



Northern
Territory
Government

DEPARTMENT OF LANDS, PLANNING AND THE ENVIRONMENT

KATHERINE REGION

An aerial photograph showing a flooded residential and commercial area. The water is murky brown and covers a large portion of the landscape, including streets, parking lots, and some buildings. In the background, there are more buildings and a line of trees under a cloudy sky. A large blue diagonal graphic element is overlaid on the left side of the image.

FLOOD
MITIGATION
ADVISORY
COMMITTEE
REPORT



DEPARTMENT OF LANDS, PLANNING AND THE ENVIRONMENT

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KATHERINE REGION

Committee Membership



- **WILLEM WESTRA VAN HOLTHE, (Chair)**
Member for Katherine, MLA and resident
- **FAY MILLER**
Mayor of Katherine, resident
- **PAUL KERNAGHAN**
Insurance Council of Australia
- **KEVIN GREY**
(represented by David Shemmell, business manager, resident) Chamber of Commerce
- **GEOFFREY NEWTON**
business owner, resident
- **CRAIG LAMBERT**
business owner, resident
- **MERRILYN STOPP**
resident
- **STEVEN ROSE**
business owner, resident



FOREWORD

Katherine is a regional town with diverse economic drivers including tourism, defence, livestock and produce farming. It is a town that is mostly built on a floodplain, adjacent to the Katherine River, and flooding is a significant risk and issue for those residents and business owners impacted.

On the 28 January 2015, the Katherine Flood Mitigation Advisory Committee was formed and tasked with developing a strategy for flood mitigation to improve community safety, as well as reducing the

damage, disruption and costs associated with major flood events in the Katherine Region.

This report provides a policy framework for managing the flood risk in the Katherine Region and is committed to reducing this risk through specific recommendations and measures.

The Katherine Flood Mitigation Advisory Committee recognises that an integrated approach, with Government, the community, local council and other stakeholders working together, is crucial to achieve sustainable flood mitigation now and into the future.

Willem Westra van Holthe

CHAIR

Katherine Flood Mitigation Advisory Committee

DEFINITIONS

| TERM / ACRONYM | MEANING |
|--|---|
| Annual Exceedance Probability (AEP) | The chance of a flood of a given size occurring in any one year, usually expressed as a percentage. 1% AEP flood is a term used to define a flood event that has a 1% chance to occur in a given year and is a flood of a larger magnitude. |
| Flood | A natural phenomenon that occurs when water covers land that is usually dry. Sources of flooding include rivers and other watercourses, local overland flow paths and groundwater systems. |
| Floodplain | The area adjacent to a river or creek that is inundated by flood waters and which covers an extent related to the magnitude of the flood. |
| DoH | Department of Health |
| DLPE | Department of Lands, Planning and the Environment |
| DLRM | Department of Land Resource Management |
| DoI | Department of Infrastructure |
| KEC | Katherine Emergency Committee |
| KTC | Katherine Town Council |
| NTG | Northern Territory Government |



Stuart Highway bridge during the 2006 flood

OVERVIEW

This report provides a strategic direction and policy framework for flood mitigation in the Katherine Region. Relevant expert advice was provided through the Department of Lands, Planning and the Environment (DLPE), the Department of Land Resource Management (DLRM), the Department of Police, Fire and Emergency Services (PFES), Katherine Town Council (KTC) and Insurance Council of Australia (ICA) to assist the Committee in the formulation of this report.

A number of recommendations have been made within the context of a flood risk management framework, and are listed in the summary of recommendations section. These recommendations address immediate, short, medium and long-term actions that improve community safety, as well as reduce the risk of damage, disruption and costs associated with major flood events.

In formulating these recommendations, the Committee has given consideration to the impact these measures may have in constraining increases in insurance premiums. These increases arise due to the ongoing introduction of risk pricing for flood where a property's risk of riverine floods results in higher premiums according to the flood risk faced. The impact on insurance premiums would be highest for those properties which are most likely to suffer frequent flooding events and/or significant damage as a result of severe flood events.

The Katherine Flood Advisory Committee has sought to recommend an optimal use of the funds allocated by the NTG for flood mitigation; however, due to

the specific circumstances of the town, it will not be possible to remove the flood risk for all those within the flood zone against the most severe flood events. The ultimate objective requires a mix of measures so that in the long term, land use and planning controls can assist the highest risk properties to either relocate outside of the flood zone or where feasible, to re-engineer buildings to be 'flood proof'.

Whilst the focus of the Committee has been on using the allocated funds to reduce the risks to property and the local economy and to improve safety from future flood events, it is clear that transitional measures may be required in the short to medium term to help maintain affordable premiums for high risk properties whilst mitigation measures are being implemented. In this regard, the Committee has recommended that an alternative flood pooling model for high risk properties be investigated by the Northern Territory Government. Recognising that flood insurance affordability issues exist across the whole of Australia, in the first instance, the Committee recommends that the NTG raise this issue with the Northern Australia Insurance Premiums Taskforce, which was recently established by the Commonwealth Government.

Structural mitigation options will be the key focus of a subsequent report which will utilise updated flood modelling and mapping recommended in this paper.

SUMMARY OF RECOMMENDATIONS

The following is a summary of recommended mitigation measures taken from the body of this report. These recommended mitigation measures should be read in conjunction with the Works Plan on page 26.

1. PRELIMINARY INVESTIGATIONS

RECOMMENDATION 1.1

New aerial topography survey of the Katherine catchment region to be carried out immediately and subsequent modelling and mapping to be updated.

RECOMMENDATION 1.2

A separate study into groundwater is commissioned to understand how the aquifer and sinkholes in Katherine can impact flooding in the Katherine Region.

RECOMMENDATION 1.3

Develop a digital hydraulic model that includes the impact of riverine flooding, the trunk drainage network and takes into consideration the impact of groundwater levels.

2. STRUCTURAL MITIGATION

RECOMMENDATION 2.1

Test structural (infrastructure) mitigation measures using the digital flood model to identify measures that will reduce either the number of properties impacted, the extent of the impact and the frequency of flooding while achieving value for money for the taxpayer.

RECOMMENDATION 2.2

Undertake a geomorphologic and infrastructure assessment of the drainage system and prepare a maintenance strategy to promote hydraulic efficiency of the Katherine River, including weed and sedimentation control.

3. LAND USE PLANNING

RECOMMENDATION 3.1

Undertake an economic assessment of the existing commercial centre, considering the current and future retail/commercial demand and the economics, impact and potential for engineered flood mitigation measures.

RECOMMENDATION 3.2

On completion of the economic feasibility assessment of the Katherine Commercial Centre, the Department of Lands, Planning and the Environment progress with the planning to deliver the infrastructure associated with the second centre in accordance with the timeframes identified in the economic assessment.

RECOMMENDATION 3.3

That the Katherine Ambulance Centre is relocated to a master-planned site outside of the flood zone and consistent with the Katherine Land Use Plan, that will facilitate the eventual creation of a Police, Fire and Emergency Services precinct.

RECOMMENDATION 3.4

The Department of Health, in conjunction with relevant Government agencies and Katherine Town Council, commence future planning for the relocation of the Katherine Hospital.

RECOMMENDATION 3.5

Upon the completion of revised modelling and mapping, investigate improved development controls for those lots in the worst affected areas.

RECOMMENDATION 3.6

That the definition of flooding within the *NT Planning Scheme* is amended to include stormwater flooding to the effect that the owner or occupier of land maintains the pre-development peak flow rates within a catchment.

In conjunction with this, best practice policy for stormwater management in the Northern Territory is addressed; including the objective to reduce the risk of stormwater flooding. To support this objective, a single agency is resourced for the responsibility to hydraulically model trunk drainage systems to mitigate the impact of development on trunk drainage systems.

4. FLOOD RESILIENCE

RECOMMENDATION 4.1

Review Katherine's early warning system, to further improve efficiency and lead times through new and/or upgraded flood gauges, a groundwater monitoring system, increased accuracy of the warning through updated flood maps to provide improved flood warning advice to residents and business.

RECOMMENDATION 4.2

Support individual flood responses through the creation of a dedicated online platform that provides a more detailed flood risk on individual properties and businesses, and access to flood warning data. This includes the recommendation that flood risk information is provided to all members of the Australian Institute of Conveyancers (NT) to support conveyancers advising potential property buyers of relevant flood risk information.

RECOMMENDATION 4.3

That the Whole of Town Emergency Plan is coordinated through the Katherine Emergency Committee and includes the identification of a fuel supply post flooding, construction of a secure hardstand to store vehicles and other relocated property, and the protection of the communications network.

5. SUPPORT MEASURES

RECOMMENDATION 5.1

Establish a Flood Resilience grant for businesses and community organisations in the flood zone to help them re-establish and return to operation quickly following a flood event.

RECOMMENDATION 5.2

The Northern Territory Government adopts a policy to facilitate concessional loan schemes to eligible businesses following a flood event to assist businesses to remain operational during this period.

RECOMMENDATION 5.3

The Northern Territory Government investigate the feasibility to rezone flood affected land for higher and better use, including options to: establish a framework to guide redevelopment/acquisition; rezone properties to facilitate regeneration of flood affected areas; or acquire the worst effected properties and rezone to a more appropriate land use.

RECOMMENDATION 5.4

The Northern Territory Government engage with the Commonwealth's Northern Australia Insurance Premium Taskforce regarding the establishment of a Northern Australia Disaster Management reinsurance pool to support the worst impacted properties identified in the updated flood modelling.¹

6. OVERSIGHT OF WORKS PLAN

RECOMMENDATION 6.1

The Katherine Emergency Committee to have oversight of the delivery of the Works Plan in accordance with the recommendations of this Report.

¹ The Committee acknowledges that support for government reinsurance pools to address home insurance affordability issues is not currently the position of the Insurance Council of Australia.



INTRODUCTION

The Katherine Flood Mitigation Strategy incorporates a holistic approach to reducing the impact of flood events for residents, industry and the community. The strategy recognises that a range of solutions are required to mitigate the risks.

The National Strategy for Disaster Resilience objectives for a disaster resilient community is acknowledged, where disaster resilience is a shared responsibility of all sectors of society, including governments, councils, business, non-government organisations and individuals. An integrated approach is essential towards ensuring effective flood mitigation.

Different non-structural (property and response modification) mitigation measures have been considered with the focus on providing the broadest community benefits within the available funding.

Structural mitigation options have also been identified in this report, however these cannot be analysed and modelled until up-to-date flood modelling is available. The outcome of the flood modelling and testing of the various structural mitigation options will be the subject of a further report.

BACKGROUND

On 20 November 2014 the Chief Minister announced funding of \$50 million for flood mitigation for the Darwin Region and Katherine as part of the sale of the Territory Insurance Office (TIO).

On 28 January 2015 the Chief Minister established a Flood Mitigation Advisory Committee in Katherine, which met for the first time in February 2015 to review the draft Terms of Reference and the work program to August 2015.

The Katherine Region Flood Mitigation Advisory Committee is to provide a report to Government by the end of August 2015 with recommendations on how \$25 million of the funding can best be spent to mitigate the impact of flooding while providing value for money for taxpayers.

TERMS OF REFERENCE

The Committee has been tasked to assess and make recommendations on effective measures to reduce risks of flood events, including risks to public safety, and the economic and social impacts of major flood events in the Katherine Region. The key role of the Committee includes the following:

- Development of an overarching Flood Mitigation Strategy for the Katherine Region, including a policy framework for the mitigation of the flood risk and the impact of flood events;
- Provision of advice on specific policies, strategies, measures and actions necessary to support the achievement of the policy objectives of the Flood Mitigation Strategy;
- Provide advice on the estimated costs of the specific measures and initiatives to be implemented under the Katherine Region Flood Mitigation Strategy;
- Provide advice on an appropriate implementation framework for the Katherine Region Flood Mitigation Strategy; and
- Identify any Commonwealth Government funding that may be available to supplement NTG funding.



Source: Water Resources Division, DLRM, 2006 flood

FLOODING IN THE KATHERINE REGION

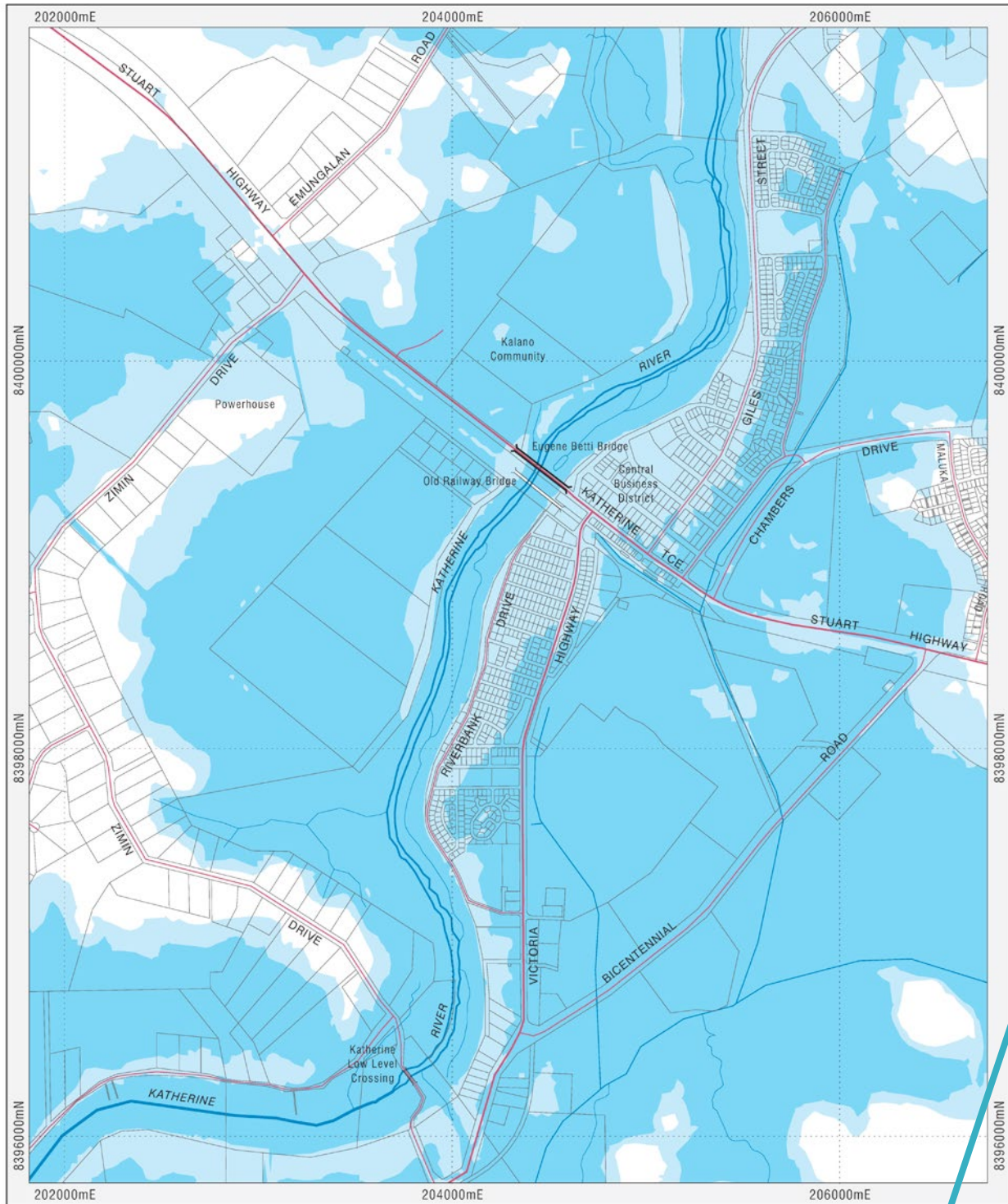
The Town of Katherine sits alongside the Katherine River and has a population of around 10,000 people¹.

The Katherine River is subject to flooding that occurs when heavy rainfall causes relatively high water levels to overtop its banks. Notable flood events occurred in 1931, 1940, 1957, 1974, 1998 and 2006. The 1998 flood was the largest on record with a peak level of 20.39 metres Gauge Datum at the old Railway Bridge. Apart from the Katherine East Residential Area, almost all residential, commercial and industrial properties are significantly affected by flood waters.

¹ ABS published data from 2012 for Katherine local government area

FIGURE 1: KATHERINE FLOOD MAP EXTENT

This diagram showing the flood extent and floodway in the Katherine town area, is an extract from the computed 1% AEP (1 in 100 year) flood map prepared in June 2006.



metres 0 200 400 600 800 1000 metres

Map Grid of Australia (MGA) Zone 53
 Transverse Mercator Projection
 Horizontal Datum: GDA 94

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LEGEND:

- Flood extent
- Floodway, depth > 2 metres
- River
- Creek or drain
- Property boundary
- Road



A summary of previous reports undertaken to map and/or study the Katherine floodplain over the last 25 years are listed below;

- **Katherine Floodplain Management Study**

(Power and Water Authority, 1992)

This study was initiated at the request of the Katherine Town Council. The study investigated building a left bank levee to protect the town, a levee around Kalano and a levee around the old Railway estate areas to protect these areas in a 1 in 100 flood event. This proposal was not recommended due to a lack of any strong community support and lack of funding.

- **Katherine Levees**

(Department of Lands Planning and Environment, 1996)

This study was based on the recommendation contained in the 1992 report that consideration be given to minor works to mitigate flood risks. The study investigated the engineering feasibility of minor levee works near the Katherine Hospital that would minimise the impact of flooding in a 1 in 100 year flood. This proposal was not recommended due to a lack of funding.

- **Flood Impacts of Raising Gorge Road and Proposed Levees**

(WRM Water & Environment, 2007)

This study was initiated by Katherine Town Council in response to the April 2006 flood event. The study investigated the impact of a levee along parts of the left bank of the Katherine River to protect the hospital and other areas from a flood of a similar magnitude to the 2006 flood. This proposal was not recommended due to a lack of funding. Properties are significantly affected by flood waters.

KATHERINE FLOOD MITIGATION STRATEGY

The Katherine Flood Mitigation Strategy developed by the Katherine Flood Mitigation Advisory Committee incorporates a range of measures to be undertaken which in conjunction with one another mitigates the impact of flooding through effective understanding and management of flood risks. The strategy builds upon existing floodplain management measures undertaken across the Northern Territory Government, Katherine Town Council and the Community.

To mitigate the impact of flooding in Katherine requires a shared responsibility across all spectrums of society,

recognising that individuals must respond to flooding with resilience, and governments support resilience through structural mitigation, appropriate land use planning and other financial support measures.

It is important to note that structural solutions have limitations. No amount of intervention can stop flooding altogether for all rainfall events. It is extremely difficult to totally eliminate all risk. There will always be properties within the existing Katherine town boundaries that will be impacted upon by flooding.

The Katherine Flood Mitigation Strategy is outlined below:



1. PREPARATORY INVESTIGATIONS

The current Katherine flood map is outdated and does not allow for the adequate testing of potential structural mitigation measures, early warning systems and the impact of changing land uses.

The Department of Land Resource Management is responsible for the modelling and mapping of riverine flooding in the Northern Territory. The current flood model for the Katherine Region, developed in 2000, is based on topography derived from aerial photogrammetry undertaken in 1998 and is considered out-dated.

Aerial photogrammetry of the entire catchment is required, together with significant ground truthing through survey to verify the ground contours. New digital technologies enable far greater accuracy in contour mapping and the development of digital elevation models to form the basis for hydraulic modelling.

RECOMMENDATION 1.1

New aerial topography survey of the Katherine Region to be carried out immediately and subsequent modelling and mapping to be updated.

A separate study into groundwater and sinkholes within Katherine is required to understand how they impact flooding and to allow for an integrated system for predicting flood events that take into account the groundwater levels.

Anecdotally, the aquifer level can influence the severity of a flood event, i.e. the higher the groundwater, the more severe the flood event for localised flooding events. Current flood modelling does not take into account ground water levels for localised flooding events.

RECOMMENDATION 1.2

A separate study into groundwater is commissioned to understand how the aquifer and sinkholes in Katherine can impact flooding in the Katherine Region.

A new flood model needs to be developed by a hydrology/hydraulic engineer taking into consideration riverine flooding and the local trunk drainage network.

The digital hydraulic model will be manipulated to test a range of flood mitigation options including structural mitigation measures, provide more detailed information with regards to flood depths across Katherine, and provide greater certainty for flood evacuations.

Investigations will also be done on downstream effects of proposed flood mitigation works.

RECOMMENDATION 1.3

Develop a digital hydraulic model that includes the impact of riverine flooding, the trunk drainage network and takes into consideration the impact of groundwater levels.

2. STRUCTURAL MITIGATION

2.1 INFRASTRUCTURE

Flooding in Katherine is complex and 1% AEP flooding or higher is inevitable, and a range of structural mitigation measures, individually and in conjunction, may reduce the extent and the frequency of flooding. The updated hydrology/hydraulic modelling will be used to understand the effect of a range and combinations of structural mitigation measures, including levees, weirs, off-site storage facilities, detention basins, trunk drains and dams.

A cost-benefit assessment of structural mitigation measures is important as a measure of the effectiveness of the mitigation measure relative to the cost of constructing the infrastructure to mitigate flooding. Some measures may be effective overall but the financial, social and community cost may exceed the benefit of the mitigation measures.

Following the outcome of this testing, structural mitigation options will be the key focus of a subsequent report.

RECOMMENDATION 2.1

Test structural (infrastructure) mitigation measures using the digital flood model to identify measures that will reduce either the number of properties impacted, the extent of the impact and the frequency of flooding while achieving value for money for the taxpayer.

2.2 HYDRAULIC EFFICIENCY

Ongoing maintenance to maintain hydraulic efficiency and structural integrity of natural and man-made drainage systems is essential to maintain effective functioning of the system.

A geomorphological study will identify hydraulic inefficiencies within the river and associated drainage system and inform an ongoing maintenance plan to keep the river free of restrictions such as the build-up of silt around bridge culverts and weed infestations.

There is currently organic matter within the river and associated natural system that may prevent flow efficiency, including Neem trees and other weed infestations and sediment build up.

Developing and maintaining a regular maintenance schedule for flood prone areas is essential firstly to clear blockages and then prevent the recurrence of hydraulic inefficiencies within the Katherine drainage system.

RECOMMENDATION 2.2

Undertake a geomorphologic and infrastructure assessment of the drainage system and prepare a maintenance strategy to promote hydraulic efficiency of the Katherine River, including weed and sedimentation control.

3. LAND USE PLANNING

3.1 EXISTING COMMERCIAL CENTRE REVIEW

The time in which it takes for a region's business and industry to become operational after a flood event is often key to the recovery of that region.

The impact of flooding on various types of businesses differs for each retailer with retailers owning higher volumes of stock at higher risk than service orientated businesses. Commercial businesses currently have no immediate options to relocate to areas outside of the flood zone to mitigate this risk.

While the Land Use Plan recognises the risk of flooding on the existing commercial centre, it identifies the need for more detailed investigation to inform land use planning within the existing commercial centre, in particular the feasibility of mitigating flood risk by building up out of the flood zone.

An economic assessment of the existing commercial centre, considering both the current and future retail/commercial demand and the economics of engineering flood mitigation will inform the Katherine Land Use Plan and flood mitigation for high risk businesses in Katherine.

The findings of this report will assist the NT Planning Commission to evaluate the current Katherine Land Use Plan in terms of its effectiveness in mitigating the significant risks associated with flooding.

RECOMMENDATION 3.1

Undertake an economic assessment of the existing commercial centre, considering the current and future retail/commercial demand and the economics, impact and potential for engineered flood mitigation measures.

3.2 KATHERINE SECOND CENTRE

The ultimate flood mitigation in Katherine is the migration of higher risk commercial and residential land uses outside of the flood zone.

The Katherine Land Use Plan was introduced into the *NT Planning Scheme* in June 2014 to inform and guide development of future residential, industrial and commercial land uses.

The delivery of the Second Centre will take place in conjunction with the development of the Hospital and the Katherine East residential developments.

The size, structure and delivery timeframes of the Second Centre will be informed by the economic assessment of the existing commercial centre.

RECOMMENDATION 3.2

On completion of the economic feasibility assessment of the Katherine Commercial Centre, the Department of Lands, Planning and the Environment progress with the planning to deliver the infrastructure associated with the second centre in accordance with the timeframes identified in the economic assessment.

3.3 KATHERINE AMBULANCE CENTRE

The existing Ambulance Centre on Kintore Street is subject to flooding, placing the most vulnerable members of the community at risk during a flood.

The Land Use Plan has identified a flood-free location for a combined emergency service operations centre, being adjacent the existing Katherine East industrial area.

The emergency services centre is to be master planned to provide facilities initially for the Ambulance Services and in time for Police, Fire and Emergency Services as well.

The funding provided as part of the Katherine Flood Mitigation for the relocation of the Ambulance Centre is to include master planning the future complex (to facilitate the location of the other emergency services), the construction of the Ambulance Centre building and all essential services and access headworks infrastructure.

RECOMMENDATION 3.3

That the Katherine Ambulance Centre is relocated to a master-planned site outside of the flood zone and consistent with the Katherine Land Use Plan, that will facilitate the eventual creation of a Police, Fire and Emergency Services precinct.

3.4 KATHERINE HOSPITAL RELOCATION

The Katherine Hospital is located within the flood zone and is subject to inundation and/or access can be cut due to flood waters.

Further investment into the current flood prone Hospital only delays the relocation to the flood free site within the Second Centre identified in the Katherine Land Use Plan.

The Katherine Land Use Plan identifies a future site for the Hospital's relocation but further planning is required in conjunction with the Department of Health to facilitate the delivery of the site and hospital buildings over the longer term.

RECOMMENDATION 3.4

Future planning for the relocation of the Katherine Hospital is to be undertaken by Department of Health together with relevant Government agencies and Katherine Town Council.

3.5 PLANNING CONTROLS

Planning and land use controls address flood mitigation at the planning level by regulating land use activities in areas that may be prone to flooding.

Flood risk should be considered as early as possible in the planning and development process and planning decisions affecting flood affected land should take into account the best available flood information.

Under the *NT Planning Scheme*, there is a requirement to avoid development of land affected by flooding. Due to the risk of flooding, a large part of the town has not been built upon and is zoned for open space and recreational purposes. Development of land in any zone within a defined flood area requires the prior approval of the DCA.

Planning and land use controls address flood mitigation at the planning level by managing land use within areas that are subject to flooding.

Existing building controls under the *NT Planning Scheme* address flood risk by requiring new homes or substantial renovations to construct habitable rooms at the minimum 300mm above the 1% AEP flood level for the site.

RECOMMENDATION 3.5

Upon the completion of revised modelling and mapping, investigate improved development controls for those lots in the worst affected areas.

3.6 STORMWATER MANAGEMENT POLICY

The rate at which stormwater runoff leaves an urbanised environment with roads, roofs and other sealed surfaces is much higher than in a natural landscape. With increasing urbanisation of a catchment there is the potential for an incremental increase in the rate at which stormwater enters the trunk drainage system which in turn may increase the frequency and intensity of localised stormwater flood events.

The availability of a stormwater, groundwater and riverine flood models would inform the relevant authorities with regards to the impact of development in flood affected areas of Katherine.

The Department of Land Resource Management is responsible for the modelling and mapping of riverine flooding in the Northern Territory but there is no government department that is responsible for mapping stormwater runoff.

The modelling of riverine and stormwater by a single agency across catchments would inform the requirements placed on development through the Development Consent Authority to facilitate any necessary upgrades to trunk drainage infrastructure so the impact on changing land use on infrastructure is addressed.

The general principle that is adopted under a land suitability assessment and stormwater management plan is that the peak flow rate as a result of development must not exceed the pre-development peak flow rate.

However, as there is no underlying legislation that deals directly with stormwater management, planning decisions requiring stormwater assessment are fragmented and responsibilities are ambiguous. There is no overarching understanding at the planning level of the principles and objectives of stormwater management to be followed in the Northern Territory.

RECOMMENDATION 3.6

That the definition of flooding within the *NT Planning Scheme* is amended to include stormwater flooding to the effect that the owner or occupier of land maintains the pre-development peak flow rates within a catchment.

In conjunction with this, best practice policy for stormwater management in the Northern Territory is addressed; including the objective to reduce the risk of stormwater flooding. To support this objective, a single agency is resourced for the responsibility to hydraulically model trunk drainage systems to mitigate the impact of development on trunk drainage systems.



Source: Water Resources Division, DLRM, 2006 flood

4. FLOOD RESILIENCE MEASURES

4.1 EARLY WARNING SYSTEM

An accurate prediction of when a flood event will occur is a significant factor in developing flood resilience within a community. Early warnings allow residents and business to respond through individual and community flood response plans.

There are existing flood gauges and rainfall recorders within the Katherine River system that provides the Bureau of Meteorology with near real time data for flood height predictions. The Katherine Emergency Committee (in conjunction with the Bureau of Meteorology) issues flood warnings to the community to prepare for potential flood events approximately 18 hours in advance of the flood peak.

The factors that provide for an effective early warning system are:

- Extend the lead in time to provide residents and business additional time to prepare for the flood event;
- Reduce complacency or undue alarm within the community by reducing the occurrence of false alarms through greater accuracy within the system to predict when an event will occur and how severe it will be; and
- The ability to alert the community to an impending flood event quickly and effectively.

RECOMMENDATION 4.1

Review Katherine’s early warning system, to further improve efficiency and lead times through new and/or upgraded flood gauges, a groundwater monitoring system, increased accuracy of the warning through updated flood maps to provide improved flood warning advice to residents and business.

4.2 INDIVIDUAL FLOOD RESILIENCE

Improving flood resilience to a flood event relies heavily on individual response to flooding by residents and businesses. It is important that individuals actually have a plan to respond to flooding by relocating valuable items that are particularly vulnerable to damage by inundation.

The key to individual flood resilience is:

- Flood information that accurately describes the risk of flooding to provide the community (in particular new residents or potential property buyers) with an awareness of the flood risk without unnecessarily overstating the risk;
- Provide efficient platforms for the community to inform itself by collating relevant information from the various sources of flood information; and
- Communicating effectively with the community prior to and during a flood event through an efficient early warning system.

This will allow a better understanding of individual property risks and inform potential purchasers. It is proposed that a dedicated website be created to increase public awareness of the flood risk where properties can be given a risk rating based on the flood mapping (similar to what is currently done on the East Coast).

RECOMMENDATION 4.2

Support individual flood responses through the creation of a dedicated online platform that provides a more detailed flood risk on individual properties and businesses, and access to flood warning data. This includes the recommendation that flood risk information is provided to all members of the Australian Institute of Conveyancers (NT) to support conveyancers advising potential property buyers of relevant flood risk information.

4.3 COMMUNITY FLOOD RESILIENCE

A flood event in Katherine is largely a whole of town event and as such there should be a whole of Community flood response.

To achieve effective coordination across multiple agencies planning for and responding to a flood event a whole of town emergency plan, managed by the one agency, such as the Katherine Emergency Committee, will achieve a greater level of cohesion.

The Community Flood Response Plan should include:

- Supporting the development of individual response plans by residents and businesses;
- Developing and managing the community information digital platform;
- Procurement and storage of materials that will assist the community to prepare for a flood event (packing boxes) and to assist with the clean up after the event;
- Establish an emergency supply of fuel for the town; and
- Protection of the communications network.

For many residents and businesses the only response is to evacuate to higher ground. A secure hardstand would provide the community with the ability to store and secure vehicles during the flood event and the post flood clean-up.

During a flood event, communications often fail when flood waters damages the power supply to mobile towers and telephone exchanges, reducing the effectiveness of the flood warning and the response to flooding.

Protection of existing systems and the potential augmentation of in particular the mobile network would provide for better communications during and immediately after a flood event.

RECOMMENDATION 4.3

That the Whole of Town Emergency Plan is coordinated through the Katherine Emergency Committee and includes the identification of a fuel supply post flooding, construction of a secure hardstand to store vehicles and other relocated property, and the protection of the communications network.

5. SUPPORT MEASURES

5.1 BUSINESS / COMMUNITY ORGANISATION SUPPORT GRANTS

A community's flood resilience is often closely linked to how quickly local businesses and community organisations can become operational post flood, therefore providing financial stability for local residents also recovering from the flood.

A flood resilience grant for (directly) flood affected businesses and community organisations would assist them in managing a flood event and return to normal operation faster. Such a grant should be used pre-flood to augment existing infrastructure to assist in recovery.

An example might be the relocation of electrical wiring and/or network systems above the flood level, or the installation of a mezzanine floor to protect stock or similar initiatives.

The grant would need to have a number of controls such as including an end date, capping the amount available and a co-contribution from commercial entities to promote the efficient use of the grant.

RECOMMENDATION 5.1

Establish a Flood Resilience grant for businesses and community organisations in the flood zone to help them re-establish and return to operation quickly following a flood event.

5.2 BUSINESS CONCESSION LOANS

Following a flood, businesses can also suffer from reduced or limited cash flow to pay suppliers or meet their financial obligations. The availability of a concessional loan scheme to eligible businesses can assist with immediate cash flows concerns following a flood and assist business to remain operational during this period.

RECOMMENDATION 5.2

The Northern Territory Government adopts a policy to facilitate concessional loan schemes to eligible businesses following a flood event to assist businesses to remain operational during this period.

5.3 REZONING AND ACQUISITIONS

The worst effected properties within the flood zone are likely to be ground level homes built prior to the introduction of existing building controls. In the long term, it is not feasible for an insurer to continue to repair such a property after flood events and is unlikely to be feasible for such a property owner to replace the home with a high set home above the flood level.

One way to encourage development in this scenario is to rezone the land for a higher use, thus potentially increasing the feasibility of such a development. An example of this might be the rezoning of a Single Dwelling lot to a Multiple Dwelling or Medium Density lot to facilitate the construction of a high set unit type product. The number of units on a rezoned lot would be determined by the zoning limitations.

Re-zoning improves the flood affected value of the properties (without windfall for owners) and provides incentive for a willing buyer/willing seller to facilitate the regeneration of significantly flood affected areas.

For properties where flood mitigation options are extremely limited or where lives are at risk, the Northern Territory Government may need to acquire the property and change the land use to something that is appropriate to the constraints on that land.

It is recognised that such a measure would be outside of the funding scope of this Committee however it is recommended that the Northern Territory Government investigate its feasibility.

RECOMMENDATION 5.3

The Northern Territory Government investigate the feasibility to rezone flood affected land for higher and better use, including options to: establish a framework to guide redevelopment/ acquisition; rezone properties to facilitate regeneration of flood affected areas; or acquire the worst effected properties and rezone to a more appropriate land use.

5.4 REINSURANCE POOL

Under historical flood insurance risk pricing in the Northern Territory by most insurers that offered flood cover, all insurance policyholders paid a similar premium in relation to the value of their property regardless of their degree of flood risk. This means that a policyholder with a lower risk of flood, or no flood risk at all, paid more than they would, had the premium reflected their actual flood risk.

The additional premium income obtained from overcharging such policyholders was used to cross-subsidise policyholders with higher flood risk exposure, enabling them to pay much less than their individual risk would require. With the advent over the last decade of the ability of insurers to price risk at the individual address level, all insurers now offering flood cover have adopted, or are moving to, risk based pricing for residential flood insurance.

Due to the impact of risk pricing on risk selection and competitiveness, it is not possible for an insurance company to continue to price flood risk on the historical cross-subsidy model once some insurers have moved to risk-based pricing. Any insurance company in the current market that seeks to retain a cross-subsidised approach will eventually lose customers with low or zero flood risk (and their associated premiums) to competitors that are offering lower, risk-based premiums to these customers.

On the other hand, a cross-subsidising insurer would retain or gain all the high flood risk property owners, but not generate an adequate level of premium to pay future flood claims. In such a situation, the solvency of an insurer applying a cross-subsidising approach may be threatened in a severe flood event.

Consistent with all other Australian jurisdictions, in the Northern Territory, most insurance companies have now moved, or are in the process of moving, to risk based pricing for flood risk.

Whilst the Katherine Flood Mitigation Advisory Committee has sought to recommend an optimal use of the Flood Mitigation Funds allocated to Katherine by the Northern Territory Government, the specific circumstances of the township mean that it will not

be possible to 'flood proof' all flood risk properties in their current locations against a severe flood event. The long term outcome is the gradual removal of risk through land use planning and/or building innovation so that properties are either outside of the flood zone or built up above the flood level where it is feasible. Unfortunately, in the interim, this means that in the absence of an alternative flood risk subsidy mechanism, the owners of high flood risk properties will be exposed to increasing and possibly unaffordable insurance premiums.

Whilst mitigation against flood through tighter planning controls, infrastructure to re-direct flood waters and relocation of property away from flood prone areas is generally more economic over time than continued restoration of damaged properties post flood, the reality is that in some locations, such as Katherine, this action may take considerable time to implement and also require very significant funding commitments, potentially at levels outside the financial capacity of the Northern Territory Government.

In the interim, it may be possible to establish a transitional arrangement to effectively subsidise insurance premiums for high risk property owners who may otherwise become unable to obtain affordable insurance coverage against flood events. Such an arrangement would need to have significant safeguards against moral hazard, for example, to prevent further building in flood prone areas, to encourage re-location if a severe flood event occurs and to retain an affordable 'price signal' (on equity grounds) to encourage appropriate mitigation and purchasing behaviour.

On 30 March, the Commonwealth Government announced the establishment of a Northern Australia Insurance Premiums Taskforce (the "Taskforce") to explore options for reducing home insurance premiums in northern Australia. The Taskforce was established as a result of concerns about the affordability of home insurance in North Queensland due to cyclone risk, however, the policy responses being considered could equally be applied to addressing concerns about the affordability of flood insurance.

It is likely that submissions to the Taskforce will highlight the fact that high flood risk can create greater home insurance affordability issues than cyclone risk. This is particularly true for the Northern Territory, which has more resilient building stock when it comes to cyclone risk than other regions of Northern Australia (ie North Queensland and North Western Australia).

However, consumer and political concerns about flood risk have been temporarily subdued outside the Northern Territory due to the availability in the marketplace of insurance policies that allow consumers to 'opt out' of flood cover if they find it unaffordable. For historical reasons, this is not the case in the Northern Territory where all insurers have made flood cover mandatory in their policies (that is, consumers do not have the choice to remove flood cover).

The Taskforce is to examine whether the Commonwealth Government could provide support to a reinsurance pool or a mutual insurer that provides cyclone-specific cover. Under the reinsurance pool model, the Commonwealth (or a State or Territory) Government could provide insurers with subsidised reinsurance, for example, for cyclone or flood. Such a model could be used to assist in the provision of affordable cyclone insurance in those areas of Northern Australia that face home insurance affordability issues due to cyclone risk, or the provision of affordable flood insurance in flood prone areas, which exist across the whole of Australia, including in the Northern Territory. Funding options for such subsidised reinsurance facilities include levies on all home insurance policyholders or directly by Government.

RECOMMENDATION 5.4

The Northern Territory Government engage with the Commonwealth's Northern Australia Insurance Premium Taskforce with regards to the establishment of a Northern Australia Disaster Management reinsurance pool to support the worst impacted properties identified in the updated flood modelling.

6. OVERSIGHT OF WORKS PLAN

6.1 KATHERINE EMERGENCY COMMITTEE TO HAVE OVERSIGHT OF WORKS PLAN

A single local entity should have continued oversight of the Works Plan through to implementation for all flood mitigation works within the Katherine Region. This entity would provide a review and reporting mechanism back to Government on the progress of implementation of the Katherine flood mitigation works.

The Katherine Emergency Committee is already an established committee within Katherine that is involved with the coordination of the whole of town response to emergencies, and in particular flood events.

The Committee is well placed with local representation across DLRM, PFES, DLPE, KTC and the Bureau of Meteorology, to oversee the delivery of works and augment the Committee's current role and responsibilities.

RECOMMENDATION 6.1

The Katherine Emergency Committee to have oversight of the delivery of the Works Plan in accordance with the recommendations of this Report.



COMMONWEALTH FUNDING ARRANGEMENTS

There is currently no Commonwealth funding available for flood mitigation. The existing Natural Disaster Resilience Program (NDRP) funding under the National Partnership Agreement expired on 30 June 2015 and is administered by the Northern Territory Emergency Service. The NDRP is a grant funding program that encourages governments to work together with volunteers, the private sector and non-government sectors in an effort to enhance Australian communities' resilience to natural disasters.

A new funding arrangement is anticipated to be announced by the Federal Government this year. The Productivity Commission has produced a paper for consideration by the Commonwealth Government that recommends a focus on disaster mitigation as opposed to recovery. Any Commonwealth funding would be distributed on a per capita basis, meaning that the Territory would likely receive limited funding.

The recommendations in this report do not consider any additional Commonwealth funding allocation at this time. Any future measures identified within the scope of the Katherine Flood Mitigation Strategy should be considered within the context of a potential matched funding arrangement with the Commonwealth to maximise the benefit to the Northern Territory.

WORKS PLAN – KATHERINE FLOOD MITIGATION

Flooding in Katherine is complex and the Katherine Flood Advisory Committee recognises that to investigate, design and deliver the flood mitigation measures outlined in this report will take time, but that there is a range of measures that can be implemented immediately.

The Committee has developed a Works Plan that has sought to identify a project lead agency, a budget and a delivery timeframe for each measure. This Works Plan will guide the implementation of the Katherine Flood Mitigation Strategy, to secure the delivery of these measures in a timely manner.

The Katherine Flood Mitigation Works Plan is summarised on the following page in Table 1: Works Plan - Katherine

TABLE 1: WORKS PLAN - KATHERINE

| MITIGATION MEASURE | LEAD AGENCY | IMMEDIATE (YEAR 1) | SHORT (YEAR 2-3) | MEDIUM (YEAR 4-5) | LONG (YEAR 5+) |
|---|----------------|--------------------|------------------|-------------------|----------------|
| 1 PREPARATORY INVESTIGATIONS | | | | | |
| 1.1 Aerial Photogrammetry | DLRM/DLPE | \$450,000 | | | |
| 1.2 Groundwater Study | DLRM/DLPE | \$50,000 | | | |
| 1.3 Hydraulic Modelling | DLRM/DLPE | \$400,000 | \$100,000 | | |
| 2 STRUCTURAL | | | | | |
| 2.1 Infrastructure Design and Construction | DLPE/DoI | | \$12.9 million | | |
| 2.2 Hydraulic Efficiency | | | | | |
| 2.2.1 Geomorphology/infrastructure Assessment | DLPE | \$70,000 | | | |
| 2.2.2 Weed /Sediment Management | DLPE/KTC | \$300,000 | \$200,000 | \$250,000 | \$250,000 |
| 3 LAND USE PLANNING | | | | | |
| 3.1 Existing Commercial Centre | DLPE | \$60,000 | | | |
| 3.2 Second Commercial Centre | DLPE | | DLPE Funding | DLPE Funding | DLPE Funding |
| 3.3 Ambulance Centre Relocation | | | | | |
| 3.3.1 Detailed design and master planning | DLPE/DoI | \$500,000 | | | |
| 3.3.2 Construction | DoH/DoI | | \$7.1 million | | |
| 3.4 Katherine Hospital Relocation | DoH | | | | DoH Funding |
| 3.5 Improved Development Controls for lots worst affected | DLPE | | | DLPE Funding | |
| 3.6 Stormwater Management Policy | DLPE/DLRM/ KTC | | | | |

| MITIGATION MEASURE | LEAD AGENCY | IMMEDIATE (YEAR 1) | SHORT (YEAR 2-3) | MEDIUM (YEAR 4-5) | LONG (YEAR 5+) |
|--|-------------|--------------------|-----------------------|-----------------------|-----------------------|
| 4 FLOOD RESILIENCE | | | | | |
| 4.1 Early Warning System | | | | | |
| 4.1.1 Flood warnings and predictions | DLRM/KEC | \$70,000 | | | |
| 4.2 Individual Flood Response | PFES/KEC | \$50,000 | | | |
| 4.3 Whole of town Response | PFES/KEC | | | | |
| 4.3.1 Pre-flooding Preparation | | \$250,000 | \$200,000 | | |
| 4.3.2 Preparation of secure hardstand | | \$200,000 | | | |
| 4.3.3 Protection of Communications Network | | \$100,000 | | | |
| 5 SUPPORT MEASURES | | | | | |
| 5.1 Flood mitigation Support Grants | NT Treasury | \$1.5 million | | | |
| 5.2 Concessional Loans post-flood | NT Treasury | | | | |
| 5.3 Property Acquisitions/Rezoning | DLPE | | | NTG Funding | |
| 5.4 Reinsurance Pool | NT Treasury | | | | |
| TOTAL | | \$4 MILLION | \$20.5 MILLION | \$0.25 MILLION | \$0.25 MILLION |

PUBLIC FEEDBACK

Public feedback was sought in the compilation and prior to the finalisation of this report. A public meeting was held on the 14 May 2015 at the Katherine Town Council Chambers to brief the Katherine community on the draft recommendations of the report and was an opportunity for the Katherine community to have their say.

The draft report was on exhibition for a period of 4 weeks and during this time seven submissions were received. Two submissions were received from local community members and five submissions from organisations. The submissions covered a range of comments and ideas which the Committee considered in full.

As a result of the submissions and feedback through the exhibition period, the Committee agreed to amend the draft report in some key areas. The main amendments are summarised below;

- A separate study into ground water to be commissioned to understand the impact of the aquifer and sinkholes on flooding in the Katherine Region and how this information can be used to augment existing warning systems;
- The downstream impact of any flood modelling is to be taken into account in the assessment of structural mitigation measures;
- The Northern Territory Government adopt a policy to facilitate concessional loan schemes to eligible businesses following a flood event to assist businesses to remain operational during this period; and
- The Katherine Emergency Committee to have ongoing oversight of the delivery of the Works Plan in accordance with the recommendations of this report.

Additionally, the quote for aerial photogrammetry came in less than originally estimated and funds have been re-allocated towards weed management for a potential five year program to address hydraulic efficiency of key areas of the Katherine River, subsequent to the findings of a geomorphologist report.

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