Appendix H

North Byron Floodplain Management Study and Plan

Introduction

Flooding can have devastating impacts on a community. Most recently, the North Byron catchment experienced a major flood event in March 2017 as a result of Ex-Tropical Cyclone Debbie. This event saw homes inundated, residents forced to evacuate, roads closed and thousands of people without power.

Byron Shire Council has engaged WMA Water to prepare a Floodplain Risk Management Study and Plan for the North Byron catchments. The North Byron study area (Figure 1) includes the towns of Mullumbimby, Brunswick Heads, Ocean Shores, New Brighton, South Golden Beach and Billinudgel. The aim of this plan is to improve our understanding of flood behaviour and its impacts in order to develop a long term strategy for managing our flood risk, now and into the future.

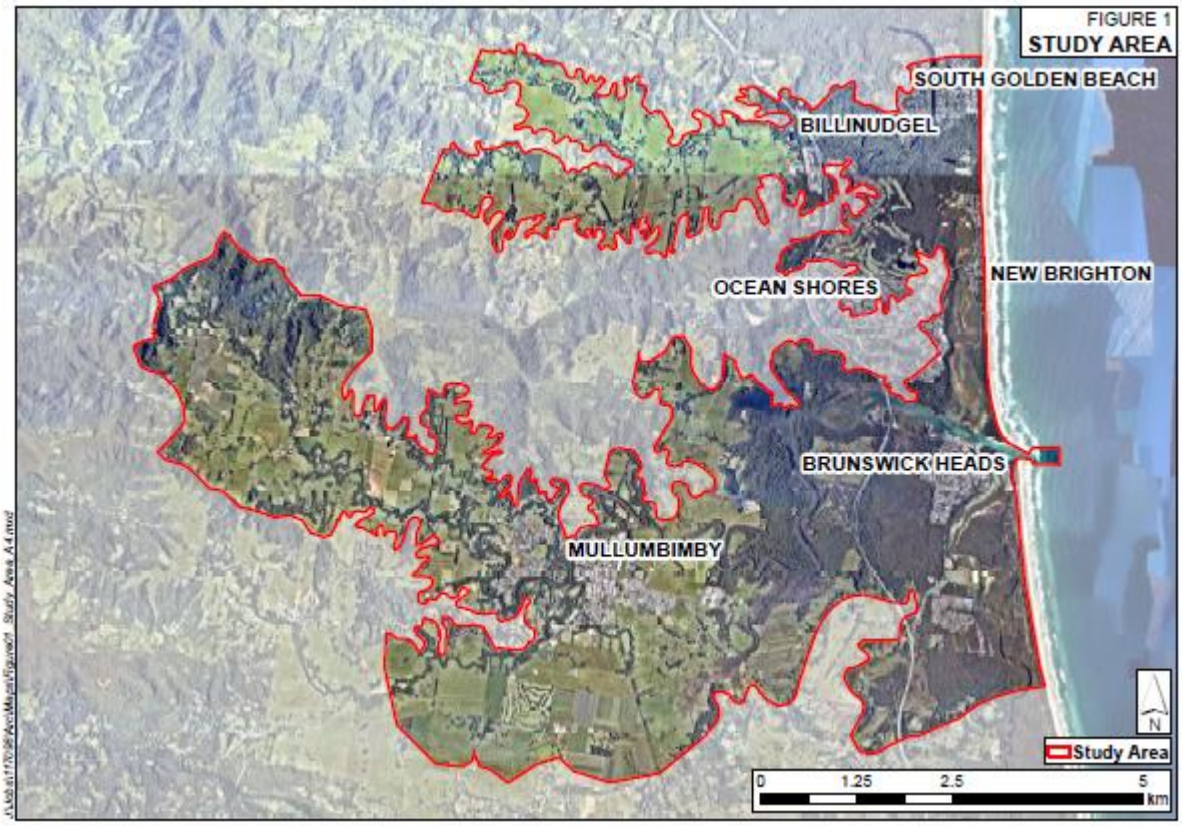

Figure 1: North Byron Floodplain Management Study and Plan - Study Area

Currently, we are in the initial phases of this project and we believe an important first step is to engage with the community and draw on your extensive local knowledge. We are seeking your input on:

- Any information you may have on past flood events
- How you would like to see flood risk managed in the North Byron catchments
- How you would like to receive flood information during a flood event

The following survey is expected to take 15 minutes to complete. We thank you for your time and value your input.

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Demographics

Q1. Which town do you live in?

- ❑ Mullumbimby
- ❑ Brunswick Heads
- ❑ Ocean Shores
- ❑ New Brighton
- ❑ South Golden Beach
- ❑ Billinudgel
- ❑ Other (please specify)

Q2. How long have you lived in the area?

- ❑ Less than 1 year
- ❑ 1 – 5 years
- ❑ 5 – 10 years
- ❑ More than 10 years
- ❑ Not sure

Q3. How many people are within the following age brackets in this household?

Less than 5 years of age	
6 – 15 years of age	
16 - 64 years of age	
Over 64 years of age	

Q4. Do you have internet access at home?

- ❑ Yes
- ❑ No

Q5. Do you have a mobile phone, landline or both?

- ❑ Mobile phone only
- ❑ Landline only
- ❑ Both
- ❑ None

Q6. Do you have mobile phone reception at home?

- ❑ Yes
- ❑ No

Q7. How many vehicles at this address?

- ❑ None
- ❑ 1
- ❑ 2
- ❑ 3
- ❑ More than 3

Q8. Do you work in the North Byron catchment?

- ❑ Yes
- ❑ No
- ❑ Not applicable

Previous Flood Events

Q8. Have you previously been affected by flooding?

- ❑ My yard was flooded (this may include sheds).
- ❑ My house was flooded.
- ❑ I was unable to access my usual travel routes.
- ❑ My workplace was flooded.
- ❑ Not applicable.
- ❑ Other (text box)

March 2017 Flood Event

The community of North Byron has been very helpful in providing extensive information on the March 2017 flood event. This information has been valuable and has been extremely useful in better understanding flooding in the North Byron catchment.

We are still looking for more information and are keen to hear if anyone noticed any large trees or debris caught underneath Federation Bridge at Mullumbimby that may have caused water to back up behind Federation Bridge.

Q9. Did you see any large trees or debris caught underneath Federation Bridge, reducing flows under the bridge in the March 2017 flood event?

- ❑ Yes
- ❑ No

Q10. If yes, do you have any photographs?

❑ Yes
❑ No

Floodplain Risk Management Measures

The NSW Floodplain Development Manual prepared by the NSW Office of Environment and Heritage discusses three approaches for increasing our resilience to flooding:

1. **Property Modification Measures** which looks at modifications to existing properties and land use planning including zonings and development controls.
2. **Response Modification Measures** increases the community's resilience through better preparedness, improved warning and recovery planning
3. **Flood Modification Measures** alters the flood behaviour using structures such as detention basins and levees.

Q11. From the list below, choose three factors that you consider to be the most important for managing flood risk in the North Byron catchment.

❑ Land Use Planning including zoning and development controls
❑ Voluntary house purchase in high hazard areas of the floodplain
❑ Voluntary house raising of suitable properties
❑ Using flood resilient design and building materials to flood-proof buildings
❑ Evacuation plans and evacuation centres
❑ Bridge works or road-raising
❑ Community education and awareness initiatives e.g. school education programs and flood information leaflets
❑ Early flood warning (e.g. mobile phone alerts)
❑ Structures such as detention basins and levees
❑ Removal of blockages and debris from streams

Q12. From the list below choose three outcomes most important to you when considering flood management measures.

❑ Low establishment costs
❑ Low ongoing costs
❑ Increases community safety during floods
❑ Reduces the cost of floods
❑ Does not disadvantage other parts of the community
❑ Does not impact local plants, animals and their habitat
❑ Does not impact water quality
❑ Other (please specify)

Structural Mitigation Options

Q13. Which of the following structural options would you support for reducing flooding?

Permanent Levees

Levees are wall like structures used to prevent floodwaters inundating areas of the floodplain. While they are designed to protect areas up to a certain sized flood, they can still offer additional warning time by delaying inundation in larger flood events. Levees can be made with manmade material like concrete or can be constructed using earthen materials as a way to blend in with the surrounding landscape.

Figure 2: Permanent flood levee in Charleville. The image was sourced from the ABC and was photographed by Luke Kleidon on February 2,2012.

Typically levees displace water from one area to another and this can increase flood impacts to other areas of the floodplain. They can also trap local drainage behind the levee and may require associated drainage to reduce this. There is the potential for levees to impact on natural floodplain process such as the movement of sediment and nutrients.

Levees can inhibit river and creek views and can reduce access to waterways. Ongoing maintenance is required to maintain structural integrity.

How supportive are you of the building of flood levees in the North Byron catchment?

1 – very supportive 2 3 4 5 – strongly oppose

Temporary levees

Temporary levees are similar to permanent levees and are used to prevent floodwaters inundating areas of the floodplain. The main difference is temporary levees are short term structures and require assembly prior to a flood event. Warning time is essential so temporary levees are not suitable for areas prone to flash flooding. Other requirements include a location nearby to store the temporary levee and people available to construct prior to a flood event.

Figure 3: Temporary levee in Rockhampton. This image was sourced from the Courier Mail and was photographed by Dan Peled.

How supportive are you of the temporary levees in the North Byron catchment?

1 – very supportive 2 3 4 5 – strongly oppose

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Floodgates

Figure 4: An example of a closed floodgate. This image was sourced from the NSW Department of Primary Industries.

Floodgates are used to control the release of water or prevent backflow of water up to a certain sized flood. These are usually installed at the entrances to creeks and waterways to prevent backflow of floodwaters upstream. It is possible to construct both large or small scale floodgates that are and are useful in reducing floodwaters in some areas of the floodplain.

There are some associated impacts with floodgates including regular maintenance and monitoring, impact on fish passage through waterways, blockage of debris and in some cases, increase in local flooding upstream when closed. As is with structural options that displace floodwaters such as levees, flood gates can decrease flooding in some areas but cause an increase in others.

How supportive are you of the installation of flood gates in the North Byron catchment?

1 – very supportive 2 3 4 5 – strongly oppose

Landscape management

Figure 5: An example of river bank rehabilitation at Mockers Road, Fernvale. This image was sourced from the Mid-Brisbane Catchment Action Plan delivered by the Council of Mayors (SEQ) Resilient Rivers Initiative.

This option focuses on restoring the catchment to its natural landscape. This includes re-vegetation of the catchment and along the riverbank and removal of manmade structures such as farm levees which inhibit the natural floodplain behaviour. There are numerous social and environmental benefits from landscape management such as:

- Improved biodiversity.
- Restoration of natural landscape.
- Reduction in bank erosion and a decrease in silting of
- downstream waterways.
- Reduction and delay of peak flows.

While it is thought landscape management may significantly reduce flow for smaller size flood events, there will be little impact on larger sized flood events. These works can impact communities upstream by reducing land available for agriculture and can cause upstream areas to be inundated for longer.

How supportive are you of landscape management as a strategy to manage flooding in the North Byron catchment?

1 – very supportive 2 3 4 5 – strongly oppose

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Detention Basins

Detention basins are designed to temporarily store floodwaters during a flood event and reduce nearby flooding. Often detention basins have an outlet that can control the outflow of water. They are designed as either wet or dry detention basins and can act as multipurpose uses such as parks, sporting fields or water bodies. They are only designed to detain water up to a certain sized flood event and if additional land is required to construct new detention basin there may be community impacts.

Figure 6: The detention basin at Garnett Lehmann Park, Toowoomba. This image was sourced from ABC Southern QLD and was photographed by David Iliffe.

How supportive are you of detention basins as a strategy to manage flooding in the North Byron catchment?

1 – very supportive 2 3 4 5 – strongly oppose

Dredging

Dredging is the removal of debris and sediment from the bed of a waterway. This temporarily increases flow conveyance in a creek or river and can decrease flood levels. However, it is not a long term solution and regular dredging is required to maintain the performance. Dredging is expensive and can have economic impacts on the community. The dredged material can be contaminated and consideration should be given to the safe disposal of the material.

Figure 7: Dredging at the mouth of the Coffs Harbour boat ramp. This image was sourced from the Hitachi website.

While dredging can reduce the impacts of flooding it has the potential to increase bank erosion, affect the natural ecosystem and impact on community waterway activities.

How supportive are you of dredging as a strategy to manage flooding in the North Byron catchment?

1 – very supportive 2 3 4 5 – strongly oppose

Dams

Dams are designed to store large volumes of water for a long period of time. They are aesthetically pleasing and can offer multipurpose including:

- Water supply
- Recreational activities such as fishing, water sports and camping
- Flood mitigation
- Generation of electricity.

Figure 8: **The Nepean Dam in New South Wales. This image was sourced from WaterNSW.**

While dams can reduce the effects of flooding, they become less effective in large scale floods and can only detain water that has travelled from upstream of the dam. Dams disrupt the natural behaviour of waterways and can impact on the ecosystem and migration of aquatic species. There are considerable associated construction and maintenance costs associated with dams and should additional land be required in the construction, this can impact on local communities.

How supportive are you of dams as a strategy to manage flooding in the North Byron catchment?

1 – very supportive 2 3 4 5 – strongly oppose

Stormwater pipe, street gutter and drain upgrades

Upgrades of current drainage networks and the installation of new pipe networks can decrease localised flooding. They are effective flood mitigation options for small sized flood events and typically do not offer significant flood protection during larger sized flood events. However, drainage networks can disrupt natural water systems and can affect migration of aquatic species and impact the natural behaviour of the floodplain. There are installation and maintenance costs associated and these can be expensive depending on the size of the network.

Figure 9: This figure shows stormwater flowing into the stormwater drainage network. This image was sourced from the City of Shoreline in Western Australia.

How supportive are you of stormwater pipe, street gutter and drain upgrades as a strategy to manage flooding in the North Byron catchment?

1 – very supportive 2 3 4 5 – strongly oppose

Rock wall alterations

Construction of the rock walls at Brunswick Heads begun in 1959. Since then, there have been suggestions to consider the removal or alterations to the rock walls at the mouth of Marshall Creek.

We would like to understand the community's opinions on the rock walls at Brunswick Heads.

Figure 10: Aerial imagery of the rock walls at Brunswick Heads. This image was captured from Google Earth on 12 April, 2018.

Q14. Which of the following options do you support?

- ❑ Changes to the rock wall at the mouth of Marshall creek.
- ❑ Maintaining the rock walls as they are presently.
- ❑ None
- ❑ Other alterations to the rock walls (please specify)

Flood Outlets

Past imagery indicates that there once may have been an outlet from Marshalls creek to the ocean through the dune system (Figure 11). Interviews of residents by Bruce Butt in 1988 indicate that this outlet may not have been natural. However this project could investigate the flood mitigation potential of an ocean outlet through the dune system. While outlets may reduce flood levels they have the potential to cause environmental impacts.

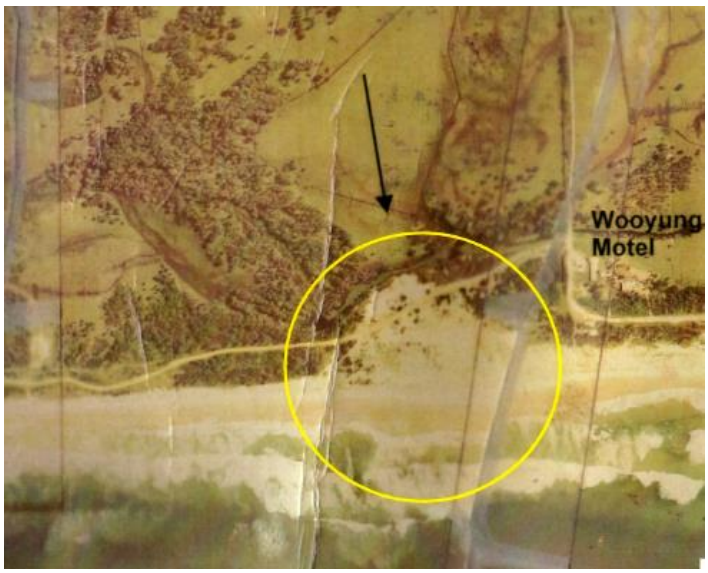

Figure 11: Historic imagery of the closed outlet at Wooyung. The source of this image is unknown, however was provided by Byron Shire Council.

Q15. Would you support the construction and management of flood outlets through the dunes?

- ❑ Yes
- ❑ No
- ❑ Other (please specify

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Q16. Do you have any other comments about the structural mitigation options above? This can include a suggested location, type, purpose etc.

Before a Flood Event

Q17. If you were to check your flood risk ahead of the wet season, where would you look?

Q18. How has your household prepared for flood events?

- ❑ Appropriate level of insurance
- ❑ I have sourced more information about my flood risk (obtained a Section 149 certificate, contacted council etc.)
- ❑ Savings to cover emergency costs
- ❑ I have prepared an emergency kit
- ❑ I have an emergency plan ready
- ❑ I know my evacuation route
- ❑ I have radio and batteries
- ❑ I have candles and torches ready
- ❑ I have modified my property (e.g. flood proofing or house raising)
- ❑ I keep/can easily move my valuables higher up
- ❑ Other (please specify)

During a Flood Event

Q19. Who do you trust to provide accurate information during a flood event?

- ❑ SES
- ❑ Other Emergency services like Police
- ❑ Council
- ❑ Bureau of Meteorology
- ❑ Community groups
- ❑ Social media e.g. Storm chasers
- ❑ Friends and family
- ❑ Neighbours
- ❑ ABC Radio
- ❑ Television
- ❑ Other (please specify)

Q20. How would you prefer to receive flood warnings?

- ❑ Emergency SMS
- ❑ TV
- ❑ Radio
- ❑ Social media
- ❑ Land line
- ❑ Email
- ❑ Newspaper
- ❑ Face to face
- ❑ Other (please specify)

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Q21. When do you think it is most useful to receive flood information? The following options are listed in increasing accuracy of information.

- ❑ As early as possible (this option provides the most amount of warning time)
- ❑ When there is a chance my suburb may get affected
- ❑ When there is a chance my street may get affected
- ❑ Only when I need to act (this option provides the least amount of warning time)

Q22. During a flood event, what sort of information do you need?

- ❑ Road closure information
- ❑ Location of evacuation centres
- ❑ Safe evacuation routes
- ❑ Warning times
- ❑ Flood levels at key locations
- ❑ Expected flood levels at my property
- ❑ Expected flood levels at my workplace
- ❑ Comparison to past floods (e.g. bigger than 2017)
- ❑ Potential school and child care closures
- ❑ Safe refuge location for my pets
- ❑ Location for collecting sandbags
- ❑ Impacts to power and water supplies
- ❑ Other (please specify)

Q23. When would you evacuate?

- ❑ You receive an early flood warning via media or social media
- ❑ You receive more than one early flood warnings via media or social media
- ❑ Flood warning specifically name your suburb
- ❑ Flood warnings specifically name your street
- ❑ Your neighbours or friends and family warn you
- ❑ You see others in your neighbourhood evacuating
- ❑ You receive a call from Council/Emergency Services or community groups warning you
- ❑ Council or Emergency Services knock on your door
- ❑ Flood waters start to inundate your property
- ❑ Flood waters start to inundate your home
- ❑ I would never evacuate

Q24. Why would you never evacuate?

Q25. Have you ever received conflicting information during a flood event?

- ❑ Yes
- ❑ No

Q26. If yes, what was it?

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Q27. What have you learnt from past flood events that will change how you prepare and respond in the future?

Q28. What other information would you like council to provide before, during and after floods and other emergencies?

Q29. Do you have any other comments that relate to the North Byron Floodplain Risk Management Study and Plan?

The following questions are optional and are only to understand where in the catchment your comments relate to. This information will not be shared without your consent and alternatively this survey can be filled in anonymously.

Could you please provide us with the following details?

Name	
Address	
Phone Number	
Email	

Do you give permission for someone from WMA Water or Byron Shire Council to contact you to discuss some of the information you have provided?

❑ Yes
❑ No