

The ethics and legalities of waterway recovery and flooding impact

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Key Points

- Waterway rehabilitation and recovery can often require re-establishing channel dynamics including floodplain re-engagement with resulting 'afflux' and potential impacts on private property
- Traditional engineering approaches consider this to be 'worsening' and creates common law issues and risk for engineers
- Approaches utilizing multi-criteria analysis and hazard based risk assessment can overcome these issues of peak flood levels as the main consideration in terms of flooding impact
- An imperative exists for practitioners of waterway recovery and floodplain management to consider holistic risk to themselves and private landholders, but also considerations of lack of action for waterway recovery on receiving environments

Abstract

- Increase in flooding and 'no-worsening' challenges professionals working in the waterway management and rehabilitation field. Waterway recovery often requires addressing modified flow regimes, channel characteristics, increasing roughness and at times reducing channel capacity. These outcomes almost always have the potential to modify flooding characteristics somewhere throughout the catchment, with potential impacts to private landholders.
- Responses to flooding and potential impacts need to consider common law, which is regularly interpreted as requiring 'no-worsening'. However this is severely limiting, usually not necessary and often inappropriate. We've found that a contemporary interpretation of common law and moving towards adaptive and risk-based approaches allows improved integration between ecological and flooding outcomes.
- The Ipswich City Council Integrated Catchment Plan is a recent example that has been challenged by risk and afflux (including channel naturalisation and a recently completed large scale natural floodplain management investigation), using a multi-criteria analysis and a flooding hazard based approach favouring flooding adaptation.
- Contemporary approaches to floodplain management are set to change the industry by encouraging adaption instead of defence. Our investigation challenges industry status-quo, considering risk and appreciable impact. This approach has positive implications for the viability of waterway management and recovery projects, allowing improved ecological outcomes.

Keywords

Waterways, Recovery, Flooding, Common Law, Hazard, Risk, Adaptation

Introduction

Waterway management is now more than ever a multi-disciplinary field that combines the sciences, engineering and social sciences. These disciplines combine to provide integrated and mixed outcomes within the waterway management sphere in order to maximise benefit. Achieving multi-beneficial outcomes is often challenging when traditional engineering perspectives of flooding and ‘no worsening’ collide with efforts to slow the flow of water necessary for recovery and contradict the efforts of waterway rehabilitation and stream recovery.

These situations give rise to an ethical and legal dilemma: should waterway managers be allowed to undertake stream recovery works to benefit the greater good, when it may result in increased flood levels for a small number of people? The answer to this question is not straight forward, particularly when considered through a traditional engineering lens. This paper explores the existing challenges for waterway managers in restoring waterways in flood constrained areas and provides opportunities and potential solutions to these dilemmas.

Waterway Challenges, Responses and Constraints

The degradation of waterways through the country’s agricultural and urban landscapes is the norm for most parts of Australia. The removal of riparian vegetation is known to impact stream health in numerous ways, including by increasing instability, introducing additional stream-based sediment inputs, reducing nutrient assimilation capacity, and eliminating critical organic and woody debris inputs.

These impacts combined with other factors such as increased runoff owing to soil compaction from grazing activities and the increase of impervious areas have combined to increase the frequency of runoff and the scale of in-stream erosion. These changes can result in feedback loops that increase stream power as a consequence of increasing channel capacity, further exacerbating erosion. In many instances, waterways have gone from containing flows in the order of the 1-year ARI (annual recurrence interval) event up to the 20 to 100-year ARI event. The high stream power and shear stresses associated with these events fundamentally change the bed load composition and have the potential to strip waterway channels of their diversity of habitat features.

Restoration requirements and flood impact

One of the most commonly used tools in the waterway restoration arsenal is revegetation. However long-term stabilisation of waterways often requires reconnection of the floodplain and potentially raising the channel bed (e.g. Rutherford *et. al.*, 2000). These approaches can have the unfortunate side effect of causing increases to flood levels, if only back to their pre-disturbance level. This increase, known as afflux, can present legal challenges when afflux occurs on private property. This can frustrate rehabilitation or remediation attempts, particularly in instances where dwellings are inappropriately located and may already experience flooding.

Common law issues

Common law is described in the Queensland Urban Drainage Manual (QUDM, 2017) changes to stormwater that may give rise to legal issues may be broadly categorised as a diversion of stormwater, concentration of stormwater flows, changes in other flow characteristics and changes that affect the future use of the land. This system of law can result in perverse outcomes when it comes to waterway health and recovery, often hampering efforts to improve waterway health and results in worsening of in-stream condition and water quality. This is particularly the case when it comes to artificial waterways that have been designed for the rapid conveyance of water out of a particular area, and

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where environmental degradation has resulted in deepening and widening of waterways, thereby providing improved flood immunity to surrounding properties.

Risk Exposure & Engineering Response

An unfortunate part of waterway revitalisation is the growing risk of legal action being taken against engineers when quantifying and investigating flood risk and flood afflux on private property (as one example). This is particularly the case in Queensland whereby engineers are held personally liable and can be prosecuted under the Professional Engineers Act 2002.

Recent events such as the Grenfell Tower Fire which involved defective fire cladding, the Wivenhoe Dam class action which revolves around negligence aspects of flood engineering and numerous flood events causing billions of damages have had a three-pronged effect on how engineers and society look and consider flooding. This includes:

- Insurers and re-insurers are now reconsidering the type, amount and conditions they provide engineers for professional indemnity insurance. This tightening of insurance is increasing the risk adverse approach by engineers
- Class actions and more legal actions by groups of people and individuals are having a flow on affect and introduces significant “real” risk by engineers involved in such projects that do have a flooding effect on private residents. This incentivises highly conservative outcomes that do not challenge the notion of what constitutes an “appreciable impact”.
- The “race to the bottom of the barrel” is encouraging poor practice and the inability for thorough investigation to occur on projects. This amplifies the risk averse nature by engineers whereby they do not have the necessary time to investigate risk fully and allow relaxation of some elements.

Overall, these issues are heightening the real risk present for engineers and continually encouraging a risk averse approach by engineers. Because of the complex arrangement, engineers are understandably concerned with their exposure and must act accordingly to decrease this exposure. This approach then can result in poor outcomes in waterway health, whereby waterway recovery is prevented because of changes of flood levels on private property.

The issue is embedded in practice historically and is gradually becoming worse due to increasing legal ramifications such as those listed above.

Integrated Approach and contemporary management

Floodplain management historically has taken a myopic view of managing floodplains and been solely focussed on reducing flood risk. Outside of waterway health outcomes, floodplain management practice has been largely archaic and focussed on structural flood mitigation outcomes (such as dams and levees). This approach is still readily apparent in the industry today, which is dominated by traditional engineers, and reinforced by vested interests of those who design and construct this significant and expensive infrastructure, and politicians that like to have a ‘big spend’ and rapid ‘fix’ to flooding problems for their next election campaign. Fortunately, more progressive and contemporary floodplain management engineers are now better versed in social and environmental outcomes, and work in multi-disciplinary teams to provide enhanced outcomes across the triple bottom line.

A suite of flood management responses are now at the disposal of floodplain management engineers, rather than simply hard engineering solutions. These solutions can occur not just in catchment headwaters through construction of dams (source control), but along the pathway to receptors typically located in downstream towns and cities (see Figure 1 and Figure 2 for examples from the

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Ipswich Integrated Catchment Plan). These responses support an emerging theme of living with instead of fighting flooding and can include natural floodplain mitigation, risk-based planning responses, adaptation and disaster preparedness.



Figure 1 – Integrated Catchment Management tools available, as demonstrated in the Ipswich Integrated Catchment Management Plan (Ipswich City Council, Synergy Solutions, Water Technology & E2Designlab).

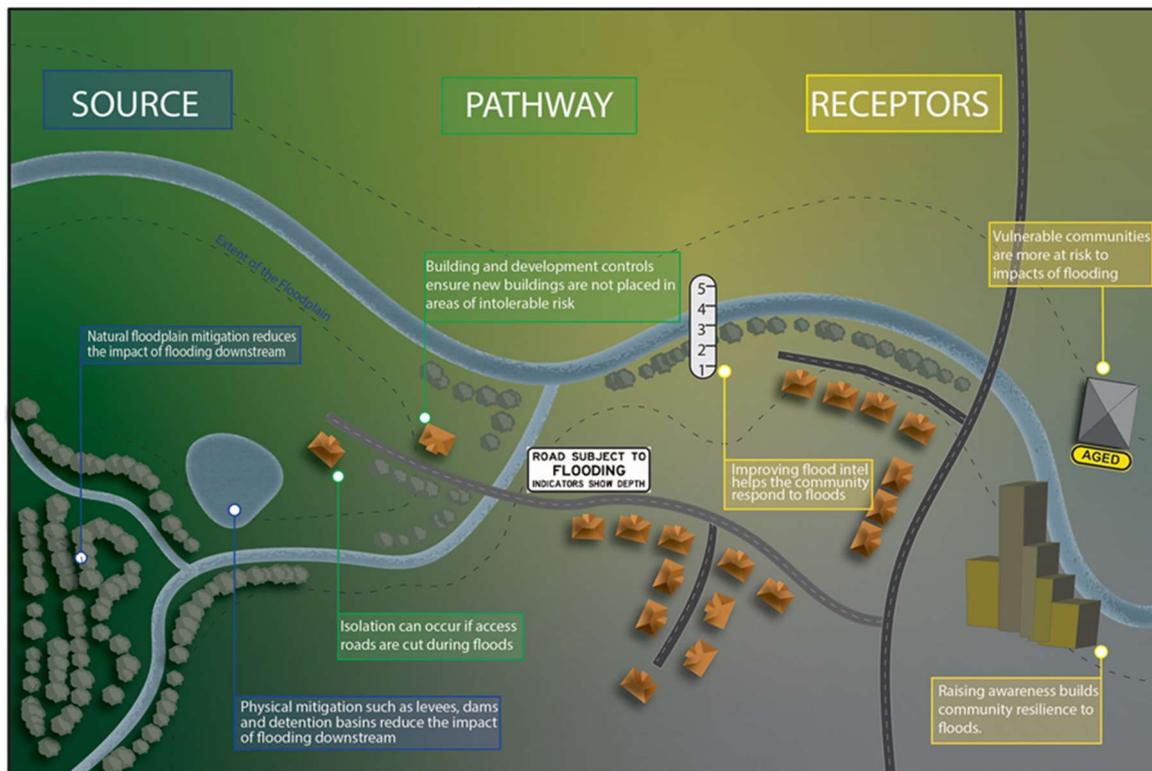


Figure 2 – Potential flood mitigation along the floodplain.

Some Council's in Queensland and the floodplain management fraternity are extending this contemporary thinking into managing the floodplain as a whole (both flood risk and opportunity combined). Ipswich City Council has investigated an Australian first approach to managing flooding which incorporates all of the new and progressive components to contemporary management of flooding and extends this further into a whole of catchment approach. This involves linking waterway health and flooding endeavours together to recognise and pursue benefits in both areas and understand, realise, recognise, and promote a new way of thinking and application in floodplain management.

The Ipswich Integrated Catchment Plan (IICP) is now recognised as a best practice method to manage floodplains and has encompassed outcomes in community resilience, emergency management, flood adaption and education in a direction whereby a softer approach is taken by the Council and community to live with flooding. This is also generated by the real risk that is created by large structural mitigation projects (levees, dams etc) whereby significant residual risk remains.

IICP NFM example

The IICP applied contemporary thinking to managing flood risk in consideration of the types and techniques of mitigation was applied. Council adapted thinking and applied the following:

- A traditional benefit cost assessment (BCA) whereby mitigated flood damages are compared to existing flood damages. This approach compared traditional structural options such as dams and levees as well as contemporary floodplain management approaches such as natural floodplain management mitigation including revegetation and floodplain re-engagement, and techniques such as property acquisition and flood resilient building materials.
- A multi criteria assessment was then also undertaken whereby other aspects could be considered such as residual risk, risk of ownership, and environmental and aesthetic values.

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The Natural Floodplain management (NFM) techniques were specifically targeted in areas of high environmental value and areas that would make a noticeable difference to flooding downstream. These options were scaled from small, medium and large intervention (and cost)

An example of one of the larger NFM measures included the following:

- Extensive “zones” of revegetation targeting riparian and floodplain roughening of the waterway.
- Providing floodplain re-engagement at key locations
- Targeting key fauna and flora corridors for these intervention measures establishing key links between areas
- Swapping out traditional approaches of damming actual waterways with using floodplain bunds instead

This approach provided a large decrease in flood extents downstream (and a substantial decrease in flood damages). Revegetation of the riparian zone and floodplain resulted in roughening and increased inundation frequency on the floodplain. This is expected to be to the benefit of the endangered *Melaleuca irbyana* as well as enhancing a critical habitat connection corridor between core habitat zones.

The results of the BCA and MCA were compared in to determine the best value outcome, as shown in the below figure. This approach highlights the value of Natural Floodplain Management.

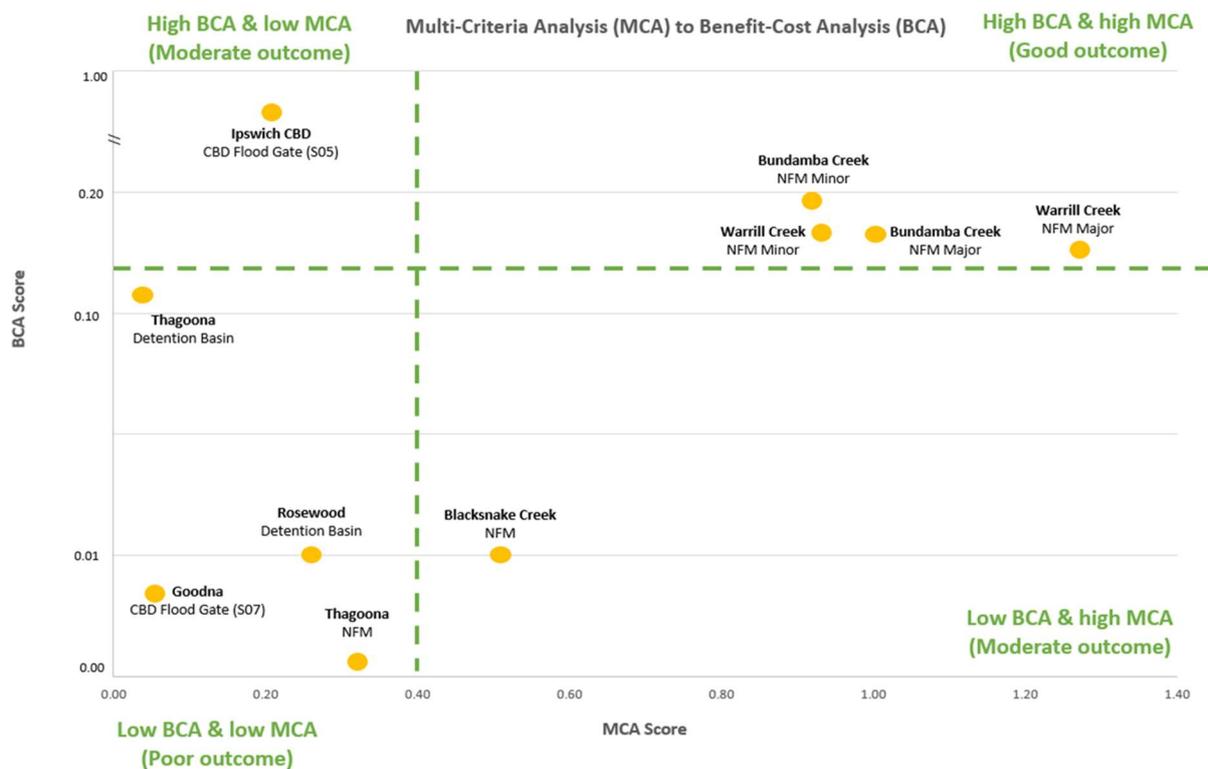


Figure 3 – Multi-Criteria Analysis to Benefit-Cost Analysis as developed in the Ipswich Integrated Catchment Plan.

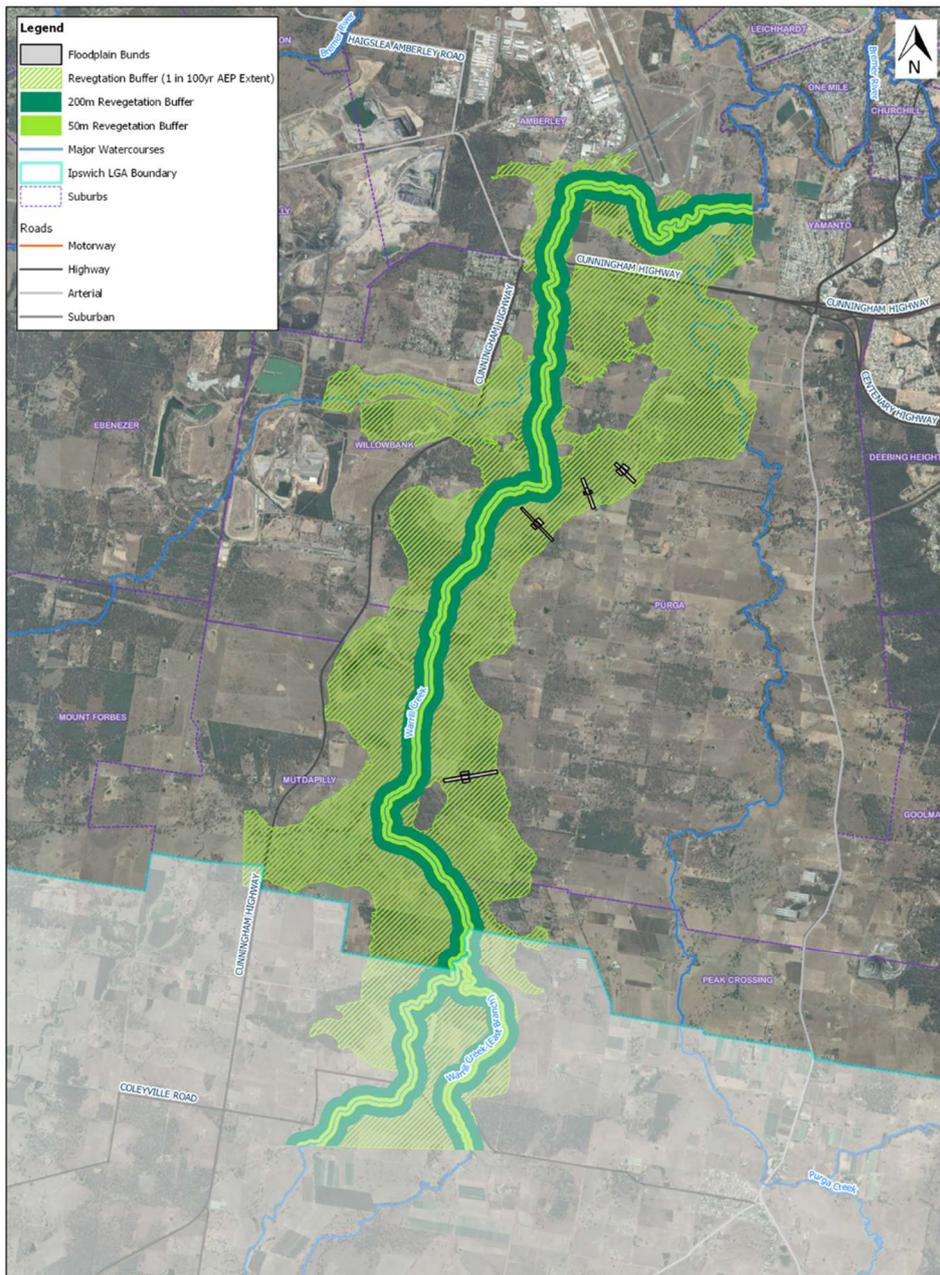


Figure 4 – Example of the use of floodplain bunds and 200m revegetation buffers of the Bremer River in Ipswich, QLD, to improve downstream flooding, which also provides significant environmental benefit.

Conclusions

Resolution of the conflict between demonstrating ‘no-worsening’ and waterway recovery may rely on several potential tools in the future. While inconsistently applied currently, the below recommendations are likely to assist waterway health practitioners and flooding engineers improve mutually beneficial outcomes.

1. **Always include a range of professionals that span the sciences, engineering, design and social sciences.** The IICP demonstrates that contemporary floodplain management can not only support waterway management outcomes, but that natural floodplain management can become a flooding mitigation tool. In this instance the use of BCAs was an important tool in

justifying the expenditure on ‘soft’ structures. Similar BCAs may be used in the future to better consider the cost of inaction of waterway recovery to ecosystem health, ecosystem services and impact to downstream waterways. The outcomes may assist to support direct payment to landholders for compensation, and to look beyond minor inconvenience potentially posed by very minor increases in flood levels.

2. **Use BCAs to consider the full range of benefits of an action against alternative options.** For example, the potential cost of marginal flooding increases (afflux) versus the increase in property value potentially achieved by contemporary waterway interventions such as channel naturalisation. For example Bannister Creek demonstrated a 4.4% increase in property values above trend increase in response to waterway naturalisation (Polyakov *et al.* 2015). Such analyses may also support, where required actions such as property adaptation or (at worst) acquisition.
3. **Require engineers to take the time to thoroughly consider the impact and understand risk to property (and themselves) due to management action.** Where traditionally afflux on private properties has been considered unacceptable, or has resulted in direct acquisition of land where considered unavoidable, further consideration of what constitutes an ‘appreciable impact’ is required. This requires that engineers are afforded the time to conduct thorough investigations to understand the risk to themselves and risk to property. In seeking resolution to such issues, consideration may also be given to the suite of tools in the flood mitigation toolbox, such as the ability to build in flood affected areas with appropriate building standards and materials being applied.
4. **Consider in depth the moral and ethical imperative to balance landholder interests with the greater good.** We regularly reduce property values to surrounding landholders in infrastructure spending in infrastructure projects such as rail and highways. Serious consideration needs to be given to the economic costs of not restoring waterways. When combined with the above approaches, flooding can be viewed, not in the black and white of a 1% AEP (annual exceedance probability) flood extent, but in shades of grey that consider appreciable impact and risk.

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