRA relief payments (except for personal hardship) would require evidence of policies and management to reduce future loses.

It is important to note that, over recent years, the contributions of the Commonwealth to the NDRA, relative to those of the States, have been progressively reduced. Thus, it is surprising that State Treasuries have not also pressed for planning to reduce future losses and thereby, State flood relief payments. Without the wider adoption of urban floodplain management in Queensland such payments will continue to escalate and as mitigation measures are usually founded in favourable cost benefit ratios it would be in the State's interest to take such steps to lessen future outlays on flood relief.

11.3 The Queensland Government and LGA floodplain management

In the Australian context the adoption of fully coercive policies, as described from the USA, are not considered as a viable strategy. A cooperative model, similar to that employed in New South Wales for over ten years, offers an alternative. However, for this to be successful it would be necessary for the State government to contribute both in terms of direct funding and with technical advice. Unfortunately changes in Commonwealth funding for assistance with studies and mitigation have declined and it can be expected that this trend will continue.

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The expenditures in New South Wales have been large, however much of the outlay was for structural measures to protect existing flood prone developments. This was important to the stick and carrot approach which required the adoption of, and compliance to, land use controls consistent with the choice of a suitable designated flood and thereby, for indemnity from duty of care. The carrot was often in the form of structural mitigation for existing flood prone developments. It could be that the Queensland government could achieve these aims but lessen the expenditure by restricting the use of structural measures.

The need in Queensland is for a cooperative, locally based approach but combined with technical advice, the input of funding (especially for assistance with flood studies), and a limited degree of coercion from State government.

11.3.1 Technical assistance

A major contribution would be for State agencies to produce and publish a Queensland-based manual to acceptable flood management practice. This could include information that is not presented in detail in the New South Wales equivalent. For example, appendices that deal with building methods and flood materials compatible with developments in flood prone locations. Another example, would be guidance to flood proofing, especially that concerned with house raising and for commercial premises. Flood proofing has the advantage that it can be undertaken by individual building owners and a subsidy contribution towards such mitigation may be considered appropriate. Assistance with the analysis of hydrological and rainfall records and rainfall/runoff modelling methods would also be helpful to many LGAs. Queensland has a good exemplar with the Queensland urban drainage manual (QDPI, 1992). Such a manual and appendices could usefully incorporate examples of mitigation measures already used by some LGAs within the State.

The recommendation is to produce a Queensland-based manual for use by local government to give guidance on all aspects of best practice floodplain management. Such a manual should also give guidance to the planning legislation in order that local floodplain management could be fully integrated into the State's overall planning policy.

11.3.2 Funding

The allocation of funding is clearly a decision for the State government but without improved funding the costs to governments, at all levels, and to individual citizens of permitting

developments in flood prone locations will continue to escalate. The linking of flood relief to the adoption of acceptable floodplain management, as prompted by the Commonwealth, should be reinforced at State level.

It is unrealistic, whatever policy stance is adopted, to expect that the total costs of flood studies and mitigation, essential to attain best practice floodplain management, can be borne by LGAs alone.

11.3.3 Duty of care

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It is not the aim of this study to persecute LGAs for not pursing acceptable floodplain management, but there remains the legal responsibilities under duty of care. It is thought that such concern has played a major part on prompting a number of LGAs in Queensland to adopt good quality urban floodplain management. The problem is why this does not apply to others?

It is likely that a clear statement on the legal liability for decisions to allow building in flood prone areas would lead to improved floodplain management. Indemnity for such liability for LGAs following acceptable procedures, is a strategy that has much to commend it.

There is little doubt that a local policy that gives as a defence for no action, 'we had no information on liability to flooding' is not acceptable either morally or legally.

11.4 Summary

Urban floodplain management in Queensland is below the standard that could be expected for the State with the largest urban flood problem in Australia. Improvements will require financial and resource outlays by both State and local governments although the benefits of these to the avoidance of losses from poorly sited future developments would outweigh the costs in the medium to long term. State assistance will certainly be necessary for those LGAs with small populations and rate base. The wider use of differential rating by LGAs, although unpopular, could lead to those who benefit from mitigation contributing to the costs.

It is to be hoped that improvements to floodplain management, and to related planning for storm surge, are not delayed so that action is only taken after the occurrence of a major disaster with extensive damage and loss of life. It is the responsibility of governments at all levels to ensure that this does not happen.

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Responses to the Questionnaire

A spreadsheet comprising the replies to all questions for all localities was prepared. A copy of this, together with the original returned questionnaire forms, is held by the Department of Natural Resources in Brisbane.

Appendix 1 is a modified version of the full spreadsheet. Information on contact names etc. has been omitted and manuscript comments have also been removed.

For some questions the number of replies may not tally exactly with those given in the text, this often reflects the extra information given in manuscript form.

All questionnaire returns are listed in this appendix, i.e., including those that did not have an urban flood problem as defined in the study. The latter are listed separately at the end of the alphabetical LGA listing of those judged to meet the definition.

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Banana Shire	Baralabe and the control of the cont	Contract - conjugate contract the scattering of			The same of the sa			COM IN ADMINISTRATION TO ANALYSIS AND ANALYSIS ANALYSIS AND ANALYSIS ANALYSIS AND ANALYSIS ANALYSIS AND ANALYSIS ANALYSIS AND ANALYSIS ANALYSIS AND ANALYSIS ANALYSIS AND ANALYSIS ANALYSIS AND ANALYSIS ANALYSIS AND ANALYSIS AND ANALYSIS AND ANALYSIS AND ANALYSIS AND ANALYSIS AND ANALYSIS ANALYSIS AND ANA	yes	
Banana Shire	Biloela			1.1. n A ma					ОП	expected water resources commission to keep data
Banana Shire	Moura	e distribute de la companya del companya del companya de la compan	discovered and account of the contract of the	and hid district sand district	Albert - Art - mann - specification drap & at manner of	and a contract of many or on the contract of	er	Conference and Confer	yes	Make A filtra index of the contract of the con
Banana Shire	Theodore	BOOKEN, who is designed by an electrical determination				and the state of t	energy Namespira voluni for and node administrate above for , deforthermorphished and confidential and administration designs	The state of the s	yes	TOTAL THE WATER AND THE WATER
Barcaldine Shire	Barcaldine	0	6	(C)	þ	<u> </u>	ender visit statement and various and and various and	2 days	yes	THE TRANSPORT CONTRACTOR OF THE TRANSPORT OF THE TRANSPOR
Barcoo Shire	Jundah	P	9	9	9		abendrossa pipakai (1900 pri pakai) padapai dapai dapai dapai kan kan dapai dapai dapai dapai dapai dapai dapai	72	numer and the No.	And Mental construction is an annual management and annual management of the control confidence and annual control con
Barcoo Shire	Stonehenge	P	6	q	П	D	gamovanių aukydy Vimovano sąkritydys, dyspoliti opiskitymininganių, ydvajoviningodinių. Tripodyja		ПО	and a second form of an ender one measurement statement and second secon
Barcoo Shire	Windorah	P	В	4	0	q			non-commence from non-commence commence	and the company of th
Beaudesert Shire	Northern area of shire	P	O		TO .	Q		1-2 days	yes	The state of the s
Biggenden Shire	Biggenden	D	O	A September 1 sept	The second secon	<u>a</u>	To the work difference of the contract of the	12 hours		uncommon event
Blackall Shire	Blackall	υ	Q	rs	p	q	Ambulance centre & fire station innundated	72	yes	The state of the s
Boonah Shire	Boonah	P		a	Ф	. ca	the coloring are a data continued appropriation of operations assessed the purple of the first of the first of the first operations are also assessed that the first operation are also assessed to the first operation and the first operation are also assessed to the first operation and the first operation are also assessed to the first operation and the first operation are also assessed to the first operation and the first operation are also assessed to the first operation and the first operation are also as a first operation and the first operation are also as a first operation and the first operation are also as a first operation and the first operation are also as a first operation and the first operation are also as a first operation and the first operation are also as a first operation and the first operation are also as a first operation and the first operation are also as a first operation and the first operation are also as a first operation and the first operation are also as a first operation and the first operation are also as a first operation and the first operation are also as a first operation and the first operation are also as a first operation and the first operation are also as a first operation are also as a first operation and the first operation are also as a first operation and the first operation are also as a first operation and the first operation are also as a first operation and the first operation are also as a first operation and the first operation are also as a first operation and the first operation are also as a first operation and the first operation are also as a first operation and the first operation are also as a first operation and the first operation are also as a first operation are also as a first operation and the first operation are also as a first operation and the first operation are also as a first operation and the first operation are also as a first operation and the first operation are also as a first operation and the first operation are also as a first operatio	6hrs	OU	The state of the s
Booringa Shire	Mitchell	d	(T)	Q	q	٩	the state of the s	4 hours	О Г	no-one bothered to record it
Bowen Shire	Bowen/ Queens Beach	U	Q	P	r.	٩		12 hrs	yes	and the state of t
Brisbane.City	Main Brisbane River	æ	ď	٥	٩	q		48 hours	yes	The second secon
Bulloo Shire	Thargomindah	P	O	ro	q	q			yes	The state of the s
Bundaberg City	Bundaberg	þ	6	-	_	STANDONNESS TO STANDON	Administration of the Company of the		yes	The control of the co
Burnett Shire	Burnett Heads/ Bundaberg Port	ō	U	ď				77 36 - should	yes	
Caboolture Shire	Веасительный	P	O	В	n	В	A CONTRACTOR AND A CONT	18 hours	yes	TO THE PARTY WAS A STANDARD AND A ST
Caboolture Shire	Bellara	D	O	ญ	Ø	æ	# No - N - Foot 10 10 10 10 10 10 10 1	managagan sa ayan da s	yes	ris de St. House
Caboolture Shire	Burpengary	О	O	n	Б	В		6 hours	yes	
Caboolture Shire	Caboolture	O	a	o.	ro.	a	meste nie geleigen steegteistet om ondersteelingspromingspropring is demographysisch in Erzycholistensproming Teleforen in des der demographysische der demographysische demographysche demographysische demographysische demographysische demograph	12 hours	· yes	
Caboolture Shire	Deception Bay	P	υ	ď	PP (0) A *	æ	-	energy (Ageling Labor)	yes	Market Management
Caboolture Shire	Donnybrook	ď	υ	n	And the second s	В			yes	
Caboolture Shire	Toorbul	v	U	n n		CO .		values ye. sy	yes	and the second s
Caboolture Shire	Woodford	ס	0		A	<u>américa reministration</u>	entregen entre cette cette construinten mennetten channellen im entresa kenn ministern om	12 hours	yes	The second of th

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Armos Chim	A	6-0	4.4	5.6	9-0	5-7	5-8	5-9	5-10	5-11
THE STEEL STREET PROPERTY OF THE STREET, STREE	AIAIIAC	THE CONTRACTOR AND THE CONTRACTOR OF THE CONTRACTOR OF THE PROPERTY OF THE CONTRACTOR OF THE CONTRACTO	yes	Commission of a second statement of second community of second com	mo j	2.0 ш	10 mm	19-4-97	<u>Б</u>	æ
Aurukun Shire	Urukun		2		~				2	
Balonne Shire	Bollon		yes	menorania destructivas de la destructivas de la destructiva della	A for some or a company of the property of the property of the company of the com	2 20 valida in - wayarmaniyadayi i Yibahan ah isinanca	The second of th	\$ *** * * * * * * * * * * * * * * * * *		
Balonne Shire	Dirraband	DNR	yes	na na statis neft s zamponenský nakon krije plopositi kal s žepský. Beslodský hadanský	A Mathematica Contraction of the property of the contraction of the co	the state of the s	the first the second se			-
Balonne Shire	Hebel		잍	Co Children describe deprise abhardes services	the state of the s		The second secon			
Balonne Shire	St George	reference	yes	and a second of the contract o	American state of the second state of the seco				: : :	· 103
Balonne Shire	Thallon	Company of the control of the contro	yes	modern came as being the state of the state	The second secon	The second of the same of the	and the same of the appropriate production of the same of the	Andreas of the state of the sta	•	
Banana Shire	Baralaba	town planning	yes	de la region de la marchadologica de la companya de	desired a construction of a construction (facility)	The second secon	A Company of the Comp		و	interviews
Banana Shire	Biloela		2			1			, <u>2</u>	interviews
Banana Shire	Moura	The state of the contract of the state of th	yes	NATIONAL CONTRACTOR OF THE SERVICE AND ASSESSMENT OF THE SERVICE O	And the second s	A state of the sta	And in the Control of	emprove emperatural training to the contract of the contract o		
Banana Shire	Theodore	town planning	yes	The second property of	christman der return colores as ex-remain and constraints.	Commence of the commence of th	Towns a grant transportation of the state of		yes	p'q
Barcaldine Shire	Barcaldine	disaster plan	no	Andrew of American Statement of Statement of the Statement of the Statement of Stat	Optima Conditionalitys (Constitution)	The Control of the Co	Transparation and make the property of the state of the s	elfortestera e transcrioren era en	yes	q
Barcoo Shire	Jundah	THE THE PROPERTY AND THE	yes	46 years	шо	3.0 m	8.46 m	1/6/1955	no no	o
Barcoo Shire	Stonehenge	The development of the control of th	yes	26 years	0,0 m	2.0 m	6.88 m	31/1/1974	ПО	The state of the s
Barcoo Shire	Windorah		2	The state of the s	Andrewson of confirmational confirmation on	The state of the s	A LANGE AND THE PARTY OF THE PA	The charge of the company of the com	00	A 3
Beaudesert Shire	Northern area of shire	subdivision & building applications, strategic plan	yes	Element (Fare - 1 1 Martin and Article of Control of C			Comments of references and the second	The state of the s	ПО	p'c
Biggenden Shire	Biggenden	VAC (B) NAN-André Védef-A, penamo conderno, cedes que a ganaj er concepta a gapa hapa do la principal de presenta de contra de	2	The state of the s	and also refer to the control of the			A Commission of the contract o	00	A
Blackall Shire	Biackail	Flood prediction and monitoring, flood mitigation	yes	A CONTROL AND A	voj. mpo v v jedjana je mpoj mpoj. v v jedva mpova kolonovjevo pospana na	The same of the sa	7.30 m	20/4/90	yes	q
Boonah Shire	Boonah	The second secon	yes	Andrew or market a makembar to calculate to calculate the second to calculate the second to calculate the calculat			to the state of th		OU	В
Booringa Shire	Mitchell	The control of the co	yes		ШO	8.28 m	8.28 m	1990	ПО	С
Bowen Shire	Bowen/ Queens Beach	planning, flood warnings and predictions	yes	40	0 m	5.5 m	The annual country of the country of	the control of the co	yes	P
Brisbane City	Main Brisbane River	calibration of flood models, setting min. development levels.	yes	156 years	me.0-	5 m (fower other locations)	5,44 m	Feb.1893	yes	: p'q
Bulloo Shire	Thargomindah		yes	30 years	2ш	3.94 m	6,78 m	9-1-1974	yes	9
Bundaberg City	Bundaberg	The state of the s	yes	The state of the s	The second secon		Andrews Popular and Andrews an	· · · · · · · · · · · · · · · · · · ·	yes	Ú
Burnett Shire	Burnett Heads/ Bundaberg Port	predicting flood profiles	and the	Yok man		re nome to			2	
Caboolture Shire	Beachmere	flood studies	00	AMERICAN TO THE PARTY OF THE PA	e y poprava u v entre e versión e valenda de versión de	Andrew Commence of the Commenc	Considers administration of the Control of the Cont	Additional conference was a second of the se	yes	0
	Bellara	inundation maps	2	T AND			AND THE PROPERTY OF THE PROPERTY AND ADDRESS OF THE PROPERTY O	The same assessment of the same as the sam	2	
Caboolture Shire	Burpengary	flood studies	10	The state of the s	and another property and an annual property for the first property of the foreign of the first property of the foreign of the first property of the foreign of the foreign of the first property of the foreign of the first property of the foreign of the foreign of the first property of the foreign of the first property of the foreign of the first property of the first prope	And the state of t	Terretimates a cipatanea manapenatempte periodo del distillo del deladornos		yes	C
Caboolture Shire	Caboolture	flood studies and mapping	2			e de Andre		The state of the s	yes	C
Caboolture Shire	Deception Bay	not used	2	· delament					no	The mark to the Property and the second
Caboolture Shire	Donnybrook	not used	ᅃ	e gelde i de elektrich de demonstration anderschaft de leide en de elektrich de des en de elektrich de demonstration anderschaft de leide elektrich de des elektrich de des elektrich de de elektrich de des elektrich de de elektrich de de elektrich de el	is to difference a cite of elements resuggiared approximation of elements.		A se se se se encontrator e servicio de la contrata del la contrata de la contrata del la contrata de la contrata del la contrata de la contrata de la contrata del l	the state of the s	ОП	A see seems to their decimand to the
Caboolture Shire	Toorbul	not used	2	nn (1) (a)darabbh euser					01	And the state of t
Caboolture Shire	Woodford	inundation maps	2		Principal de la companya del companya de la companya de la companya del companya de la companya del la companya del la companya de la companya del la companya de la companya del la companya	Commence and the commen	Above a ser was an experience of the party of the series o	The state of the s	yes	p

:						Flood			Properties	~~;		∢	APPENDIX 1	IX 1
Local Government	Town/Community	6-1	6-2	6-3	6-4	6-5	9-9	2-9	8-9	6-9	6-10	6-11	6-12	6-13
Aramac Shire	Aramac	ou ,		2	2		andre					r-attur		
Aurukun Shire	Urukun	DO	The second secon			monotonical designation of the second property of the second propert							Andrews and the second second	
Balonne Shire	Bollon	OU .	and the second applications of the second		Control of Authority Control of Parts	ying diplace of the filter of the best of the filter of th		Company of the Compan	A CANADA ANTONIA DE LA MANTINA ANTONIA DE COMENTA CO.	Paramon .	Could of their forwards footbounders govern	parties commented a second reference	or semiodoles semio, que	character for the feet of
Balonne Shire	Dirrabandi						A Victoria de Companyo de Comp	and a second	e () () paragrap (m.) () () () () () () () () ()		artina A.V. reference or commence of the comme	***************************************	A CONTRACTOR OF THE CONTRACTOR	Control Manager Company
Balonne Shire	Hebel	DNR	The state of the s		American complete the control of the	anjo dinamanganjanganganganganganganganganganganganganga		-	den den digita de segundo des de segundo de segundo de desendo de segundo de desendo de segundo de segundo des	-	-		And the control of th	Management description of the Advanced
Balonne Shire	St George	yes (DNR)		yes	***************************************	Попе	-		***************************************	***************************************		Called to the second at land, and an examination	de la companya de la	Andreas of Laboratory
Balonne Shire	Thallon	DNR		on the control of the	O CONTRACTOR OF THE PARTY OF TH	· decreases repullings i male Adress V FreishAdor.	Control will work the second s	The state of the s	A description of the second se	***************************************	bedressedammentensky despektyte	A separate management of the contraction of the con	Aspertation of the resource	COLUMN IN CONTROL CONT
Banana Shire	Baralaba	no	The state of the s	-		in a falle by some broken banding some someone and a supple sup-			A Charles and Commence of Comm		-	Trible DAA - white place - makes the control of the	The second second second second	Administration and a character of
Banana Shire	Biloela	<u>Б</u>		2	2	And de la contraction of the con	The same of the sa		and the same of th	The same of the sa	-			1
Banana Shire	Moura	TO Proposition of definition persons to resting which is defined by the second of the	A CANADA MANAGA			for any desired and another measurement of the following states of the special states of	THE STATE OF	cathor to mental addition	to the the section of	Andrew Company of the	A contract of the Analysis of Spine	: : : :	L	
Banana Shire	Theodore	ПО	medical control of the control of th	1	\$ 1	The state of the s				Water to the state of the state				
Barcaldine Shire	Barcaldine	OU .			and the second second	to a management of the control of th	The state of the s		What is a life out the said of manifolds.	To the same of the	minimum com er com manifestaria	in the second of the second of		
Barcoo Shire	Jundah	00	a de la companya de l					<u>.</u>				1 · · · · · · · · · · · · · · · · · · ·		
Barcoo Shire	Stonehenge		And the control of th		*	College Colleg	1							1.
Barcoo Shire	Windorah	DO	The state of the s			And the second control of the second control			and depart of the second second second	A remarks described and a second				:
Beaudesert Shire	Northern area of shire	yes	1974 flooding	00	no n	1 in 50, 100, highest known	92	4	38	4	I manadamini,	E CONTRACTOR OF THE PROPERTY O	0Г	8
Biggenden Shire	Biggenden	DO .	American in the second of the	and the state of t	The same stands were still described	TO THE CONTROL WAS CONTROL TO THE CONTROL OF THE CO		- 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200 · 200		A department of the second sec		east a a telegraph and a community of the	and the state of t	describes altered to the south
Blackall Shire	Blackall	yes	max. flood event	은	yes	The back to a boundary of the back to the			April 1970 to the state of the	man demand de Billioneau e mpo aprapa		trans account of the common of the co	2	yes
Boonah Shire	Boonah	no	A designation of the contraction			The Spinish Co. State and Spinish Spinish Spinish Spinish			A THE RESERVE A THE PROPERTY OF THE PROPERTY O	ere und dalle spok spok spok settember er e same	And the statement in Arthur Asset and and asset as	and displaying and a special s		
Booringa Shire	Mitchell	υu			í	A STATE OF THE STA			And which the following the first of the fir	WATER TOTAL PRINTED AND ADMINISTRATION OF THE PRINTED ADMINISTRA		THE PROPERTY OF THE PROPERTY O		
Bowen Shire	Bowen/ Queens Beach	yes	1 in 50 and 100	yes	yes	(1 in 50)	yes	g	940	15	9	100	60	yes
Brisbane City	Main Brisbane River	yes	1 in 2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000, 10 000, 100 000, and PMF	, yes	20	1 in 100	OU	p'q	4 420	648	773	, 186	yes	yes
Bultoo Shire	Thargomindah					the management of the control of the				The same of the sa				4 - ward or statement a construction of the co
Bundaberg City	Bundaberg	υO	den frank i den de	yes	6	none] 	A service of the second of the	and the state of t		The state of the s	10	ОП
Burnett Shire	Burnett Heads/ Bundaberg Port	2						·					•	!
Caboolture Shire	Beachmere	sek	1 in 10, 50, 100	ос -	2	1 in 100	yes	U	957	0	0	0	2	yes
Caboolture Shire	Bellara	yes: tidal prediction	1 in 100	2	2	1 in 100	00		25	of managed from anti-channers, which make that			2	yes
Caboolture Shire	Burpengary		1 in 10, 50, 100	2	ou	1 in 100	yes	U	130	5	0	10	2	2
Caboolture Shire	Caboolture	yes	t in 10, 50, 100	2	ог Ог	1 in 100	yes	U	10		2	30	2	yes
Caboolture Shire	Deception Bay	yes: tidal prediction	1 in 100: tide event	2	2	1 in 100	yes	U	30	•			2	yes
Caboolture Shire	Donnybrook		1 in 100	2	92	1 in 100	yes	ပ	- 15	The Children was a second followings		The state of the s	20	yes
Caboolture Shire	Toorbul	yes: tidal prediction	11 in 100	2	2	1 in 100	yes	U	80	2	A CONTRACTOR OF THE PARTY OF TH	CAN ATTACK OF ALTER AMERICAN STATES OF ALTER AND ALTER A	00	yes
Caboolture Shire	Woodford		1 in 100	2	. 00	1 in 100	yes	p	20	0	0	0	2	yes
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Aurukun Shire	Urukun	00	er egel eine er men eine der der der der der der der der der de	The same of the sa	Active to the state of the stat	conduct de familia de la monocada e en en el esperado colombian despis adoles.	And the second of the second of the second second second of the second o	The Wall - darknesse whe and deposed the technologic desides on the	попе
Balonne Shire	Bollon	2	0		A second				попе
Balonne Shire	Dirrabandi	2							ra ·
Balonne Shire	Hebel	2							поле
Balonne Shire	St George	2		.,				The same of the sa	попе
Balonne Shire	Thallon	2				September - reprint a company or reprint a company	A manufacture of the control of the	es "	TONE
Banana Shire	Baralaba	9		noi bent	The state of the s	And the state of t		enter F. mily trible (characterist political enter the characterist and the characteristic and t	and the state of t
Banana Shire	Biloela	2		. ~		The same of the sa			₩ pho · · ·
Banana Shire	Moura			The second secon	MANUFORM PARK THE CONTROL OF THE CON	Christian and Christian and Christian Christia	Printed and the first of the second of the s	ra je voj (otkomo kanada kala koje majoma kanada koje koje majoma kanada kala koje voje majoma kanada koje koj	of the first and development may be a real and another than the second and the second man in the second man and the second man
Banana Shire	Theodore	인							The second secon
Barcaldine Shire	Barcaídine	yes	æ	yes		0.2 m	on application to council	a, council policy	improved drainage in town
Barcoo Shire	Jundah		A CONTRACT OF THE CONTRACT OF				A CONTRACT OF THE CONTRACT OF	November and a second s	The second state of the second
Barcoo Shire	Stonehenge	2					14A	The state of the s	
Barcoo Shire	Windorah	2						TO THE STATE OF TH	
Beaudesert Shire	Northern area of shire	yes	a,b	yes		0 - 1.0 m	O	a,b	
Biggenden Shire	Biggenden	2							
Blackall Shire	Blackall						Aller - St. Democracy		vegetation clearing
Boonah Shire	Boonah	yes	And Americal Articles (A.) and the department of the anticles	yes	provinces and the first control of the first contro	500 mm	A PART OF THE PART		NONE
Booringa Shire	Mitchell	yes	planned data	yes	200 - 100 · · · · · · · · · · · · · · · · · ·		n n	The state of the s	diversion drains
Bowen Shire	Bowen/ Queens Beach	yes	a,b	yes			U	a,b	TD:
Brisbane City	Main Brisbane River	yes	a, b	yes	200	res: 525 mm. com./ind: 0 or more	b,c	a,b	a,b,c
Bulloo Shire	Thargomindah	yes	The contract of the contract o	yes	. Annual 2011		O	æ	
Bundaberg City	Bundaberg	2	anyd dyssi yn daesendad dae. Ysfod dydaeson dy defest deissandadoese can		trapped in traces. SuitAmen's the past to the state	en e	A A A A A A A A A A A A A A A A A A A	те — с давлей «Он—С» — отправа чес базация давля в далейств базасств	CI
Burnett Shire	Burnett Heads/ Bundaberg Port	2					a tarifi, _A ukadiga		ayaa da Marinag
Caboolture Shire	Beachmer	yes	q	20	to the shameters of the boundary about the same	0.1 П	C	a,b	none
Caboolture Shire	Bellara	yes	۵	2		0.1	U	a,b	ООПО
Caboolture Shire	Burbengary	yes	9	on.	maryon temperature and the second of the sec	0.01 m	2'q	3,b	LODE
Caboolture Shire	Caboolture	yes	d	2	energen met springe minmen sprin i i i be neger de neger meterske skriver	0.1m	U	a,b	none
Caboolture Shire	Deception Bay	yes	q	6		res: 0.3 m. other: 0.1m	U	a,b	попе
Caboolture Shire	Donnybrook	yes	þ	on.	State of the control	res: 0.3 m, сот: 0.0 m	O O	a,b	none
Caboolture Shire	Toorbul	yes	g .	2		res; 0.3 m	O	a,b	поле
Caboolture Shire	Woodford	yes	q	ou .		0.1 m	2	a,b	none

Local Government	Town/Community	8-2	8-3	8.4	4.4	6.9	6	100	9	3 0	20
Aramac Shire	Aramac				yes	yes	yes	2 2	2 2	2-3-97	3.1 m
Aurukun Shire	Urukun	and the second s	попе	попе	ves	ves	2	2	9		
Balonne Shire	Bollon	randa e e e e e e e e e e e e e e e e e e e	And the second s	open fallelle i impagniti prode i sepressonomente i primadoproprije som o	Yes	S A	2 2	2	5	1000	
s programmy promotopy productive to be programmy as a programmy productive to the productive to th	Diraband	Prophose with the statement Makes and well, and makes the statement of the statement	to the first and the second se	and the second of the second o		No.	2	- 0	700	The state of the s	
Balonne Shire	Hahal	dielder i eine der ihr eine eine eine eine eine eine eine ein	And the second s	Salahayana - yar hala dijama - ya mpi ngapayana - ya na - yaga - ya	3	3 3	2 2		606		
Belone Chiro	The state of the s	akan dan dengan pengangan - Inggang perunggan penganggan dan kepangan dan Kepangan pengangan dan penganggan da	The state of the s	*	2 !	3	2 : 1		g .		
	or deolge	erak in de	Steen of property and decoulable enterior section accommission of the control of	dependent in the Alab for Aleman or an actual section and the Alaba and Alab	yes	yes	2	2	yes	1990	The second secon
Balonne Shire	Thallon	none many many many many many many many many	er op 1986 – opp en erfeste methode met statemen ach i mennspringsgebote. E	menonemonemon e e promiento e en construir de partir de la constante de la con	yes	yes	2	Marcania A & Survey and	yes	1976	The state of the s
Banana Shire	Baralaba	B	The state of the s	dend of the second seco	yes	yes	yes	yes	yes		
Banana Shire	Biloela	æ	o		yes	yes	2	2	yes		
Banana Shire	Moura	eren et i til skille for de eren eren eren eren eren eren eren	Constitution of the state of th	And the state of t				Our Passare Based N	of the state of th	ANT - manufa primatina di diastena mifaka santing diastenaka (pang-galanin san	and the second second second second
Banana Shire	Theodore	a,b,c	The state of the s	The second secon	yes	yes	yes	yes	yes		
Barcaldine Shire	Barcaldine	q	none	q	The World State of the State of	yes	2	OL .	yes	1990	al her bodden a water membershap in \$1.00 and
Barcoo Shire	Jundah	emprovo autoropologicas, societa i kristoniarionali udeli dedicante dedicante dedicante dell'anticono	And the state of t	Note to the Note of the Manager of the company of the particle of the Note of the Not	yes	yes	2	2	yes	20/2/97	4.8 m
Barcoo Shire	Stonehenge				yes	yes	00	2	yes	20/02/97	
Barcoo Shire	Windorah				9	8	yes	ou	2	AND	
Beaudesert Shire	Northern area of shire	a,b,c		And the second s	yes	yes	2	2	2	7-10 Feb 1991	Comment per Contract and Association Contract and Contrac
Biggenden Shire	Biggenden	9			00	yes	9	2	yes	1956	
Biackali Shire	Blackail	a,b,c	q	p'c	yes	yes	yes	ou	yes	1997	6.2 m
Boonah Shire	Boonah	a principal control of the control o	0	And the state of t	yes	yes	2	2	2	1991	
Booringa Shire	Witchell	D		q	yes	yes	yes	2	yes	1990	8.28 m
Bowen Shire	Bowen/ Queens Beach	a,b,c	p'c	o'q	yes	yes	2	2	2	1991	
Brisbane City	Main Brisbane River	a,b,c	oʻq	a,b,c	yes	yes	2	yes	2	May 1996	2.75 m
Bulloo Shire	Thargomindah	U		Manage	yes	yes	8	2	yes	12-2-97	5.17 m
Bundaberg City	Bundaberg	d,s	The state of the s		yes	yes	6	2		1974	The state of the s
Burnett Shire	Burnett Heads/ Bundaberg Port	a'e	contacts and		yes	yes	5	2	2	1942	
Caboolture Shire	Beachmere	none		Done	yes	yes	01	0.	92	de company of the company company company of the co	1.60 m
Caboolture Shire	Bellara	попе	υ	попе	yes	yes	일	50	2	o de en	
Caboolture Shire	Burpengari	none	The state of the s	TODIC TO THE TAXABLE OF T	yes	yes	ou	2	yes	1991	thirthe miled votes waspes page to a mile
Caboolture Shire	Caboolture	none	U	; none	yes	yes	6	2	2	1991	de l'anguage de maler op verganger ; any
Caboolture Shire	Deception Bay	none	U	попе	yes	yes	2	2	2		1.60 m
Caboolture Shire	Donnybrook	поле	O	иоле	yes	yes	no	ОП	ОП	A Principal A Table and a Mount wanted amount out of the state of the	egen pro roma de promitiente de mante de la companya-
Caboolture Shire	Toorbul	попе	Ü	попе	yes	yes	잍	2	2		1.60 m
Caboolture Shire	Woodford	none	O	none	yes	yes	2	5	9	The state of the s	remain in which the second section is necessarily

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APPENDIX 1

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Aumoo Chim	1	0-6		7.01	?	10.0		7-1	2	1	-
Aramac Snire	Aramac	ANTAN VII . A K. SOM AN SETIMAN A MAKAMIN MAKAMINYA SHILIMOMAANA MA SAMAANA	0	AMBARINGAN AND A MANUAL	0	i den i gegen den per i en se i superiorismente i specialista de la compania de la compania como della della d	yes	2	2	yes	yes
Aurukun Shire	Urukun	 The control of the cont	0	CO	2		2				
Balonne Shire	Bollon	On and American and an analysis of the analysi	O	A CONTRACTOR OF THE CONTRACTOR	yes	q	yes	yes	yes	yes	2
Balonne Shire	Dirrabandi		υ	q	yes	q	yes	по	yes	yes	2
Balonne Shire	Hebel	The first of the f	ט	q	yes	q	yes	yes	yes	yes	
Balonne Shire	St George	A shiply View with springs what were a construction to the construction of			. Xes	Company of the compan	yes	ይ	yes	yes	2
Balonne Shire	Thallon	1 in 10-15	O	q	yes	distribution of the second of	yes	yes	yes	yes	2
Banana Shire	Baralaba	And applications with the contraction and the contraction of the debta contraction and the contraction and		A STATE OF THE PROPERTY OF THE	0u	There are required to the control of	The second secon		The state of the s	:	
Banana Shire	Biloela		n n		2		yes				
Banana Shire	Moura	propose descriptional descriptions and proposed for the first of the early to the first and the firs		or operator of the definition of the definition of the property of the definition of	white is a second property.	in the control of the device of the control of the			•		:
Banana Shire	Theodore		. .	q	2	and the second and the second	**************************************			:	1
Barcaldine Shire	Barcaldine		Ų	S S	2		yes	yes	yes	yes	yes
Barcoo Shire	Jundah	de de la companya de	q	9	은	Species of Asia mesos industrial mesos, include conditions and decreases and decreases and decreases.	yes	2	2	yes	yes
Barcoo Shire	Stonehenge	A supplied A busharian and a company of the company	۵	Δ	2	And a control of the property	yes	00	yes	yes	yes
Barcoo Shire	Windorah	A TO THE	q	•	2		yes	2	2	yes	yes
Beaudesert Shire	Northern area of shire		D,C	O	2		yes	yes	yes	yes	yes
Biggenden Shire	Biggenden	The state of the s	O	2	00	POPUPATAN PARA PARA PARA PARA PARA PARA PARA PA	yes	1	Farming and a later to the second	0.000	***
Blackall Shire	Blackall		o'q	o'q	yes	3,0,0	yes	6	yes	yes	2
Boonah Shire	Boonah	AND A THE TAXABLE OF A PART AND A THE TAXABLE AN	0		yes		yes	yes	2	yes	00
Booringa Shire	Mitchell	1 in 100	þ	C)	yes	a,b,d, fire sìren	yes	yes	2	2	2
Bowen Shire	Bowen/ Queens Beach	1 in 50	۵.	Ü	yes	b,d, telephone	yes	yes	yes	yes	yes
Brisbane City	Main Brisbane River	1 in 10	O	0	yes	b, telephone	yes	yes	50	yes	yes
Bulloo Shire	Thargomindah		oʻq	oʻq	yes	word of mouth	yes	yes	yes	yes	5
Bundaberg City	Bundaberg	AND A THE	o	0	6	And the state of t	yes	yes		1	
Burnett Shire	Burnett Heads/ Bundaberg Port	1 in 50	O	æ	9		2	,			
Caboolture Shire	Beachmere	1 in 10		The control of the co	00	AND THE REAL PROPERTY AND THE PROPERTY A	yes	01	2	2	yes
Cabooiture Shire	Bellara		ros	a	2		yes	2	yes	yes	yes
Caboolture Shire	Burpengary	< 1 in 20	CO.	c, rainfall data	yes	b, telephone	yes	ПО	yes	yes	yes
Caboolture Shire	Caboolture	1 in 20	ø	c, rainfall data (flood studies)	2	AARIBINA WEEGAARII AARIBAAAAAAAAAAAAAAAAAAAAAAAAAAAAA	yes	UO	yes	yes	yes
Caboolture Shire	Deception Bay	1 in 10	a	æ	ဥ		yes	2	2	2	, sek
Caboolture Shire	Donnybrook		8	9	9		yes	00	01	yes	yes
Caboolture Shire	Toorbul	1 in 10	ros	ro.	2		yes	2	2	2	yes
Caboolture Shire	Woodford		CO	c, rainfall data (flood studies)	01		yes	00	yes	yes	yes

Local Countymont	T	Continue	104000		,	,			١				
Lucal Coveringent	Continuenty	Dramage	Coasta	1-7	7-7	2.3	7 7	5-2	2-6	2-7	3:1	3-2	3-3
Cairns City	Cairns city	Pacific	yes	Cairns city area	20 000	. +4%	20 000	0	end and	and a distribution with company of	yes	The state of the s	yes
Cairns City	Mulgrave	Pacific	yes	Ваггол	2 800	+3.5%	1610	72	20	80	yes 1979	62	yes
Calliope Shire	Tannum Sands, Boyne Island	Pacific	yes	Boyne River	7 500	+3%	2500	200	100	200	yes	on the supplementary the commencer problems.	yes
Caloundra City	Kawana Waters	Pacific	yes	Mooloolah		Annual Company	according to the control of the cont	The same of the sa	\$ S	galanda et established et en	yes	se debendar en de describent à s'a soutiaire debruide de la comment de la commentant de la	yes
Cambooya Shire	Cambooya	Inland	9	Hodgson Ck, Condamine Ctchmt, Murray-Darling Basin	790	+2.5%	272	9	-	makakir da di darawa di dalah da kamanan da da	0	AND THE PROPERTY OF THE PROPERTY AND THE PROPERTY OF THE PROPE	Al Venezalisman reduced 3. A.
Cardwell Shire	Tully Heads, Cardwell, South Mission Beach	Pacific	yes	the manufacture was to manufacture and the man		The state of the s				and the state of t	yes	and the control of th	yes
Carpentaria Shire	Kurumba	Guif	yes	Norman /Flinders	200	expended an amount wavelence.	ega av rent vist value er gen	* ***		mary An America of Franchiscophica National Association (Association)	yes 19	1976 major	00
Carpentaria Shire	Normanton	Gulf	<u>о</u> г	Norman /Flinders	1 500		3	- in the second		THE WAY IN WARRY TO A COMMENT OF THE PROPERTY OF THE	OL	The state of the s	. Swept to content
Chinchilla Shire	Chinchilla	Inland	10	Condamine	3 500	+0.2%	1000	100	20	30	9		
Cook Shire	Ayton	Pacific	yes	Bloomfield	65	+2%	30	4	1	10	yes Ma	March 1996	2
Cook Shire	Coen	Pacific	oп	Coen	350	*2+	0,2	6	e	20	00		;
Cook Shire	Cooktown (including Marton)	Pacific	yes	Endeavour	1 700	+5%	700	40	-	90	yes		yes
Cooloola Shire	Gympie	Pacific	yes	Mary	20 000	+1.5%					2	di consequente di con	
Croydon Shire	Croydon	Gulf	OU.	Gilbert	300	+1%	90	5		15	ОП	a see a s	
Dalby Town		Infand	2	Myall Creek	10 199	+1.08%	3 2 4 9	243	200	80	700	The Theory of the American	
Diamantina Shire	Birdsville	Inland	0	Diamantina	100	+5%	8	4	2	8	2	of the control of Affiliation on the months of	
Douglas Shire	en (et 2007) en major (et 100 meter) et 100 meter en 100	Pacific	yes	And the second s	9 867				manage of the second		yes	er. And de c'hoaned en san den en benevel en beken er.	yes
Eacham Shire	destinanted to determinate appropriate when interprints along a pro-expelication consequences expedient	Pacific	no	North Johnstone	1 200	+2.4%	450	33	20	30	<u>е</u>		
Emerald Shire	Emerald	Inland	OU	Nogoa	10 500		2900	160	150	100	no 1950	00	2
Esk Shire		Pacific	00	Brisbane and Lockyer	7 000	+3%	2500	100	90	20	0.0	ilo - c'ella c'elestifices « maiste essentamentamente esta del espe	Variation part of the second
Gatton Shire	Grantham	Pacific	02	Sandy Creek	200	< 2%	100	15	-	Arribante de conflictor	2	arm, arm, intermedia, and control and a supplemental and a supplementa	
Gayndah Shire	Gayndah	Pacific	ОП	Burnett	1 800	+0.5%	602	90	17	2	은	maga ka maharan ka maharan manan manan ka maharan ka maharan ka maharan ka maharan ka maharan ka maharan ka ma	
Gladstone City	Gladstone	Pacific	yes	Auckland Creek	27 000	+2%	8, 500	w			yes		yes
Gold Coast City	Nerang	Pacific	yes	Nerang		+6.0%	Wat y				yes 1974?	4?	2
Goondiwindi Town	Goondiwindi	Inland	оп	McIntyre	4 600	+1.5%	1200	200	100	ന	2		
Herberton Shire	Herberton	Infand	υO	Herbert	1 000	+2%	300	7	r	12	u ou	And provided the second second second	
Hervey Bay City	Pacific Haven	Pacific	yes	Burrum/Cherwell	150	+8%	80 est.	0	0	6-10	yes 20/2	20/21 Feb. 1992	2
Hervey Bay City	Urangan, Toogoom & Burrum Heads, Eil Waters Pialba	Pacific	yes	Hervey Bay Foreshore	10-15 000	%8÷	000	30-40		3-4 parks	yes Cyc	Cyclone Fran, 1992	yes
Hinchinbrook Shire	Ingham/Lower Herbert area	Pacific	yes	Herbert River	12 000	0	5 000	300	50	200	yes	er o de la prima de la composição de la prima del la prima de la prima del la prima de la prima del la prima de la prima del	2
Inglewood Shire	Inglewood town	Infand	по	Macintyre	1 000	-1%	348	40	90		· e	:	
								-			~		

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4-8 Δ ပ Ф o limited 2 40 0 0 0 20 0 0 0 2 0 22 4 0 0 0 9 0 many buildings limited <u>e</u>. <u>e</u> 35 0 0 2 2 36 n 0 0 က 0 (125) 200 200 8 4-4 33 V. 20+ 20 15 무 5 **0** 0 9 72 20 12 ည 0 12 - 14 hours few days 6 - 12 hrs 2-3 days 2 weeks 1 week 3 days 1 week 2 days 3 days 3 days 7 days 2 days 1 day 24 hrs 4-3 0 2200m3/s (May 1996) 1 730 cumecs 4 600 m3/s 8 200 m3 4 430 m/s 1 134 1 850 12 000 Believed to be Cyclone Daisy 7-2-1981 27 Nov 1950 March 1967 March 1996 Narch 177 26-1-1996 3-2-1893 Jan 1974 Feb 1942 Jan '79 1974/75 Jan 1974 1947 1988 1942 1989 1893 1974 1979 1982 1992 1974 1967 1974 1967 1967 4-1 Urangan, Toogoom & Burrum Heads, Eli Waters Pialba Tannum Sands, Boyne Island Tully Heads, Cardwell, South Mission Beach Cooktown (including Marton) Ingham/Lower Herbert area Town/Community Kawana Waters Inglewood town Pacific Haven Goondiwindi Cambooya Normanton Herberton Chinchilla Mulgrave Kurumba Grantham Gladstone Birdsville Gayndah Croydon Gympie Emerald Nerang Ayton Coen Local Government linchinbrook Shire Goondiwindi Town Carpentaria Shire Carpentaria Shire Diamantina Shire Cambooya Shire Inglewood Shire Chinchilla Shire **Herberton Shire** Hervey Bay City tervey Bay City Caloundra City Cardwell Shire **Bold Coast City** Cooloota Shire Croydon Shire Gayndah Shire **Sladstone City** Calliope Shire Emerald Shire Douglas Shire Eacham Shire Cook Shire **Satton Shire** Cook Shire Cook Shire Dalby Town Sairns City Sairns City Esk Shire

Local Government	Town/Community	4-9	4-10	4-11	4-12	4-13	4-14	4-15	5-1	5-2
Cairns Cily	Cairns city	U	q	q	q			2 hrs	yes	•
Cairns City	Mulgrave	0	q	q	- 100 cm - 1	Q	Capacity of emergency services was limited	30 hours	yes	
Calliope Shire	Tannum Sands, Boyne Island	D	Ü					24 hours	yes	
Caloundra City	Kawana Waters	Afrikansa (Sympleysymma symples of	To a page and page and a construction of the second		and the state of t		e de service de la descriptor de completante de service de completante de service de completante de la descriptor de la descr	en manerela amparicia, arr han madaristi	yes	
Cambooya Shire	Cambooya	U	U	a			-		00	
Cardwell Shire	Tully Heads, Cardwell, South Mission Beach	0	q	م	Φ	. م		A del cities de la company		Information supplied by DNR
Carpentaria Shire	Kurumba	Company of the party of the par	many)				A CONTRACTOR OF THE CONTRACTOR	ууу дарга донула үчүнүламмариямда ининтитул тиги	Space of the space	tendrak ded a partidistra (**) ed 3 te 70 t. Aspektola demokrati semokratismatern milathakkund Arbeit (Arbeit)
Carpentaria Shire	Normanton	O	q	q			hospital isolated by floods	days	limited	manumini da de kondi jaski, de jedijaski di de arringan opijamini medilipoj kumbinadilima. Objecte kondi jaski
Chinchilla Shire	Chinchilla	Ü	q	æ	п	ro.	roads cut	(С) (1974) (Медиция в на населения населения на селения на селения (С) (1974) (Медиция на селения н	yes	ңойда, тап далдан поруш аулу шашагашкан каккой каккой шайка Майлуайт, тап даналу, тарабая
Cook Shire	Ayton	P	ບ	ro .	q	q	на (придаждання) в придаждення в примен в придаждення в придажден	12 hours	OU .	ға (уунды) ағалының регерінен Анна, үлеке дерен мек бағақ жерек теребереке дереке берелек төлек еңетермереке
Cook Shire	Coen	P	þ	q	q	п	e delikaka dari khikada hiyingi yayayana . Namayay khima amamana namandam aban amamandam abada (ingi kakin 5 hiyin ada) yakin aliya ka	24 hours	no	Appan agh af e alling and e and é challe agus Léóig Arithééig Athréig agus agus 15 é réin mar cagaig a managan agus e
Cook Shire	Cooktown (including Marton)	D	а	٥	۵	· ο		10 hours	OU	надилляння намог выпакую, от технология навагательного в обите ветейного том
Cooloola Shire	Gymple gymple	CI	Q	0	q	ro		varies	yes	
Croydon Shire	Croydon	Ö	The second secon	a	And All Andrews Andrews Williams Andrews Andre	demonstration of a subdeministrative	Surrounding properties flood bound. Town cut off by road and rail.		UI.	ende (ex.) - dede o des (e.) - de de o des (e.) - de
Dalby Town	i i nambida distribir i in krati departera metalika (Aruda) e Aruda). Verifor Veriforio Feriforio Aruda de Aru	O Commence of the control of the con	q	d	no.	В		7 hours	yes	e og Bringeri. A profile forme for mer styrke militer ogsådelsyndenske formerske kommente kom
Diamantina Shire	Birdsville	Þ	В	æ	а	ro		A CORRESPONDE - RODAN (In part 184, critisha Navarrya 🖋 197 - 197	no n	no recording
Douglas Shire	, ka da da ka	æ	O	þ	es.	٩	The second secon	12 hrs	no no	The second property of the second sec
Eacham Shire		þ	υ	q	:		Commission of Commission building the control of the Commission of	propulation (stablings spatisfies that defined edge of the com-	And the second sections and the second section of the second second second section second sec	e pe estada esta
Emerald Shire	Emerald	٩.	م	ro	ro .	О	e des des des des des des des des des de	200 hrs	yes	
Esk Shire		ם	υ	ro	ro	ю :	and the second s	24 hrs	yes	The second secon
Gatton Shire	Grantham	Ø	O Commence	q	υ	B		12 hours	yes	 If the control of the c
Gayndah Shire	Gayndah	q ,	Ü				V) proof to the work and by Primary M; was 4 M or July 1900 at	enderhalbergerik melik mendersken de serial de sekse (1906 july) geles princepten en en	yes	
Gladstone City	Gladstone	В	en .	ď	O	ro		gy, pennagan sparigacaldur ar anord de Adold Anadolegacella sept all 1904 (90).	ПО	там в розника дом гом, Этийн Андийн төгч архийндар мередин и там алдаг подвиду водинатель а
Gold Coast City	Nerang	В	es	a	م	Д	Ambulance, Fire and Aged care affected,	24-48 hrs	yes	e e l'agen y come o come experiencement compandamentations debte als alleis à per ANC HARRES.
Goondiwindi Town	Goondiwindi	O	В	n	a	Ø		48 hours	not held by council D	DNR/Met Bureau responsibility
Herberton Shire	Herberton	O	C	q	The state of the s	G	A single-photocological sightweet the potential potentia	2 hrs	no di	didn't have an engineer on staff
Hervey Bay City	Pacific Haven	q	ပ		ф	arrors and her arrows	Androne (1994) The Androne (1994) An	6 hours	limited	manie dan destruite en manie (en destruiten des
Hervey Bay City	Urangan, Toogoom & Burrum Heads. Eli Waters Pialba	ס	ပ		Ф			12 hours	limited	de um militar Lamand en externatione é des des de Valencia major responsable que constituir de Valencia de Valenci
Hinchinbrook Shire	Ingham/Lower Herbert area	U	q	ш	٩	q	Fire buildings affected. Roads flooded	1.5 days	yes	te danamen ett jung ett ett ermyndogsste i Nysbert fondamen och den som till stode endedden
inglewood Shire	Inglewood town	ပ	q į	q	q	Д		48 hours	no	lack of resources

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Cairns City	Local Government Iown/Community	0-3	5-4	5-5	5-6	5-7	2-8	5-9	5-10	5-11
And All an experience and experience community of the party of the Andrews of the Andrews	Cairns city	referenced by owners, developers and consultants	2			Amproprie	The Article Landson	- Holomoon	yes	
Cairns City	Mulgrave	calibrating flood modelling	yes	30 years	1,8 m	varies	3,6 m	Mar. 1977	yes	p,c
Calliope Shire	Tannum Sands, Boyne Island	The second secon	01	A SPANISHEN PARAMETER - COMMANDER COST COST MINISTER COST COST COST COST COST COST COST COST	The state of the s	A STATE OF THE PARTY OF THE PAR	Annual security to the second company of the second	And the second control of the second control	OU	٥
Caloundra City	Kawana Waters	public information, calibration etc.	00	es e manuschaberen kontonblåkselenkin år - saky k. 15.5.	And Company in the second was subjected papering of allowing and	m dalaphila () reconstruction () and property of the second of the sec	A SECOND CONTRACTOR OF THE CON	Accordance from	00	4
Cambooya Shire	Cambooya	enter de l'autre des consequents des consequents de la consequence del la consequence del la consequence de la consequence de la consequence del la consequence de la conseque	01	PRANT OF LAND COMMUNICATION AND ANALYSIS OF THE STREET, ANALYSIS OF THE STREET, AND AN	auto racinal desses o linicia. Il no cadempo rivas corpos	The former experience of the contract of the c	A MARKET TO THE TOTAL THE	Andrew Company	: :	
Cardwell Shire	Tully Heads, Cardwell, South Mission Beach	The state of the s	. 2	And Application Control of the Contr					S SA	
Carpentaria Shire	Kurumba	many many many delivery delivery only only the photometric delivery many on a fill the contract of the contrac	Auto Alambara	CONTRACTOR OF THE WARRY OF DRIVEN, TO DO SAID	AND THE THE PARTY OF THE PARTY	ter vitalim i in deri ik ini liberiwa albania d	The second secon	The same of the sa		÷
Carpentaria Shire	Normanton	The control of the co	yes		And the state of t	A COMMISSION OF THE PARTY OF TH		A CANADA	yes	p
Chinchilla Shire	Chinchilla	Advice to interested persons	yes	The state of the s	Commission of the state of the	The control of the second seco	Andrew Common Co	Approximate to the state of the	yes	
Cook Shire	Ayton	re a tradition and the desired support of the destruction of the destr	LIO .	mention of the contract of the	And the second s	April - Application of the section o	The first designation of the entire decrease makes a conditional decrease and the conditional decreases the conditional decreases and the conditional decrea	de la company de		Control of the contro
Cook Shire	Coen	A CONTRACT OF THE PROPERTY OF CONTRACT OF THE TANK OF	2	the states as the say of the states of the s	a continued by a service of the continued of the continue	de format e de la formation de sociales de la companya de la formation de la f	remain appriment sammapi i falphada ar verme balada - esa perp que des es	And the second of the second o	n DO	
Cook Shire	Cooktown (including Marton)		0	commodern with the december of the company of the control of the c	g Andrewson is assessed again to page 20 years of the second of the con-	And And Advantage of the second secon	temblem AdmirAkpand passent passentation (A)	And the state of t	no	a
Cooloola Shire	Gympie	planning	yes	125 years	probably zero	varies	25.4 M	1893	yes	b,c,d
Croydon Shire	Croydon	Andrew Common Complete and Commonwealth and Commonwealth and Commonwealth Commonwea	2	- MANAGEMENT AND	Commence and the control of the control of the company of the comp	rie er stelle er dat dikterkontegrandsoorg mag spraggenens. Den	NO Estat Phono attack conjugación (Mindia Principa Princi	The state of the s	ПО	G
Dalby Town	etom ou sout franchestation and second secon	information to public	yes	16 years	The Committee of the Co	1.0 m	4.5 m	7-2-1981	yes	م ٰ
Diamantina Shire	Birdsville		2	men i regioni e di pappi sebandan paggi e A tena i ti a que i i i i i i		m der - syde - Fredhjälde fins - en delphysis dennighte syd -	to the second		00	0
Douglas Shire	and the state of t			mmen and an arthur and antidemental managements and antidemental and an appropriate region and an arthur and an arthur and arthur and arthur and arthur and arthur	And the second s	A A A A A A A A A A A A A A A A A A A	American and major a manager of the state of	The second secon	Secured married and selfs, chit, chit, chit death of	The state of the s
Eacham Shire			00	mental space data spok supported in Expanding a single plane.	The state of the s	SINNOVINE VAN proprietion previous neighbors a ple printing	An and a second sec		700 Park Company Services	A Address of American and and
Emerald Shire	Emerald	flood study and prediction of current events	yes	40+ years	161.95 m	169 m+	177.65 (15.69 m)	27/11/50	OU	þ
Esk Shire		flood information -Development. Control -	yes	den prinz d' - nimer d'annimique n'ambre na calcidad America de marie na calcidad de marie de marie de marie d	And the state of t	roder d'asses en l'extre septembre d'arright format de dessence assesses	16.43 m	1974	yes	p.c
Gatton Shire	Grantham	setting minimum floor levels for new buildings	F.O.	The second secon	And a section of the	m - p A. with well-reproduct water page 1 a. s. a.			, OL	· · · · · · ·
Gayndah Shire	Gayndah		00	de des estados de como mayora en actual desagona en actual designados en actual de como de com	of the second se	endelen ur er ere medeten eigen ergen ergen er er eigen bestelten er er er er bestelten er er er er er er er e	\$		yes	. 4
Gladstone City	Gladstone	eder for the same that is the same that the	02	for the second s	And the state of t	derformen dik aktual och som en graven mig sekturen der	The state of the s	and the second s		<u>a</u>
Gold Coast City	Nerang	basis for modelling	yes	60+ years	tidal	3,5 - 4,5 ₪	6.0 m	1974	yes	b,c,d
Goondiwindi Town	Goondi⊮indi	The state of the s	yes		The state of the s	levee does not	10.61 m	26-1-1996	yes	9
Herberton Shire	Herberton	Co. 10. Share p	20		The bridge control of our delivery management	The second secon	AND ALL WATER BOTH AND THE STREET, IN THE STREET, IN THE STREET, AND THE STREE	AN Jahren Maksanahanan in 1777 - Ny Arust nin Brasich Boboth pay o	0.00	, nd
Hervey Bay City	Pacific Haven	public awareness, development of flood warning system	<u> </u>	the self-field and the second self-field and self-field	The state of the s	Allon - Annabasa	Ambiliate describes conditionary (posterior Ambiliate structure).	And the second s	yes	9
Hervey Bay City	Urangan, Toogoom & Burrum Heads. Eli Waters Pialba	public education	2	The second secon		And the second s		A format to manage of Assembly	ПО	9
Hinchinbrook Shire	Ingham/Lower Herbert area	building floor levels (new), flood prediction	yes	30 years	шо	6 m+	12,7 m	Mar. 1967	yes	q
Inglewood Shire	Inglewood town	The state of the s	yes	75+ years	12 m	9-10 m	12 m	1956	, OO	•

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Local Government	Town/Community	6-1	6-2	6-3 6-4	6-5	9-9	2-9	8-9	6-9	6-10	6-11	6-12	6-13
Cairns City	Cairns city	yes	from 1 in 5 to 1 in 100	ОП ОП	1 in 100	2				To the state of th	(+ + + + + + + + + + + + + + + + + + +	0.	5
Cairns City	Mulgrave	yes	1 in 5, 10, 50, 100, 25	yes no	1 in 100	yes	p'5	099	8	20	49	2	yes
Calliope Shire	Tannum Sands, Boyne Island	yes	1 in 50 and 100	yes no	1 in 100	yes	၁'႖	86	0	0		OU.	yes
Caloundra City	Kawana Waters	yes	1 in 20 and 100	оп оп	1 in 100	yes	p'c	0	0	0	0	61	2
Cambooya Shire	Сатьооуа	OU		00 } оп	2000	2	di addana Tom V	a permittent de rémettence de			and today in the		
Cardwell Shire	Tully Heads, Cardwell, South Mission Beach	OU		7									The state of the s
Carpentaria Shire	Kurumba	And all the state of the state	define control define control control de la	The state of the s								1	
Carpentaria Shire	Normanton	011		OU OU	none	2	and the second	South American State of the Control	Control of the Contro	and demanded a second and a second a second and a second		٠ ا	<u>و</u>
Chinchilla Shire	Chinchilla	ПО		A) and a stage promption updates and a stage of	odlime 1 - No. Advis 1 - NY - Advis 1 - Chi - Ch	. bassas		To account on the control of the con	Complete the compl		,	2	2
Cook Shire	Ayton	оп	The state of the s	And the state of t	d Annual Annual Annual Annual College				All care care and an analysis	administration of the state of			:
Cook Shire	Coen	OU	entenen in terret i de a meteropera de la colonia mandra (il 17 millio), del me colonia per de america en meser della colonia de	When they make of the transfer transfer for the	phonon in a second contract of columnia			244000000000000000000000000000000000000	A constitution of the cons	and the second of the second o			:
Cook Shire	Cooktown (including Marton)	01		and the gate day of contract to the contract t				A see a	Annipatation discounting the special section of the			:	:
Cooloola Shire	Gympie	Ou	Same and the same	a de la companya de l	Agents you and to have been a second or second	and control of the co		And the second s	Annata young a CA CA Garage of the Care of the C	Advance & Advanc	Approximate the control of the contr	Proposition Arrest	
Croydon Shire	Croydon	ОП								A to the state of			
Dalby Town	er en redering skrivet frankriket frankriket i den de frankriket frankriket frankriket frankriket frankriket f	yes	1 in 250	, yes	none	2	Ø	Andrew Laboratory and a contract of the contra	man me en mehr) - denskardelsken	A CALLERY AND A CALLERY OF THE PARTY OF THE		yes	2
Diamantina Shire	Birdsville	OU.		And the second second second	Administration of the Property of the Administration of the Admini			State And State of the State of					
Douglas Shire	Amerikan merekalanda dengan kanada dan kanada dan kanada dan kanada dan dan dan dan dan dan dan dan da	onough - unfolken annotate for a production of the state	A. A	A) - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (10 - (diseases diseases and the second section of the sec			To an and the Action of the Ac	C.V. gas papabana pro y strongal shawan ng mata-	And the state of t	commonweal () conserved former by large	And the second section of the second	THE MOST OF STARS ASSESSED.
Eacham Shire		no	e de la companya de descripción de la companya de l	and the second s					necessary and make suppose property	e and company of the second business of the s	- 100 mary in the contract of		e gravingstep in charge and a
Emerald Shire	Emerald	yes	1 in 50, 100	yes no	1 in 50,100	yes	q	200	10	25	90	90	DL
Esk Shire	en eine der der der der der der der der der de	uo		no no	1 in 100	2	၁ ဌ)	the sale: golden and sale of sale sales	the statement of the st	Variability of the second of t	no	ПО
Gatton Shire	Grantham	ou		Vanishumanamuminumanamuminumanamuminumanamuminumanamuminumanamuminumanamuminumanamuminumanamuminumanamuminuman	en de la company de solvent de Abbe and de Abbe and de Abbe and de Abbe and and Abbe and and Abbe and	in the second se		Andreas de Principal de Mandre de Victoria	Confidence entrails/94 per since et l'empres	decidence of the state of the s			white children is seen and city is well-asing
Gayndah Shire	Gayndah	υU	ховаричения вы переда на перед На переда на переда	Contraction Contract of the Co	agys (cycae)descenae deber en desce Accade deber de	-			American American (196) december American				- na gang adams some
Gladstone City	Gladstone	yes	1 in 50, 100	yees yes	1 in 50	yes	р		1	1		n	000
Gold Coast City	Nerang	yes	1 in 2, 5, 10, 20, 50, 100, to 1 in 200 yr	00 00	1 in 100, max. recorded	yes	0	(13 400	400		200	yes	ou
Goondiwindi Town	Goondiwindi	2						A state of the sta		Str. Bar a	Abr.		The second like a second
Herberton Shire	Herberton	ου	e de la companya del companya de la companya del companya de la companya del la companya de la c	Constitution and Assessment Section 6.1.	Specific reason for moved specific control control of the first of the	en return contains contains (c	di - wan management and	An utilizate de alta folde de anti-	Production 1 of the control of the physical and the	A codin republish to a concentration of		dynamic control control of	-
Hervey Bay City	Pacific Haven	Ou					-	18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18 (1. 18	Schoolsen to		***************************************	1	
Hervey Bay City	Urangan, Toogoom & Burrum Heads. Eli Waters Pialba	ου		OU OU	1 in 100	2	٩	The state of the s	The second section of the sec	A. P. W. d. a. d.	The state of the s	The same read to the control of the	149 m. and a Archae (A Administral, 1821
Hinchinbrook Shire	ingham/Lower Herbert area	yes	1 in 3	0П .	1 in 50	yes	٩	2 000	100	25	(20)	yes	yes
Inglewood Shire	Inglewood town	ם)				

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Local Government	Town/Community	7-1	7-2	7-3	7.4	7-5	9-2	7.7	8 4
Cairns City	Cairns city	yes	a,b	,		0.15 m			U
Cairns City	Wulgrave	yes	Q	yes		res:150 mm. com./ind: 0 m	And the special of the second	designation of the second of t	flood channel
d printerprinterprinters when themselven survey and designates the second secon	Transmission was to the entreprenent amount of the first of the state		des emisses emisses and emisses are emissed and emisses and emisses and emisses are emisses and emisses are emissed and emisses are emisse		A desirate de la fina de la mandalesta de la fina de la desta de la fina dela fina de la fina de la fina de la fina de la fina del la fina dela fina della	The content of the co		DIC	improvements
Calliope Shire	Tannum Sands, Boyne Island	ou .	q	yes	englede debester stellen er eine stelle eine verkelt in de eine kommenten er wenn meter den wester	Andrew Constitution of Constit	d'e	d.e.	попе
Caloundra City	Kawana Waters	yes	b, physical model	yes	The second control of	0.50 m	æ	q	in the first of the first of the first of the second contract of the first of the f
Cambooya Shire	Cambooya	2					A A ST OF THE STATE OF THE STAT	A TO THE WAY THE REAL PROPERTY OF THE WAY THE	estimated by Market and Application of the Applicat
Cardwell Shire	Tully Heads, Cardwell, South Mission Beach	2	t de la la palation est para noma motor a para motor de la companya de la company		The state of the s	entre var except.	der in der begeneren großelbe state bestehn materialische in so so so sone	And constitute a system of the corps of the selection of the corps of	The state of the s
Carpentaria Shire	Kurumba		a desta esta esta esta esta esta esta esta	The state of the s	The date of the design of the design and the season	egi ki jihkusofe atuma i kilomano maspidansi popujapa opesijo opesijos sako	oper in model of demander models from any contained, by the factor of contained statements, where it	for a : : : Annichment fan sa anne (sa Langua party à 1960 à templos décision de la company)	· · · · · · · · · · · · · · · · · · ·
Carpentaria Shire	Normanton	2	STATES AND TANKS (MANAGEMENT ALL WAS LOSTED FOR THE STATES AND TANKS AND TAN		ad de made i Color - é céras monoco - ora es de Vojernapago compago e console	6 C · · · · · · · · · · · · · · · · · ·	en izitani Zok, kanaponempran popi aprikapisa VA soka kitiabisa denaminasaa	q	november of the second of the
Chinchilla Shire	Chinchilla	9	THE COUNTY OF TH		The designation of might original or a contract country to the contract of might open the contract of might original or a contract	To the Company of Company of the Com	Papari milimannessammaan inumiriyyyy (KKA) AV-1860 (AN) kala (AN) (Kalainiyi) a diimanna		Tanks From Standard Standard (Standard Standard Standard Standard Standard Standard Standard Standard Standard
Cook Shire	Ayton	2		A 44 - may	And a factor of the state of th	edity i de divina ke pildidaya kakiraha kana mane panjinone ya, nana e ya na e najinje kanina	Afficial mandeful according systems of managery, matter and a fightile of the configuration of the same	A THE COLOR OF THE	The second of th
Cook Shire	Coen	2			e de la companya de l	A THE RECOVERAGE OF THE PROPERTY OF THE PROPER	mandy sufficiency as each type of the supplies to the manufact probability conscilings a resonance of gravity of	definition of a company of matter than a transfer of a fundamental sequence of the second sequences of	THE PROPERTY OF THE PROPERTY O
Cook Shire	Cooktown (including Marton)	2	The state of the s	2000	The second secon	And the state of t	 - Grand Principles and Communication (Conference on the Bank 1975) (2004) (2004) 	ammentatur - gradjajani, i kidanjajajajajajajajajajajajajajajajajajaj	editions and demand the comment of the state
Cooloola Shire	Gympie	yes	d _i e	6	acceptable for commercial to flood	0.3 m		q	
Croydon Shire	Groydon	ou Ou	Nike) - Village de la commune de desamente de managemente de de de managemente de		and the control of th	and the second of the second o	o de la company de la campany de la camp	de cade e dedennos rengan a septembrio sprijante a sure datumpata cada.	The state of the s
Dalby Town		2				The second secon		***************************************	p
Dlamantina Shire	Birdsville	5					and the state of t		
Douglas Shire	- Valley de Verfeije - Ver de New York of de Verfeije - De State de Addition and entre de State de Verfeije - De V		A. A. Top of Alberta Absorbed Action (Absorbed Action (Action			The state of the s	na o ha si finalessa (si a a a a a a a a a a a a a a a a a a a	This is not owner to addresse in anywhite earth age of the second in the case of the case	
Eacham Shire	agirini irinin (rinjunin (rinna Nyah-naji) (rinjuna) urajina (vojina) alijoje koji kanji (ramati varnan antorna de	ou l	hada — ann miligenskynn, megistler "megistlerspanskynningen einemen.		100 miles	The state of the s	A MATTER OF THE PROPERTY AND A STATE OF THE PROPERTY AND A	E de opposite de la company de la constitución de l	The second distribution of the second
Emerald Shire	Emeraid	9	q	yes		300 mm	υ	q	1
Esk Shire	entry to 1 - 1 - 1 - 2 - 2 - 2 - 2 - 2 - 2 - 2 -	yes	d,b	yes		300 mm	0		And the second sec
Gatton Shire	Grantham	yes	ro .	yes		0.3 m	o	d,s	none
Gayndah Shire	Gayndah	o.				And the state of t	one form electronica valuability is formal and a reference operation operation.	e de Vigle de la companya de será de companya de Compa	The second secon
Gladstone City	Gladstone	9	The Collection of the State of	yes			0		Andre, Levitor to the measurement of the contract of the contr
Gold Coast City	Nerang	2	Q	yes			þ	b, council	b (HINZE- multipurpose)
Goondiwindi Town	Goondiwindi	2	e e e e e e e e e e e e e e e e e e e	4			Principal delication of the state of the sta	ANN TRANSPORTER - THAN TRANSPORTER FOR THE TRANSPORTER - TAINING AN	A CO POR PARENTAL INVESTIGATION AND THE ARMS AND ADMINISTRATION ADMINISTRATION ADMINISTRATION ADMINISTRATION ADMINISTRATION ADMINISTRATION ADMINISTRATION ADMINISTRATION ADMINISTRATION
Herberton Shire	Негрентоп	9	in the control of the	W AFF	edele - des encommende inspecificate entre - de se delenta entre e	dam (openhologische schrödenster des dessauges einschlieben des dessen, der vorst	And the state of t	P Te di Verre de l'annual de commune de comm	none
Hervey Bay City	Pacific Haven	yes	0	1			CT CT	G	none
Hervey Bay City	Urangan, Toogoom & Burrum Heads. Eli Waters Pialba	yes	CG CG	e G		3.5 m	a,b,c	a,b	2
Hinchinbrook Shire	Ingham/Lower Herbert area	yes	۵	yes		300 mm	D	q	a,d, flood-gated creeks,
Inglewood Shire	Inglewood town	2							auou

Local Government	Town/Community	8-2	8-3	8.4	9.1	9-2	9-3	9-4	9-5	9-6	9-7
Cairns City	Cairns city		various sources	varies incl. developer	yes	yes	2	yes	yes	Jan 1979	
Cairns City	Mulgrave	a,b,c, requisitions on properties up to 1 in 100	c, Cairns Port Authority	0	yes	yes	2	yes	yes	Jan 1979	3,6 m
Calliope Shire	Tannum Sands, Boyne Island	q'e	 	none	2	yes	2	2	2	1973	
Caloundra City	Kawana Waters		b, Kawana Estate P/L	The control of the co	90	QL	0	0	Constitution of the same of th	And Andrew Strategy and the second strategy are second strategy and the second	
Cambooya Shire	Сатьооуа	e man national			· # - * 4		cr.man				
Cardwell Shire	Tully Heads, Cardwell, South Mission Beach	of the many transfer at the state of the sta	of the contract of the contrac	ender overgræden i dem istal overgræden om endelden	yes	yes	2	OU.	yes	And Osan - of proceedings of the angles of the control of the cont	1
Carpentaria Shire	Kurumba		And the second s		The state of the s	Manager a control of the control	The state of the s			A A A A A A A A A A A A A A A A A A A	Mandradon To catalogo gal catalogo e e e e e e e e e e e e e e e e e e
Carpentaria Shire	Normanton	The control of the co	A CAMILLA CAMILLA CONTRACTOR CONTRACTOR CAMILLA CAMILL	dender A.c Gred with Addition 100 artificial and 100 adds.	yes	yes	on O	u no	no	1974	WANT WITH FROM A WITH STATE OF THE STATE OF
Chinchilla Shire	Chinchilla	and the second control	And the state and makes a control or the state of the sta	Andrews and second seco	yes	yes	2	2	yes	1983	RL. 991
Cook Shire	Ayton		and space register from the state of the sta	in and design for the control of the	yes	yes	2	yes	yes	March 1996	Arthritis - April i professenský fraktiský sese
Cook Shire	Соеп			· inter practical for company where the company of	yes	yes	on.	on O	yes	AVAN NOTON VANORANYA YANGONYA AMBONYA AMBONA AN ABBANA AN AMBONYA	meritanis bian upa likin when man carinteriors
Cook Shire	Cooktown (including Marton)	6			yes	yes	2	01	yes		
Cooloola Shire	Gympie				yes	yes	2	2	yes	1992	16.1 m
Croydon Shire	Croydon			oder addriction und demander		and and demands in sold				ary south for a committee of the south of the	and the state of t
Dalby Town	and the state of t	p'q	a,b,c	a,b,c	yes	yes	yes	ou	yes	23-6-1983	3.8 m
Diamantina Shire	Birdsville	C			yes	yes	2	2	yes		AND THE THE RESIDENCE OF THE AND COMPANIES.
Douglas Shire	and Coulty A faile feet de and a standard Addition (A failed Addition A coult Addition	Story (All v. a) Venez-o A. 1990 or challeng or brightness or good an in debtor and which debtorated debtorated by the second of		A Section of the sect							
Eacham Shire	деле из выполняем в применения в пределения в пределения в пределения в пределения в пределения в пределения в	Commence of the commence of th	the second and beginning from the second sec	and the second s	yes	yes	yes	2	yes	The state of the s	100000000000000000000000000000000000000
Emerald Shire	Emerald	a,b	U	U	yes	yes	yes	ဥ	ou.	4/4/56	176.79 (14.84 m)
Esk Shire		a,b	b.c		yes	yes	2	2	yes	May 1996	16.43 m
Gatton Shire	Grantham	a,b			yes	yes	yes	2	yes	May 1996	
Gayndah Shire	Gayndah	a'p					01	5	2	1942	Ann ann fan Salama e Malainne a Malainne de Janeir
Giadstone City	Gladstone	To the state of th	or drive to example to the control of the control o	Amerikan de							
Gold Coast City	Nerang	a,b,c	U		yes	yes	2	ç	2	1974	2.89 m
Goondiwindi Town	Goondiwindi	q	U	c, subsidies	yes	yes	2	2	yes		The second secon
Herberton Shire	Herberton		none of the second seco	TOUR CONTRACTOR OF THE PROPERTY OF THE PROPERT	UO.	5	00	ОП	yes	1986	Philippe des aux consentations despus
Hervey Bay City	Pacific Haven	ů	a,b,c		yes	yes	2	yes	yes	1992	ı
Hervey Bay City	Urangan, Toogoom & Burrum Heads. Eli Waters Pialba	Q	a,b,c		yes	yes	6	yes	yes	17 March 1992	ŧ
Hinchinbrook Shire	Ingham/Lower Herbert area	a,b,c	b,c	a,b,c	yes	yes	5	yes	yes	1991	11.3 m
Inglewood Shire	Inglewood town	a,b,c	none	попе	yes	yes	5	yes	yes	1976	11 m

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Local Government		Town/Co	Town/Community				8-6		Щ	10-1	Ц	 	10-2		10-3			404		H	11-1	11-2	11-3	11-4	11-6	
Cairns City	Cairns city	ξį							****				ٍ م		2	- + ,				V a water	yes	2	0	e		
Cairns City Mulgrave 1 in 30	Mulgrave	-	Care Colombia to the Year of the Colombia to t	Second Adult Report		alter de l'alter de l'	1 in 30	disease again sugar start de			the agreement for the second s	and you allow a few search and	ou q	THE PROPERTY OF THE PROPERTY OF	ПО	. A . 9	A A COMPANY A CONTRACT OF THE	4 CA (100 CA) (100 CA (100 CA (100 CA (100 CA) (100 CA (100 CA (100 CA) (100 CA) (100 CA) (100 CA (100 CA) (yes	yes	OU .		yes	
Calliope Shire Tannum Sands, Boyne Island 1 in 20 w/o dam, 1 in 100 year with	Tannum	Sands, E	Tannum Sands, Boyne Island	pui	1 in 2	20 w/o da	am, 1 in 10 dam	10 year wi	ļu,	q	4	Management returnment of the second s		***************************************	On the second se	Table Comment of the	The state of the s	and the state of a space of A.	and the state of t	Company of the		οu	00	non no market ma	00	
Caloundra City	Kawana Waters	Waters			~ · 4 m					р			Р		g		yes	Control States of Control Stat				0	no yes yes	yes	2	;

Local Government	Town/Community	8-6	10-1	10-2	10-3	10-4	11-1	11-2	11-3	11-4	11-6
Cairns City	Cairns city		q	q	50		yes	ou 	OU		
Cairns City	Mulgrave	1 in 30	U	q	50		yes	yes	01		yes
Calliope Shire	Tannum Sands, Boyne Island	1 in 20 w/o dam, 1 in 100 year with dam	q		00	adeltad esperatorprintipati esper deprenduquementesperatoris desperatoris e esperatoris de l'appropriedad de c	yes	no no	DO		2
Caloundra City	Kawana Waters	The state of the s	q	q	or	TROUGHANT TO THE	yes	DO.	yes	yes	2
Cambooya Shire	Cambooya				2		yes	2	E		2
Cardwell Shire	Tully Heads, Cardwell, South Mission Beach	. Its vist and the same alternative and the same of the same and the s	q	q	9	A CONTRACTOR OF THE CONTRACTOR	yes	yes	yes	yes	2
Carpentaria Shire	Kurumba	A CAMPAN CANADA CAMPAN CANADA	:	a de la composiçõe de l		AND THE PROPERTY OF THE PROPER					
Carpentaria Shire	Normanton		ro.	ro,		a,b	yes	2			,
Chinchilla Shire	Chinchilla	1 in 20	ပ	q	yes	b,c, recorded message	2	:			
Cook Shire	Ayton		æ		yes		yes	yes	yes	yes	2
Cook Shire	Coen	A CONTRACT C	8		<u>о</u> г		yes	9	2	2	2
Cook Shire	Cooktown (including Marton)		ĸ	O	yes	a,b	yes	yes	8	<u></u>	2
Cooloola Shire	Gympie	< 1 in 50	ပ	q	2		yes	yes	yes	yes	yes
Croydon Shire	Croydon		υ	O	yes	a,b, telephone	yes		yes	yes	9
Daiby Town	Annual Control of the		O	9	yes	p'c'q	yes	yes	yes	yes	yes
Diamantina Shire	Birdsville	AND THE OWNER OF THE PARTY AND	O		5		yes	2	yes	yes	2
Douglas Shire		egon quan en meror en	V) and Work of the property of the control of the c	d phylodenny a quantitation and a phylore in participation of the second							
Eacham Shire	WARE REPORTED THE SECOND PROPERTY OF THE PROPE	. планда, Лиши (q	TO THE PROPERTY OF THE PARTY OF	п 0	налист далын фринялы дар фильма далыр фанда түйсөн түүлөн түүлөн түү	yes	yes	2		9
Emerald Shire	Emerald	1 in 40	n	. O	yes	oʻq	yes	yes	yes	yes	yes
Esk Shire		1 in 7	Q	O	은		yes	yes	yes	yes	yes
Gatton Shire	Grantham		q	activating counter disaster organisations	20		yes	yes	ПО	yes	0
Gayndah Shire	Gayndah	in Period (see the CV), and CV, and the control of control of the CV and the	O WAR	ab b	oп		92			-	
Gladstone City	Gladstone	CHAPPERSON, INVESTOR IN A JUSTINATE RESERVE BOXISTONES AND AND AND AND AND AND AND STREET OF THE PROPERTY OF T	and the state of t	man i richar in a mandeydaman in Quanter dendir od is manga hamadaya inggayên jingêye yebi. Yebis in yebis in	reson, di resona di giri tivo finales	Activated in November Residence in our destrobled communities in stable and advisority in memory resiscous in speace with every contractive to the contractive in the	0.	1	27. 94.	And the second s	
Gold Coast City	Nerang	1 in 80	p'c		yes	phone-in					
Goondiwindi Town	Goondiwindi		υ	Q	yes	notice at town gauge	yes	2	2		2
Herberton Shire	Herberton	The definition of the control of the	ю	TO	2	And the second s	yes	2	<u>С</u>	no	DO
Hervey Bay City	Pacific Haven	•	p'c	ပ	yes	е	yes	yes	2		yes
Hervey Bay City	Urangan, Toogoom & Burrum Heads. Eli Waters Pialba		o'q	O	yes	a,b	yes	yes	ou.	Pro dis una disupper	yes
Hinchinbrook Shire	Ingham/Lower Herbert area	1 in 20	o'q	O	yes	b, phone-in	yes	yes	yes	yes	yes
Inglewood Shire	Inglewood town	1 in 20	p'c	O	yes	a,b,telephone	yes	yes	yes	yes	20

Pacific no Inland no Inland no Inland no Inland no Pacific yes Pacific no Pacific yes Pacific no Pacific yes Pacific no Inland no Inland no Inland no Inland no Pacific yes Pacific no Pacific yes Inland no Inland no Pacific yes Inland no Pacific yes Pacific yes Inland no Pacific yes Pacific yes Pacific yes Inland no Pacific yes Pacific yes Pacific yes	no Brisbane/Bremer no Barcoo no Alpha Creek no Jordan Creek no Lagoon Creek no Cakey Creek no Kilcoy/Sheepstation Creeks no Stuart River no Laidley Creek yes Fitzroy	135 000 140 340 160 9-18 000 150	+2% 4 0 0 0	0	3 0	0 4 4		on on on			1
Pavicin City Pavicin City			0					5 G	The state of the s		1
Sisford Inland) O C			, , , , , , , , , , , , , , , , , , ,		2			1
Alpha Inland In			0 6								1
Jericho Inland no			c	-	,					. :	
Te		.,		55	5			2	The same of the same of the same of		-
Dondaryan township Inland no Oakey Inland no Oakey Inland no Killcoy Pacific no Kilngaroy Pacific no Mackay Pacific yes Whole of Shire Pacific yes Whole of Shire Pacific yes Whount Isa Inland no Mount Isa Inland no Mount Wouth Morgan Inland no Ire Mundubbera Pacific yes Ocharleville Inland no Charleville Inland no Charleville Inland no Charleville Pacific yes]	+1%	2 500	150 5	2	0	yes 1996	ate and specific production of the con-		yes
Jondaryan township Inland no Oakey Killcoy Pacific no Pacific no Pacific no Pacific no Pacific no Pacific yes Whole of Shire Pacific yes Pecific no Finch Hatton Pacific yes Mount Isa Inland no Inland no Pacific yes Pacific yes Pacific yes Pacific yes Pacific yes Pacific yes Pacific no Pacific yes Pacific no Pacific yes Pacific no Pacific yes Redcliffe Pacific yes Pacific yes		-	~1%	~60	4			2		rom w.	2
Nerimbera Inland No			+1-2%	1100	100 5	50	30	no	And the state of space of the tentor		
Kilcoy Pacific no Kingaroy Pacific no Nerimbera Pacific yes Mackay Pacific yes Whole of Shire Pacific yes Mount Isa Inland no Mount Worgan Inland no Mount Worgan Inland no Charleville Inland no Charleville Pacific yes Cunnamulla Inland no Cunnamulla Pacific yes Redcliffe Pacific yes Redcliffe Pacific yes Bay Island Pacific yes		~ 4 5		\.\	J.		20	00	and the same of th		1
Kingaroy Pacific no Nerimbera Pacific yes Mackay Pacific yes Whole of Shire Pacific yes Whount lsa Inland no Mount worgan Inland no Augathelia Inland no Charleville Pacific no Cunnamulia Inland no Cunnamulia Pacific yes Redcliffe Pacific yes Redcliffe Pacific yes Bay Island Pacific yes		1 650	+1.8% t	3	2	3		2			į
Nerlinbera Pacific no Mackay Pacific yes Whole of Shire Pacific yes Whole of Shire Pacific yes Whout Hatton Pacific yes Mount Isa Inland no Augathelia Inland no Charleville Inland no Cunnamulla Inland no Cunnamulla Inland no Redcliffe yes Redcliffe yes Redcliffe yes Bay Island Pacific yes		000 8	+3.0%		Salindamente	apparace united	generally couped comments to	2	*		*
Mackay Pacific yes Whole of Shire Pacific yes Whole of Shire Pacific yes Whout Isa Pacific yes Mount Isa Inland no Mount Worgan Pacific no Augathelia Pacific no Charleville Pacific no Cunnamulla Inland no Cunnamulla Inland no Redcliffe yes Redcliffe yes Bay Island Pacific yes		13 500	+7%	3595	150 🐪 2	52		2			
Mackay Mackay Whole of Shire Whole of Shire Pacific		400	+2%	180	4	2	10	2			
y Mackay Pacific yes Shire Whole of Shire Pacific yes gh City Pacific yes hire Finch Hatton Gulf no city Mount Isa no Shire Mundubbera Pacific no nire Augathelia no nire Charleville Pacific yes re Cunnamulla no re Cunnamulla no re Cunnamulla no ire Quilipie no ire Quilipie pacific yes city Redcliffe pacific yes hire Pacific yes		160 000	+3.5% 5	52, 435 1	1 125 1 (1 010	732	2		!	e :
Whole of Shire Pacific yes Whole of Shire Pacific yes Whole of Shire Pacific yes Gulf no Gulf no Gulf no Gulf no Mount lsa Inland no Augathella Inland no Charleville Pacific yes Pacific yes Cunnamulia Inland no Redcliffe Pacific yes Redcliffe Pacific yes Redcliffe Pacific yes	yes Ploneer River	55 000	+2%	25 648 1	1 479 9	938	250	yes 1918	-	• • •	yes
whole of Shire Whole of Shire Finch Hatton Mount Isa Mundubbera Augathelia Augathelia Inland Charleville Cunnamulia Pacific Pacific Pacific Pecific Pec		108 000	+5.5%	27, 000			. y	2			
Pacific yes Gulf no Gulf no Mount Isa Inland no Mount Worgan Inland no Augathelia Inland no Charleville Pacific no Cunnamulia Inland no Pacific yes Pacific yes Pacific yes Redcliffe Pacific yes Redcliffe Pacific yes		28,000	+1 2%	9 467	7.06	and the same of the same of the same of	350	yes Feb	Feb 1976		yes
Finch Hatton Pacific no Mount Isa Inland no Mount Wigan Inland no Augathelia Inland no Charleville Pacific no Cunnamulia Inland no Quilpie Pacific yes Redcliffe Pacific yes Redcliffe Pacific yes Redcliffe Pacific yes Bay island Pacific yes	yes Mary Kiver	-		-			Name of Contract o		and concerning the property and the con-		
Finch Hatton Pacific no Mount Isa Inland no Mount Worgan Inland no Augathelia Inland no Charleville Inland no Cunnamulia Inland no Cunnamulia Inland no Redcliffe Pacific yes Redcliffe Pacific yes Bay Island pacific yes	no Nth-Flinders River, Sth-Diamantina	1 300	0	280	30	е.	10	00	make being the common to the at the co	and the same	Control of the Contro
Mount Isa Inland no Mount Morgan Inland no Mount Mount Morgan Inland no Charleville Inland no Cunnamulia Inland no Cunnamulia Inland no Redcliffe Pacific yes Redcliffe Pacific yes Redcliffe Pacific yes	no Cattle Creek		0	120	우	 س	ഹ	00	The second secon		1
Mount Morgan Inland no Mount Morgan Inland no Charleville Inland no Cunnamulia Inland no Cunnamulia Inland no Cunnamulia Inland no Redcliffe Pacific yes Redcliffe Pacific yes Redcliffe Pacific yes Redcliffe Pacific yes	no :Leichhardt	24 000	0	7369	250		920	2	San Archest day Justines mecuments		and the second
Mundubbera Interior no Augathelia Inland no Charleville Inland no Charleville Pacific no Pacific yes Pacific yes Pacific yes Pacific yes Redcliffe Pacific yes Redcliffe Pacific yes Redcliffe Pacific yes	1	4 000	+1%	1 262	54	15	2	DO	enders, Oddodjer vjengs te transfer 🕏 (o	-	Vandy de College
Augathelia inland no Charleville inland no Cunnamulia inland no Cullpie intand no Redcliffe yes Redcliffe Pacific yes Redcliffe Pacific yes	1	1250	+0.9%	550	55	8	٤	2			1
Augathelia Inland no Charleville name Pacific yes Cunnamulia Inland no Pacific yes hire Pacific yes Redcliffe Pacific yes Redcliffe Pacific yes	Systems Systems	400	-5%	And the control of th	4			5		-	and so a November 2
Charteville inland no Cunnamulia Pacific yes Cunnamulia nolatific yes Redcliffe Pacific yes Redcliffe Pacific yes Redcliffe Pacific yes	1	3 500	+0.2%	1750	80	20	40	<u>о</u>		e as . w	
Pacific Ito Cunnamulia Pacific yes Redcliffe Pacific yes Redcliffe Pacific yes Redcliffe Pacific yes	:	2 800	+5%	1000	20	20	3	ло			
Cunnamulia Inland no Cunnamulia Inland no Pacific yes Redcliffe Pacific yes Pacific yes re Bay Island Pacific yes		30 000	+10%			200	1 000	yes Feb	Feb 1992		2
Cunnamulla Inland no Quilpie Inland no Redcliffe Pacific yes Redcliffe Pecific yes		900 9			•	-	20	00	di belganji nemamanini jeye i diyeje in		,
Pacific yes Quilpie Inland no Redcliffe Pacific yes Bay Island Pacific yes	no Warrego	200		200		-	5	,00c 1003			Ves
Quilpie Inland no Redcliffe Pacific yes e Bay Island Pacific yes	:	110 000	*44%	35, 000	935 46	ç	3	, co ,	:	T F	<u>}</u>
Redcliffe yes Pacific yes Bay Island Peoific yes	no Bulloo	029	· · ·	300	. }	7	e description of the	1			000
Bay Island Pacific yes	yes Saltwater Creek/Coastal	50 052	+0.6%	17 085	456	483	365	yes 1974	4 ·	* 1	Sp.
The state of the state state of the state of	yes Moreton Bay	2.810	%8+	900				yes		1	은 :
Dark Brower Street Capalaba (Pacific yes Tin	yes Tingalpa Creek	15 homes		15	1	• [2	1		2 :
Richmond		006	0	665	15		7	٤ .			
Bookhamnfon Pacific 10	no Filzroy	65 000	+1-1.5%	27 000			www w	OU .			
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Local Government	10wn/community	4-1	4-7	4-3	4-4	4-5	4-6	4-7		4-8
Ipswich City	ilpswich city	1974	4 105 m3/s	3 to 4 days	1635	200		66		υ
Isisford Shire	Isisford	April 1990		2 weeks	0	0	0			υ
Jericho Shire	Alpha	April 1990	The state of the s	2 days	(123	(F)	A CONTRACTOR OF THE CONTRACTOR	· •	*0	; o
Jericho Shire	Jericho	April 1990	the first through the second of the second o	3 days	55	5	The second of th			: : o
Johnstone Shire	. Commentation contracts a contract contract of the deletament of contracts of the force of the	1913	A Marie Committee of the Committee of th	and the state of t	The second secon	· · · · · · · · · · · · · · · · · · ·	and the control of th	The second secon	\$, 0
Jondaryan Shire	Jondaryan township	May 1996	A data seed on the control of the co	ericke der bestehn den er er er beginne	and the state of t	The contract of the Contract o	a market and the season and the seas		i i	· ·
Jondaryan Shire	Oakey	1983	Addition to the state of the st	few hours	12	Andrew and Complete to comment of the restaurant of the seconds.	in death for despiritions. The second engineering destruction of the control of t	And the second s		و
Kilcoy Shire	Kilcoy	1897	The second secon	4 days	4		The state of the control of the control of the state of t			:
Kingaroy Shire	Kingaroy	March 1982		3.5 hours	4	Section and the section of the secti	ender von der	The state of the s		ن ز
Laidley Shire	To the second of the second se	1974	See The Control of Con	5 days	200	08	of control environment of control and although the additional definition of the anticontrol of the additional and the additional anticontrol of the additional and the additional anticontrol of the additional and the additional and the additional anticontrol of the additional and the additional and the additional anticontrol of the additional and the additional anticontrol of the additional and the additional anticontrol of	de Trade a describirados de comunidades de participados menos estados de participados de parti		
Livingstone Shire	Nerim bera	1918		e designant participation of the company of the com		The state of the s		The same and the same of the s		υ
Logan City		1974	4 650	3 days	2 034	51	833			ф.
Mackay City	Маскау	1958	9 439	24 hours	(6 800	An aide d'utantific, à l'archeannais répains verd s	The service of control procedures are designed to a control and the service of th	Company of Communications of the Communication of t		۔
Maroochy Shire	Whole of Shire	1992		12 hours	200	0		0		
Maryborough City		1893	25 000	5 day	330	(20)	20	•		. 0
McKinlay Shire				٠			A transferant rate of managements the promption of the command of the commandation of	***	•	υ
Mirani Shire	Finch Hatton	1958	1			. ග	A MAN TO THE THE PROPERTY OF T	0	:	υ
Mount Isa City	Mount isa	1974	•	7 days		50	The strength of the strength o		r	۔ د
Mt Morgan Shire	Mount Morgan	1929	12 000	2 weeks	ro.	0	The state of the s	0		U
Mundubbera Shire	Mundubbera	9-13 Feb 1942	River height 108 ft	3 days	30			0	: - 	. v
Murweh Shire	Augathella	20 April 1990	3 400 m3/s	***************************************		And department of the control of the	the control of the statement of the control of the	to the state of th		:
Murweh Shire	Charleville	20 April 1990	5 700 m3/s	3 days	1 250	all	O	20		ပ
Nanango Shire		1974	The state of the s	2 hours		0	1 school	The second secon	e quanto	þ
Noosa Shire		Feb 1992	er wester		83			2 council + 2 private parks	+2 Ks	٩
Paroo Shire	Cunnamulla	1990 April		2 weeks	2	0	O			0
Pine Rivers Shire		Jan 1974	· · · · · · · · · · · · · · · · · · ·	1 day	, - 6/4, 4m			Andrew Control of Cont	and the second second	
Quilpie Shire	Quilpie Quilpie	4/1963 A/1963 A/1963 A/1963	er eine der	And the state of t	0	And the Anthropology and Library and Anthropology and Ant		0		O
Redcliffe City	Redcliffe	1974	an was a share	6-12 hours	. 50	20	20	50		q
Redland Shire	Bay Island	en de de la composition della	The state of the s		2 000 8	Dates by an elementary statement and the same statement.	a mendender i den statum menden system i mengen system menden statum sing den service den service de service d	the state of the s		V - V W 1444
Redland Shire	Part Brewer Street Capalaba	Acceptant communication and an extension of the second politics of the second second politics of the second	the products of the day of the da	Commence of the state of the st	0	The state of the s				
Richmond Shire	Richmond	1974	and the second s	21 days	0	0 1		0		
Rockhampton City	Rockhampton	1918	23 500	14 days	(14)	161		. •	-	υ

	T	Φ.ν	4.10	4-11	4-12	4-13	4-14	4-15	1-0	7-C
Local Government	lown/community loswich city	î o	a	q	q	q		24-48 hours	yes	process of the second s
And the second of the second o	is in the second	P			. ro	60	to the state of th	3-4 days	yes	
	SISIOI U						The second secon	24 hrs	yes	
A TENERAL PROPERTY OF THE PROP	AIDTA			ء د		ء		24 hrs	yes	And the second of the second o
Jericho Shire	Jericho	נ		3	9		And the second s		american construction of the construction of t	The second secon
Johnstone Shire	egysteller (to the extension of a complete styre insulating and the extension of the complete styre of the com	٥	q	٩	Ω	0	(otally immobilise confirmality	7 = 10		and the second of the second o
Jondaryan Shire	Jondaryan township	æ	U	æ		ro :	According to the second	The second name of the second second second second	DINGS	יומכת עו השפעות מש
Jondaryan Shire	Oakey	в	æ	rs	_ م	٩	The property of the second section (ASA) is the second second second section (ASA). The second section (ASA) is the second section (ASA).	7 hours	little	lack of resources
of head of the same of the party of the	Kilcoy	p	U	Land Strike Street		angelon of the second	des place, as general momentum des and the same as company (or let by 1 = 1 and the pay property and the Active by the momentum desired.	And the state of t	00	est e a mandele des establemente este commenten e taman commentante (capat estamante commente
Ire	Kingaroy	O.	q	0	q	æ	access - major difficulty	1 day	minimal	e de desente mande est et est pop des des planes es des est est des planes des designates de designates de desente de desente de designates de
and the state of t		0	O	p	d	9	ambulance, hospital, fire dept - all isolated	1 day	some	1 i de en mer en est es aporte aporte de entre d
hire	Nerimbera	o	q		Commence of the control of the contr	a take a company of the second	A A A A A A A A A A A A A A A A A A A	Annually is presidently experimental annual and and an experiment by (*** ** "Andrews"). Annually is presidently experimental annual and the contract of the	ou o	heights in adjacent shire are recorded
		q	U	۵	Q	۵		6-8 hrs to 2 days	yes	The second secon
Mackay City	Mackay	9	Э	O	q	Q	Access roads may be cut	6-12 hours	yes	A
Maroochy Shire	Whole of Shire	-	В	70	q	o.		> 6 hours	yes	e uur warrander ee, diseel gere, warranner i Grobe dan de foel de Verenigien warrande diseable de Glam Virtus werpsande Annet.
Maryborough City	andre and any angular members of a minimum of the property common and the property and the property of the pro	q	В	6	q	0		3 days	yes	т се става в селава са стор до степература в деватовата положен предсествення селава постава селава селава сел
McKinlay Shire	AMERICAN AND THE THE THE PROPERTY OF THE PROPE	J	e	0	es es	a	A CONTRACT OF THE PROPERTY OF	ı	υo	urban areas unaffected
manufacture of the property of	Fireh Hatton	p	U	q	q	q	** ** ** ** ** ** ** ** ** **	few hours	yes	\$.
-A-THI-A-A-A LAMANDANIM MENANGHANAN AND MINISTER MENANGHAN AND MENANGHAN	e de la companya de la composição de la composição de la companya del companya de la companya de la companya del companya de la companya del la companya del la companya de	The state of the s		· c		٩	the state of the s	The state of the s	limited	The state of the s
Mount Isa City	MOUNT ISA		J	Contraction of the last of the	CO CONTRACTOR AND	d	der endelfelderingen der	12 hours	yes y	
Mindubbera Shire	Mundubbera	D	p	P	þ	q	and county properties and safe of the properties of a properties of a properties of a state of the safe promovement formal and	24 hours	yes	
Murweh Shire	Augathella	published based framework procedure book to					And the state of t	er ogginn er detende i vila og degen – velnaretild (AVID-18) (delette – g englan er detende i ven vyraven) de aministe de la la territor – g englan er senske i ven vyraven) de aministe de la la territor – g	to the contract and the contract of the contra	The first of the first of the second
Museum Chiro	Charleville	O	2	q	q	q	all essential services affected	24 hours-3 days	yes	
muwen June		p	2	æ	q	, a	American in the state of the st	2 days	OU	cost of damage didn't warrant survey
Nanango Snire Noosa Shire	e de la companya de l	9	q	o	q p		the state of the s	12 hours	yes	
Paro Shira	Cunnamula	O	в	В	8		man Maria (indicatorismos estados en estados primaros mantes en estados (indicatorismos de estados en entre en estados en estados en estados en estados en estados en entre en estados en entre en estados en entre en estados en entre entre en entre en entre	5 days	yes	m. (m. 1984) de la Companya (m. 1984) de la Co
Pine Rivers Shire	dende of the state	<u> </u>	D	0	The second of th	60	minor limitations on services as a result of local flooding	6-12 hours	yes	т ден и под се под Се под се под
Quilpie Shire	Quilpie	3		0	0	8	engapanananintelestationen en		ΠΟ	e – U. A travelski a modala in 4.1 d.C.Pradițient ferminaram de Andrij Vereziana i moderatorationel de est
Redcliffe City	Redcliffe	p	q	a	٩	····		3-5 hours	yes	ga ang inguna sa jakganas, i inger anyananahan, pinangan gerangan penyangan penyangan kanggangan orang
and Angelston and Chiral Chira	Bay Island	prof. Appelant covers on the facility	The state of the s		The second secon	-			no T	er ann e grang bringer kommed da interferjellen in betrep betannen den den bestelligt bestelligt betretter inter
Redland Shire	Part Brewer Street Capalaba	AND AND RECOGNISHED AND PROPERTY OF	A continuent of the property o	The second secon	(A) (A) the special worked was provided and section of the contract of the con	W Accessors in a commercial area on the Additive			no	echarije (une prospenie autonomy met 6 de Pepalais, principal anglede de Abbield (1900-ya). Un 5 de paris, prospenie serven
Richmond Shire	Richmond	0	q	0	В	q		36 hours	ПО	
	Rockhampton		q	ro.	n	rd		up to 14 days	yes	AN - 1-2000A

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	town community	Reference material, Flood warning,	†	6-6	0-0	ò	0-0		5-10	11-6
					6 m to 2.2 m (tidal					•
	ich city	prediction	yes	100 years	influence)	7 m	24.7 m	1893	yes	p'oʻq
	ord	predict flood levels downstream	yes	35 years	2 3	£	10 m	April 1990	yes	Д
	r.	town planning and warning information	yes	6 years	Eo	8 m	10.26 m	20-4-1990	yes	9
	.ho	town planning and warning information	yes	6 years		The state of the s	1.1 m	April 1990	yes	p
-			yes	7 years					2	oʻq
Johnaryan Shire	Jondaryan township	general information	2					· · · · · · · · · · · · · · · · · · ·	some	Ф
Jondaryan Shire Oakey	V	general information	2	• • • • • • • • • • • • • • • • • • •					some	۵
Kilcoy Shire Kilcoy	And the second temperature of the second temperature and tempera		2	:				<i>:</i>	2	ø
Kingaroy Shire Kingaroy	aroy	flood investigations	2						2	ю
Laidley Shire		building control, town plan development	yes		Box 14 mages developed to 1.0	÷ · · · · · · · · · · · · · · · · · · ·			yes	p'c
Livingstone Shire Nerim	Nerimbera		2				9.72 m		2	, ro
900 de la 1047 school /		Flood plain management for rezoning, subdivision and building control including emergency, management	yes	40 years	1.5 m (tidal)	3.5 m (varies)	13.7 m	1974	yes	p'c'q
Mackay City Mackay	ay		yes	25+ years	tidal	4.3 m	6.05 m	1958	yes	Ф
Maroochy Shire Whole	Whole of Shire	model calibration and issuing of fill and floor levels	yes	40 years			TO THE CONTRACTOR OF THE PART	The state of the s	0	. U
Maryborough City		public information on property flooding	yes	100 years	3.0 m	4.40 m	12.27 m	1893	yes	p'q
McKinlay Shire		~~~	2					The same of the sa	ou	B
Mirani Shire	Finch Hatton	Local Town Planning, Flood estimation, River Management	yes	recent	A Company Superintendent of the Control of Superintendent	The state of the s	93.7m S.D. (1958 flood)		yes	p'q'c
Mount Isa City Mount Isa	it isa	er e	2	and the state of t	to distribution plant and demonstrate in the day of a special part performs	democratic deservation and management representation of the second secon	- Stock - Griph N. Patrials (N. V.) Walter Stock (Stock of American Stock)	And the state of t	20	q
Mt Morgan Shire Moun	Mount Morgan	dam design	οu	comments of the second	and property of the control property of the control				00	
Mundubbera Shire Mund	Mundubbera	reference	yes	10 years	-2 m	14 m			00	ro
Murweh Shire Augat	Augathella	AND THE STATE OF T		the section of the se	Belle Me De	6 m	7.28 m	April 1990	yes	٩
	Charleville	flood warning, etc.	yes	87 years, 7years: telemetric system	0.0 m	6.5 m	8.54 m	20-4-1990	yes	p'q
Nanango Shire	ANAMERIE IN VERVERA AV VIEW SI MISSER V. SEGARAN SI SI VERSA AN ASSASSIVA SI SEGARAN SI SEGARAN SI SEGARAN SI Segaran Segaran		2		A STATE OF THE PARTY OF THE PAR	To the control of the		The second secon	00	ros
Noosa Shire		1992 flood used as benchmark	sek	8.5 years			1.81 m	23/2/92	yes	p'q
Paroo Shire Cunna	Cunnamulla	flood prevention measures	yes	many years	and the second of the second o	8.5 m	10,25 m	April 1990	yes	d,e
Pine Rivers Shire		Flood advice to owners. Verification of hydrological model analysis	2			· · vvacanu			yes	p'q
Quilpie Shire Quilpie	[e		2	to companyon analogy years never forms a warmer analogue on the party was provided and analogue of the party was provided and analogue on the party was provided and analogue of the party was provided and analogue	source of the state of the stat				00	ď
Redcliffe City Redcliffe	liffe	Verify computer programs to define floods. Set minimum floor levels	2		The same and				yes	q
Redland Shire Bay Island	stand				And the second s		4		2	
Redland Shire Part B	Part Brewer Street Capalaba		00	Wyjning to your second makes and the second makes a	Company of the Compan			armony professional	υ	A CONTRACTOR OF THE CONTRACTOR
Richmond Shire Richmond	election and the second	The second contract of the second sec	2	The state of the s	- Annual Control of the Control of t	The property of the state of th	* Prima all februaries (* 200 men prefestion and a manach de-stable in debute	resource by made as complete in the complete page.	ou .	o
Rockhampton City Rockh	Rockhampton	flood prediction and warnings to households	yes	138 years	-1.5m to +1.6m (tidal)	6.2 m	9.7 m	Feb 1918	yes	q

-						Design		25	200			Ā	APPENDIX 1	1X 1
Local Government	I own/Community	P-9	6-2	6-3	6-4	6-5	9-9	6-7	8-9	6-9	6-10	6-11	6-12	6-13
Ipswich City	Ipswich city	ou		yes	yes 1 i	1 in 20	yes	 o	ar Takon		****		yes	5
Isisford Shire	Isisford	0						4			*			*
Jericho Shire	Alpha	yes	1 in 50		7	1 in 50	yes) . q	120	15	0	0	01	00
Jericho Shire	Jericho	00	1 In 50	6	no 1 i	1 in 50	yes	9	55	5	+		yes	Ves
Johnstone Shire		yes	1 in 50	-	1. Or.	in 50	yes	b,c						,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
Jondaryan Shire	Jondaryan township	лужи и по	is to standard and another property and the standard content of the standard content and the sta	A Emperature and the contract and the co	As a solution of comments of	-	-			per complete programme and the complete			- Control of the Cont	2
Jondaryan Shire	Oakey	ПО	of the same of the control of the state of the state of the state of the same	A Market Contract Con	empressed sample of made of the	The state of the s	and the state of t		Was and the second of the second	- Terre and the second of the	-	de Constitución de como de respecto de la constitución de la constituc	A transport of the second	THE WAY CANADO WAS A COMMON OF
Kilcoy Shire	Kilcoy	ПО	Proceedings of the control of the co		and the state of t		-		Section and the section of the secti	a mandad distribution of the control		The second secon		The state of the s
Kingaroy Shire	Kingaroy	OU	design of the control and the control of the contro	UD	no 1 ir	1 in 50	90	0		Address of the contract of the		adjusterments communications	2	2
Laidleý Shire	A medickar resource sea, resource sea, visit se kingdisk had respectively and a triple season season.	TO The relative of the relativ	in 20 and 100	2	no 1 in 5	in 50, 100	2	7	150	50	2	0	00	: OL
Livingstone Shire	Nemina	80							V					?
Logan City		yes	1 in 2, 10, 20, 50,100, other: 1974 and > 1 in 100 & 500	- - -	1974 flo	1974 flood, 1 in. 50, 100	yes b	b,c,d	2 034	(\$1)	(83)	189	. e	yes
Mackay City	Mackay	yes	1 in 10, 50, 100, 60 and 200	2	ло 1 in 4	in 42, 50	02	а			TANK TANK TANK		yes	. 00
Maroochy Shire	Whole of Shire	yes	1 in 20, 50, 100		1 jn	1 in 100	ou Ou	V	< 50	minimmal mi	minimmal	minimmat	92	yes
Maryborough City		00		Comments of a change of the comments of the change of the	and the state of t	William da fanor da -	a hard of the same	The harden and the second		and the state of t	er e			:
McKinlay Shire		υO			And the state of t			Contraction of the Contraction o	And the second s		San Parket	And I the Mark option when you do Andrew were	1	:
Mirani Shire	Finch Hatton	00		LO L	no 1958	1958 flood	yes	b	55	5	2	The same of the sa	00	yes
Mount Isa City	Mount Isa	yes	1 in 5, 50, 15	J 0L	no 1 in	1 in 15	yes	C 5	50	20		The second second	92	. 2
Mt Morgan Shire	Mount Morgan	ПО	e establishe e establishe e establishe e e e e establishe e e e e e e e e e e e e e e e e e e	01	ou ou	попе	2) e					2	2
Mundubbera Shire	Mundubbera	00	Alama Valentina		w	den 18 19 19 19 19 19 19 19 19 19 19 19 19 19	,			Williams and Advisor to the control of the control	And the second s	C to A commenced of Administration of Administra		The same of the sa
Murweh Shire	Augathella	yes	The second secon	02	no l	-			amen of conditions of the contract of the cont	Table 1 Add Proprietation Commences and an an	4	to the second of the second of the second	yes	yes
Murweh Shire	Charleville	yes	1 in 100, 150	2	ou	State Street	yes	p		The state of the s			yes	yes
Nanango Shire		ПО	The state of the s	1	The second of th					The state of the s		Andrew Commence of the Parket		and the state of t
Noosa Shire	од од Сом од	yes	1 in 20, 50, 100	yes	yes 1 in	in 100	yes 1	9) q	90	(20)	0	0	yes	yes
Paroo Shire	Cunnamulia	yes	1 in 100	00 ye	yes 1 in	in 100	2	a	2		Appellon 14 windows as mount, pea	electrical and a second	10	ПО
Pine Rivers Shire		yes	1 in 2, 50, 100	yes	yes 1 in 50	in 50, 100	yes b	b,c			***************************************		2	2
Quilpie Shire	Quilpie	OU .	A de la company de la comp		The second		: : :							·
Redcliffe City	Redcliffe	yes	t in 2, 5, 10, 50, 100	ог П	no 1 in '	1 in 100	yes t	b 2	20	0	10	0	 UO	yes
The state of the s	Bay Island	yes	1 in 100, tidal storm surge	yes ye	yes 1 in	in 100	yes d	1 20		to be the second format of the second	-			:
S. A. and A Co. and W. Co. and W. Co. and Co.	Part Brewer Street Capalaba	yes	1 in 100		1 in 100		yes b	15	5		-		2	
Richmond Shire	Richmond	now references to the special despectation	The desired state of the state		попе		00	0		- 0	0	0		
Rockhampton City	Rockhampton	yes	1 in 2, 5, 10, 20, 50,100	yes yes	s 1 in 100	* * * * * * * * * * * * * * * * * * * *	yes b						yes	yes

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Local Government	Town/Community	7-1	7-2	7-3	7-4	7-5	7-6	7-7	8-1
Ipswich City	ipswich city	yes	derived 1 in 20	yes		0,3 m	combination in various circumstances	a,b,d	
Isisford Shire	Isisford	yes	Q	yes	<u></u>	•		a,b	
Jericho Shire	Alpha	2		yes	} ;	0			
Jericho Shire	Jericho	0		yes			The state of the s	Property and the state of the s	CO :
Johnstone Shire	mente en a depen antique per estada en antiquan a caracteria de la proposación de la proposación de manda de l	2		2				b, building application	OS.
Jondaryan Shire	Jondaryan township	C			-				попе
Jondaryan Shire	Oakey	2							попе
Kilcoy Shire	Kilcoy	2						Allow I designation of the second of the sec	q
Kingaroy Shire	Kingaroy	2		- 1		90 O		The second secon	stream modification and clean up
Laidley Shire		2	Ю	2	as per QUDM	300 mm	O	ם	
Livingstone Shire	Werimber Product of Anna Contraction and Anna Contraction of the Anna Contraction of the Production of	no	enters of other particular content of the content o		The second of th	An experience and product to the Contract of the section of the se	CONTRACTOR OF THE CONTRACTOR O	ing men di deleksik deleksik deleksik deleksik bela sek saaksa sama saken deleksik deleksik deleksik sek Bela seksik deleksik deleksik deleksik deleksik saken deleksik deleksik deleksik saken deleksik deleksik delek	and the state of t
Logan City		yes	q	yes	edicipal de Liberty Base i str. sed. 1111 c. microsco.	150 mm	b _c c	a j.b	p'o
Mackay City	Маскау	yes	physical model	yes			Ω	þ'q	ပ္ပံဧ
Maroochy Shire	Whole of Shire	yes	d,s	yes			۵	a,b, Brisbane Flood Mitigation Act	ပ္
Maryborough City		yes	В	yes		0.3 m			p
McKinlay Shire		2					,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		попе
Mirani Shire	Finch Hatton	yes	q'e	yes		300 mm	1958 flood	p'q	
Mount Isa City	Mountisa	yes	9	yes	The second secon	Compared to the contract of th	Special district of the minimum and the minimu	for a decision of the contract	annered and the contract of th
Mt Morgan Shire	Wount Morgan	9	the constant policies (A. Palacie) (A. Calebo (A. Caleb	and any use were discovered	And the second s	The second straining of the second se	decommon will be dec. the contract of the contract of the contract of the decided	dia dihawara cara, hoda karamana dia da masa apaga da masa	the second department of the second s
Mundubbera Shire	Mundubbera	yes	æ	yes	:				
Murweh Shire	Augathella		The section and the section of the s		Se Milliand, group in the first pay part of the first in the first in the first payment by	dende dan de versidano e sene e care e de area de celebrato de celebrato de la capital de la capital de la cap	The second of th	дет чест под видентериосивания в денимати симентивно в сел с честовность с сел с	none
Murweh Shire	Charleville	yes	a, local knowledge	yes			G.		ם מ
Nanango Shire	andere de la companya de la company La companya de la companya del companya de la companya de la companya del companya de la companya del la company	2	eng we have described invasional for the first were miss described in the contract of the cont		Commence of the commence of th	AND THE RESERVE AND THE PROPERTY OF THE PROPER	The company of the property of the composition of the company of t	entre en der	Company of the compan
Noosa Shire		yes	q	yes	The state of the s	0.6 m	Michael Michael Michael Manager project of province and address control of the co	d	redevelop above flood
Paroo Shire	Cunnamulla	yes	q'e	yes	And the control of th	in transfer on the College was a second of the college of the coll	Commercial and the commercial an	a,b,c	The contract contract of the contract c
Pine Rivers Shire		yes	d,e	yes	1.	0.6 m to 1.0 m	p,c	a,b,c	c, drainage schemes
Quilpie Shire	Quitple	9	the second secon	The second	the fact that the second secon	manuscripture opportunities of the contraction of t	The second in the second secon		And desired a market for section to a market of a market for the forest
Redcliffe City	Redcliffe	yes	q	yes	The state of the s	Andre enter enter and and former as a finished in the debugs and a second and a finished in the finished and a	no filling below Q100 fload	q	S
Redland Shire	Bay Island	2	те перед дей на предержавания в передержавания по передержавания в передержавания в передержавания в передержа	s and often direct Ambuse	en geograpologische es ein er dann eine dan einem bei ein eine der eine der	Abbades Anna Anna Anna Anna Anna Anna Anna Ann	q	q	The state of the s
Redland Shire	Part Brewer Street Capalaba	2	and the second s	The second second	And the second s	A tradition by information of the case of	des en		
Richmond Shire	Richmond	2	And the second s			tropological and the second	A CONTRACTOR OF THE CONTRACTOR		
Rockhampton City	Rockhampton	yes	a'p	yes			Q	۵	поле

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Local Government	Town/Community	7-0	24.0		ves	Ves	ves	ves	ves	May 1996	17.3 m
Ipswich City	Ipswich city	a,b,c	a'n'c	. A physical legister in the prompt register of Paper and register of parts	}	3	}	2	3	COOK STATE OF THE COOK STATE O	
Isisford Shire	Isisford	q	e de la composito de la compos	ey exemple - 1 - 14 2 - 1 - 1 - 1 - 1 mengen gapte 1 14 Miles 1 1 - 4 - 1		yes	yes	2	yes	1990	
Jericho Shire	Alpha	The state of the s	U	C	yes	yes	yes	yes	yes	April 1990	10.2 m
Jericho Shire	Jericho	U	U	C)	yes	yes	yes	yes	yes	Feb 1997	E 0.3
Johnstone Shire	information and control of the contr	o'ë	a,b,c	b,c	yes	yes	9	2	yes	1996	•
Jondarvan Shire	Jondaryan township	none			yes	yes	9	2	2	To provide the same of distance and distance and the same of the s	
Jondaryan Shire	Oakey	DON	y comments of the second secon	The section of the se	2	yes	2	ОП	2	1983	and the state of t
Kilcov Shire	KIICOY	The same same same same same same same sam	b _i c	p'q	yes	yes	ОП	9	2	1992	conseque to gar production of the conseque
Kingaroy Shire	Kingaroy	HONE	O	U	yes		2	2	2	Jan1996	e proper es expensives en habitats de contrato de establica de establica de establica de establica de establica
Laidley Shire	en e	a,b,c	Water Infrastructure Task Force	C Commission and the commission of the commissio	yes	yes	yes	ou`	yes	May 1996	a autoria (n
Livingstone Shire	Nerimbera	q'e	ALLEGORIAN CONTRACTOR OF THE STATE OF THE ST	en er der verster der der gerenden mellen franke der der der der der der der der der de	yes	yes	eu	2	2	Jan 1991	9,35 m
Logan City		a,b,c, property aquisition (DCP)	a,b,c	U	yes	yes	5	yes	yes	May 1996, Feb 1991	9.06 ш
Mackay City	Mackay	C	made varieties of the control of the	a,b,c, Pioneer River improvement Trust	yes	yes	2	yes	yes	Jan 1991	Andresia Property and Company and
Maroochy Shire	Whole of Shire	a,b,c	O	a,b,c	yes	yes	yes	00	yes	1992	
Maryborough City	naced supply the space and an amount of the supply of the	Commonwealth of the Common	No. of Company and Company of Com		yes	yes	yes	0	ou .	1992	9.48 m
McKinlay Shire	AND THE PROPERTY OF THE PROPER	попе	none	попе		yes				A CANADA CANADA A TARA A TARA A CANADA A A CANADA A CANAD	V was the adoption price in Proceedings concentration for the sec
Mirani Shire	Finch Hatton	a,b,c	a,b,c	a,b,c	yes	yes	2	yes	yes	1958	
Mount Isa City	Mount Isa	· ····································	O	The second section of the second section secti	yes	yes	2	ou .	ou .	1991	Was de la company of the second
Mt Morgan Shire	Mount Morgan	e de la companya de l La companya de la co		6 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	5	2	00	, no	yes	agis iyo garay mahamaddikishisistanya di wanayadan gibirada ddi	The state of state of the state
Mundubbera Shire	Mundubbera				yes	yes	yes	2	yes	1974	
Murweh Shire	Augathella	The control of the co	many many transfer of the contract of the cont	And the state of t	yes	yes	UO ,	ni no		4-2-1997	6.45 m
Murweh Shire	Charleville				yes	yes	yes	2	yes	3-4 Feb 1997	7.44 m
Nananna Shira	TO THE THE PARTY OF THE PARTY O	a,b		The second section of the	yes	yes	01	ou ,	yes	1974	In seaso case o present they are taken therefore
Noosa Shire	r day a soon was a soon a soon of the soon	Commence of the commence of th	v	And the state of t	yes	yes	е С	ou	yes	Feb 1992	1.81 m
Paroo Shire	Cunnamulia	q	a,b,c	a,b,c	yes	yes	u l	51	yes	1990	10.25 ш
Pine Rivers Shire	AND CONTRACT OF THE PROPERTY O	a,b	U	b,c	yes	yes	ou .	ou	yes	1993	
Quilple Shire	Quilpie	9	manananahkivethir heliphija //memarethiamli (b. de/Vyeels	nelike melikeriyakan an an mada kendelikeriyak yalami in kalabah mengalikeriya melikeriyak yalami in kalabah m	yes	yes	2	6	yes	The second secon	And the state of t
Redcliffe City	Redciiffe	Φ	ပ	C. C	yes	yes	2	2	00	1974	A STATE OF THE PARTY OF THE PAR
Redland Shire	Bay Island	Commence of the second of the	b,c	C	yes	yes	90	OU	00	Compression of the second seco	es delicate delement delicate est des maneres est.
Redland Shire	Part Brewer Street Capalaba	q		A PROPERTY OF THE PROPERTY OF	2		2	2	2		
Richmond Shire	Richmond		AND ADMINISTRAL COMPANY OF THE COMPA	A A STATE OF THE S	yes	yes	ou	0	yes	er en	Anna de de de de la compansa de la c
The artificial and the second of the second	Dockbampton	a, b, c,	a,b,c		yes	yes	2	yes	yes	Dec-Jan 1990/91	E 6.9

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+	Townstraite	8-6	10-1	10-2	10-3	10-4	11-1	71-2	?	F	2
Local Government	Inewich city	1 in 20	υ	ပ	yes	b, SES, police, citizens watch	yes	yes	yes	5	yes
ipswich Oily	Special control of the second control of the	The state of the s	9	q	yes	q	yes	yes	2	yes	yes
Isisford Shire	Sistord	emerk = 12, 100001 vi = 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,		A day of the commendate by the experimental of the day of the section of		G G	SdA	Ves	ves	Ves	ves
Jericho Shire	Alpha	1 in 200		Q	yes	3	3	25.			
Jerícho Shire	Jericho		U	p'c	yes	13	yes	yes	yes	yes	Sać
Ichnstone Shire	and the second s	The state of the s	p'c	υ	yes	q'e	yes	yes	yes	yes	٤ ,
To the second se	Inndarran fownship	the first term of the forest term damped to the first term of the	CG CG	Company of the Compan	2		2				Market on the second
Jonata Sine	A CALCAIN	And the second s	0	Agents of the control	2		욘	0	00	· · · · · · · · · · · · · · · · · · ·	no
Jonan Shire	Kilon	1 in 10	p	q	02		yes	2	e	20.00	52
Viocette Shire	Kingarov	1 in 10	Commission of the commission o	A New Walter for the first and problem addition to the first first first first to the first first to the first firs	00	AMAZON AND AND AND AND AND AND AND AND AND AN	yes	yes	2		OU
ningaroy oune	A LEGISTICAL CONTRACTOR CONTRACTO	d marky (spiratography). All rides, in spirate a rediction of spirate and independent of the control of the con	and a susception of the Company of t	A THE BESTAND AND AND AND A SHARP AND A SHARP COMPANY OF A SHARP AND A SHARP A	00	ANA ANA MANANANANANANANANANANANANANANANA	yes	yes	yes	yes	9
Laidley Shire	ALA IV TO CAN DEPENDENT OF AN AREA PROPERTY AND	1 in 20	ט	د.	2 2	2 L	ves	yes	yes	yes	00
Livingstone Shire	Nerimbera	The second section of the second seco	O	Commission organization of the control of the contr	2	A MANUFACTURE TO THE A CONTRACTOR OF THE PARTY OF T	ļ	***************************************	The same of the sa		
Logan City	comprised to the control of the cont	1 in 5 (1996), 1 in 20 (1991)	O	of the management of the management of the second of the s	yes	a, telephone, warden system (local area emergency group)	yes	yes	yes	yes	yes
Mackay City	Mackay		ú	q	yes	p'q	yes	ou .	OU .	yes	yes
Maroochy Shire	Whole of Shire	1 in 70	4	a constant of the constant of	yes	b,c, telephone	yes	yes	00	•	yes
Maryborough City	ara de familie de destante de companya de la companya de managementa de companya de compan	T in 20	O S	O	2	And a substantial control of the con	yes	yes	yes	yes	DO
McKinlay Shire	eme vo apvança e de abbandante en en especiales dels establistas dels establistas de la companya de la company	The same of the sa			and the state of t	appenamente de selector de servicio de servicio de servicio de servicio de selector de sel	Autosystomers and disables and		Constitution of Africa,	Company of the Compan	 Por Vagastinar Favor di vedo V i auchtebir f
Mran Shire	Finch Hatton	The second of th	'alert' system	oʻq	yes	p'c	yes	yes	9	1	
Mount is a City	Mount ISa	1 in 5	20	And the second s	00	дадыну водун учисины мен осоний адам у чуул бару ческой куй у Жүйүү тада касыный адамда устан жайган жайга	00	-	Asserting the state of the stat	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	ggy ; jun management mense fresh denkir v
Mt Morgan Shire	Mount Morgan	Sign - Mark C - m - m A tricking in the Anthony of the C - m - m A tricking of the C - m - m A tricking of the C - m - m A tricking of the C - m - m A tricking of the C - m - m A tricking of the C - m - m A tricking of the C - m - m A tricking of the C - m - m A tricking of the C - m - m A tricking of the C - m - m A tricking of the C - m - m A tricking of the C - m - m A tricking of the C - m - m A tricking of the C - m - m A tricking of the C - m - m A tricking of the C - m - m A tricking of the C - m - m A tricking of the C - m - m A tricking of the C - m - m A tricking of the C - m - m A tricking of the C - m - m A tricking of the C - m - m A tricking of the C - m - m A tricking of the C - m - m A tricking of the C - m - m A tricking of the C - m - m - m A tricking of the C - m - m - m A tricking of the C - m - m - m - m - m - m - m - m - m -	The second secon	В	6	desightes graphastissis extensiber for printed a triangue as weeds bloodings (17, 77) can designate designate designate comments of the second	yes	yes	DO .	yes	OU
Mundubbera Shire	Mundubbera	e de la companya del la companya de la companya del la companya de	CO	q	잍	A PRODUCT OF THE PROPERTY OF T	yes	DO .	DO .	2	A comment party and miles of the
Murweh Shire	Augathella	aparamente de l'establishe de	D D	Ü	yes	The second secon	wide/liber of representation of the liberary o		accessment was considered to	Accessed to the Company of the Accessed to the	and and and a control of the
Murweh Shire	Charleville	4 in 85	D,C	p'c	yes	p'q'e	yes	yes	yes	yes	yes
Nanango Shire	entre de la companya de la companya esta companya esta companya de la companya del companya de la companya de la companya del companya de la companya del la companya del la companya de l	eminera similar i de comença e de comença e manda comença de menera de comença de comença e de decidad comença Eminera de menera de comença de mo	0	en kenn dermyken de melden for de melden de demokratieken bestellt der staten de melden der staten de melden d Company dermyken de melden fordere de demokratieken de staten de der de	Ш	desen videnskradisen kalen kristen kristen kristen och statistisk och statisk (kristen ja desendett i sen och semalandet	22	STATE OF THE PROPERTY OF THE P	and the second s		***************************************
Noosa Shire		1 in 70	a	IJ	yes	а, в	yes	yes	yes	yes	yes
Paroo Shire	Cunnamula	1 in 100	J	p ¹ C	ПО	en apor amenaram ana mendra aporta (A) (en espera assenti de Nort es de A) en en est sen en en entre de Aport Canonom de Apor	yes	민	yes	yes	2
Pine Rivers Shire	e de la companya de l		P	q	<u>е</u>	MERCE ARRESTANCE (\$1.00 (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100) (100)	yes	yes	2	and address of the party of the	yes
Quilpie Shire	Quilpie	mended des Prijes (ann projekt annover (ek de 19 y 1). O'un prima nem mel en 1900). O'un prije merjek nicht mende dek die prije spenier (ek de 19 y 1). O'un	O Company	р,с	2	ARAKA KARAKAN MUMATURAN MARKAN PARISA BANGA BANGA BANGA BANGA BANGAN BANGAN PARISA PAR	2		-	- Control of the Cont	And the second second second second second
Redoliffe City	Redcliffe	1 in 45	To the state of th	CO	2	enterprise de la primera de la mentra deservada de médica de la mentra de mentra de la mentra de la mentra de m	yes	00	eu		01
Redland Shire	Bay Island	авияне да до форму и форму (), торым умученного и отноську высова выеренностью высовает выдачает в установления высовает выполняет выс	9	mindele of states, communicate for delete of the states of states of the states of the states of the states of	and personal our similarity designed by Assessand	des Artes and Charles of Constitution and a september of the section of the secti	And a second sec	op per manie (photologica per de primer)		The second secon	-
Redland Shire	Part Brewer Street Capalaba	na malaka dan di Ojoboy, na ujama anabada Dibbi Kibana na sanasan namada babibi (1911 pisanasin nana) dibi Jaw	Ø	S de la constant de l	e a contraction of the contracti	inderfolgensete formation of Allah Vort species as any enconserved major (Allah Vort species) by the Conference of the Confere	ou		- Co	900	00
Richmond Shire	Richmond	egypadori standa i semi i zedimi i pičimi i pičimi zivjadimi i sprajem i sejemjama mesta ziverje i i bio inkjes v sovien	q	an	2	AMPANARALITY - TOTALATOLIAN WINE AND HARVE AND THE THEORY CAMBANANCE CONTROL VARY FOR A 7" VARIABINA AND AND AND AND AND AND AND AND AND A	yes	9	אַפּאַ	200	2
Rockhampton City	Rockharnpton	1 in 60	υ	υ	yes	b,c	yes	yes	yes	yes	yes

			1	7.0	00	0 3	7.0	u c	3 6	7.6	٠,٠	3.9	
Local Government	10wn/Community	Diamage.	COastai		TO 20	2	1 200		2 9	,	;	1,007,007	
Roma Town	Roma	Inland	00	Balonne	b /38	0	7384	CR7	119		2	7,03/1997	yes
Rosalie Shire	Cooyar	Inland	2	Brisbane River, Cooyar Ck	70	0	သ	10	drani tro vi in	MANUAL TO THE PROPERTY OF	2	of the community of the	2
Rosalie Shire	Quinalon	Inland	00	Myall Ck, Murray-Darling Basín	50	< 2%	50	ю	-		2	1989	ę
Sarina Shire	Armstrong Beach	Pacific	yes		200	+3%	8	/	0	52	yes	Cyclone - 1918	yes
Sarina Shire	Campuri/Sarina Beach	Pacific	yes	The second secon	425	+0.5%	150	5	0	30	yes	Cyclone 1918	yes
Sarina Shire	Grassfree Beach	Pacific	yes	and the second	330	+1%	130	ы	0	0	yes	Cyclone - 1918	yes
Sarina Shire	Louisa Creek	Pacific	yes	The state of the s	250	+0.1%	100				yes	Cyclone 1918	yes
Sarina Shire	Salonica Beach/Half Tide	Pacific	yes	erin in the condition of the conference of the c	370	+1%	150	7	. 5	40	yes	Cyclone 1918	yes
Tambo Shire	Tambo	Inland	no DO	- AND THE STREET OF THE STREET	400	A CANADA TANADA	109	18	•	9	2	promote thereon	
Tara Shire	Tara	Inland	2	Undulla Ck Moonie R.	4 030	+1%	2200	90	20	40	2		
Taroom Shire	Taroom	Inland	OU	FIZTOY	200	-0.2%	250	24	9	4	5		
Thuringowa City	and the control of th	Pacific	yes	Ross River/Bohle River	40 000	+5-8%	15 000	500	100	and the second s	yes	December 1971 cyclone "Althea"	yes
Tiaro Shire	man and the state of the state	Pacific	6		4 500	%6+	1700	20	9	200	yes	potential only	2
Toowoomba City	Toowooomba City	Inland	UO U	Gowrie, Westbrook & Spring Cks Condamine River	90 560	+1,53%	33 000		all the first independent of	quality of the State of State	2		
Townsville City	Townsville	Pacific	yes		88 855	+1%	21,000	3 300	ar come anna ar c		yes	1971	yes
Waggamba Shire	erodes (* 16.000,000,000,000,000,000,000,000,000,00	Inland	ОП	Border Rivers	438	0	182	S		0	잍	1984	2
Wambo Shire	Jandowae	lnland	OU .	Condamine	875	+0-2%			al di Pillari i Sandhou		2	1981	9
Waroo Shire	Surat	Inland	no	Ваюппе	200	-5%	250	20	9	-	2	en e	
Warwick Shire	Warwick	Inland	OC	Condamine River	12 000	+1.7 %	4 000	250	150	115	2	To the state of th	The state of the s
Winton Shire	Winton Winterman	Inland	no.	Western River	1 000	Negative	250	40	22	50	2	1993	no
		o di co	1	1	- 8					:	***************************************		
Relvando Shire	No communitites at risk	Inland	6	The second secon				S. Correction	-	The state of the s	- Company	The second secon	
Broadsound Shire	no towns or buildings in the Broadsound Shire are subject to flooding.	Pacific	yes	LILL		The state of the s	2400	99	20	200	yes	de con commentation de la commen	DO .
Bungil Shire	euniu	Pacific	2	Injune Creek - not flood prone	1 100	0	153	53	8	9	2	The Assistance of Comments of the Comments of	- Company
Clifton Shire		Inland	2		te les quesces measurement dimense	And the Control of th		No. of Concession, Name of Street, or other Persons, Name of Street, or ot	CANTON CONTRACTOR TO THE	albu a francisco e el malo la esta esta el malo		Salahata Araba Marana Araba (Salaha (Salaha Araba (Salaha (Salaha Araba (Salaha (Salah	of lane of wanted and gapt of
Cloncurry Shire		Guff	2			. However, consumptions of		Sensitive S	***************************************	coparties of the special statement		an united man representation of the state of	
Diamantina Shire	Bedourie	Inland	o _a	Georgina	100	+5%	30	8	2	10	잍	and court over the court of the	***************************************
Duaringa Shire	Andreas and the second control of the second	Pacific	2	Dawson/Mackenzie	11 000	+1%	2000	100	ta bira pikera Jasalanda Nyandaria	100	01	goden bedenn er hentskerkvinder blommeren er beden be. Geben be den er er	00
Isis Shire		Pacific	61	Se work shame Assess remainmented with the "Them," AND statistical observations of the source of the	Addressment of Milliam Street Co. No. 64 No 50 No.	- Libration of spiral from Africa Garden	i i			Table of the second second		d autoritisha 166 Vendan/MedidaCX (4 tabbe (1884-184 e Ata NOZdalo	
Kilkivan Shire	And the state of t	Pacific	ПО	tegendaking meganegkal mingdi. Silin. VII. s. All "Vig. Merkelesi sijand ili kempaj sama reproperti on omes p	Commence of the commence of th		· ·	amedical control	THE PARTY STATES	- MATEUR - VI TAME	Anni Jan Cone	ego quadant iy da — ngu cabant madalan dab jaldani dir. Labbi ya kan	-
Kolan Shire	magneria de la selectión de la composition della	Pacific	2	V 1					A channel and rela-				
Millmerran Shire		Inland	no	>74.					******				

Local Government	Town/Community	4-4	4.2	7.3				און דר בואטוא	-
	1		7-4	4-3	44	4-5	4-6	4-7	4-8
Кота Тоwn	Roma	7/3/1997.		48 hours	8	2	8	2	b(97), c(63)
Rosalie Shire	Cooyar	1989	A Company of the Comp	12 hours	12	9	The same of the manufactures of the same o		. 0
Rosalie Shire	Quinalon	Feb 1983	And the second of the second o	24 hours	est comment of the co	Commence of the commence of th	The second secon		. 0
Sarina Shire	Armstrong Beach	1918 (storm surge)		Name of the state		The state of the s	Today: 1.5m tidal surge would affect > 50%	destrict Name of Association (1988) and the same of th	C C
Sarina Shire	Campuri/Sarina Beach	1918 (storm surge)	en e	Section (A) and response to a same per supplementation and construction an	Printe Str. A) their commencement and a regard	A Commission of the fact that the commission of	1.5m tidal surge would affect 60 persons	round to the state to still Andrews when representations and the	0
Sarina Shire	Grasstree Beach	1918 (storm surge)	en sor - · · ·				3m tidal surge would affect 30% or about 100 persons	Andrew California and	0
Sarina Shire	Louisa Creek	1918 (storm surge)				Commence of the same of the sa	100 persons would be affected by 1.5m storm surge	· · · · · · · · · · · · · · · · · · ·	0
Sarina Shire	Salonica Beach/Half Tide	1918 (storm surge)	A THE STATE OF THE		And the second comments of the second	Andreas and American by Present American program	30 persons would be affected by 3m storm surge	ka di Amori. Dipan direjan gapapapapa	
Tambo Shire	Tambo	1983	Annual Annual Control of the Control	1 week	0	des verd alles dette de stad per d'adresseré		m. m. auginalagis jepāgajas m. m.)
Tara Shire	Тага	1983	e de la companya del companya de la companya del companya de la companya del la companya de la c	2 weeks	15	0	0	Control of the desired particular and the state of the st	q ,
Taroom Shire	Taroom	1890	ight out the car is not consider an about the car is th	rangen i e ili pia Novellad di lomat querçadgadepo : g	25	12	- Commenceror and a standard was discussed by a first was dependent or the commencer and property and a standard and a standar	4	q
Thuringowa City		1940's		1-2 days		yes	y commence of the commence of	yes	0
Tiaro Shire		1894	The second of th	3 weeks		MARTINE MINAMENA (MARK)		THE PART THE PART AND DESCRIPTION OF THE PART OF THE P	q
Toowoomba City	Тооwооотba City	1890's	The first of the control of the second of th	< 1 day	an designation of the property of the contraction o	enney estim - of many state braising	A Company of the Comp	· PRINTER TRANSMISSION COMMISSION TO AND ADMITTAL	q
Townsville City	Townsville	varies		0.25 - 3 hrs		Militaryomo - Alfa Nervy milada Algada	The state of the s	CONTRACTOR III III MARKATAN III III	C
Waggamba Shire	The second secon	1956	And the second s	5 days	700% - 110 ³ buildings	2	(Sawmill)		U
Wambo Shire	Jandowae	1946	229m3/s	2 days	9	m	The state of the s	; ! •	. 0
Waroo Shire	Surat	Jan/Feb 1996		10 days	·	0	The second secon	0	Ů
Warwick Shire	Warwick	11-2-76	1400	2-3 days	F BS		2 marks and safety constants to the constant and the cons	0	0
Winton Shire	Winton	1954		1 week	40	20	2	15	0
	and the second s					manufacture and of the second of the contraction of	TOTAL THE REAL PROPERTY IN THE PROPERTY OF THE	por in . Indicator - autonomic and against an	den mangement den men oppy
Atherton Shire						!			:
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Broadsound Shire	no towns or buildings in the Broadsound Shire are subject to flooding.	Dec 1990, Jan 1991		3 - 4 weeks	D		0	0	v
Bungil Shire	aniu	Ann de Ann Grand Vander en general van de Anne Vander (Vander) de de Lander en Anne Vander en Anne Anne Anne A	And the second s		0	0	0	0	
Clifton Shire		Advance was a styletototo sandion to common a commontant to the styletoto.	AND THE RESERVE OF THE PROPERTY OF THE PROPERT		Commence of the manufacture of the second of	en vormalerska fê' . Ayda' franskarvansen untagen	TO THE RESIDENCE OF THE PROPERTY OF THE PROPER	Commercial in the contract of	
Cloncurry Shire		e de la companya	dendistrefeksakskasses odrojevo - (45,0 in ledkas (40) - 1,0 in 1,0 in 1,0	The state of the s	Commence of the Commence of th	nijirojeki (m V. lipmužė klanam kranmano), gap		and development and an address of the second	and collections of the control of th
Diamantina Shire	Bedourie	1974	Andrew description of the control of	distribution and services of the services of t	0	0	O	10	Anni Verren matematerial programe
Duaringa Shfre	од оборности в поставления в серествення в	The state of the s	AND THE PROPERTY OF THE PROPER	a francisco, estante averviente terro, fabrico de la manda de la constante de	The state of the s	CHARLES AND			111 11 20 11 11 11 11 11 11 11 11 11 11 11 11 11
Isis Shire	о денежний перединальный денежный пределенняй пределенняй перединальной денежной дене	Adjustics - College of College College of Association (Association of Association College of Association College of Association (Association College of Association College of Coll	V. Company of the com	Control Ma Security of the Control o	White was introduced account to	alabade de forma se de la grapa de la grapa de grapa de grapa de forma de la grapa de la g	THE THE PARTY OF T		The state of the s
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Kolan Shire	 On Bart C. (1997) and the Control of States of the Control	A second				The state of the s	And the second fine and some one company of a second of the second of th	market of the Advantagement of	. Nation of adding a community
Millmerran Shire			A TOTAL CONTRACTOR OF THE CONT	The second secon	And the second control of the second control of the	Charles and the contract of th			

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Local Government	Town/Community	4-9	4-10	4-11		4-13	+	21.7		1
Roma Town	Roma	b(97), d(63)	a(97), c(63)	æ	b(63 & 97)	b(63 & 97) b(97), a(63)	als species in highers species appetation page 4 way aware park visits instanctions cannot be seen player.		yes	the contract of the contract o
Rosalie Shire	Cooyar	P	υ			q	e nome e west destruction hand destruction and the second of the second	9	yes	The part of the state of the st
Rosalie Shire	Quinalon de la company de la c	P	O				Company of the second s	12 hours	yes	
Sarina Shire	Armstrong Beach	P	υ			о				
Sarina Shire	Campurison of the Campurison of the construction of the constructi	D	0	0		A construction county to the construction of t	ender der der der der der der der der der			
Sarina Shire	Grasstree Beach	D	Ų	a	-	q	And the second contract of the second		The state of the s	
Sarina Shire	Louisa Creek	T	U	Ø		م				
Sarina Shire	Salonica Beach/Half Tide	P	2	A CONTRACTOR OF THE PARTY OF	The second second second second	9	en e	Andrew Comment of the		Visit to the second of the sec
Tambo Shire	Tambo	70	Ф	æ	1	d	emperator i pipili e il mai a Mandelli Mandelli (Mandelli de de Permero de Locale III), e il composito dell'empero		no no no no no no no no no no no no no n	no records
Tara Shire	Tara	o	þ	œ	æ	ď	У в и Кероневай Синона Алейнай Андайн — «Алейнайна дей дара автаман жейнайна нь «Алейн — (Алеж Андай Андай	1 day	no	A particular to the state of th
Taroom Shire	Taroom	D	æ	ro (þ	d	s, _g enterespensesement kalkansente i distante ette stere este este ette speciel sterete et distante	3/4 day	OU	lack of resources
Thuringowa City	de armanamentarior de como estados es los compresentes estados estados estados en os paramentos como contradirios de como contrador de como como como como como como como com	٥	v					12 hours	2	too early in history
Tiaro Shire		J	v	ro.		9	de laborar de servicios estados especiales de la companya de la companya de servicios de la companya de la comp	9	UO	partial data available - some aerial photographs
Toowoomba City	Toowooomba City	9	C	rd.	0	D		15-30min	limited	storm durations are usually too short
Townsville City	Townsville	O O	q		q	q		0.5-4 hours	yes	No. de Contra de
Waggamba Shire	management outstand outstand of a supervision of command which a set of command outstand outs	C	O Commence of the commence of	þ	a	q	en menderaliske de skrivet med maner med de mende mende de mende de mende de mende de mende de mende de mende m	1-2 days	ПО	apathy - some unconfirmed data available
Wambo Shire	Jandowae	0	q	o.	æ	æ		18 hours	nyo.	 a. 1. Ville ** ** ** ** ** ** ** ** ** ** ** ** **
Waroo Shire	Surat	P	O	O	æ	, ro	· · · · · · · · · · · · · · · · · · ·	72 hours	yes	records now being kept by Council and police
Warwick Shire	Warwick	a	٩	a	q		- 0	a A T T Companies (1) with the Land Companies (2) with the	yes	And the second control of the second control
Winton Shire	Winton	O Commence of the contract of	q	æ	P	•	The second secon	24 hours	OU OUT	KIII K. T. KARAMATERIA (KINANE ART. 1.2 JANUARI) III YAZI K. T.
America interview de dispressor de la constante	A CONTRACTOR OF THE PROPERTY O							•	į.	
Atherton Shire	THE		**	:	ı		Complete Com			
Belyando Shire	No communities at risk	Control of the Contro	\$ 10 mm mands = 1000, day()/400000	o Apacita Statement or a section			copyrian and understands to be described to the street of the control of the cont		The State of State State 1 State 1 State 1 State 1	
Broadsound Shire	no towns or buildings in the Broadsound Shire are subject to flooding.	ט	CO CONTRACTOR CONTRACT	n .	n		1 min or 1 m	2-4 hours	home the second	no flooding problems exist
Bungil Shire	[II]une		0	B	0	В	muser Normal Representation of State of State of State of States (States) in the State of States	Section Wester Services and Section Services and Section Services	ΠO	no flooding in town
Clifton Shire		Special and the state of the st	The state of the s	a visitati w um wordshire	-andri - a - c - q - quant	on in configuration of the control o	and the second production of the second consistency of the second constitution of the second constitut	a manda decidinani seri, independente sangi a nego estima en estiman en estim	e styrk auto — o ober de de leenbege egeldek dek besterek seleker o	. un - interior de lances chartes - de excessión desandes proprietas moneros mandros estados e
Cloncurry Shire	um neer in die meerde deele heerde je deele gebeure de deele deele de deele deele de deele de deele de deele de deele de deele de deele deele de deele de deele de deele de deele de deele de deele deele de deele deele de deele de deele de deele de deele de deele de deele de					-	angung er og ekkeles er	And the second s	Action and the second of the s	to the same of the
Diamantina Shire	Bedourie	7	0		0	. b	responsable to the first support to define to the first support from the support to the support		00	ino official recording
Duaringa Shire	ggyr - i mannafdrindig þjórndig þróm þeing þrí sem er dannen enn er er er þrí þrí þein enn er sem þei - Hjórndig Heinstein enn sem þei - Hjórndig Heinstein enn sem þei - Hjórndig Heinstein enn enn sem þei - Hjórndig	The second of the second	Contraction of Management of the Assessment	A	r and a second	20 - Colque y Agripa marina cum constitutorira constitutivi de	playdiste from Alber Astropology inspirituasions on distinct mobile 65 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5		ann amaile dess assumed velocies in Americans of Indoord principals	The Tourism Transmitted and the Transfer and Confession (Confession and Confession and Confessio
Isis Shire	endeze) - Verk spink, i kochmin destind Vertur Verkspink i Verkska en kerzem (NY-delinis) kann direktifen i de	Control of the second	The province of the contract o	medical controls	near common or wanted about the	and desired the control of the contr	oproper proposition consistence of the West Collection of the constituent of the constitu	and the second s	erende de l'emmentation de sommer (en le control de l'estables	
Kilkivan Shire	n an early and the end of the end		A principal copyright appears of the copyright of the cop	The second secon			e equal equal esta established esta established establ	The second secon	er i i mprispas de c'he su spopole president propi e begin paktu	TO SEE THE SEE SEE SEE SEE SEE SEE SEE SEE SEE S
Kolan Shire	AND THE	Committee of the Commit		- 100	And the second second section of		ade a compandada de transferencia medica e de casa que como alcada e de cista antes e de ser esta en el companda e de casa de casa e de		Application of a simple data, and a simple decidation	
Millmerran Shire										· · · · ·

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									APPENDIX	L III
Local Government	Town/Community	5-3	5.4	5-5	5-6	5-7	5-8	6-5	5-10	5-11
Roma Town	Roma	town planning regulations, contours map	yes	15 years	2 m to 3 m	6.10 m	7.32 m	7/3/1997	yes	p'c'q
Rosalie Shire	Cooyar	building approvals	. 2	and the same of th	and when the property of the contract of the c	Resignation — the exploration representationally regards of	Abelegy is a second control to the second co	Controlled to beginning to the best states of the states o	yes	Δ
Rosalie Shire	Quinalon	building approvals	ou	regeratore de made pro- : A dimpo de la del	of interest research	to and the content of the state	e extensionation meter interpretate resourced, tendents generated	Annual control of the state of	yes	þ
Sarina Shire	Armstrong Beach	- 1 - 6 - 6 - 6 - 6 - 6 - 6 - 6 - 6 - 6	****	.				along tullen - keal	storm surge	٩
Sarina Shire	Campuri/Sarina Beach	alian amangaya amang apat adan sababaha dalanggayada isa dalah bebada dalah sababaha sababaha garap atau ingga Angarap ada ada ada ada ada ada ada ada ada a	The Art The Cartinopalation of	ender in der		er legt viderskip e de semme repellement yn e medicky i genigespromenen i Prise de	-ake a kala dien a menggapa penada pa nendi dip byek bila sebah sayan ya ya Panada ji jigipa nana pinya penada panada bana sayan ini ini njirak bi pakasan ini pa	A Commence of the comment of the com	storm surge	b
Sarina Shire	Grasstree Beach		4.8.4		,			Michael W. L. Ant L.	storm surge	٩
Sarina Shire	Louisa Creek	towards the state of the state	the state of the state of	of empy . The color of public endough the color of the co	in er find degreepe met et ten ligget figheringen	and comments of the second of	NA SERIE PARAMETERISTINAN PRO SERVICES BURNISTINAN PA	Annual State Control of the Control	storm surge	.
Sarina Shire	Salonica Beach/Half Tide	e de de la companya en la companya de la companya del la companya de la companya del la companya de la companya de la companya del la companya de la companya del la c	4 m 4 m 4 m 4 m 4 m 4 m 4 m 4 m 4 m 4 m	to be a second and we will also be a second and a second		The formation was a series of the series of	the first of the control of the cont	Company of the contract of the	storm surge	
Tambo Shire	Tambo		yes	3 years	E O	4.5 m	5.2 m	2/2/97	٠ و	n
Tara Shire	Tara	The state of the s	yes	e service of the serv	Et.	6m	E 6.0	May 1983	은 .	m m
Taroom Shire	Taron management and the second secon		yes	135 years	of the state of th	The second secon	14.78 m	March 1890	2	ฒ
Thuringowa City		· · · ·	yes	10 years				24/3/1990	OL .	т
Tiaro Shire		house siting	00						2	p'q
Toowoomba City	Toowooomba City	calibration of Flood Study	yes	And the appropriate to the second sec	And the second of the second o	The state of the s	n.k. elitoisiski tojaniisija, kirik. Jar. enevelit.		001	
Townsville City	Townsville	Public information, Identifying flood prone areas. Strategic planning, mitigation works. Access roads cut.	00	A Company of the Comp	A Particular Maria Control of the Co	en de de la companya	Average, ones required with a second temperature of the Average of	Averagement of control	- yes	p'c'q
Waggamba Shire		building heights	on O		a de la calenda i que l	-	-	A A S A A A A A A A A A A A A A A A A A	limited	ด
Wambo Shire	Jandowae		yes	3 years	1	,	•		oп	n
Waroo Shire	Surat		yes			10 ш	13.8 m	Jan/Feb 1996	OI	D
Warwick Shire	Warwick	property searches, etc.	yes	120 years	0.15 m	3.0 m (lowest point)	9.10 m	11-2-76	yes	٩
Winton Shire	Winton	ής το γενικόρηση φυρή (January η μεριτικό εκτικοποιοποιοποιοποιοποιοποιοποιοποιοποιοπ		took kind and a product make the first and the product of the control of the cont	And the state of t	alas de Johann de Maramana, de Maria d	ria a ministra i un instituta kata indistrata kata kuusi ata kanna kata kata daddiin ka kata kata kata kata ka	No. di Salamat (1970-1984), i di distribut di Antonia del Antonia	00	CD.
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Belyando Shire	No communitites at risk				rappa in					
Broadsound Shire	no towns or buildings in the Broadsound Shire are subject to flooding.		00			2	are, and all 20 malesymmetry among any commanders and		OL :	ro -
Bungil Shire	Injune	e en el esta de la companya del companya de la companya del companya de la companya del companya del companya del companya de la companya del company	ПО	The transfer of the state of th	and the state of t		Service and Constitute	obs. c. made these there was a state of the	no on	, co
Clifton Shire			ender over the state of the state of	and the sales of the substitution of the sales of the sal	e gele to dang benganak e ana e canada disabah dan dan pak	American Company (Company)	dan out description (Vermount wouldn't be to workeling of		and the second s	
Cloncurry Shire	тер бер нің тер тарарын я ветаруунун конориясти ететаруын теперадуі облуданун ублектуу жеректері.	The state of the s		A COMMITTEE OF THE PARTY OF THE		w. a w.		A STATE OF S	erger same .	
Diamantina Shire	Bedourie	(g)	01		englanda under a describer a la companya de la comp		* American angeren dem dem dem (1900-1906 - 1908 - 1	the state of the s	no no	6
Duaringa Shire		The state of the s		troops to come to be a property of contract to the	- agreem - m- asser widolessees is do m- the methodoless	A STATE OF THE STATE STATE STATE OF THE STAT	entrance of the entrance of the second of th	person of the copposite party and a second second section and the second sec	de mario oprime na agroda - page	
Isis Shire			Annual absorption of the state	reducario (son reter unitambanolismo unamano). He annos	And Above and the most assume and arms and arms and arms and arms and arms and arms are a second and arms and arms are a second and arms are a second and arms are a second ar	ARTHUR ON A CANADAMAN AND WARRED A RESURED A CONTRACT AND REPORT OF	seled, militarovom anomed with in democratikene of major felik anom	e de la destructue de l	outh - ofermen approximatesperantesper - coppers the	name challes two shirt or fa.
Kilkivan Shire	rementerpresent from the first part garden is separate security research the security of security of sequential			and the company of page 1 games on the con-	And the second s	AND THE ANTHONOR OF THE PERSON	The designatures of the section of the control of t	and the second s		
Kolan Shire	W. C. C. D. C. CARROL - TRANSPORTER THAN SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET COMPANIES AND ADMINISTRATION OF THE SECUL . SPECIFIC STREET C			When the second	medicular and the suit of the	tages symmetrate the manufacture day to transmission on transmission	A THE CONTRACT OF THE PARTY OF			
Millmerran Shire										

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Local Government	Town/Community	1-9	6-2	6-3	6-4	6-5	9-9	6-7	8-9	6-9	6-10	6-11	6-12	6-13
Roma Town	Roma	안	1 in 50	2	yes	1 in 50	yes	• •		•	1	,	yes	1
Rosalie Shire	Cooyar	no	e de constitue de la constitue		The state of the s	Alleman de accompanyologica est est de est est est est est est est est est es	Additional to the control of the con				S proposition and the second	apper - america de periodo		
Rosalie Shire	Quinal and on	OLI			The state of the s	A Company of the Mark No. (1990) and the Company of			The state of the s	The second secon				
Sarina Shire	Armstrong Beach	92					A P. W. S.		A STATE OF THE STA	and processing and the state of		Selection Addition	to be a series of the series o	The analysis country of programs of a popular
Sarina Shire	Campuri/Sarina Beach	00	egy manasara o trans. Aparaga, or arana o desara, paraga, or arana o desara, paraga, or			ed organization in the contract of the contrac				AND THE PROPERTY OF THE PROPER	A CONTRACTOR OF THE CONTRACTOR CONTRACTOR OF THE	egy same: Academy Hands 1889	Topogrammandos citações citações de la composições de la composiçõ	· · · · · · · · · · · · · · · · · · ·
Sarina Shire	Grasstree Beach	<u>0</u> 2	A CONTRACTOR OF COMPANY AND	111111111111111111111111111111111111111		Andrews became the term of the configuration and the even	Total and the second second second		goden by approximate take a milytop	The second control of the second	The second secon	OF 11 Spring from the part and the training	and wanted	and design and the second of the second
Sarina Shire	Louisa Creek	01			80. a 80. j. n. n.				The state of the s	of the second se	A WARRY OF THE PARTY OF THE PAR	benefit between the training of the formation of the second		AND STREET, STREET, 1971
Sarina Shire	Salonica Beach/Half Tide	no				and the state of t	Application of the state of the		opening is spin duty a spinor, to an quantum on					metrical and the designation
Tambo Shire	Tambo	OU .	The second secon			And the state of t				-		Company of the Compan		
Tara Shire	Tara	no	The second secon	- 3/18/10/10/10/10/10/10/10/10/10/10/10/10/10/	e passana vy amount	A consistent and the resource wave buildings. (Note that of the second o	And the second second second second	gyar y Tu yanandi dadii mi A	The second second	And the second of the set of the	s from I to cold accessment to be of contract of reported	of all of Memory in pile 200 to delight in 195	To the state of th	- unitalizated - unitalizate
Taroom Shire	Taroom	oЦ	A deposition on the design of the contract of	2	01	1 in 100	2	ro .	(25	12	Control of the contro	4	2	2
Thuringowa City		yes	1 in 20, 50	2	6	1 în 50	yes	p,c	20	0	0	:	2	yes
Tiaro Shire	AND THE RESIDENCE OF THE PROPERTY OF THE PROPE	OLO			- Control of the Cont	de manager de la companya de la comp	The state of the s		The second secon	Spire complete. Supercipant company		:		
Toowoomba City	Toowoomba City	yes	1 in 2, 20, 100	2	2	1 in 100	2	م	,	>10		:	2	yes
Townsville City	Townsville	yes	design studies on AR & R information	on.	01	1 in 2, 10, 20, 50				a volgander mål til a skale en	en recental e mell ere es pede	2	yes	
Waggamba Shire	Andrewsky in another grant translation of the contract of the	yes	1 in 50	2	2	1 in 50	2		110 (100%)	7 (100%)	1 (100%)	•	00	<u>و</u> .
Wambo Shire	Jandowae	OLL		2	2	попе	2	๙	,	Section and the section of the secti	The second state of the second	e ye doo de kan qondy i'a yeenada i de	2	011
Waroo Shire	Surat.	ПО	The second of th	OL.	2		2	ю	, 2	A STATE OF THE PARTY OF THE PAR	The state of the s	d per manife a per benegation and the con-	2	20
Warwick Shire	Warwick	yes	1 in 10, 20, 50, 100, 200, 500, and PMF	yes	yes	1 in 100	yes	а	06	-	32	0	2	0.0
Winton Shire	Winton	no	er der der der der der der der der der d	оп С	2	The state of the s	accept and an experience of the second	•)	A total delicion, of the C C A fin the Commissioner	A contract of the contract of	law A clark Folia: "JAN 4:00 Hop	Comprehensive States of section (1)	water states in community reprint
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Broadsound Shire	no towns or buildings in the Broadsound Shire are subject to flooding.	OU	a control of the cont	**************************************	- I sale materials	· Copper value of the copy of	many and the second of the sec		de ende en Assessante America en plus ante page			ARTHUR ARTHUR MARKET		MATERIAL AND THE SECTION OF THE SECT
Bungil Shire	Injune	no n		01	2	none	2	ra	0	0	0	0	92	01
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Cloncurry Shire	ден на при	AMERICA KARINGA AMERICAN MENTANTAN MENTANTANTAN MENTANTANTAN MENTANTANTAN MENTANTAN MENTANTAN MENTANTAN ME	The second secon	enchance de deput conte		and the state of t	-					er openskipte opperations		1
Diamantina Shire	Bedourie	ΠO		2	2	поле	2	æ	and the state of t		- worder		00	2
Duaringa Shire	The second secon	mpeler goods en west steller de 440 (de 1841 (4 a) generalmen m		and the state of t					and the second second	Annual Annual and a control		a section of confidence of confidence of	And the second second second second second	- Jan deligaçõe de con
Isis Shire		een maken ja vale de tot men de se menten van die de de seen van de de seen de seen de de de de de de de de de	ender der met for independent of the electric was minute independent for a paint of a page way—a met announcement of the electric way is a page way of the electric way is a page way of the electric way is a page way of the electric way is a page when the	and the second second second second	the state of the Anna	e y minimiza conficience despendente e appropriate y sention and			to compress and in display observed the exist.	Andrews Commence on a consecu-	the second section of the property of the second section of the section of the second section of the section of the second section of the section o	A soud - 12 of tresentables	Charles on more removed the	- von ambiele end beleen
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Millmerran Shire	yya-akt.						*			`				

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local Government	Town/Community	7.4	7.3	7.3	7.7		3		
			7-1	?	#./	C- /	9-/	7-7	8-1
Roma Town	Roma	yes	ro.	yes			U	۵	none
Rosalie Shire	Cooyar	yes	q			300 mm	· co	a,b, local law	D re
Rosalie Shire	Quinalon	yes	p	yes		300 mm		a,b, tocal law	•
Sarina Shire	Armstrong Beach	2					The second secon		none
Sarina Shire	Campuri/Sarina Beach	01	The second of th			The second of th	And the management and appropriate the state of the state	A CONTRACTOR OF THE STREET, WINDOWS AND A STREET, WAS THE STREET, AND ASSESSED AND ASSESSED ASSESSED.	name of the second of the seco
Sarina Shire	Grasstree Beach	2				Market of the state of the stat	Promise of the control of the contro	The state of the s	попе
Sarina Shire	Louisa Creek	2	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		No. Cartestan	Made the Name of the Company of the	A Committee of the control of the co	man der ber der der der der der der der der der d	поле
Sarina Shire	Salonica Beach/Half Tide	20	 A control of the second designation of the second se	The second second and the second seco	eri i	man de de la place de la companya de	THE TANKE SALE CONSTRUCTOR ON THE SALE OF	The state of the s	ACCOUNTS TO A STATE OF THE STAT
Tambo Shire	Tambo	00	the second secon		Carried and the second	The second section is a second section in the second section in the second section is a second section in the second section in the second section is a second section in the second section in the second section is a second section in the second section in the second section is a second section in the second section in the second section is a second section in the second section in the second section is a second section in the second section in the second section is a second section in the second section in the second section is a second section in the second section in the second section is a second section in the second section in the second section is a second section in the second section in the second section is a second section in the second section in the second section is a second section in the second section in the second section is a second section in the second section in the second section is a second section in the second section in the second section is a second section in the second section in the second section is a second section in the second section in the second section is a second section in the second section in the second section is a second section in the second section in the second section is a section in the second section in the section is a section in the section in the section is a section in the section in the section is a section in the section in the section is a section in the section in the section in the section is a section in the section in the section in the section is a section in the section in the section in the section is a section in the section is a section in the secti	The same of the sa	Managed the separate of the se	DIO.
Tara Shire	Tara	2	the transfer of the control of the c	j	• · · · · · · · · · · · · · · · · · · ·	Anne de la companya d	The restriction of the Value April 1985 and a series of the series of th	to the control of the	The second second second second
Taroom Shire	Taron Commence of the control of the	2	mand of the mandry of the party	yes		der Ungelige William in der Africa. Der Anna dem Schale Steinen der	TO A STATE OF THE PARTY OF THE	A TO THE REPORT OF THE PARTY OF	de santa esta esta esta esta esta esta esta es
Thuringowa City		yes	q	yes	-	450 mm	q	q	CO. The second commence of the second commenc
Tiaro Shire		yes	q	yes		The section of the se	CO	a, Building Act	
Toowoomba City	Toowooomba City	00	e en		The state of the s	that therefore the cast plans in their contains of the cast described and their contains the cast described and the cast described and their contains the cast described and the cast described and their contains the cast described and their contains the cast described and the cast de	The state of the s	A configure (withing A behalamba A annocky y Grynn raying), who gives becomes resident	Street Colored Street Colored Vision of the Street Street Colored Colo
Townsville City	Townsville	yes	æ	2			g	a,b, council policy	a,b,c, improvement to channels
Waggamba Shire		2			A Laboratory designs on the contract of the co	Andrew Art of State - Commentagement of the Commentagement	To Victorian deconstructura accompany a martica (s.) — martica (s.	The contract of the contract o	
Wambo Shire	Jandowae	2				•	levee bank by-laws etc.	p'e	p
Waroo Shire	Surat	2				A Victoria de Caractería de Ca	The state ordered and management plants plants plants plants plants and the state of the state o	The statement dependence in the statement of the statemen	none
Warwick Shire	Warwick	yes	æ	yes		. 0	Local laws and policies	a,b,c,d	попе
Winton Shire	Winton	2	ed as condend any any property to any a segment property and and any property and any and any property and any			Trade of the control	And the second s	to the contract the second of the contract of	euou
							Ambiena (per ren) - 1 a militimates - 1 a social de la decimina de la composição de la comp	the second development of the second	Commence of the commence of th
Atherton Shire	THE						1		
Belyando Shire	No communitites at risk	d-folioson i c			A CONTRACTOR OF THE CONTRACTOR	A Control of a dead open speciment in the control of the control open in the control o		the state of the same of the state of the st	the state of the s
Broadsound Shire	no towns or buildings in the Broadsound Shire are subject to flooding.	2			WATER TO THE TOTAL THE TOT	The server community to reduct to the seededs to the several sector.	er freihe er familier for virallegelier denskalende mennete mytere grefe voorstelle	And the reference position public spins day, making page (and the public	TOTIE
Bungil Shire	Injune	οu					approximate — on the controlled description or community controlled to the controlled		The second secon
Clifton Shire	e trade de tende e departe, processore et en epoka y C. popydy e grad, volge, come brad quel y comma a despr	www.mi				The state of the s	A CONTRACT OF THE PROPERTY OF	And the Associated the retails the content of the c	CONTRACTOR MINISTERANTIAN OF THE SINGLESS STANDARD STANDA
Cloncurry Shire	onders process representation of the second contract of the second secon			-		The first of the f	And the second of the second s	A color of the first and the second contract of the second color o	A benefared organization to site 1,24 ratio and 1 to the department of
Diamantina Shire	Bedourie	2					department of the control of the con	And other as a contract of the	THE
Duaringa Shire	-файдами V г. В.А.Б. Адамира в Ar Obliddow-Manifeld calculus geologicides page — в подвищение учение пределат		The state of the s			The state of the s	of decided and responsible and the control of the c	The strength of the strength o	taken i produce proposto proposto i reconstante i estado de la compania del la compania de la compania del la compania de la compania del la compania de la compania de la compania del la compania
Isis Shire	. The second of the second				The state of the s	TO COMMENT OF THE PARTY OF THE	noviki. Additionaministin novikilijojo, d. džitelek kindomo odminimaminimo, majagago no	· Company of the first state of the company of the control of the company of the control of the	Andre signalished designation areas and regularity than 1840 through the Andreas Andre
Kilkivan Shire	ere, energy on metamonomy en mye the party apropriation and an experience of proposition of any energy company	V.//.be-	de promoting agents continue the design		the state of the s	THE PROPERTY OF THE PROPERTY AND THE PROPERTY OF THE PROPERTY	To Advance data demonstrate construction of the part of the Control of Advanced Advanced Advanced Services (Advanced Advanced Adv	A CONTRACT PARTICULAR CONTRACTOR AND	a defens typ, majeriye debe e debe mån nyr, somppa, jamappamanderske ist ist den
Kolan Shire	The second secon		3				The second was a second of the	Administration and representation of the contraction of the contractio	the man object to the contract of the contract
Millmerran Shire						The second secon	The state of the s		THE RESERVE THE PROPERTY OF TH

Rona Cooyer Sona Substituting Substitutin			0.3	V-8	5	ç	6	17-0	9.5	9.6	6-7
Normat Normat Normat Normat Normat	lownicommunity	7-0	?-0			4-6	2 5	, ;		7004/6/7	7 32 m
Comparing States Cooper Cooper	ma	a,b	C commence control of the control of	per sel commentation and management of personal selection of the selection	S	20	g S	2	yes	1011011	
Cimputification Beach a bbc C C	oyar	a,b	per destruction of the state of	Commanda communication of the state of the communication of the communic	yes	yes	yes	2	yes	1989	man there is no case a solder of the
Armstrong Beach a,b,c c	inalon	a,b		ت در	yes	yes	yes	2	yes	1989	
Comput/Sartine Beach a.b.c c c c c c c c c c	e - mad Mens, - 1	a,b,c	Ų	volume of a		yes	2	yes	yes		
City Communities at risk City Communities at risk Communities at risk City Cit		a,b,c		ede o mengelin om grant gred greg van de mengelingske det om gred och det etter och en en en etter och en en en etter och en		yes	2	yes	yes	gen en e	The second second
Louisa Creek	ma max	p,b,c	U		- **-	yes	2	yes	yes		
Fambo	A LANGUAGE AND	a,b,c	υ			yes	2	yes	yes	-	
Tara Taron C	" (Amount) - 1470 of 1100 of parameters of a laser to a "ter-industrial AMOUNT	a,b,c	0	The second of the property of the second of		yes	2	yes	yes	The state of the s	
Tara Tara Tara C		ပ		-	yes	yes	yes	5	yes	1983	6.2 m
re Tarconn a,b c, developer's contribution city Townsville a,b, advice c, works undertaken by subdividers Sinte a,b, advice c, works undertaken by subdividers Sinte a,b, advice c, works undertaken by subdividers Sinte a,b, advice c, works undertaken by subdividers re Jandowae b,c River Trust Channel improvement re Warwick a,b,c a,b,c River Trust Channel improvement re Wintion none none none ring Beadourie b none none site Injune b b none none site Injune b b none none	The state of solutions are suppressed in the state of the	the same of the sa	O	p'q	yes	yes	2	2	yes	Jan/May 1996	0.9 m
Towroomba City a a ab, advice c c, works undertaken by suret c a a ab, c c subdividers by suret c a ab, c c subdividers by Warwick ab, c ab, c ab, c improvement c improvement c c c improvement c c c improvement c c c c contribution c c c c contribution c c c c c contribution c c c c c contribution c c c c c c c c c c c c c c c c c c c	moo .				yes	yes	yes	yes	yes	11/1/1996	7.15 m
Townsville C, works undertaken by Townsville a,b, advice c c, works undertaken by subdividers c subdividers c subdividers c c c c, works or buildings in the communities at risk not even or buildings in the communities at risk not even contact con	manadaman ka 1940, inging va usa Vangabahan dan dan dan dan dan dan dan dan dan d	a,b	c, developer's contribution	developers contribution	yes	yes	2	2	yes	19 Feb 1991	dental to the same of the
Townsville a,b, advice c c, works undertaken by subdividers a b,c d a,b,c d a,	to care the control of the control o				yes	2	6	2	0	1992	- 177 M. S.
Townsville ab, advice c c, works undertaken by subdividers bc subdividers bc subdividers c c c subdividers c c c c c c c c c c c c c c c c c c c	SWOOOMBA City	CO	The state of the s		yes	yes	2	2	00	Feb 1995	MARRIAN AV. 1996 PR. PR. PR. 1997
Jandowae b,c River Trust Channel Surat c C River Trust Channel Surat c C a,b,c a,b,c a,b,c Minton none none none No communitites at risk notowns or buildings in the flooding. Injune Bedourie b Bedourie		, advice	U	c, works undertaken by subdividers	yes	yes	2	yes	Country and an area of the second	1990	B
Surat Surat Surat Warwick Warwick Winton Winton Winton Mo communities at risk no towns or buildings in the Broadsound Shire are subject to flooding. Injune Bedourie Bedourie Bedourie Bedourie Broadsware Bedourie Bedourie Broadsware Broadsware Bedourie Broadsware Broadswar	endadore and compat Capatage of a global Company of the company and a second company of the comp	2	a,b,c	v	yes	yes	8	2	yes	1984	ı
Surat c Warwick a,b,c Winton none No communitities at risk none no towns or buildings in the Broadsound Shire are subject to flooding. none injune b Bedourie b	ldowae	b,c	a company and a	River Trust Channel Improvement	yes	yes	2	00	yes	1983	ann and a character of the particular of the par
Winton none none none none none none none	rat	٥		Transition of the state of the	yes	yes	yes	yes	yes	Jan/Feb 1996	13.8 m
Winton none none none none none none none		a,b,c	a,b,c		yes	yes	2	2	20	5-5-96	7.0 m
No communitites at risk no towns or buildings in the Broadsound Shire are subject to none none flooding.	сар и применя выполняющих верхине в до недер до	none	none	попе	yes	yes	yes	0.	yes	1993	
No communities at risk no towns or buildings in the Broadsound Shire are subject to none flooding, injune Bedourie b		The second section of the second			1			··		:	
No communitites at risk no towns or buildings in the Broadsound Shire are subject to none none flooding. injune Bedourie b	руда, Б. У.У., Симосивичен — вин беневического — Соберен, Симоров, Симоров, Б. С. С Сида, Б. У.У., Симосивичен — вин беневического — Соберен Беневического — Соберен Веневического — Соберен Венев	* parameter - management consequence describe		A CAMPAGE AND A			1	0.74	and the family	The state of the s	
Broadsound Shire are subject to none none none looding. Injune Bedourie b	communitites at risk		and the second s			, 4	· · - · · · · · · · · · · · · · · · · ·		a de la companya de l	And the second s	:
Bedourie	or buildings in the nd Shire are subject to	лоле	none	uoue .	yes	yes	2	2	yes		
	Jne	TO THE THE PROPERTY OF THE PRO	a de compa mentenden Secretarionista de la casa	The second secon		** **		00	yes	Color on a contration of classic burners of present processing	***************************************
Bedourie	e year day an an dan sanahan ka jiri ya wa wa angan da yaki ya Vi ya ya da ya ma ƙasan an dada yakiyi ka sani da dan jabay ili da Ka ya ma manan an	Continue of column 6660 - Column 6680 - Colu	About the second of the second	The second secon	Common of the co			The Contract	. ***	Angeles - Par Campaigne Balanch make & Cambridge (1984)	the death of the last date of the control with the
Bedourie	ten i entre en				1					The street of th	and a supplemental
Duaringa Shire Isis Shire Klikvan Shire	dourie	q			yes	yes	은	2	yes	Mark and the sale of the sale	C MANAGE CONTRACTOR
Isis Shire Kiikiyan Shire	agar - 1 mar - 1 t Olanda Organiza de Angles Corpora, com Bassaca and Grades Anna Albana (Maria Angles Corpora	American material encode monotational and constitution of constitution of the constitu	A	Bus to a global translation of names and confidence on the second section of the second	No. of the section of	de de	Annual Property of the Control of th	A Comment Comments	And the second second second	To colore but define account of assess the readily interpreter	a dia 1961 ani a dia mpika dipira a bibambila NG dia bib
Kiikivan Shire	Y and drag many owner of the first contraction of the property		AND COMMENTAL PROPERTY OF COMPANY OF COMPANY OF COMPANY	e des de de la company de la c	and described and the		The state of the s	Mary Company	CANCEL AMERICAN CALABORA	TO CA TOMAN OF THE ANNUAL PROPERTY AND THE PARTY OF THE PARTY.	A. To Add Dream to Milester Physiology (Commission Scientific
	e en recombinament de la come en El comer e en menor de desprimentation de transportation de la come accession en modernidade de la come accession de modernidade de la come accession de la come acce	The state of the s	en establishe especial establishe establishe establishe establishe establishe establishe establishe establishe	enter in new professor property of the state	No. of Contract of	and the second				The second secon	
Kolan Snire	The state of the s			The state of the s	a come						
Milmerran Shire					,	1000					

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	Town/Community	8-8	10-1	10-2	10-3	10-4	11-1	11-2	11-3	11-4	11-6
Roma Town	Roma	1 in 34	o'c	U	yes	d,e	yes	yes	yes	yes	yes
Rosalie Shire	Cooyar	1 in 100	O	The control and the control an	-00	A THE PROPERTY OF THE PROPERTY	yes	ou	yes	yes	no
Rosalle Shire	Quinalon	1 in 20	O	the professional and the second secon	2	AND	yes	ou	yes	yes	2
Sarina Shire	Armstrong Beach		O	U	yes	b,c, SES	yes	yes	2		yes
Sarina Shire	Camponia and Campo	en de jaron jaron de jaron de De jaron jaron de jar	0	Control freed and reference that we have been been the formed between the most find the special specia	yes	b,c, SES	yes	yes	υu	der de commente en en elemente de se parado de se de commente de commente de se de se de commente de se de se de commente de se de se de commente de se de s	yes
Sarina Shire	Grasstree Beach		U	U	yes	b,c, SES	yes	yes	2		yes
Sarina Shire	Louisa Creek		U	ဎ	yes	b,c, SES	yes	yes	2		yes
Sarina Shire	Salonica Beach/Half Tide	to you have made to be such that you you by the manual season with a manual season of season the among the desirable model desirable products of the season	C C	Control of the second of the second place of the second place of the second of the sec	yes	VIII TOTALING OFFICE OFFICE DE CONTROL OFFICE OFFIC	yes	yes	01	Maria and Automotive Control	yes
Tambo Shire	Tambo	1 in 10	p'c	c, road closures	yes	SES	yes	2	yes	yes	yes
Tara Shire	Tara	namingraphy proving species and proving species are constructed and species are an experience and a species are a species and the species are a specie	q	b, SES	2	a demonstrative and the contractive of the contractive designation of the contractive designa	yes	yes	0		yes
Taroom Shire	Taroom	ANA ANALAN KAN KAN KAN KAN KAN KAN KAN KAN KAN K	b,c	That is trained to the total standard and the second delice of the temperature and the second an	no	q	yes	yes	2		. 6
Thuringowa City	distinct to the	1 in 8	co	ra	2		yes	2	2	yes	yes
Tiaro Shire	enter a returnation de la constanta de la cons	1 in 4	a		00	Antonima visuala de matemataçõe de signa de campos de la como de campo de c	yes	yes	5	2	yes
Тоомоотра City	Toowooomba City	is the begans wellow the construction of the 2-5	TO THE RESIDENCE OF THE PARTY O	THE CONTRACT OF THE CONTRACT O	00	Vietens "Ambrikanskillikkatilikanskillikonskilli i socia-vi-karif kom." – Am diskanovinsk sid at a	00	***************************************	1		1
Townsville City	Townsville	1 in 40	No.	counter disaster procedures	yes	b,c, police, post	yes	yes	e		yes
Waggamba Shire	A MANAGOR AND	erityra kanit ma o maine e mengamu noon mandakan matamirka kanitan matamirka mandan matamirka mandan matamirka	O CONTRACTOR OF THE CONTRACTOR	Quantum Company and Company of the C	yes	reform recorded message	yes	yes	ou	yes	00
Wambo Shire	Jandowae	ARANJA A B. I KANANA . AB'A KANANA I JABARA BARA (MARANANANANANANANANANANANANANANANANANANA	10		2	· · · · · · · · · · · · · · · · · · ·	yes	ou	00	O L	. 2
Waroo Shire	Surat	onene vada diraksi malionskelesta kleustorak diraksin stellatur kur kurakte. Aratur 17.0, a TVIN En. do.	C comment the constitution of the constitution	Did	yes	b, с	yes	yes	yes	yes	yes
Warwick Shire	Warwick	1 in 10	ord .	D,C	yes	TO THE RESIDENCE AND A STATE OF THE PARTY OF	yes	00	00	OL	00
Winton Shire	A VIOLEN CONTRACTOR CO	T THE STANDARD CONTRACTOR AND	The state of the state and a state of the st	The state of the state of Andrew Andrew Control of the state of the st	01	тариянда субення да серения высода под пределения выполня высода в под	yes	01	22		01
			a as a a a a a a a a a a a a a a a a a		**************************************				AL-100 and also day of the		
Atherton Shire	And the state of t	to commercial control to the place of the financial statement of the control of t		The state of the s	man or to promote person to resource.	l splitsjeld demokratje debe de derkt derekt kræminskender i krenterne av sæderæme tr.				+ + + + + + + + + + + + + + + + + + + +	******
Belyando Shire	No communitites at risk	An one way to be designed to be designed to the second of	The second secon	The second secon		- WANDARD VALVE (AN MARTY) (AN ARRANGA KARAMAN KARAMAN KARAMAN AN ARRANGA KARAMAN ARRANGA KARANGA KARA					
Broadsound Shire	no towns or buildings in the Broadsound Shire are subject to flooding.		٩	Q	2		yes	yes	OU	e	yes
Bungil Shire	lnjune	л анд не учений не селений на селений не селений не делений на делений не делений не делений не делений не деле	C)	the second of th	00	A the set of the second of the state of the second of the	yes				- Colore
Clifton Shire		Ver — негоду провуду ченовна по войного на гологодомо да в нава на подверена в петано вудивана дуже негодина н	The second secon	COMMANDES	Part Anthorne Ct St colored at 1884 A.	едиливного удиненичный деней дене деце повыходимился на головору (кг. т. — долую удуд, дус. туда, фин. тусуда, 1	An and an angelon and an	Commence and the commence of t]		1
Cloncurry Shire		о подост о делен се от ответе се от везодненије се дедину менене пое везум истаним и деленде везодне уме вус	. 6- 4- 1- 1- 1- 1- 1- 1- 1- 1- 1- 1- 1- 1- 1-	The state of the s	***	The Control of the Co				. , ,	
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	Township	Drainage Coastal	Coastai	1-7	┨							-
Local Government				Three Moon Creek / Montal Creek:		. ,,,,	00	00 BN 20	20	00		
Monto Shire	Monto	Pacific	2	Burnett River	1 200	0 %74	000	000 000 454	``` }	t_ 	•	
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	Local Government	Monto Shire	Murgon Shire	Peak Downs Shire	Perry Shire	Whitsunday Shire	Wondai Shire

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Local Government	Town/Community	6-1	6-2	6-3	6-4	6-5	9-9	6-7	8-9	6-9	6-10	6-11	6-12	6-13
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Local Government	Town/Community	8-2	8-3	8-4	9-1	9-2	9-3	9-4	9-6	9-6	2-6
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APPENDIX 1

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10-1	ပ	o				
10-2	, yes	signs at creek crossings		a a yes	Towns of Whitsunday and Prosperpine	
10-3	2	0.0		2		
10-4						
11-1	yes	8		yes		

Appendix 2

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The Questionnaire as Circulated to all LGAs

Where appropriate, aggregate responses have been added to the questionnaire. These are restricted to replies which indicated that an urban flood problem, as defined in the study, existed.

Some LGAs submitted responses for more than one flood prone locality. The aggregate replies are for locality and not for LGA. Details of LGAs responding and for the individual localities are given in Appendix 1.

Urban Flood Risk in Queensland

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The Department of Natural Resources has commissioned a study of Urban Flood Risk in Queensland as part of an overall project addressing floodplain management in Queensland. The objectives of this study are to:

- define the size, vulnerability & spatial distribution of flood prone communities in Queensland; and
- provide a basis for prioritising more detailed investigations into the extent of flood problems and establishing ways of mitigating the problems.

This questionnaire has been designed to provide the basic data for this study.

As mainstream flooding is the primary focus of this investigation, consideration of flooding from urban drainage surcharge should be excluded. However, flooding resulting from storm tide should be included as flooding and storm tide are often coincident. Where possible flooding from storm tide should be identified.

It is requested that a separate questionnaire be completed for <u>each</u> town/community within your Local Government boundary where the number of buildings at risk of flooding during the largest recorded event or during the estimated 1 in 100yr event is greater than 10. If the number of buildings within a town/community at risk to flooding is less that 10, no response is required.

In the case of major towns, it maybe appropriate to complete separate questionnaires for areas with discrete separate flow systems.

It is acknowledged that not all Local Governments will be able to complete every item in this questionnaire. However, it is requested the each Local Government provide the best information available for each flood affected town/community.

Definitions of some terms used in this questionnaire are attached at the end of the questionnaire.

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Local Government	
Town/Community	

1 Contact Person

1.1 Contact Person	
1.2 Position	
1.3 Telephone Number	

2 <u>Town/Community Data</u>

2.1 River Basin	
2.2 Total Population in Town/Community	
2.3 Percentage Growth Rate	

(Please estimate from the bes	ngs within the Community st data available)
2.4 Residential	
2.5 Commercial	
2.6 Industrial	
2.7 Caravans & Mobile Ho	omes

3.1 Does a storm tide problem			
exist?		yes	
f "no" is the answer to the above question,	, please go to	Question 4	•
3.2 Date of the last event which caused flooding of buildings		W	
3.4 Does a storm tide inundation map exist?		yes	
Details of Largest Known_Ever	1 t	et i Sang red gebes in	34363
4.1 Date of largest known flood			
event			
event 4.2 Estimated Max Discharge			
event 4.2 Estimated Max Discharge (cumecs) 4.3 Duration of Flood Inundation Total Number of buildings floo	ded by L	argest Re	ecorded
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Effect of Largest Known Flood	on Lifel	ines
4.8 Major Roads		no access roads affected
		some access roads cut
		all access road cut
4.9 Rail		no rail links affected
		some rail links cut
		all rail links cut
		not appliciable
4.10 Airport		airport unaffected
		airport closed or services interrupted
		not appliciable
4.11 Water Supply		water supply unaffected
		water supply interrupted by flooding
4.12 Sewerage Facilities		sewerage facilities unaffected
		sewerage facilities flooded
4.13 Electricity Supply		electricity supply unaffected
		electricity supply interrupted by flooding
4.14 Other (eg fire,ambulance or hospital)		
		;

Estimates of Flood Warning Ti	ime for Largest Known Flood
4.15 Time between commencement of rainfall and initial flooding of urban area (hr)	
Mappingof Past Flood Even	nts
Data Collection	
5. 1 Is historical flood data available?	yes 🔲 no
5. 2 If no historical flood data has been recorded, please give reasons.	
5. 3 If historical data is available, what is the data used for?	
Town Flood Gauge	
5.4 Does a town flood gauge exist?	☐ yes ☐ no
If "no" is the answer to the above question,	, please go to Question 5.10.
5.5 Length of Gauge Record (years)	
5.6 Gauge Height corresponding to zero flow conditions (m)	
5.7 Gauge Height at which water flows over the river banks (m)	

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yes no
none
paper plans
GIS
Aerial Photographs
Satellite Imagery
Satellite Imagery yes no

6.2 Floods Studied	1 in 2 yr event 1 in 5 yr event 1 in 10 yr event 1 in 20 yr event 1 in 50 yr event 1 in 100 yr event other (please specify)
	*
Probable Max Flood Event	
6.3 Has the Probable Max Flood Discharge been estimated?	☐ yes ☐ no
6.4 Has the Probable Max Flood Event been mapped?	☐ yes ☐ no
Designated Flood Event	
6.5 Adopted Designated Flood Event	no designated event 1 in 20 yr event 1 in 50 yr event 1 in 100 yr event other (please specify)
Designated Floor M	
Designated Flood Mapping	
6.6 Have the designated flood limits been mapped?	☐ yes ☐ no

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6.7 Designated Flood Mapping Method		none	
		paper pla	ns
		GIS	
		Aerial Pho	otographs
		Satellite In	
Total Number of buildings floor Designated Event (Please estimate			
6.8 Residential			
6.9 Commercial			
6.10 Industrial			
6.11 Caravans & Mobile Homes			
Further Studies			
6.12 Has a Damage Study been carried out?		yes	no no
6.13 Have Floodplain Management options been developed?		yes	☐ no
Flooding Policy			
7.1 Has a flooding policy been developed for this community?		yes	☐ no
If "no" is the answer to the above question,	please go t	o Question 8.	

	Hydraulic basis for flooding policy	historical data adopted designated flood event other (please specify)
7.3	Is the Designated Flood for residential buildings the same as the Designated Flood for commercial buildings?	yes 🔲 no
7.4	If the answer to question 7.3 is 'no', please explain policy decision	
7 6	Difference	
7.5	Difference between allowable floor levels and designated flood levels (m)	
	floor levels and designated	adhoc individual approvals
	floor levels and designated flood levels (m)	
	floor levels and designated flood levels (m)	approvals filling policy determined on the basis of

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7.7 Legislative mechanisms used	Local Government Act
	Local Government (Planning & Environmnet) Act
	Water Resources Act
	River Improvement Trust
romanianianianianianianianianianianianiania	other (please specify)

8 Flood Mitigation Measures

Flood Mitigation Measures used to reduce effect of flooding on community			
8.1 Structural	Levees		
	Flood Control Dams		
	Retention Basins		
	Flood Proofing of Buildings		
	other (please specify)		
8.2 Non-structural	Building Controls		
	Land Use Controls		
	Flood Warning system		
	other (please specify)		

U.J	Funding for Flood Studies		Commonwealth Government	
			State Government	
			Local Government	
			other (please specify	
3.4	Funding for Structural Works		Commonwealth Government	
			State Government	
			Local Government	
44.450 44.450			Local Government other (please specify)	
(401) 25(1)		_	outer (piease specify)	
<u> </u>	rent Level of Flooding An	varene		
	Is the community aware it is located on a floodplain?	varene		
).1	Is the community aware it is	varene	<u>SSS</u>	
).1).2	Is the community aware it is located on a floodplain? Is the community aware it can be flooded? Are past flood levels indicated locally (eg flood	varene	yes	
9.1 9.2 9.3	Is the community aware it is located on a floodplain? Is the community aware it can be flooded? Are past flood levels	varene	yes no	

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Last Flood causing Flooding of	Buildings
9.6 Date of the last flood	
9.7 Max Height at the Town Gauge, if available (m)	
9.8 Estimated Average Recurrence Interval, if available	

10 Flood Warning System

10.1 Flood Warning supplied by the Bureau of Meteorology	None
	Qualitative information (ie min/moderate/major flooding)
	Predicted heights at given locations
	other (please specify)
10.2 What use is made of the information supplied by the	None
Bureau of Meteorology?	information relayed to the community unaltered
	information is interpreted and translated into predictions in particular areas
	other (please specify)
· Transa is a Section of the Control	

10.3	Does your Local			
	Government maintain a local	Ц	yes	☐ no
	Flood Warning System for			
	this Town/Community			
10.4	If the answer to Question		door-kno	ockina
	10.3 is 'yes', how is the flood information relayed to the		GOOT-KIIK	Jeking
	affected community?	Ц	radio	
			televisio	_
	(tick more than one box, if		relevisio	1
	appropriate)		loudspeak	ers
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			otner (pie	ease specify)
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<u>.ou</u>	<u>nter Disaster (Flood) Pla</u>	<u>in</u>		
14.43	Does an Counter Disaster			
11.1			yes	u no
11.1	(Flood) Plan for this		yes	☐ no
11.1			yes	☐ no
	(Flood) Plan for this community exist?			***
`"no'	(Flood) Plan for this community exist? 'is the answer to the above question, y	ou need no		
`"no'	(Flood) Plan for this community exist? 'is the answer to the above question, y	ou need no		
"no' uestic	(Flood) Plan for this community exist? 'is the answer to the above question, y	ou need no		***
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11.2 11.3	(Flood) Plan for this community exist? Is the answer to the above question, yours. Is the Counter Disaster (Flood) Plan linked to any flood warning procedures? Was the Counter Disaster (Flood) Plan activated during the last major flood event? Was the Counter Disaster (Flood) Plan effective when last activated? Was the Counter Disaster	ou need no	yes yes	y further no
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11.6 Does the Counter Disaster (Flood) Plan use or contain information from flood studies?	☐ yes	no
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Definitions

Town/Community to be included in this study

Town/Community where the number of buildings at risk of flooding during the largest recorded event or during the estimated 1 in 100yr

event is greater than 10

Flood overbank mainstream flooding

Storm Tide total water level caused by storm surge adding to the height of the

astronomical tide

Residential residences plus, where possible, number of dwelling units in blocks

of flats

Commercial retail outlets, service stations etc

Industrial any large enterprise eg milk factory, port installation, extensive rail

yards etc

Lifelines roads

rail links airport water supply sewerage facilities electricity supply

Flood warning

time

time between the commencement of rain and the initial urban

flooding

Designated flood

event

flood event selected for planning purposes

Probable Maximum Flood the largest flood that could conceiably occur at a particular location

Damage Study study of damage costs associated with particular statistical flood

events

Floodplain

Management Plan

plan which details strategies for minimising flood damage on the floodplain based on economic, social and environmental factors

Flood Proofing a combination of measures incorporated in the design, construction

and alteration of individual buildings or structures subject to

flooding, to reduce or eliminate flood damages

Average the long-term average number of years between the occurrence of a

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Recurrence Interval flood as big or larger than a given eflood event

Counter Disaster Plan plan prepared by Local Government, in accordance with Part 4 of the State Counter Disaster Organisation Act

Appendix 3

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The Significance of Probable Maximum Flood Case Studies from New South Wales

Areas for which detailed residential (and other) damage estimates have been prepared are for the Hawkesbury-Nepean river system to the west of Sydney (Penrith to Windsor), Queanbeyan and Canberra and with less detail for several flood prone catchments in Sydney. With the exception of Sydney, these studies were undertaken in order to provide estimates of damage from dam failure but to undertake this work it was necessary to consider the worst possible case for river flooding, i.e. to the level of the PMF. The results presented below refer entirely to river flooding not to damage from potential dam failure. Much of the detail is reported in consultant reports to Sydney Water although a summary is given in Smith (1991). The third study was for the Georges River, Prospect Creek and the Upper Parramatta catchments in Sydney, this was reported in Smith et al. (1990). In this case the numbers of buildings were estimated from air photos in contrast to the dam failure studies which used databases from detailed field surveys of all buildings at risk.

Table A3.1 Numbers of residential buildings with overfloor flooding and failure from extreme floods for a selection of sites in New South Wales

	Total Urban	Rural*
(a) Hawkesbury-Nepean region		
l in 100 year	1762 (67)	415 (237)
1867 floor	5411 (733)	555 (380)
1 in 1,000 year	10,602 (5090)	915 (563)
PMF	11,594 (7162)	915 (625)
(b) Queanbeyan (data collected 1987)		
l in 10 year	3 (0)	
1 in 100 year	448 (N/A)	
1 in 2,000 year	1360 (992)	
PMF	1953 (1422)	
(c) Prospect Creek and Georges River		
(Data collected 1986. No information on		
building failure)		
1 in 20 year	1422 (N/A)	
1 in 100 year	2807 (N/A)	
PMF	5381 (N/A)	
(d) Canberra		
1 in 100 year	0	
1 in 2,000 year	76(1)	
PMF	750 (135)	

Based on reconnaissance survey only.

Numbers in brackets indicate building failure, data collected early 1989.

The increases in the numbers of properties at risk from extreme floods in the study area is given in Table A3.1. the numbers at the level of the PMF are 4 to 6.5 times greater than for the 1 in 100 year event. In general terms the increases are related to the increases in stage between the 1 in 100 year and PMF. The best information on these stage increases is presented in Table A3.2. For instance, the increase of over 4.35m at Queanbeyan changes the number of residential buildings at risk from 448 to 1953. Table 3.7b lists a selection of sites in Queensland for which the flood range, in this case from the 1 in 20 to 1 in 100 year flood events, is known to be large.

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Table A3.2 Increases in flood height from the 1 in 100 year flood to the PMF for a selection of sites in New South Wales

Hawkesbury-Nepean (at Windsor)	10.0÷m
Queanbeyan Prospect Creek and Georges River	4.35 m
- Trospect creek and deorges Kiver	4.0 m

Appendix 4

Flood Studies for the Brisbane Creeks

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Flood mitigation schemes in Brisbane – an overview. BCC. 1989.

Bulimba Creek

Bulimba Creek flood study. BCC. 1992.

Cabbage Tree Creek

Flood mitigation study. Kinhill, Cameron, McNamara. 1991.

Cubbera Creek

Cubbera Creek flood study. BCC. 1996.

Enoggera Creek/Breakfast Creek

Reidel and Byrne. 1986. Macdonald Wagner. 1988.

Gold Creek

Dam safety review. SMEC. 1993.

Kedron Brook

Kedron Brook flood study. Connell Wagner. 1995.

Moggill Creek (including Gold and Gap creeks).

Moggill Creek flood study. Sinclair, Knight, Merz. 1994.

Norman Creek

Norman Creek flood mitigation report. BCC. 1987.

Norman Creek flood study. Connell Wagner. 1995.

Oxley Creek

Oxley Creek and Stable Swamp Creek. BCC. 1981.

Oxley Creek system – flood mitigation report. BCC. 1984.

Sandy Creek

Sandy Creek flood study report. BCC. 1997.

Wolston Creek

Wolston Creek flood study. BCC. 1996.

Appendix 5

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Effective Flood Warning Times for Flood Prone Queensland Locations

These data were provided by the Brisbane Office of the Bureau of Meteorology, in April 1997, as a specific contribution to the report into urban flooding in Queensland.

Effective warning time is classified into three categories:

A is less than 12 hours

B is 12-24 hours

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C is greater than 24 hours

Effective warning time is an estimate of the river height prediction lead time currently available and is limited by climatological factor and/or flood monitoring networks and prediction tools.

The appendix also contains other information from the Bureau's data base, for example estimates of the number of flood prone properties, presence of flood gauges, key flood heights, the nature of the flood warning system etc. In some cases these are not identical to those given elsewhere in this report. The Bureau's data base is the most comprehensive available account of flood-related information for Queensland but it is stressed that some of the information is not necessarily precise. The Bureau would be pleased to receive additions or modifications to the information given.

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