FLOODING AND FUNDING

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ABSTRACT (300 WORDS MAXIMUM)

Urban stormwater is often referred to as the "poor cousin" of the three waters, with limited funding available compared to water and wastewater. The exception to this seems to be in the years immediately following local flood events, when funding becomes available for stormwater and flood mitigation works, often for a limited period of time. This trend appears to have persisted for generations, despite changes to legislation requiring local government to have long term plans in place with a 10 year minimum planning horizon.

Tools available for understanding flood risk, and exploring mitigation performance and cost, should enable a more structured long term planning approach, although costs can be high both for studies and for works, and potentially unpalatable politically except when public consciousness of flood risk is high.

This paper will explore the relationship between flood events and funding of stormwater and flood mitigation works around New Zealand, using case studies and data from a few local authorities around the country. It will also explore alternative approaches to planning, programming and funding of these works, and how these fit with current regulatory requirements.

KEYWORDS

Flood management, flood mitigation, funding, planning

PRESENTER PROFILE

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1 INTRODUCTION

Local authority capital expenditure for stormwater and flood mitigation works appears to increase in the years following flood events. Such funding increases are sometimes dramatic and often for a limited period of time, and this trend appears to have persisted for some time. This paper investigates examples of this trend around the country, and considers the advantages and disadvantages of this approach and alternative approaches.

Given the large number of local authorities around the country, each managing its own budgets, the data presented in this paper is not intended to be a complete or exhaustive review. Rather, it is intended to present a series of case studies from selected councils to explore a trend.

2 EXAMPLES FROM AROUND NEW ZEALAND

2.1 GENERAL

Examples of capital works following flooding can be seen in infrastructure projects which have been constructed, upgraded or extended following flood events, and changes in planned capital programmes following more recent flood events.

2.2 INFRASTRUCTURE PROJECTS

The following cases studies, both from Canterbury, are examples of infrastructure projects which has been constructed and then upgraded or extended following flood events.

2.2.1 DUDLEY CREEK, CHRISTCHURCH

The Dudley Creek catchment in St Albans, Christchurch has been prone to flooding for some time. A series of projects have been undertaken during the last 40 years to mitigate the flood risk in the catchment, each following a flood event or events.

- Late 1970s - Dudley Creek Diversion and PS205. This followed a series of floods from 1974 onwards, with significant flooding in the Dudley Creek catchment in 1975. The work involved a new 2.8 km long 1800 mm and 2100 mm diameter piped diversion of Dudley Creek from Philpotts Road to Horseshoe Lake and a 13 m^3/s Archimedes screw pump station (PS205) at Horseshoe Lake pumping into the Avon River.

- Late 1980s - Upper Dudley Creek Diversion and PS219. Despite the completion of the Diversion and PS205, the Dudley Creek catchment still suffered flooding in the July 1986 storm event, leading to further works. These works involved a new open drain through the Cranford Basin area, diverting the Dudley Creek further upstream than the earlier works, a new 2.5 m^3/s pump station (PS219) pumping into the Dudley Creek Diversion pipeline.

- 2014 onwards - PS202 and Dudley Creek Remediation Works. The Canterbury earthquake series (2010 to 2011) caused differential settlement and waterway changes, which increased the flood risk in the Dudley Creek catchment. Storms in 2013 and 2014, most significantly March 2014, led to flooding in the Dudley Creek catchment, and accelerated further works. This work involved two projects: a new 2 m^3/s pump station and rising main (now complete), diverting a sub-catchment (Tay St drain) to the Dudley Creek Diversion pipeline; and works on Dudley Creek (currently under construction) including waterway widening, culvert replacement, and a new 2m x 4m box culvert bypass in lower Dudley Creek.

The locations of these phases of work are shown on a map in Figure 1 (red for 1970s, blue for 1980s, and yellow for 2014 onwards).

Figure 1: Dudley Creek Works

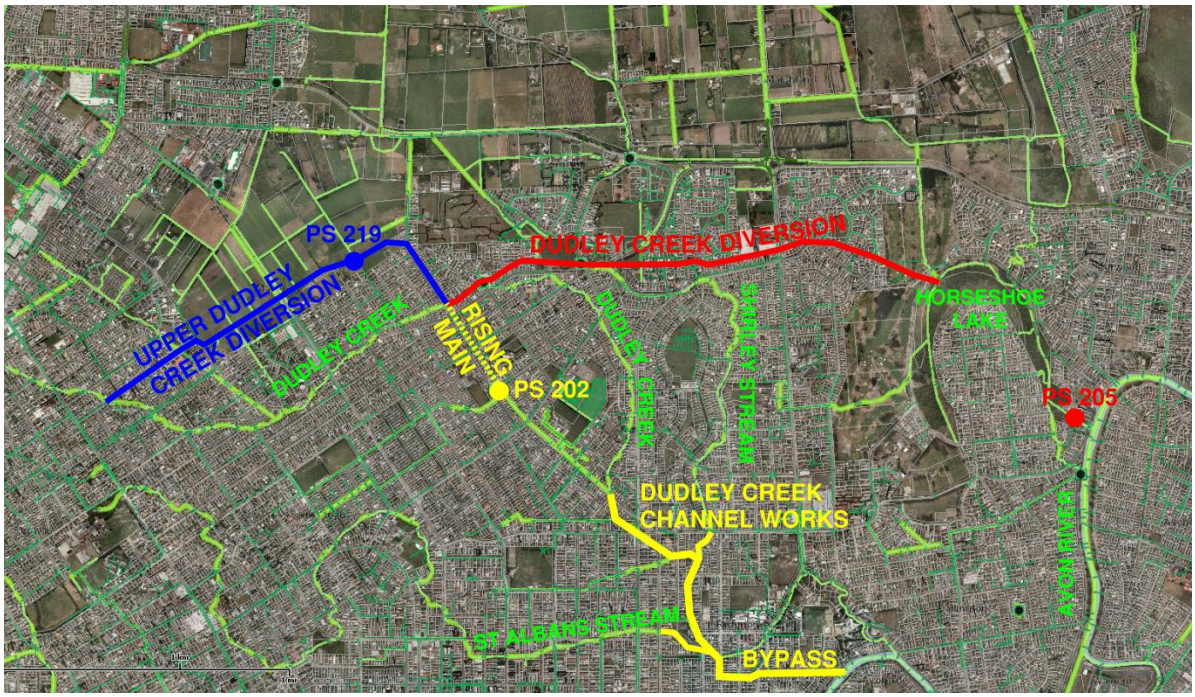
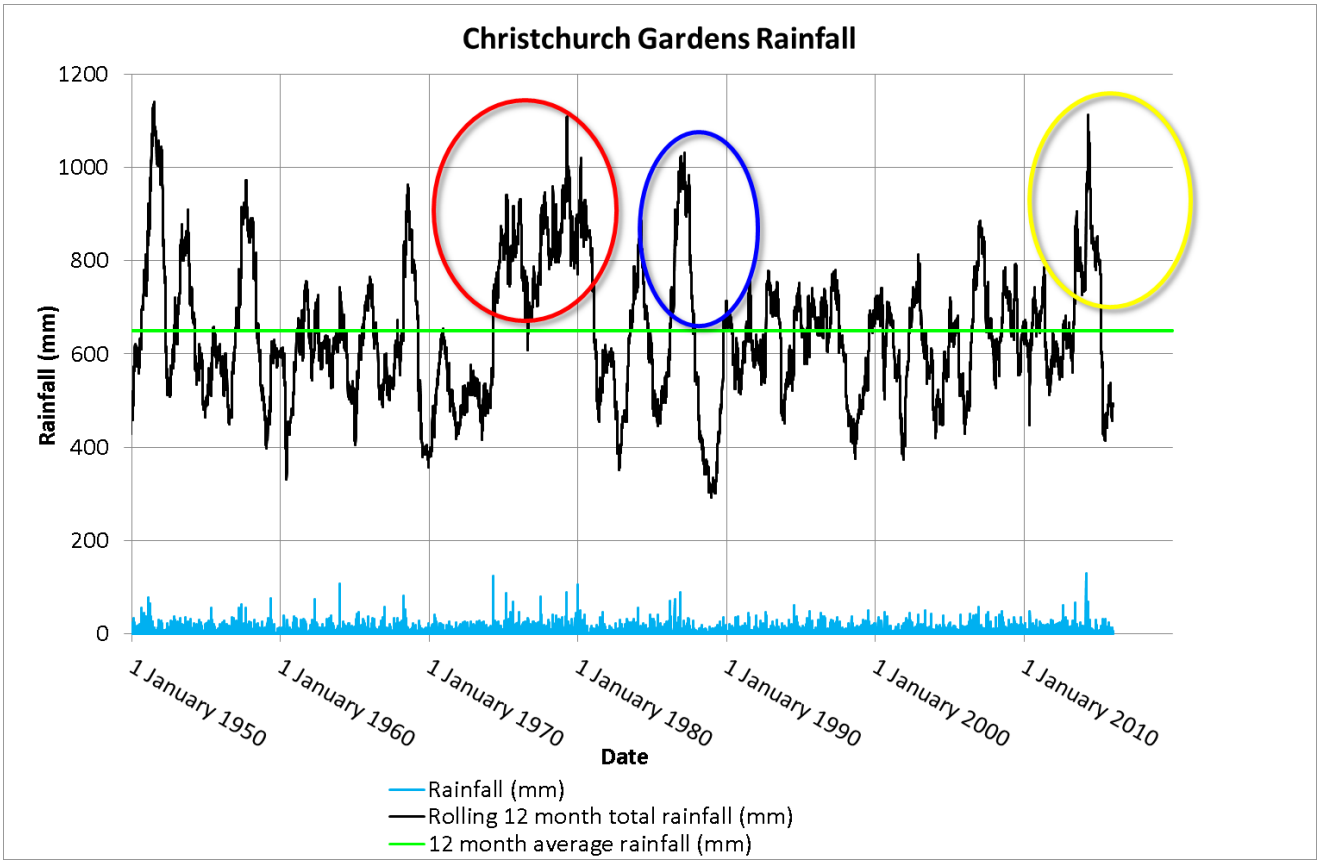


Figure 2 shows rainfall and rolling annual total rainfall at the Christchurch Gardens from 1950. The storms which preceded each stage of the works, as described above, can be seen (circled) in the rainfall record in Figure 2.

Figure 2: Christchurch Gardens Rainfall 1950 to Present



2.2.2 PARNHAMS DRAIN, KAIAPOI (WAIMAKARIRI DISTRICT)

South-western Kaiapoi is low lying and prone to flooding. With the construction of the Northern Motorway in the 1970s, Parnhams Drain was realigned, the last 350m to the Kaiapoi River was piped, and a flap gate was installed at the outlet. The Parnhams Drain system has since been upgraded twice: following flooding in 1986; and following flooding in 2014.

- Early 1990s - Parnhams Drain Pump Station. Following flooding in 1986, a 1 m³/s lift station was constructed, to allow the previously gravity only drain to continue to discharge to the Kaiapoi River during high river levels and high tides. Upgrades to pipework discharging to Parnhams Drain were also undertaken around the same time.

- Late 2014 – Parnhams Drain and Pump Station Upgrade. Following flooding in April 2014 and worse flooding in June 2014, the drain was widened and the pump station was upgraded to 2 m³/s capacity.

The location of the Parnhams Drain, pump station and pipeline are shown in Figure 3.

Figure 3: Parnhams Drain Works

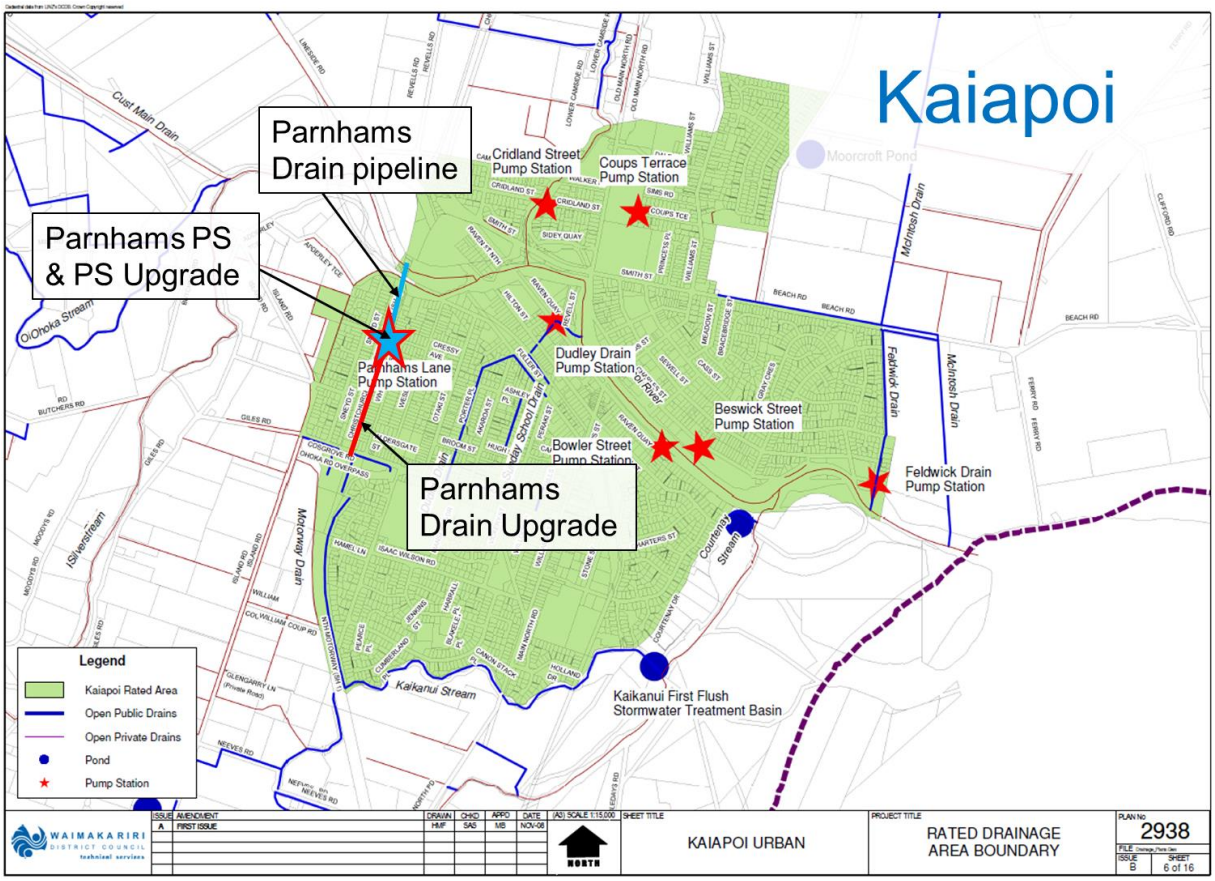
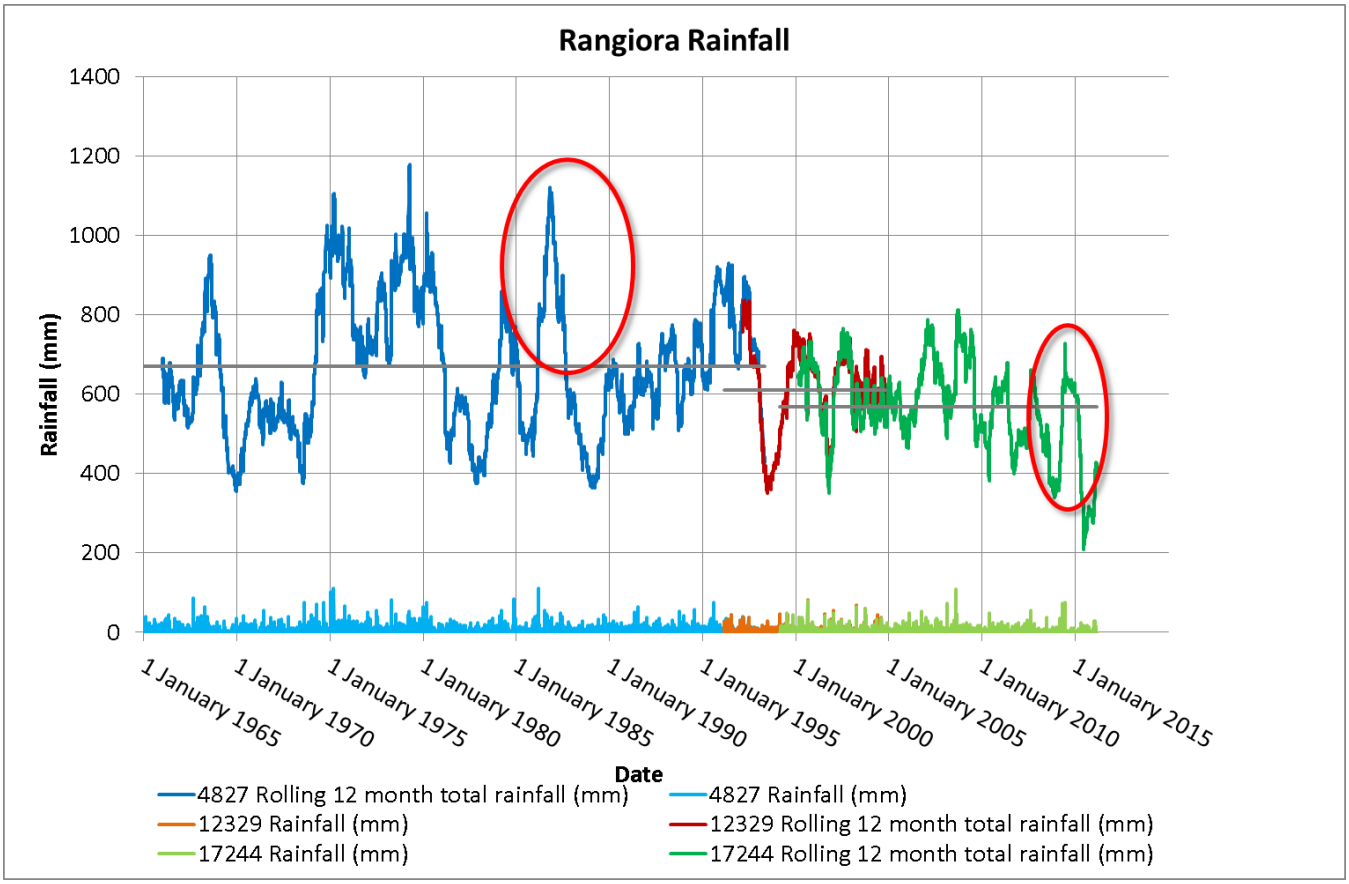


Figure 4 shows rainfall and rolling annual total rainfall in Rangiora (nearby town) from 1965 to present, using three separate rainfall records. The floods in 1986 and 2014, which preceded works on Parnhams Drain and pump station, can be seen in Figure 3 (circled in red). Other storms in the intervening period led to investigations and operational changes at the pump station.

Figure 4: Rangiora Rainfall 1965 to Present



2.3 CAPITAL FUNDING RESPONSE

Some examples of recent increases in 10 year capital funding following storm events from around the country are shown in Table 1. The additional 10 year capital funding shown is the total increase in the 10 year plan for stormwater and flood mitigation works compared to prior to the flood event.

Table 1: Recent Flood Events and Council Increases in Stormwater and Flood Mitigation Works Capital Funding

Location/ Local Authority	**Event**	**Rainfall total (Duration)**	**Assessed Average Recurrence Interval (Duration)**	**Additional 10 year capital funding**
Tauranga City	April 2013	192 mm (48 hours)	10 years (48 hours)	$110m*
Waimakariri District	June 2014	178mm (48 hours)	66 years (48 hours)	$17.8m
Christchurch City	March 2014	141mm (24 hours)	119 years (18 hours)	$59.4m+
Dunedin City	June 2015	142mm (24 hours)	>100 years (24 hours)	$0.5m

* Followed flood events in 2005 and 2011. $5m initially plus $105m over 10 years extrapolated from first 3 years' works programme at $10.5m per annum.
+ For 9 years rather than 10 years due to data availability.

Figures 5 and 6 show the Waimakariri District Council and Christchurch City Council 10 year stormwater capital programme before and after the districts' respective flood events. Both Waimakariri District Council's and Christchurch City Council's increased programmes include investigation and modelling, as well as design and construction, in a number of catchments and locations.

Tauranga City Council's increased programme includes strategic review, design and construction in targeted areas. Further information on Tauranga City Council's approach, and how this has modified over time, is provided in section 4.3.

Dunedin City Council's proposed additional capital works following its 2015 flood are currently limited to replacing the screen on the Portobello Road pump station (which drains South Dunedin).

Figure 5: Waimakariri District Council 10 Year Capital Drainage Budget Pre- and Post-Flood Event

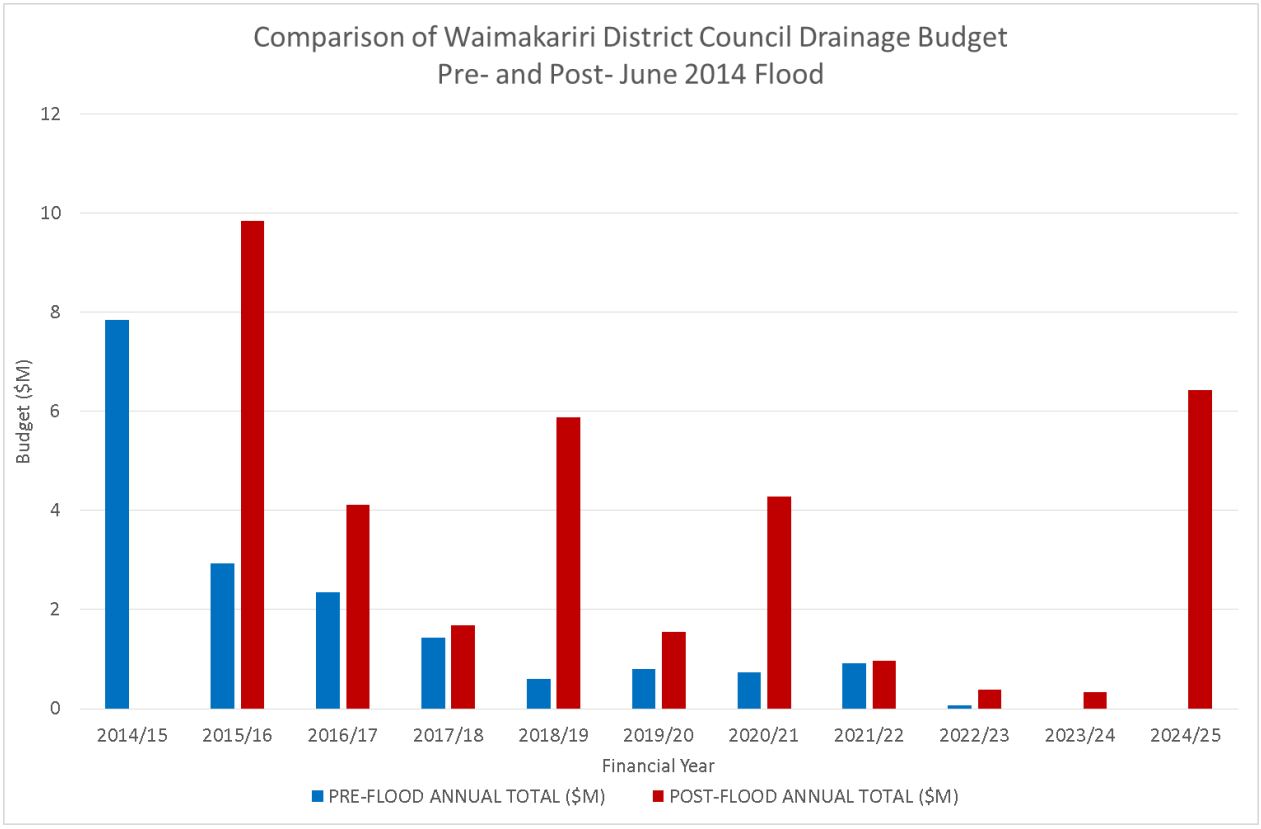
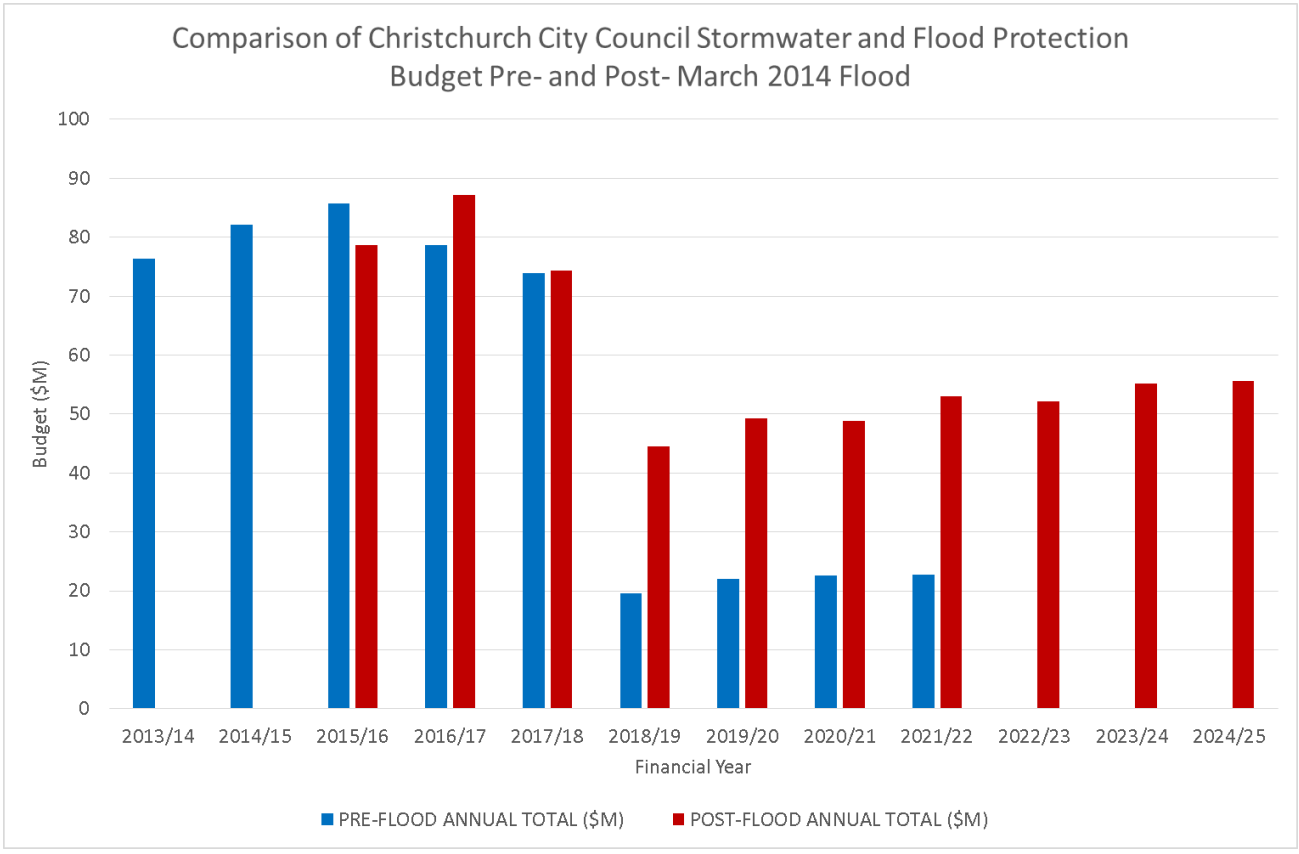


Figure 6: Christchurch City Council 10 Year Capital Stormwater and Flood Protection Budget Pre- and Post-Flood Event



3 ADVANTAGES AND DISADVANTAGES OF REACTIVE APPROACH

Immediately following flood events public interest and local media attention regarding flooding is heightened, and political will for funding stormwater and flood mitigation works increases. There are strong incentives for councils to be seen to be responding to what has happened and the damage to private property. This provides an opportunity to obtain funding for projects which may be less popular in times of fair weather. Put another way, when there have been no recent flood events people forget that there is a risk, and there is little appetite to increase rates to provide large capital spend.

However, there is often time pressure associated with works following flood events, with public pressure to carry out remedial works as soon as possible, not necessarily taking a long term view. This can lead to focusing on mitigating the effects of the recent event, rather than considering all possible events and effects across the city or district. A storm of a similar return period, but with a different spatial or temporal pattern, may produce more severe flooding in other locations. In contrast, a more strategic risk based approach may result in focusing of mitigation works on different areas or issues.

Even if critical areas are identified and works are prioritised, achieving the council's design level of service may not be affordable across the city or district. A more comprehensive review of flood mitigation levels of service and affordability may result in different decisions.

Sudden increases in capital works can be a disadvantage in terms of securing adequate resources to design and construct the works. Conversely, an increased works programme may be an advantage if larger packages of work can be used to attract a wider range of tenderers and/or lower costs through economies of scale.

Additional expenditure on stormwater and flood mitigation works in response to an event also needs to be funded, requiring immediate increases in rates or borrowing to spread the cost over future years' rates.

4 ALTERNATIVE APPROACHES

4.1 GENERAL

Rapid hazard flood modelling, development of catchment management plans, and targeted 2D or 1D-2D coupled modelling can be used to develop understanding of existing system performance and flood risk.

Current levels of service for flood mitigation can be reviewed and the affordability of applying these levels of service across the city or district can be carefully considered, without the time pressures of responding to recent events. This can include considering lowering the return period of floor level protection or targeting flood hazard (depth x velocity) rather than flood level protection in existing development (brownfields) areas.

These investigations can be used to develop a prioritised long term programme of stormwater and flood mitigation works, with a set timeframe to meet an agreed level of service, in conjunction with other stormwater capital works (renewals/replacements, improvements and growth).

An example of an alternative approach, from Tauranga City Council, is described in section 4.3.

4.2 FUNDING

There are a number of approaches to funding stormwater and flood mitigation works including general rates, a city/district wide flood rate, flood or disaster reserve funds, and area specific rates or rating areas. This capital funding can be raised through current rates or loan funding. Any proposed changes to works programmes and funding needs to be considered against the relevant council's significance and engagement policy, and community consultation is likely to be required through the Long Term Plan (LTP) process.

4.3 TAURANGA CITY EXAMPLE

Tauranga experienced extensive flooding in 2005 and further flood events in 2011 and 2013. Following the 2005 and 2011 events, Tauranga City Council invested in a number of capital works projects and a 2D modelling programme.

Following the 2013 flood event, Council undertook a comprehensive review of its levels of service and affordability. It identified that protecting existing houses (i.e. in brownfields areas) from floor level flooding across the city in a 100 year event would have a significant capital cost, and would be difficult to justify in terms of prudent financial management. A number of level of service options were identified, advantages and disadvantages assessed and, using modelling results and extrapolation across the city, costs for each option were estimated. Following public consultation, a new "safety to persons" focused level of service was adopted by the Council through its 2015/25 LTP. This "safety to persons" focused level of service is based on identifying at risk properties which breach a depth x velocity threshold ($\geq$0.4 m²/s for residential and rural) within 8 m of habitable floors in a 100 year event.

The options considered by Tauranga, and corresponding 10 year capital cost estimates, are set out in Table 2. The capital costs associated with the "safety to persons" level of service approach are primarily property purchase and overflow flow path works.

Table 2: Tauranga City Level of Service Options and Capital Cost Estimate

Level of Service	**Estimated 10 Year Capital Cost (mid-point)**
"Safety to persons" in 10 year event	$105m*
No floor level flooding in 10 year event	$190m
No floor level flooding in 20 year event	$250m
No floor level flooding in 50 year event	$300m
No floor level flooding in 100 year event	$375m

* Extrapolated from first three years capital programme of $10.5m per year

In addition to this "safety to persons" level of service approach, Tauranga City has also established a $2m per annum Stormwater Reactive Reserve fund to support the

community in a variety of risk reduction methods and responses following future flood events.

5 CONCLUSION

There are a number of examples around the country (some illustrated here) of the trend of increased capital funding following flooding events, although this is not always the case. While flood events can provide the public and political appetite for expenditure on flood works, there are advantages to a planned, more proactive approach to managing stormwater and flood risk.

Ideally, strategic planning should be carried out to develop a long term programme of stormwater and flood mitigation works to meet an agreed and affordable level of service.

In Tauranga, a series of flood events over a number of years provided impetus for Tauranga City Council to take an alternative approach, and reconsider its level of service and affordability. This led to Tauranga City Council revising its levels of service and works programme.

Depending on other community needs, there may not be the public or political will for local councils to invest in stormwater and flood mitigation until there is a flood event. In this case, flood events may provide the opportunity to obtain funding for investigations and future planning, as well as for flood mitigation works.

ACKNOWLEDGEMENTS

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