

# MANAGING THE FLOOD RISK IN COFFS HARBOUR IN THE AFTERMATH OF THE 1996 FLOOD

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## ABSTRACT

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Coffs Creek flows through the heart of the Coffs Harbour residential and commercial areas. The November 1996 flood caused widespread devastation to property located on low-lying land adjacent to the creek. Some 260 homes and 200 commercial premises were inundated above floor level. The flood was also significantly larger than the previously estimated 100 year flood that had been adopted by Council for planning purposes.

So how has Coffs Harbour Council managed to stay afloat in the aftermath of the 1996 flood?

Much work has been undertaken in the subsequent years, culminating in the preparation of a floodplain management study and plan for Coffs Creek. The study presented its own challenges – including winning back the support of an angry community, many of whom were convinced that the only solution to the flood problem was to dredge the lower estuary or to clear it of mangroves.

The floodplain management study and plan was developed in close liaison with the community. There were regular community working party meetings that were chaired by an independent facilitator. Community ideas were carefully considered, analysed, and the results brought back to the community with the aid of simple demonstrations.

Many of the lower estuary options that had been initially suggested were eventually discarded. The focus of the study then shifted to potential works in the upper catchment and other non-structural measures, such as improved planning controls over the full range of floods that can potentially occur.

The recommended plan includes the construction of up to four detention basins in the upper catchments and other drainage improvements through the CBD area. Whilst these works won't totally solve the flooding problems in the catchment, along with the proposed planning controls and other flood awareness initiatives, it should go a long way towards managing the flood risk in the Coffs Creek catchment.

# MANAGING THE FLOOD RISK IN COFFS HARBOUR IN THE AFTERMATH OF THE 1996 FLOOD

## 1. INTRODUCTION

On the evening of 23 November 1996 Coffs Harbour experienced a flood much larger than the 100 year flood that Council had planned for.

This was the biggest flood in living memory to hit the Coffs Harbour area. The flood caused widespread devastation to property located in the Coffs Creek catchment. Some 260 homes and 200 commercial buildings were inundated above floor level.

The striking feature of this storm event was not just its magnitude, but the distribution of rainfall over the catchment. Rainfall depths in the upper catchment were much higher than at the Bureau of Meteorology gauge on the coast.

These factors made it clear that a review of Council's design flood profiles and the development of a revised floodplain management plan for the catchment were necessary.

## 2. THE COFFS CREEK CATCHMENT

Coffs Creek is a small coastal stream typical of those that drain from the coastal range. The creek, shown on Figure 1, is roughly rectangular in shape and has a catchment area of about 25km<sup>2</sup>.

The catchment divide is located about 9km from the coast, with a maximum height of around 490m. The upper slopes of the catchment are very steep and largely occupied by banana plantations.

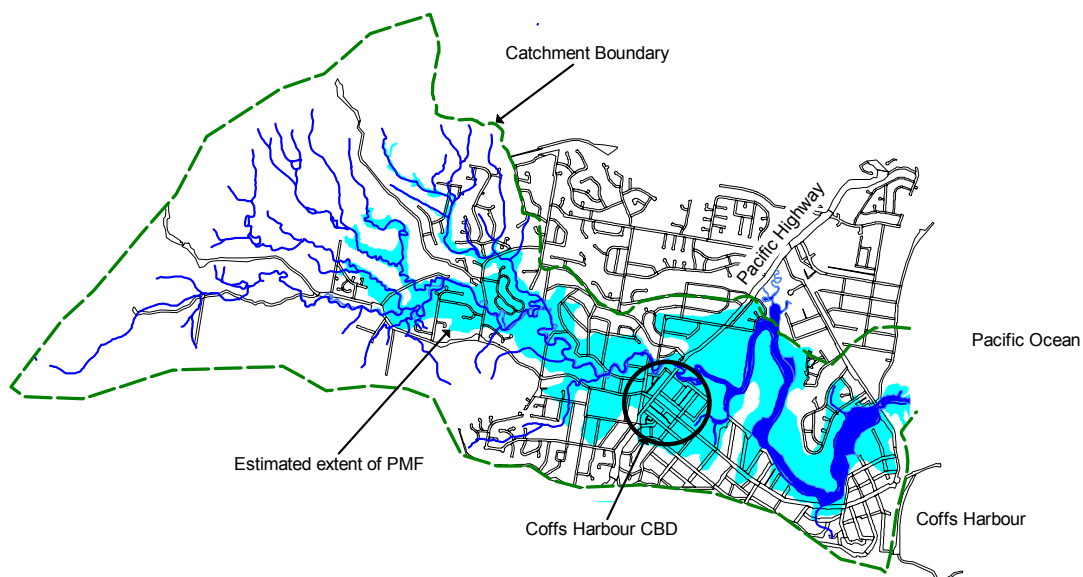


Figure 1 – The Coffs Creek Catchment

About 60% of the catchment is either urbanized or zoned urban. Most development is located towards the middle to lower part of the catchment. The Coffs Harbour CBD is located in the lower catchment, on either side of the Pacific Highway. The Creek is tidal downstream of the highway, and becomes a broad estuary as it meanders towards the ocean. This lower estuary is characterised by relatively dense mangroves and large shoals of marine sand.

### 3. THE NOVEMBER 1996 FLOOD

The storm that caused the November 1996 flood was an intense, short duration event. Some rain occurred during the morning of 23 November, but it was not until 3pm that the main rainfall commenced. In the ensuing 6 hours an average of around 500mm of rain had fallen over the catchment. The most intense rainfall occurred in the upper catchment areas.

The storm caused flooding that was devastating for Coffs Harbour. About 1,100 properties were affected by flooding with 460 flooded above floor level. Total insurance claims were about \$31M.

One person died during the flood. Some residents who lived in a caravan park lost their homes.

People were shocked and traumatised by the suddenness of the storm and flooding. Residents did not look on Coffs Harbour as being a “flood town”. Owners of affected properties often stated that given the fact that their floor levels were 0.5m above the 100 year flood (as Council requires) they assumed they were safe from flooding.



Photo 1 – Much of the commercial area of Coffs Harbour was affected by the 1996 flood

#### **4. HOW BIG WAS THE 1996 FLOOD?**

The flood height for the 1996 flood was around 1m higher than the predicted 100 year flood for the section of the creek upstream of the highway. This is the area where most of the existing flood-prone residential properties are situated.

Following the flood, Council commissioned a revised flood study for Coffs Creek. The study specifically looked at the impact of orographic effects on design rainfalls due to the close proximity of the catchment divide to the coast.

The study, supported by mathematical modelling undertaken by the University of NSW, concluded that the high rainfall experienced in the upper catchment for the 1996 storm was typical of what could be expected for other storms. Consequently a weighting was applied to design rainfall intensities to reflect the higher rainfall intensities likely to occur in the upper catchment.

The methodology for this aspect of the study is outlined in another paper at this conference by Scott Little and others, titled "Rainfall Gradients: The Marriage between Hydrology and Meteorology – Coffs Creek Catchment".

With the application of these weighting factors on design rainfall intensities, the resultant design flood levels increased. Based on the revised levels, the 1996 flood is now roughly similar to a 200 year flood upstream of the highway, and similar to a 100 year flood downstream.

#### **5. THE COFFS CREEK FLOODPLAIN MANAGEMENT STUDY AND PLAN**

The 1996 flood revealed that the magnitude of the potential flood problem in Coffs Creek was greater than Council or the residents had previously thought possible. The revised Flood Study also resulted in design flood levels increasing by 500mm or more for many places within the catchment.

Residents were demanding that action be taken to reduce the flood risk. There was also ongoing pressure for new development within the catchment, in areas where the flood risk was greater than previously thought.

Council subsequently commissioned Bewsher Consulting Pty Ltd to undertake a floodplain management study and plan to investigate and recommend measures to reduce the flood risk in the catchment.

#### **6. THE FLOOD PROBLEM**

A database of all potentially flood affected properties within the Coffs Creek study area was developed as part of the floodplain management study. The database contains information on individual properties and buildings, including estimated ground levels, floor levels and computed flood levels for every property below the probable maximum flood (PMF). The database then provides details of those properties that would be affected in different sized floods, and allows for the calculation of potential flood damages within the catchment.

Key results from the database indicate that:

- ▶ 1,464 residential homes and 424 commercial buildings would be flooded above floor level in a PMF event;

- ▶ 308 residential homes and 111 commercial buildings would be flooded above floor level in a 100 year flood;
- ▶ the predicted flood damage in the 100 year flood is \$28M, whilst the average annual flood damage is estimated at \$2.2M and the present value of all future flood damages is estimated at \$24M.

The flood problem in Coffs Creek can be largely categorised into two types, geographically separated by the Pacific Highway. Flooding upstream of the highway predominantly affects residential development, including both established and new residential subdivisions. This area contains 77% of all homes that would be inundated in the 100 year flood, and accounts for 65% of the total flood damage in the study area. Flooding downstream of the highway predominantly affects commercial and industrial development, including a large portion of the Coffs Harbour CBD area.

## **7. MANAGING AN ANGRY COMMUNITY**

The 1996 flood caused considerable grief to many residents and business owners. Some of the homes that were flooded had only recently been constructed, with floor levels at 0.5m above the 100 year flood (Council's previous estimate). Other established home owners felt the new development that had occurred in the upstream catchment was a contributing factor. Many others felt that neglect of the lower estuary was largely to blame for the flooding that occurred.

Needless to say, the 1996 flood personally affected many people within the community, and there was a certain amount of anger that needed to be vented. A comprehensive community consultation program was therefore vital for the success of the floodplain management study.

The Centre for Ecological Economics and Water Policy Research at the University of New England was engaged by Council to plan and coordinate community consultation for the study. This diverged from the usual process of "telling the community about predetermined options" to involving the community in all aspects of the study, including the preliminary identification of options; consideration of the implications of those options; and in the selection of the final options to be included in the recommended floodplain management plan.

A working party was formed to oversee and direct the floodplain management study. The working party comprised community representatives and organisations with an interest in the study area. Membership to the working party was through open invitation, with no limit set on the number of members who could join. Some of the working party meetings were attended by over 200 people.

The working party meetings were organised and chaired by the Centre for Ecological Economics and Water Policy Research, acting as independent facilitators. The working party met several times during the study to determine the floodplain management options to be evaluated to alleviate the risk of flooding, and to consider the findings and implications of these options. These meetings were most valuable in allowing the community to have their say in what they believed to be the causes of flooding; the floodplain management options that might reduce these problems; and in gaining community ownership of the final floodplain management plan.

A special project letterhead was also designed for the study, carrying the logos of Council, the Department of Land and Water Conservation (now DIPNR), the Centre for Ecological Economics and Water Research, and Bewsher Consulting. The roles of each organisation

and further contact details were also included in the letterhead. This was used for all correspondence in relation to the study, and helped to convey a “team effort” approach in tackling the problems in Coffs Creek. It was also beneficial in deflecting individual criticism that may have otherwise been directed at Council when providing advice on flooding issues to the community.

A project web site was also developed to provide details about the study and other information on flooding in Coffs Creek. Notes of all working party meetings were also posted on this web site. The site can be viewed at [www.bewsher.com.au/coffs.htm](http://www.bewsher.com.au/coffs.htm)

## **8. MAYBE WE DON'T NEED TO DREDGE THE CREEK!**

At the outset of the study, there was a growing perception in the community that the lower creek (downstream of the highway) was the main cause of the flood problem in Coffs Creek. There were many demands to “dredge the creek” or “clear the mangroves”. Some others felt that replacing the railway and road bridges near the mouth of the creek would alleviate the congestion. Many considered these to be obvious solutions that should be undertaken immediately.

Coffs Creek becomes a broad tidal estuary between the highway and the ocean, with some dense areas of mangroves and marine shoals within its lower reaches. The tidal reaches of the creek and its surrounding mangroves have been identified as a significant environmental resource and ecosystem. The whole area is included within the boundaries of the Solitary Islands Marine Park for protection and future conservation. Options such as dredging or removal of mangroves would have significant environmental impacts and consent for such activities would be most unlikely. Earlier investigations had also shown that these options provided little, if any, flood benefit.

Nevertheless, these were options that many members from the community were insisting upon. It therefore presented a significant challenge for the floodplain management study to overcome.

A working party meeting was dedicated to assessing potential options in the lower creek. The meeting was attended by many community members, representatives from the Marine Parks Authority, NSW Fisheries, and other relevant organisations. The Centre for Ecological Economics and Water Research, acting as independent facilitators, led the working party through an examination of the various issues associated with dredging and/or the removal of mangroves. Members from the various organisations were also asked to comment on environmental implications of the above works. After these issues had been thoroughly explored, Bewsher Consulting was asked to discuss the results from a recent assessment of the likely flood benefits from these proposals.

Although the flooding assessments of similar options had been investigated as part of an earlier flood study review, it was decided that an independent analysis should be undertaken using a different model and the results demonstrated to the working party. A MIKE-11 model was used for this demonstration. The structure of the model under existing conditions was described in simple terms to the working party and the results from a model simulation displayed graphically in terms of a time-varying longitudinal flood profile. Changes to the model to incorporate the dredging (and other) proposals were then described and a new flood simulation demonstrated. A comparison between the existing and dredged flood profiles provided an indication of the relative benefits of the proposed works. Other variables, such as the influence of assumed ocean conditions on these flood profiles were also examined with the working party.

The conclusions from these demonstrations, was that the various lower creek options only had an appreciable impact on reducing flood levels in the lower creek. Little or no flood benefit was provided upstream of the highway, where most of the flood affected residents are located.

The working party finally concluded that works in the lower creek had high capital costs, significant environmental implications, and limited flood benefit. It was then agreed that other options and measures in the catchment should be investigated.

## 9. THE PREFERRED STRATEGY

Previous flood strategies for Coffs Creek had largely involved creek improvement works and culvert amplification to increase the conveyance of the creek system. Whilst these measures can be reasonably effective within the proximity of the works, they can lead to detrimental impacts further downstream. The floodplain management study therefore looked at opportunities to delay or detain runoff in the upper catchment areas using detention basins.

A strategy was developed which included four basins in the upper catchment, ranging in storage capacity from 100,000m<sup>3</sup> to 270,000m<sup>3</sup>. These are relatively large basins, which could reduce downstream flood levels in a 100 year flood by as much as 0.5m if all four were built. The total cost of the four basins is estimated to be of the order of \$8.5M (includes land acquisition).

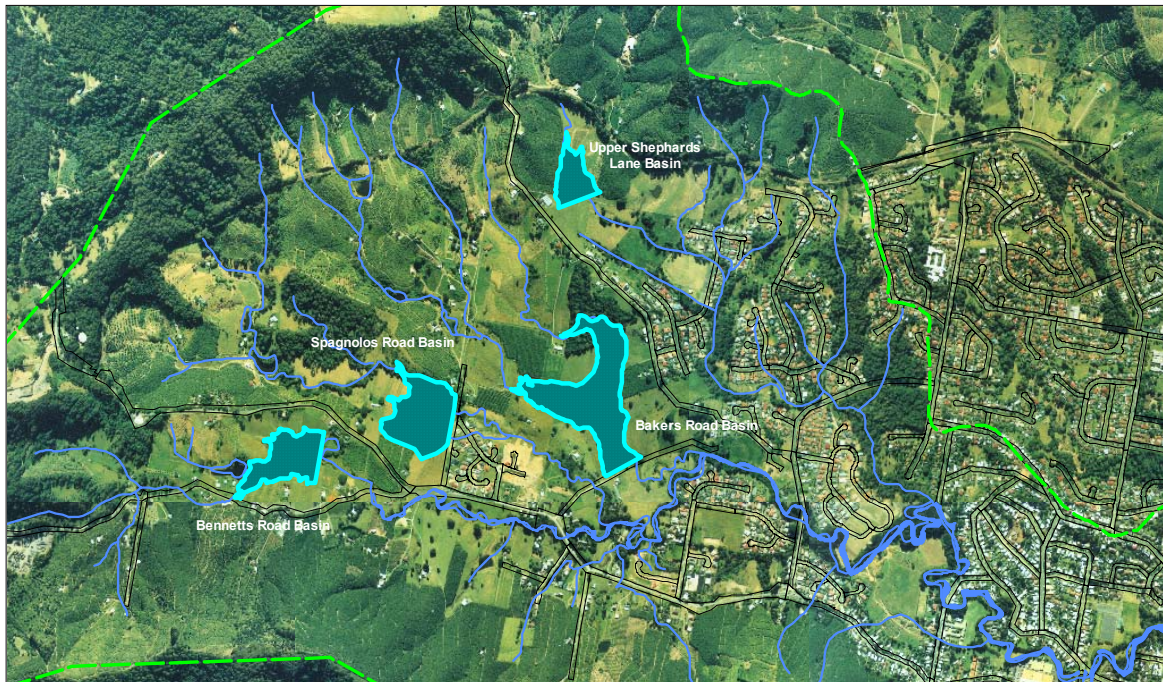


Figure 2 – Proposed Basin Strategy in the Upper Catchment

Other works have been identified in specific areas of the catchment. These include drainage improvements within the CBD area (subject of separate investigations), minor creek improvement works just upstream of the highway, and some additional investigations within the catchment.

A range of catchment-wide measures were also recommended. These include revised land use planning and development controls, improvements to the SES flood plan for Coffs Creek, raising and maintaining flood awareness within the catchment, and the preparation of a vegetation management plan for the creek corridors.

The recommended measures have been incorporated into a draft floodplain management plan. The total cost of the Plan is estimated at approximately \$9.0M. The flood benefits are estimated to be about \$17.7M in a 100 year flood, which represents a net present value of flood benefits (from all floods) of \$7.4M, and an overall benefit/cost ratio of 0.8.

The recommended strategy was considered by the community and relevant organisations at a working party meeting in November 2002. The strategy was favourably received by all community members who attended the meeting. This also included some measures which by themselves may have been less favourably considered, such as classifying land between the 100 year flood and the PMF as a "low flood risk" area.

## **10. CONCLUSIONS**

The 1996 flood on Coffs Creek was a much larger flood than Council had been prepared for, and presented Council with a number of challenges.

It led to the revision of design rainfall gradients across the catchment, and subsequently an increase in design flood level estimates. This had implications for development that had previously been permitted within the catchment based on the former flood level estimates. It also impacted on other development recently approved within the catchment.

The flood personally affected many people within the community. It was clearly evident that there was a certain amount of anger and frustration. Consultation was therefore a critical component of the floodplain management study, which diverged from the usual process of "telling the community about predetermined options" to involving the community in all aspects of the study. This included the preliminary identification of options; consideration of the implications of these options; and in the selection of the final options to be included in the recommended plan.

A range of structural measures have been proposed which help to reduce the flood problems in Coffs Creek. These works will not totally solve all flooding problems within the catchment. However, in conjunction with the range of non-structural measures that have been proposed, it provides Council with an overall strategy to manage the flood risk in the aftermath of the 1996 flood.

## 11. ACKNOWLEDGMENTS

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- ▶ Coffs Harbour City Council;
- ▶ Department of Infrastructure Planning and Natural Resources (Coffs Harbour); and
- ▶ The Centre for Ecological Economics and Water Research, University of New England.

## 12. REFERENCES

Bewsher Consulting Pty Ltd, "*Coffs Creek Floodplain Risk Management Study*". Draft report prepared for Coffs Harbour City Council, April 2003.

Bewsher Consulting Pty Ltd, "*Coffs Creek Floodplain Risk Management Plan*". Draft report prepared for Coffs Harbour City Council, April 2003.

Coffs Harbour City Council, "*Urban Stormwater Management Plan*", 2001.

Webb McKeown & Associates, "*Coffs Harbour Flood of 23 November 1996 – Data Collection*". Report prepared for the Department of Land and Water Conservation, June 1997.

Webb McKeown & Associates, "*Coffs Creek Flood Study*". Report prepared for Coffs Harbour City Council, May 2001.