A Blueprint for Improving our Waterways

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After 15 years of State Planning Policy (SPP) Stormwater Management Design Objectives (SMDOs), there has been millions of dollars of infrastructure built to protect our waterways without which our waterways would be in a worse condition, but are we seeing the best ecological return on investment?

Water by Design (WbD) is a capacity building program that aims to improve management of urban stormwater and waterway health. For the last 2 years WbD have been researching the latest science and policy developments from around the country and have interviewed dozens of representatives from the stormwater industry.

This paper discusses some of the shortcomings of the current system. At the moment pollution load reduction targets (e.g. 80% of TSS, 60% of TP and 45% of TN) are applied to developments without any consideration of downstream waterway values or any special needs or lack thereof. There has also been much focus on "how we treat water pollution" (i.e. bioretention basins and gross pollutant traps) at the expense of "why we treat water pollution" (i.e. waterway protection). As a result, many other threats to the waterways have been sidelined including, temperature, rising sea levels, dissolved oxygen, habitat disappearance, fish connectivity and other types of pollution.

Returning to the original objectives set out in the Queensland Environmental Protection (Water) Policy 2009 (i.e. to protect and enhance water values), WbD have offered a blueprint for improving the management of our waterways. The blueprint has 12 key themes to improve our waterway management including:

Values Protection; 1. Strategic Planning and hotspot mapping; 2. Special protections for high value waterways; 3. Additional flow controls where needed; 4. Reducing threats at their source

Value Maintenance; 5. Monitoring; 6. Maintenance; 7. Quality Control; 8. Improvement

Values Enhancement; 9. Strategic opportunities (funded via offsets); 10. WSUD Integration and co- benefits; 11. Water for cooling and liveability; 12. Water reuse and the circular economy

1. INTRODUCTION

The beauty of the current Stormwater Management Design Objectives (SMDOs) is their simplicity. Waterway health is framed in terms of mitigation of the impacts of stormwater pollution, of which there are many types, but the main surrogates are: Total Suspended Solids (TSS), Total Nitrogen (TN), Total Phosphorus (TP) and Gross Pollutants (GP). The Queensland Government has set SMDOs through the State Planning Policy (SPP) that ensure stormwater is filtered before it is discharged to a waterway and that the pollutant load for each key pollutant is reduced by a certain amount (e.g. in Brisbane they are 80% TSS, 60%TP, 45% TN and 90%). These SMDOs are based on the economic point of diminishing return ensuring the best pollutant load reduction without wasting additional resources on diminishing returns.

The SMDOs have resulted in widespread effort to mitigate stormwater pollution impacts across the state. As a result of this legislation, nearly every housing development (above a threshold of 2500m2 or 6 lots) across Coastal Queensland needs to install pollution control devices such as bioretention basins and Gross Pollutant Traps (GPTs) to reduce the flow of damaging pollution.

Although much progress has been made, there is still much we can do to improve waterway management practice. After extensive consultation (WbD, 2020) and research (Alluvium 2018), it appears the key limitation with the current SMDO's is their simplicity. Currently there is:

- No incentive to reduce pollutant creation at its source
- No incentive to invest in WSUD integration and co-benefits even when it makes economic sense
- No incentive to invest in other aspects of waterway management e.g. restoration, weed removal
- Limited published evidence connecting SMDO's and downstream waterway condition
- Limited published evidence if SMDO's are delivering what our waterways actually need

This paper aims to provide solutions to the above issues is divided into three parts including:

- An outline of current waterway issues (i.e. urbanisation, flow, water quality, and climate and shade).
- Reasons why holistic and strategic thinking is needed.
- Solutions to improve waterway management practices.

To address these limitations, there is a need to move the industry towards holistic waterway management. This paper suggests the first step in achieving this is is to broaden the definition of waterway health management to include more than just 80/60/45 pollutant load reductions. The second step is to act strategically and focus on what will benefit the waterway most.

2. METHODOLOGY

Healthy Land and Water (HLW) have previously assessed and documented the state of waterway management in Queensland in 2014 and again in 2017 (WbD). More recently, HLW and Alluvium undertook an extensive review of scientific literature (Alluvium, 2018) throughout Queensland and internationally focusing particularly on the hydrologic and water quality impacts of urban development on waterways. Informed by this research, the team also held eight half-day workshops with key consultants (Alluvium, E2Designlab, Switchback, DesignFlow, Water Technology), industry groups (the Cooperative Research Center for Water Sensitive Cities, Stormwater Queensland) and key councils (Brisbane City Council, City of Gold Coast and Mackay Regional Council) (WbD, 2020) to gather insight and a further appreciation into the current science and stormwater management practices across the State.

3. EXPLORATION OF WATER ISSUES

3.1. Urbanisation

In Brisbane there is an enormous legacy of catchment modification that isn't managed through the State Planning Policy (SPP). Brisbane City Council (BCC) estimates that new development applications each year cover just 2% of the urban footprint. At this rate it would take approximately 50 years for the city to undergo full renewal and for WSUD to cover the whole city footprint and address these legacy issues.

There is also a large percentage of new development that slips below SPP trigger values. The current SPP threshold applies only to development larger than 2500 m^2 in area or 6 lots, and as a result many properties are constructed without any stormwater treatment. In Brisbane (an area with many small infill developments) the number of new WSUD assets reduced by 75% after SPP 2017 threshold values were adopted. In Brisbane at least, the SPP will not be able to reverse legacy issues for quite some time.

State housing records show that the size of house lots are reducing. In the year 2000 the median lot size was 700m^2 which reduced to 450m^2 in 2019. Since high percentage imperviousness is linked to waterway impact (Walsh, 2012), the hazards created by urbanisation show no sign of abating. Worldwide it is estimated that 70% of 1st order streams are lost due to urbanisation and subsurface

drainage. (Elmore and Kaushal, 2008). These statistics point to the need to move away from the traditional 'slab on ground' housing approach and adopt low impact design housing practices with greater surface permeability and less pollution runoff. (Refer Strategy 4)

3.2. Flow increase

As a catchment develops, the amount of impervious area increases. Once a threshold of approximately 5-10% impervious area is crossed, then there is evidence that streams will move towards poor in-stream ecological condition (Walsh et al, 2012). Furthermore, it is estimated that for a fully developed catchment, flow volumes can increase by approximately 5 times when compared to natural conditions (Walsh, 2020) and potentially cause significant damage to streams with erodible banks. These statistics point to the fact that there is potentially much disturbance that can occur as a result of flow change however there is also much uncertainty when it comes to impacts in SEQ. Potentially there are 120 flow metrics that describe ecologically relevant characteristics of the natural hydrologic regime (Kennard et al, 2010). While the potential impacts have been studied in Melbourne, In Queensland there is a lack of contemporary studies investigating the flow impact from development on South East Queensland (SEQ) streams. McIntosh et al, 2013 is the only contemporary study.

To improve management, we recommend assessing the potential loss of waterway value associated with a development and if this is significant (e.g. due to High Ecological Value (HEV) waters or a large development scale) then more study is warranted (Refer Strategy 3).

3.3. Water Quality

In South East Queensland, over the last 20 years nutrient concentrations in the Brisbane River have reduced by 4-fold (HLW, 2019). This can be associated with improvements in wastewater treatment and better catchment management practices. However, our local waterways could be missing out on further improvement due to poor Water Sensitive Urban Design (WSUD) maintenance practices. In the recent Stormwater Queensland (SQ) survey 46% of bioretention basins are under- performing. Furthermore, if the plants die off in a standard bioretention basin, the potential Total Nitrogen (TN) removal is reduced to nil and the system can result in 14% TN generation (Dalrymple, 2019). These statistics point to the need to maintain the treatment devices in good working order to preserve their ability to remove pollution from our stormwater discharge (Refer Strategy 6).

3.4. Climate and Shade

The CRC WSC INFFEWS tool lists over 2000+ line items relating to the non-monetary value from a WSUD approach. By focusing on a narrow 80/60/45 goal post we are not encouraging the full realization of these benefits. One of the potential co-benefits associated with a Water Sensitive Urban Design approach includes the ability to reduce microclimate temperatures during a heatwave and improve liveability. CRC WSC scenario modelling at Yarrabilba shows a WSUD approach can reduce heatwave temperatures by an average five degrees (CRCWSC, 2019).

Intelligent use of stormwater can be leveraged to improve urban greening and mitigate some of the heat impacts of climate change (Refer Strategy 10). A recent Brisbane City Council (BCC) Water Wise Street Tree (WWST) Trial showed a significant improvement in tree height for a WWST (3.4m high) compared to standard street tree installation (2.5m high). Since this measurement was taken, the control tree has subsequently perished. If a water wise approach is mainstreamed across the city, then the water needs of our street trees will be well catered for. This in turn will help to mitigate the Urban Heat Island Effects and take the edge off temperature increases resulting from climate change.

4. REASONS WHY WE NEED TO THINK DIFFERENTLY

Waterway values can degrade because of many factors including land clearing and development. It can also happen regardless of our actions through natural events such as floods, droughts, or invasive species, etc. There is a need for the industry to take a step back and examine our effort to protect waterway within this broader context. This will allow us to identify unmanaged threats to the waterway. When considering the next evolution of the SMDOs the industry needs to consider the following:

- Waterway threats don't just occur in a development's 'operation phase' (Figure 1)
- Achieving the SMDOs won't guarantee healthy downstream waterways. Aquatic ecosystem survival depends on many things – not just water quality (Figure 2)
- SMDO's provide a fraction of human needs with regards to water (Figure 3)
- There are many alternative ways to manage waterway health that should be considered and enabled (Figure 4)
- SMDO's can't address some climate impacts and damage from acute events (Figure 5)

4.1. The need to think holistically

The SMDOs typically regulate pollution leaving a housing estate during the construction and operational phases. However, waterway impacts occur throughout the development lifecycle, so by the time the WSUD measures are in place waterway health could already be declining considerably (Figure 1). Our substantial focus on mainly the operational phase can lead us to miss significant threats within other phases of development.

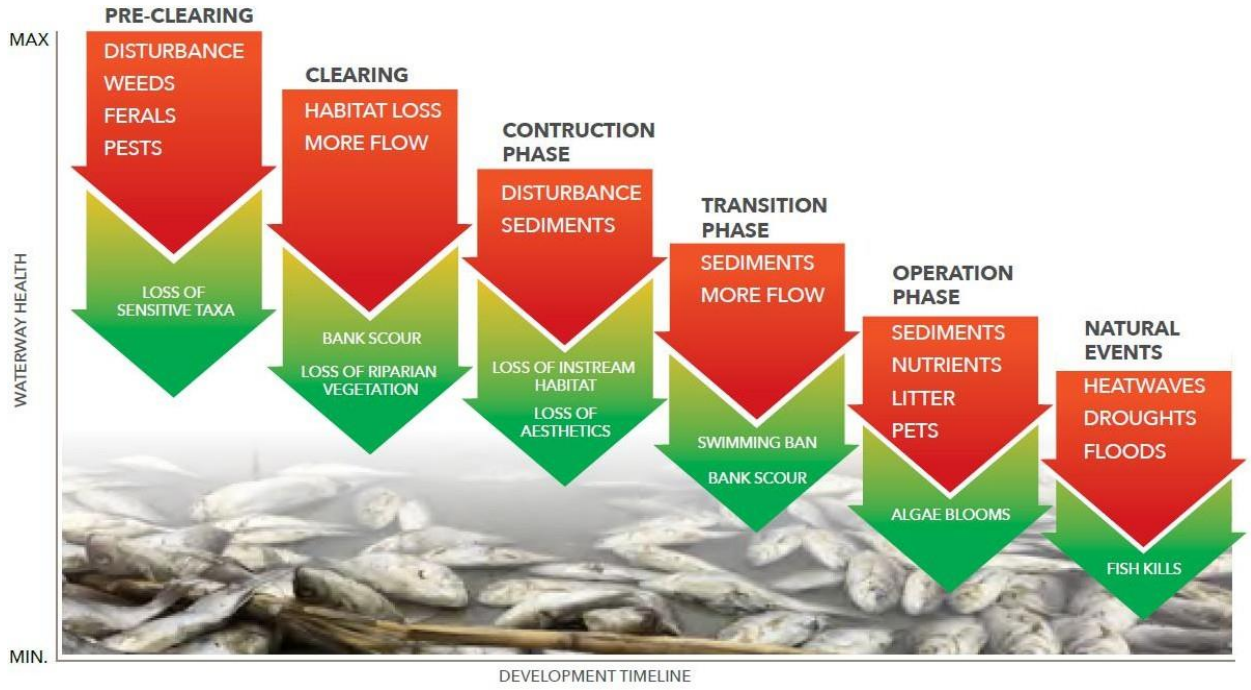

Figure 1 – Waterway health diminishes with time [WbD, 2019]

Water quality is just one (albeit important) aspect of a healthy aquatic ecosystem. Looking at the bigger picture, the SMDOs in their current form regulate only a portion of the needs for fish survival, so it could not be presumed that if the SMDOs were satisfied by a given development that there would be a healthy ecosystem downstream. To make this assumption, there would need to be many more aspects of the waterway regulated as illustrated in Figure 2.

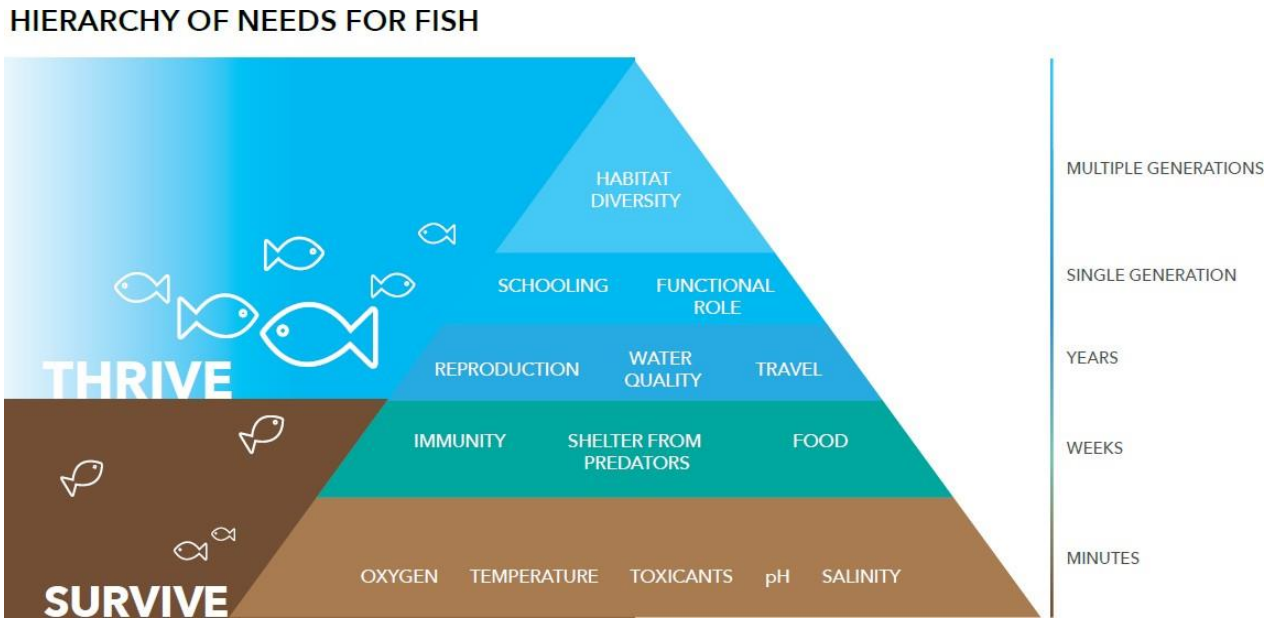

Figure 2 – Stormwater Management Design Objectives consider only part of the water needs for aquatic ecosystems [WbD, 2019]

The regulation of stormwater within the SMDOs also needs to be seen in the broader context of human reliance on water as illustrated in Figure 3. There is a need to be conscious of the links to other aspects of the water cycle.

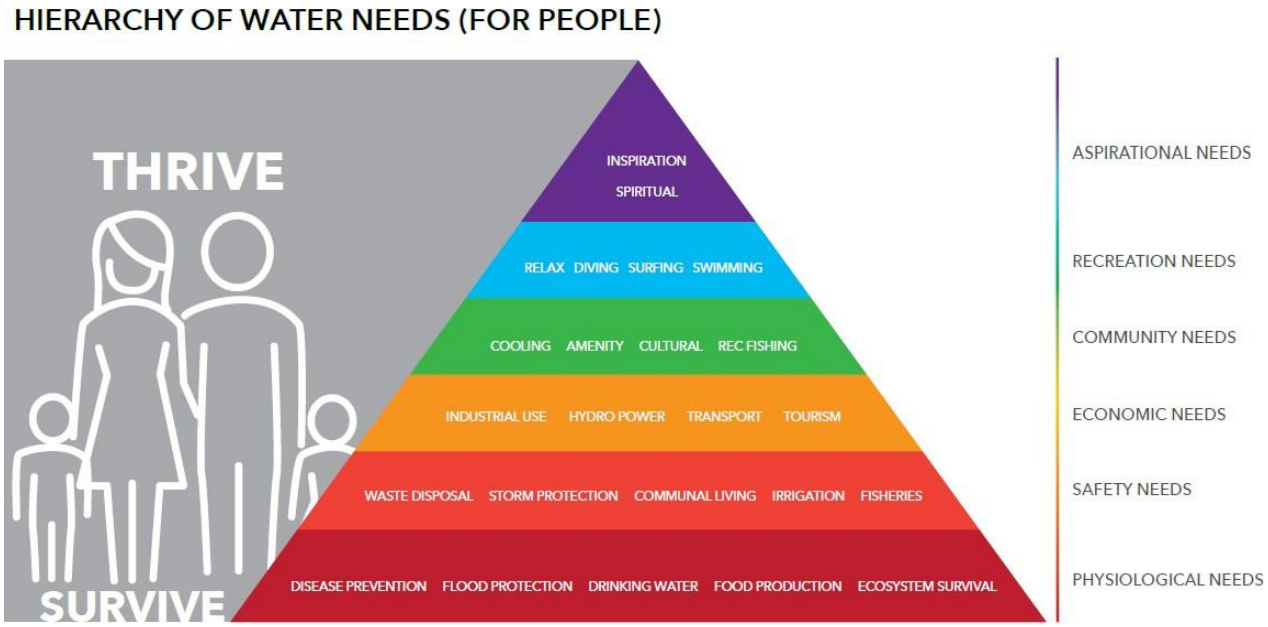

Figure 3 – Stormwater Management Design Objectives consider only part of the water needs for people [WbD, 2019]

4.2. The need to act strategically

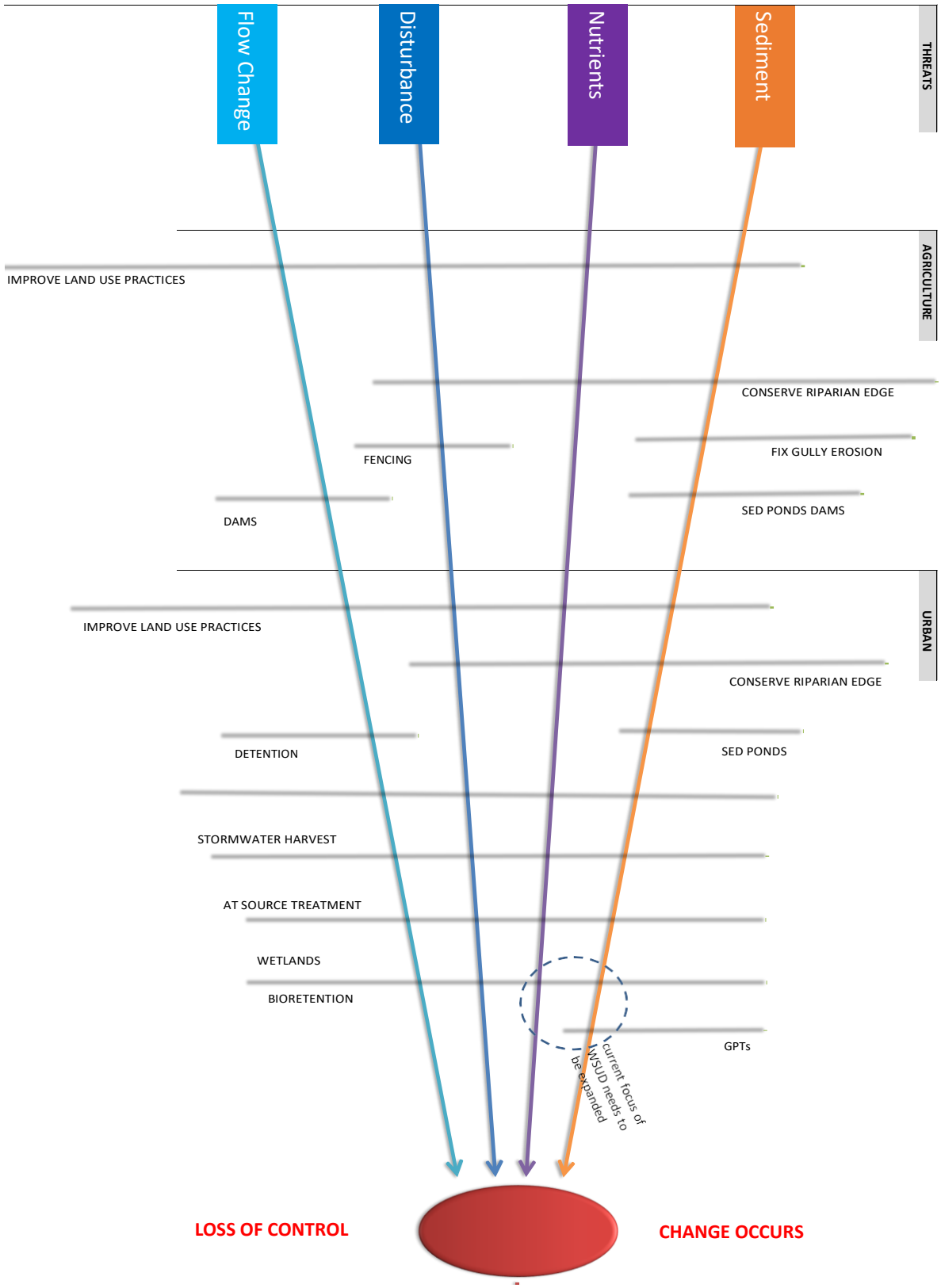

Figure 4 – There are many possible actions to improve waterway health [adapted Browning, 2019]

Figure 4 above illustrates a threat / barrier diagram for waterway health. Our substantial focus on the SMDOs is leading us to the implementation of just one or two solutions to protect waterway health (e.g. bioretention and Gross Pollutant Traps (GPTs)). When we consider the bigger picture, then we can start to identify other actions that will produce the same risk mitigation effects such as improved land use planning,

Continuing with the threat / barrier diagram in Figure 5, if we consider the negative impact that Climate Change (e.g. increasing temperatures, and sea level rise) can have on our waterways then this has the potential to undermine our investments in WSUD assets like bioretention and GPTs.

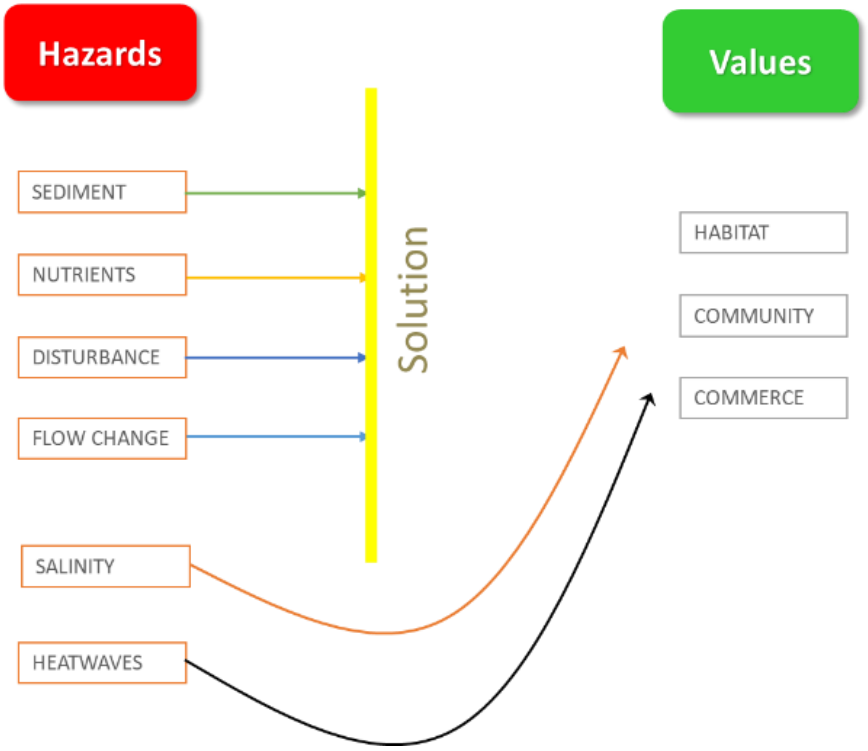

Figure 5 – Climate impacts can bypass typical Water Sensitive Urban Design solutions [Browning, 2019]

5. SOLUTIONS

To address the above issues, Water by Design has proposed 12 key strategies grouped under three themes: Protect, Enhance and Maintain. The full detail behind each of the strategies is listed in the Blueprint for Improving Waterway Management (WbD, 2020).

5.1. Values Protection

Strategy 1. Strategic Planning and hotspot mapping: Categorise and prioritise waterways. Target investments to where they make the biggest impact.

Strategy 2. Special protections for pristine waterways: Put extra protections in place for our High Ecological Value Waterways.

Strategy 3. Additional flow controls where needed: Reduce detrimental impacts of flow increase.

Strategy 4. Reducing threats at their source: target pollution 'at source' by improving the urban development template with underlying WSUD principles.

5.1. Value Maintenance

Strategy 5. Monitoring: Gather data to understand the condition of our waterways, our WSUD assets and their impact on waterway health.

Strategy 6. Maintenance: Waterways and the systems that protect them require ongoing maintenance.

Strategy 7. Quality Control: Waterway protection and improvement projects need to deliver on their design intent.

Strategy 8. Improvement: Periodically adapt and improve our management systems.

5.2. Values Enhancement

Strategy 9. Strategic Offsets: collect WSUD money from areas where they make the least impact. Invest in high impact areas.

Strategy 10. WSUD Integration and co-benefits: Encourage WSUD integration and multiple benefits.

Strategy 11. Water for cooling and liveability: Enable water as a tool to cool our suburbs.

Strategy 12. Water reuse and the circular economy: Enable fit for purpose reuse of stormwater.

6. CONCLUSIONS

The review of scientific evidence shows that, while we have made significant progress towards mitigating waterway pollution from urbanization, there are still many issues that need to be addressed. Unfortunately, if this remains the case and we let the waterway health trajectory to continue to decline and not stabilize, then the significant investment in WSUD throughout the state may eventually provide protection for disturbed ecosystems and waterways regardless of our actions. This paper recommends building on the foundation provided by the SPP SMDO's and examining new ways to Protect, Enhance and Maintain the health of our creeks and rivers.

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