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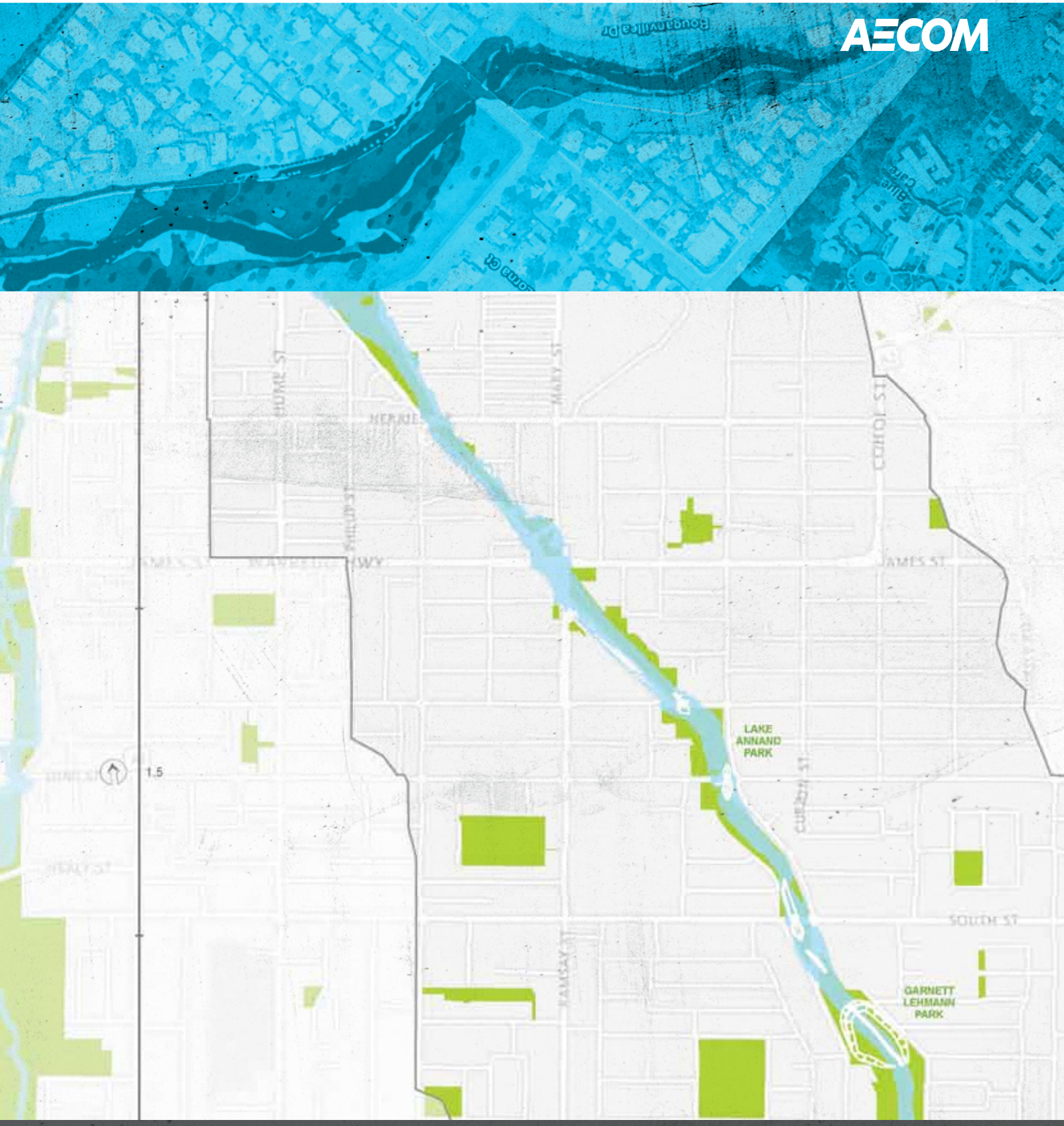
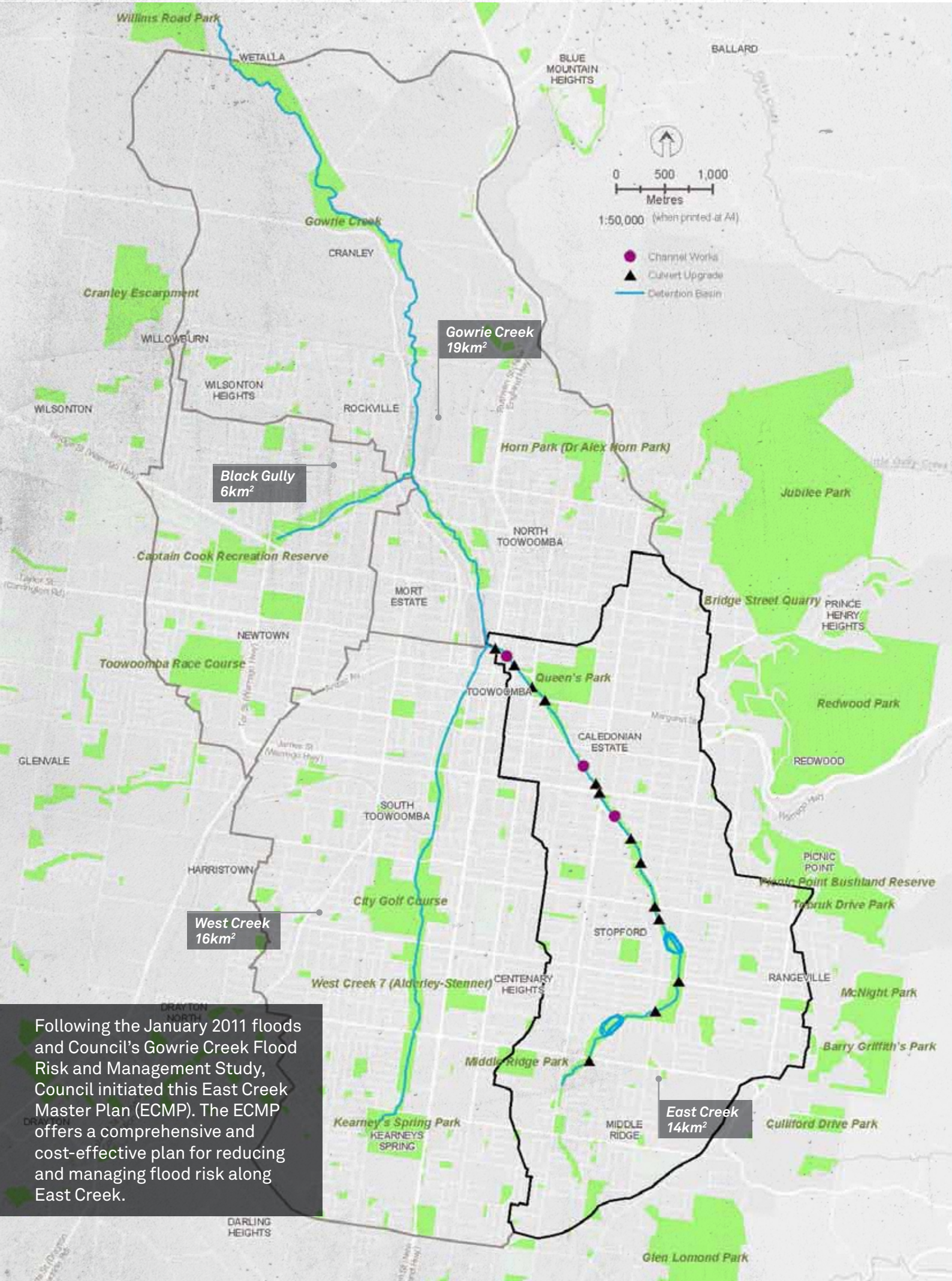


East Creek Masterplan

Executive Summary

Prepared for Toowoomba Regional Council | 17 December 2013



Following the January 2011 floods and Council's Gowrie Creek Flood Risk and Management Study, Council initiated this East Creek Master Plan (ECMP). The ECMP offers a comprehensive and cost-effective plan for reducing and managing flood risk along East Creek.

East Creek Masterplan

A plan for East Creek

In January 2011, Toowoomba experienced one of its worst floods in history, demonstrating the susceptibility of Toowoomba's creek-side urban areas and roads to flooding. Along East Creek, high-velocity, deep flooding damaged Central Business District (CBD) buildings, flooded every road crossing, limited emergency vehicle access, washed away parked vehicles, and at the James Street and Kitchener Street intersection caused two fatalities after washing a vehicle into the creek.

In response to the January 2011 floods, Toowoomba Regional Council (Council) commissioned the Gowrie Creek Flood Risk and Management Study (AECOM, 2012) (FRMS) to better understand flood risks along Gowrie Creek. The study demonstrated that the East Creek corridor and road crossings have at least a 10% to 20% chance or greater of flooding every year and that 43 buildings have a 1% chance or greater of flooding. This flooding is likely capable of washing pedestrians and vehicles into the creek and/or significantly damaging buildings and infrastructure.

Following the FRMS, Council initiated this East Creek Masterplan (ECMP). The ECMP offers a comprehensive and cost-effective plan for reducing and managing flood risk along East Creek, from the CBD to Stenner Street. The ECMP presents capital works, such as upgrading road crossings ,channels and new detention basins, along with opportunities for land acquisition and planning that can reduce the likelihood and consequences of flooding.

The ECMP has been developed to offer a range of key outcomes and clear, quantifiable value as follows:

OUTCOME	VALUE
Implementation plan	Assists Council in scheduling proposed works and provides rationale for specific works
Preliminary cost estimates	Assists Council in developing future capital works budgets and in applying for State and Federal funding opportunities
Flood maps	Clearly demonstrates the benefits of proposed works and ensures coordination with on-going capital works such as Council's Outer Circular Ring Road (OCR)
Executive Summary	Offers a clear, concise document to engage stakeholders and State and Federal authorities
Technical Report	Provides technical details to support decision making, engineering and planning

Masterplan Development

The ECMP represents Council's latest understanding of flood-related issues and opportunities along East Creek, which includes approximately 14km^2 of East Toowoomba from north of Stenner St to the CBD. The ECMP is based on a technical foundation of flood modelling and mapping, previous Council efforts and workshops with Council's engineering team. The following provides a brief summary of key steps in developing the ECMP and how these steps have provided a comprehensive, informed plan for managing flood-related issues along East Creek.

Flood modelling and mapping

Flood modelling was undertaken using Council's 2013 Gowrie Creek Flood Model previously developed as part of the FRMS. Modelling was performed to determine anticipated benefits of proposed works, refine those works based on their benefits and to ensure Council's on-going flood mitigation efforts in the CBD and West Creek were accounted for. Flood modelling results, such as depth, water surface elevation and hazard, were then mapped to visually demonstrate the benefits of proposed works and to refine designs.

Flood hazard maps were produced to show the physical impact flood waters are likely to have on people, property and infrastructure based on water depth and velocity. Reductions in flood hazard achieved through the proposed works was then used as a key metric in assessing their benefit. Flood depth maps were also produced and accompanied by water surface elevation contours to assist in the design process.

Incorporating previous efforts

Council's previous efforts to understand flooding and identify potential flood mitigation works were used to inform and develop the ECMP. As a result, the opportunities presented in the ECMP are consistent with Council objectives and expectations. These previous efforts include flood modelling and mapping and assessment of possible detention basins at Garnet Lehman and Ballin Drive parks.

Workshops

Workshops were held between Council's engineering team and AECOM to assess whether previously identified flood mitigation works were still preferred and to identify any new, potential works.

These workshops also provided an opportunity to confirm Council's objectives and key performance metrics for proposed works, such as reductions in flood hazard, increases in road crossing flood immunity and reductions in the number of buildings at risk of flooding.

Design

An iterative design process was adopted to develop planning-level designs based on Council preferences, site characteristics, hydraulic performance and associated benefits. These designs provide Council sufficient detail and confidence in making planning-level decisions, while further detailed designs can be initiated as needed.

Preliminary cost estimates

Preliminary capital works cost estimates were developed to support planning-level decisions, an implementation plan, capital works budgeting and future State and Federal funding applications.

Stakeholder engagement

Workshops and discussions were held with Council's Parks and Recreation, Water and Waste Services, the Department of Transport and Main Roads and other internal stakeholders to gain feedback on the proposed works and identify any major concerns prior to finalising the ECMP.

Reporting

Clearly communicating the purpose, value and outcomes of the ECMP was considered key to gaining stakeholder support and assisting with future implementation and planning. As such, this Executive Summary provides an overview of the ECMP for Council members, internal stakeholders, State and Federal funding authorities and others as desired.

A Technical Report was developed to provide Council's engineering team with detailed information, such as design and landscape sketches, cost breakdowns, flood maps and hydraulic reference data to support discussions, planning and detailed design.


Lorna Cl
Blue Gate Village Acces

Flood Issues

While the January 2011 floods represented one of the most extreme flood events in Toowoomba's history, it's well known that areas along East Creek are also susceptible to flooding during more frequent storms, such as a heavy afternoon rain. Flooding can quickly impact properties, people and roads adjacent to the creek due to its steep and shallow channel. The creek's large catchment, from southern Toowoomba to the CBD and from the Great Dividing Range to the historic 'Middle Ridge', can produce large amounts of runoff quickly. During January 2011 for example, flood waters rose rapidly within 1.5 to 2 hours, resulting in hazardous flooding at road crossings and roads adjacent to the creek, such as Mackenzie St, Chalk or Kitchener Street.

The following provides a summary of the types of issues flooding presents along East Creek, while additional detail on where these issues occur is provided in later maps. Understanding why these impacts occur and the risk they pose to people and property is key to making cost-effective decisions about how best to manage flooding along East Creek.

Flood hazard

The term "flood hazard" refers to the physical hazard flood waters present to people, property and infrastructure. The degree of hazard, from Low to Extreme, is based on the depth and velocity of the flood waters as shown below. Identifying the hazard flooding presents can help focus management efforts on minimising the risk to life and property.

LOW	- Self-evacuation for adults and children - Vehicle stability within tolerance of 4WD
SIGNIFICANT	- Working limit for trained safety workers - Vehicle evacuation unsuitable - Building code limitation
HIGH	- Limit of uncompromised stability for adults - Dangerous to most adults
EXTREME	- In excess of known stability limits

Flood hazard as obtained by the Queensland Reconstruction Authority.

The entire East Creek corridor and Kitchener St has at least a 10% chance every year of experiencing Extreme hazards. Other areas adjacent to the creek, such as Chalk Drive, Burstow St, Aberdeen St and Ballin Drive have between a 2% to 10% chance each year of experiencing hazardous flooding. Of greatest concern, when road crossings overtop, Significant to Extreme hazard flood waters will likely occur with the potential to wash cars into the creek.

Road crossings

There are 15 locations along East Creek where roads and/or pedestrian bridges cross the creek. While some of these culverts and bridges correspond to minor roads or pedestrian-ways, several are major roads or highways providing critical north-south and east-west connectivity. The majority of these 15 crossings have a 20% chance or greator of flooding each year and will likely experience hazardous conditions when overtopped, creating situations where vehicles and pedestrians could be washed into the creek. Reducing the likelihood and hazard of flooding at crossings, especially major roads, is key to reducing the risk to life and increasing the resilience of critical transport routes for regional, local and emergency access.

Roads and roundabouts

In addition to road crossings, there are areas along the creek where flood waters are likely to break out of the creek and flood adjacent roads and roundabouts. These situations have the potential to impact basic travel during flood events, reduce the effectiveness of disaster management and emergency evacuation, and present a risk to pedestrians. Areas include Chalk Dr, Kitchner St, Aberdeen St, and Ballin Dr, where every year there between a 2% to 10% chance of flooding. When flooding occurs, it is likely to present Low to Extreme hazards.

Buildings and property

When floods impact buildings they impact people's lives, property and businesses. Council also faces operational and financial risks when Council-owned buildings are flooded. While some of these impacts are non-tangible, such as the social impact of a primary residence flooding, the impacts to a building's structure and contents often have clear economic impacts. Combined, mitigating the potential impact to buildings represents real benefits for Council and the community.

There is approximately a 1% chance each year that 43 buildings will be at risk of flooding. These include single and multi-family residences, industrial areas, commercial offices and shops, and Council owned facilities. While 18 buildings may experience flooding adjacent to the building only, 25 are likely to experience flooding above the first floor. Of greatest concern, ten buildings have a 10% chance of flooding each year, while nine have a 10% chance of experiencing flooding adjacent to the building.

Flash flooding

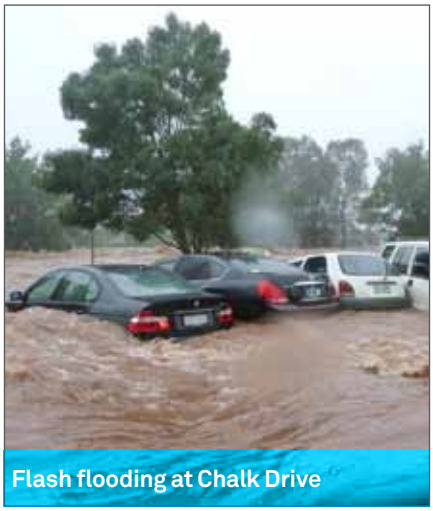
The term "flash flooding" refers to flooding that occurs within six hours of rainfall. As experienced in recent years, flash flooding can occur quickly and unexpectedly in Toowoomba. For example, the average time it takes for runoff to reach East Creek is 24 minutes due to steep slopes up to 6% and dense urban areas where rainfall cannot infiltrate into the ground.

An intense afternoon storm can produce flooding within an hour along East Creek, increasing the chances that people will be present in parks, businesses and residences adjacent to the creek. In addition, East Creek's shallow channel and low road crossings have limited capacity to convey runoff, resulting in frequent, severe flooding. Council is currently installing street warning lights and Council's emergency management staff has recognised that limited warning and response times may be available prior to flooding. In addition, Council currently operates early flood warning alert systems at Alderley St, South St and Long St and is investigating options to install systems at all major East Creek road crossings. Due to the additional risks that flash flooding presents along East Creek, it is even more important to reduce hazards when flooding does occur.

Car parks

Car parks located adjacent to the creek serve small businesses, parks and commercial areas. During large flood events, in addition to the damage that can occur to vehicles, parked vehicles may be washed into the creek and become lodged in culverts, increasing local flooding and requiring a significant clean-up effort. Car park flooding was a major issue in the January 2011 flooding, as documented through photographs and video.

Flood damage at confluence



Flash flooding at Chalk Drive

Flood damage at Russell St

Flood Management Opportunities

How can we manage our flood risk?

While East Creek's flood-related issues represent a significant challenge, a range of feasible, cost-effective opportunities exist that can reduce the likelihood and consequences of flooding. The following summarises the types of opportunities available to Council, developed in collaboration with Council's engineering team and based on previous studies, local knowledge and the latest flood modelling and mapping.

Culvert upgrades

Upgrading existing culverts at road crossings with larger and/or additional culverts can increase the capacity of road crossings to convey flood waters. This reduces the likelihood of overtopping during floods and the hazard when roads do overtop. The ECMP aims to reduce the chance of minor roads overtopping to at most 10% each year and for major roads at most 1% each year. In many cases these objectives have been exceeded, such that minor roads have at most a 1% chance of overtopping.

Channel works

Undertaking channel works to increase conveyance in the creek allows more flood waters to remain in the channel, reducing flooding adjacent to the creek. Channel works can also reduce the chance of road crossings overtopping, reduce erosion and subsequent maintenance, and incorporate social and environmental features.

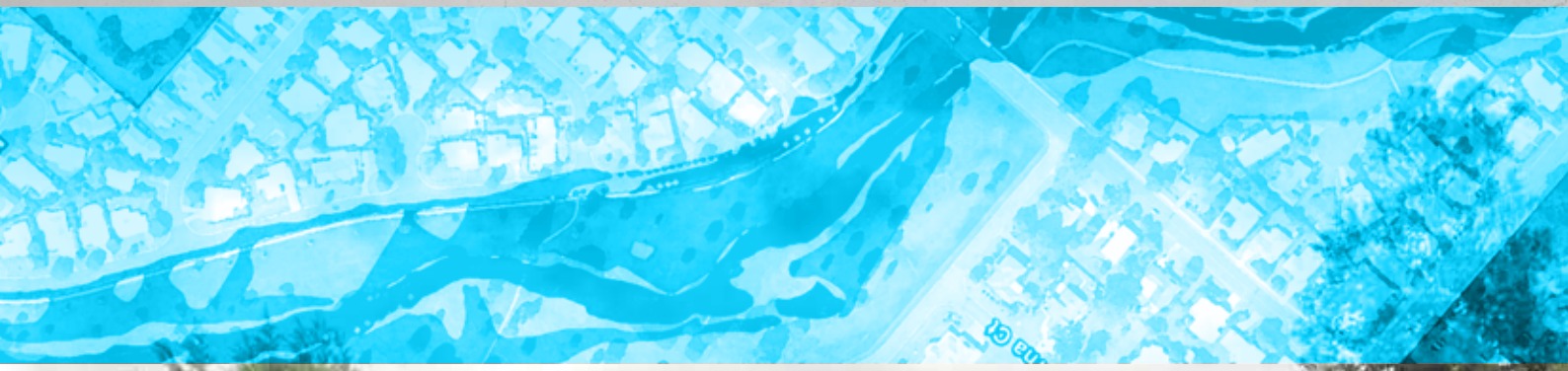
The ECMP proposes channel works from Perth St to Herries St and Neil St to Ruthven St, where every year there's a 10% chance of hazardous flooding along streets adjacent to the creek, such as Kitchener St and Chalk Dr.

Detention basins

Detention basins are critical to reducing the amount of water in the creek during a flood, which can reduce flooding and hazards downstream. They provide regional benefits by storing runoff during large floods and releasing it slowly after the flood. Balancing the size, location and configuration of detention basins is key to developing cost-effective designs while maximising benefits.

Due to the characteristics of East Creek, detention basins in the upper areas of the creek are critical to achieving 100 year immunity at road crossings and reducing hazardous flooding along creek banks, such as at Kitchener St.

While several detention basin options were considered, two smaller basins were proposed at Garnet Lehmann and Ballin Drive parks totalling 117 ML. These basins were selected through an options assessment conducted in consultation with Council's engineering team. The assessment considered the basins' ability to reduce flood hazard, mitigate properties, improve road immunity, minimise social and environmental impacts and maximise their cost-benefit.



Land acquisition

In areas where buildings are at risk of flooding, Council could also consider purchasing buildings and associated property. These assets could then be retained by Council to reduce flood risk and possibly provide community benefits such as bikeways, habitat or recreational green space along East Creek. Acquisitions could also be considered in place of or in tangent with proposed capital works; for instance, if an acquisition eliminated the need for a specific capital works or reduced the size of works to achieve the same benefits, this may present a more cost-effective approach.

Planning controls

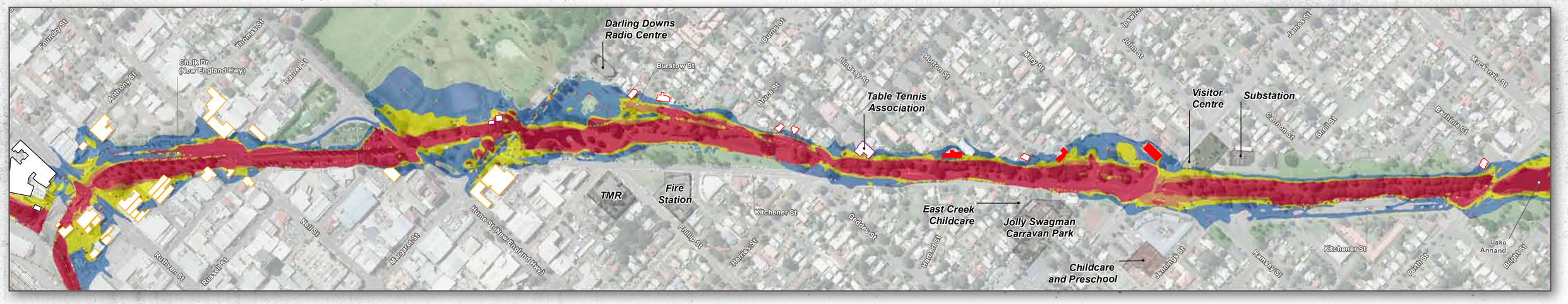
Opportunities exist to implement planning and development controls based on Council and State policy. Efforts should align with Council planning policy while incorporating the latest flood risk information from the FRMS and ECMP. These efforts could focus on addressing at-risk precincts such as the CBD and/or individual buildings and properties through long-term planning.

Ruthven to Perth

Flood Hazard (nominal 100 year)
Low · High · Current Conditions
Significant · Extreme · Buildings Mitigated

Buildings at Risk of Flooding
Residential, Multi-Family · Commercial · Public
Residential, Single Family · Industrial · Proposed Works

100 Year Current Flood Hazards (includes Council's proposed OCR and West Creek works)



Mitigated 100 Year Flood Hazards (Includes all masterplan works)

1

Ruthven St to Neil St proposed works

Ruthven St to Neil St **$5.49M**
Ruthven St and Neil St culverts upgraded and channel work performed to increase immunity from < 10 year to 20 year at Neil St, Ruthven St and 10 year at Chalk Dr. The proposed works also reduce 50 year and 100 year hazards at Ruthven St, Neil St & Chalk Dr and 10 year hazards in the CBD. Chalk Dr and Ruthven St will be accessible by 4WD during a 50 year event and Neil St during a 100 year event. Six buildings are also mitigated during a 100 year flood.

2 **Hume St** **$4.91M**
Hume St culverts upgraded to increase immunity from < 10 year to 100 year. Flooding is also reduced in Queen's Park.

3 **Margaret St** **$2.61M**
Margaret St culvert upgraded to increase immunity from < 10 year to 10 year and 4WD accessibility during a 50 year event. Hazards are also reduced at the Margaret St and Kitchener St roundabout and sidewalk.

Notes

4

Herries St to James St proposed works

Herries St to James St **$5.55M**
Channel works performed between Herries St and James St and the James St and Mary St culverts are upgraded to increase immunity from ≤ 50 year to 100 year. Seven buildings will also be mitigated during a 100 year flood, including three multi-family residences.

5

James St to Perth proposed works

James St to Perth St **$4.94M**
Channel works performed between James St and Perth St and the Perth St culvert is upgraded to increase immunity from < 5 year to 100 year, including along Kitchener St. Opportunities may also exist for park and water quality improvements in the creek. It should be noted that the Kitchener St immunity is achieved primarily due to proposed detention basins at Garnet Lehmann and Ballin Drive parks and the Perth St culvert upgrade.

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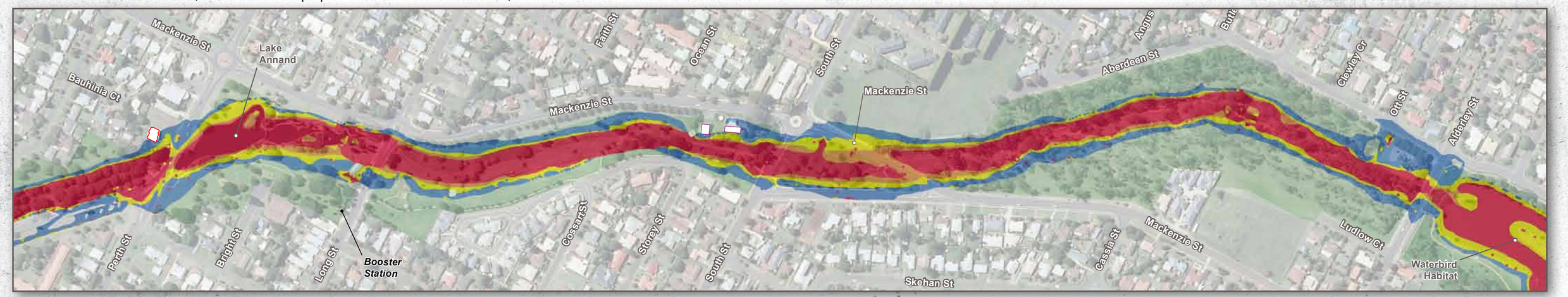
Perth to Alderley

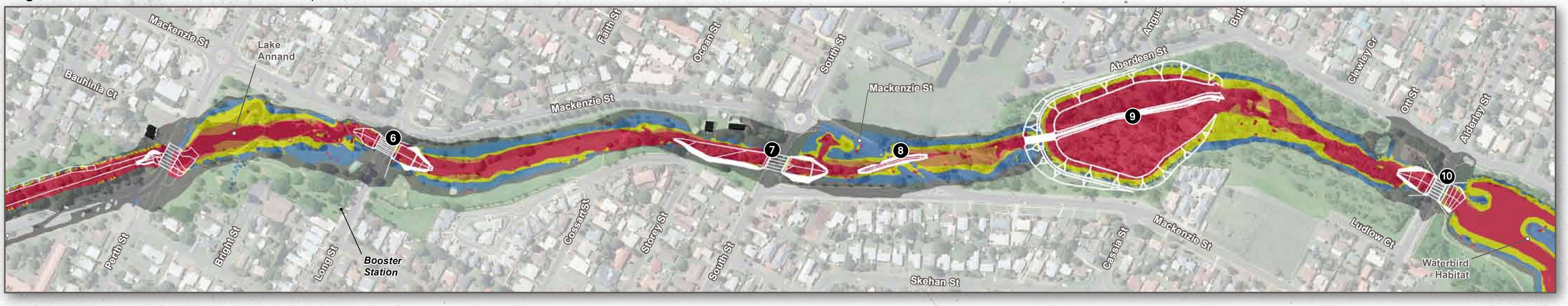
Flood Hazard (nominal 100 year)
Low · High · Current Conditions
Significant · Extreme · Buildings Mitigated

Buildings at Risk of Flooding
Residential, Multi-Family · Commercial · Public
Residential, Single Family · Industrial · Proposed Works

100 Year Current Flood Hazards (includes Council's proposed OCR and West Creek works)



Mitigated 100 Year Flood Hazards (Includes all masterplan works)



6 Long St $2.57M
Long St culvert upgraded to increase immunity at Long St and the Long St and Mackenzie St roundabout from < 5 year to 100 year.

7 South St $2.82M
South St culvert upgraded and channel works performed to increase immunity from < 5 year to 100 year at South St, the South St and Mackenzie St roundabout and throughout the channel. Hazards are also reduced along creek banks. Council's two buildings are also mitigated during a 100 year flood.

8 Mackenzie St near South St $0.76M
Mackenzie St is removed to eliminate flood risk to vehicles and to remove maintenance obligations.

Notes

9

Proposed detention basin at Garnet Lehmann Park

Garnet Lehmann Park $5.91M
Construction of a 75 ML detention basin in Garnet Lehmann Park to achieve immunity levels at road crossings and reduce hazards downstream. The basin is critical to achieving the benefits from Ruthven St to Mackenzie St and mitigates buildings during a 100 year flood. It also provides opportunities to implement social and environmental features within and surrounding the park as desired by Council.

10 Alderley St $2.48M
Alderley St culvert upgraded to increase immunity from < 5 year to 100 year, including along Aberdeen St.

Notes

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Alderley to Stenner

Flood Hazard (nominal 100 year)
Low · High · Current Conditions
Significant · Extreme · Buildings Mitigated

Buildings at Risk of Flooding
Residential, Multi-Family · Commercial · Public
Residential, Single Family · Industrial · Proposed Works

100 Year Current Flood Hazards (includes Council's proposed OCR and West Creek works)

Mitigated 100 Year Flood Hazards (Includes all masterplan works)

11 **Mackenzie St near Ballin Drive** **$1.56M**

Mackenzie St culvert upgraded to increase immunity from < 5 year to 100 year.

Notes

12

Proposed detention basin at Ballin Drive Park

Ballin Drive Park **$5.69M**

Construction of a 42 ML detention basin in Ballin Drive Park to achieve immunity levels at road crossings and reduce hazards downstream. The basin is critical to achieving benefits downstream to Mackenzie St in combination with the proposed Garnet Lehmann Park detention basin. The basin also helps mitigate buildings during a 100 year flood and provides opportunities to implement social and environmental features within and surrounding the park as desired by Council. Works also include channel works upstream of the Stenner St crossing to achieve 100 year immunity and prevent overflow into the basin.

Notes

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Prioritising Action

The ECMP provides a range of capital works that vary in benefits, cost and feasibility. Prioritising and planning for how best to implement works based on these criteria can assist in applying for State and Federal funding and developing Council's future capital works budget.

A brief, high-level cost-benefit analysis and implementation plan has been developed to highlight where immediate action should occur and to offer a plan for works to be implemented at a later date (see table). This plan was develop through workshops with Council staff with an emphasis on balancing the challenges of each measure, such as financial, environmental and coordination with the State, with the benefits, such as reducing flood risk to people, property and infrastructure and creating new multi-use public park space. This plan should be considered a guide to implementation, open to discussion and refinement based on future funding, feasibility and any refinements in design.

High priority

The proposed detention basins at Garnet Lehmann and Ballin Drive parks are considered to be of the greatest priority, primarily because they are critical to achieving the long-term, nominal 100 year benefits of the Masterplan and because State, Federal and Council funding may be available to support immediate construction. In addition, Council recently began works on the West Creek Clewley Park detention basin and has been working with the State on updating the regulatory status of other basins. Continuing now with efforts to design and construct two new detention basins ensures consistency and familiarity with the design, construction and permitting processes.

Medium priority

Of lower priority but of significant importance to reducing flood hazards and road crossing immunity are the proposed works from Herries St to Mackenzie St near South St. The majority of these efforts provide similar benefits at comparable costs, such as 100 year flood immunity at road crossings and areas adjacent to the creek. These could be further prioritised based on the need to achieve immunity at key local and regional routes, such as Ruthven St, Neil St, Humes St, Herries St and James St, and to reduce Extreme hazard flooding on streets adjacent to the creek, such as Chalk Dr and Kitchener St.

Low priority

The remaining works likely remain a lower priority since they do not represent critical transport routes or significantly reduce hazardous flooding in adjacent streets. However, they do offer clear benefits by reducing the public safety risk associated with roads overtopping. As such, they should be considered an important piece of comprehensively managing flood risk along all of East Creek.

Proposed Capital Works Implementation Plan (listed from higher to lower priority)

Priority	Location	Culvert	Channel	Detention	Est. Cost	Key Benefit(s)
HIGH	Ballin Drive Park		✓	✓	**$5.9M**	- Critical to achieving 100 year road immunities - Reduces hazards - Mitigates buildings - 100 year immunity at Stenner St, key local route in upper catchment
HIGH	Garnet Lehman Park			✓	**$5.6M**	- Critical to achieving 100 year road immunities - Reduces hazards - Mitigates buildings
MEDIUM	Herries to James	✓ ✓	✓		**$5.55M**	- 100 year immunity at Herries St and James St, key local and regional routes - 7 buildings mitigated, including 3 multi-family residences
MEDIUM	Ruthven to Neil	✓ ✓	✓		**$5.49M**	- Reduced flooding and hazard along Chalk Dr, Neil St, Ruthven St and in CBD - 6 buildings mitigated
MEDIUM	James to Perth	✓	✓		**$4.94M**	- 100 year immunity along Kitchner St (due mainly to Perth St and basins) - 100 year immunity at Perth St
MEDIUM	Hume	✓			**$4.91M**	- 100 year immunity at Humes St, a key regional transport route
MEDIUM	South	✓			**$2.82M**	- 100 year immunity at South St and roundabout, providing local access route South of James St - 2 Council buildings mitigated
MEDIUM	Mackenzie near South	✓			**$0.76M**	- Removes maintenance obligations and vehicular flood risk
LOW	Margaret	✓			**$2.61M**	- 10 year immunity and reduced hazard nearby
LOW	Alderley	✓			**$2.48M**	- 100 year immunity at Alderley St and along Aberdeen St
LOW	Mackenzie near Ballin Drive	✓			**$1.56M**	- 100 year immunity at Mackenzie St
LOW	Long	✓			**$2.57M**	- 100 year immunity at Long St and roundabout

A Plan for East Creek

The ECMP offers a comprehensive and cost-effective plan for reducing and managing flood risk along East Creek, from the CBD to Stenner St. The ECMP presents capital works, such as upgrading road crossings, improving channels and constructing detention basins, along with ideas for land acquisition and planning that can reduce the likelihood and consequences of flooding. These proposed works, taken as a whole, are anticipated to provide the following benefits.

Roads

Throughout East Creek, the chance of roadways flooding is anticipated to decrease from 10% or 20% to less than 1% each year. The areas from Margaret St to Ruthven St will likely have a 5% to 10% chance of flooding each year, although these areas are anticipated to be accessible via 4WD during a nominal 50 year flood event. The following summarises the anticipated increase in road immunity and 4WD* accessibility during floods.

Increases in road immunity and 4WD access (nominal ARI)

	IMMUNITY	4WD ACCESS
Margaret St	10 year	50 year
Chalk Dr	10 year	50 year
Ruthven St	20 year	50 year
Neil St	20 year	100 year
All others	100 year	Between 100 - 500 year

Hazards

When floods do occur along East Creek, the hazards they present to people, property and infrastructure is anticipated to be significantly reduced. At Kitchener St, for example, the chance of Extreme hazard flooding occurring has been reduced from 10% to less than 1% each year. The degree of hazard has also been reduced through all of East Creek, most notable at Ruthven St, Neil St, Chalk Dr and the CBD.

Buildings

There is a 1% chance each year that 43 buildings will be at risk of flooding, including 26 commercial, nine residential, six public and two industrial buildings. The ECMP would reduce the number of buildings at risk of flooding by reducing the depth and extent of flood waters as follows.

Number of buildings mitigated (nominal ARI)

	10 YEAR	50 YEAR	100 YEAR
Current	19	38	43
Masterplan	9	16	24
Mitigated	10	22	19

**Based on Queensland Reconstruction Authority definition.*

To achieve the above benefits, an anticipated $45.29M of capital works is required as outlined below. This is based on a preliminary, planning-level cost estimate that includes anticipated design and construction costs.

Preliminary capital works cost estimates:

Culverts & Channels	$33.69M
Detention Basins*	$11.6M
TOTAL	**$45.29M**

*Includes channel works at Stenner St, associated with Ballin Drive detention basin.

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