

Draft Stormwater Management Plan - West Torrens Drainage Catchments

Overview 2022

August 2022



CITY OF WEST TORRENS

Copyright

This document is based on research by staff of the City of West Torrens and other authors as cited. Apart from any permitted uses under the *Copyright Act 1968*, the work may be reproduced for study or training purposes, provided the source is acknowledged. Reproduction for commercial use requires prior written permission from the City of West Torrens and the various sources cited.

Access to document

This document has been prepared by the City of West Torrens. You may access copies of this document from Council's website, westtorrens.sa.gov.au. You may download and print this document in unaltered form, only for your personal use or use by your organisation.

Disclaimer

While reasonable efforts have been made to ensure that the contents of this document are factually correct, the City of West Torrens does not accept responsibility for its accuracy or currency. As information is subject to change, the City of West Torrens shall not be liable for any loss or damage that may occur through the use of, or reliance on, the contents of this document.

Production acknowledgment

This document was produced by the City of West Torrens, with assistance from members of the West Torrens community who contributed during public consultation.

Kaurna Acknowledgement

The City of West Torrens is located on the Traditional Homelands of the Kaurna Nation of People, the first Traditional Owners and Custodians of the Adelaide Region.

It is important to recognise that, while colonisation has resulted in the dispossession and dislocation of the Kaurna Meyunna, their Spiritual, Cultural Heritage and relationship with their Country is enduring. Kaurna's Connection and obligation to their Ancestral Lands the (Yarta) is still as important to the living Kaurna people today. The Kaurna people have lived on their lands for more than 50,000 years and developed strong and enduring spiritual, social, economic and governance systems that are still relevant for Aboriginal Title and are recognised within the 1836 Letters Patent.

Contents

Purpose.....	6
Definitions	7
Strategic alignment.....	8
Our city and community.....	10
What is Stormwater	11
What is a Stormwater Management Plan.....	11
Preparation of this Stormwater Management Plan.....	12
Goals for the Stormwater Management Plan.....	12
Characteristics of the catchment	13
Emerging issues for stormwater management.....	15
Issues affecting system capacity and performance	15
Water quality.....	16
Stormwater harvest and reuse.....	17
Flooding hotspots	18
Proposed stormwater management strategies	22
Flood mitigation	22
Non-structural flood mitigation measures	29
Water quality and water sensitive urban design	30
Stormwater harvesting and reuse opportunities	31
Cost estimates	32
Budget and rates impacts	33
Priorities and timeframes.....	33
Consultation on this Plan	33
Implementation and reporting.....	34
Summary of proposed stormwater management measures.....	35
Stormwater Management Plan Objective Review.....	40

Document history

Version
1.0

Date
9 August 2022

Details
Draft for consultation

Message from the Mayor

West Torrens is a great place to live, work, learn and play as it is conveniently located between Adelaide's Central Business District (CBD) and the coastline.

Consequently, we have seen a growth in population accompanied by substantial economic growth, and the fact that we are home to our state's international airport and interstate rail services means that most visitors and tourists arrive and depart Adelaide through West Torrens.

West Torrens is also experiencing increasing infill development and, as a result, this is creating greater demand for our services and amenities, including our infrastructure. Infill housing also means that during rainfall events, more water is channelled from numerous roofs into our streets, gutters, onto roads and footpath pavements and, ultimately, into our stormwater systems. As such, it's important that our stormwater systems are able to accommodate this increasing demand, now and into the future. Changes to our climate also predicts that rainfall patterns will alter and that this will affect our stormwater volumes and flows. All of these factors combined put a strain on our network to effectively manage anticipated stormwater.

To help prepare for future community growth, a changing climate and to meet the evolving needs of our community, Council has developed this draft Stormwater Management Plan for the local drainage network. It outlines an integrated management framework for local drainage systems and includes both structural and non-structural solutions designed to reduce the risk of flooding. It also includes strategies to improve water quality, downstream ecosystems and opportunities for water reuse, which will help support roadside vegetation and ameliorate urban heat.

The anticipated social benefits of improved stormwater management include better public safety and property protection, continuity of community services, reduced nuisance flooding and road closures. There will also be economic benefits resulting from less disruption to business trade and transport routes and less financial outlay and insurance claims associated with flood damage.

I am pleased to present this Stormwater Management Plan as a framework to integrate development, land use and infrastructure planning in the catchment, thereby fostering environmental, social and economically sustainable outcomes.

Michael S. Coxon

Mayor, City of West Torrens



Purpose

This document presents an overview of the draft 'Stormwater Management Plan - West Torrens Drainage Catchments' (the Plan) for consultation purposes. It aims to convey the range of issues and the proposed management strategies in an easy reading format to enable people to understand the issues, the proposed works and to provide feedback.

A more comprehensive and technical analysis can be found in the full draft 'Stormwater Management Plan - West Torrens Drainage Catchments' document which will be available on Council's website during community consultation.

The Plan provides the framework for a coordinated and multi-objective approach to the management of stormwater on a catchment wide basis.

The Plan focuses on the analysis and operation of the majority of the local drainage network in West Torrens. Based on the catchment based approach of a SMP process small portions of the City of Adelaide and the City of Charles Sturt were included in the study where they contribute stormwater runoff to West Torrens systems.

The stormwater catchments within West Torrens which discharge into the Sturt River have not been included within this project, as they are being considered within a similar SMP project being undertaken in conjunction with neighbouring Councils who share many of these systems. This excluded area represents about 10% of the total area of our city.

It is also important to note that this study does not directly analyse or consider the performance of the major creeks or waterways which border or cut through the West Torrens area (ie River Torrens, Brown Hill Creek, Keswick Creek, Sturt River and Patawalonga Lake).

These major systems require separate consideration and may have mitigations requirements and flood risks which overlap with elements of this Plan. As example, the approved SMP for the Brown Hill and Keswick Creeks systems is currently seeing the implementing of multiple packages of mitigation works across the catchments of these creeks. This will include major works with West Torrens, works which will not direct impact on the outcomes or recommendations of this SMP.

It is intended that the Plan be used to integrate development, land use and infrastructure planning in the catchment, and foster environmental, social and economically sustainable outcomes, while also serving as a support tool for funding submissions, and be used as the basis for developing budgets for implementation of recommended works.

The purpose of the stormwater management plan is to:

- Identify stormwater management objectives
- Describe existing and future stormwater issues
- Inform drainage requirements to cater for infill development and climate change
- Develop measures/actions to manage stormwater and flooding, improve water quality and explore any reuse options
- Provide an estimate costs and benefits of implementing the actions
- Identify actions eligible for funding assistance

In doing so, the plan provides Council with a consistent, environmentally aware and integrated approach to stormwater management for the majority of its local drainage systems.

Definitions

AAD	- Average Annual Damages
AEP	- Annual Exceedance Probability
ARI	- Average Recurrence Interval
EY	- Exceedances per Year
LGA	- Local Government Association of South Australia
MAR	- Managed Aquifer Recharge
SMA	- Stormwater Management Authority
SMP	- Stormwater Management Plan
Southfront	- Specialist Engineering Consultants engaged by Council to undertake the SMP
WSUD	- Water Sensitive Urban Design

Strategic alignment

Our community has expressed its desire to live and work in a city that embraces diversity, is safe, engaged and active with functional and sustainable natural assets and a thriving business environment.

Council's Community Plan 2030 reflects our community's vision for 'West Torrens - committed to being the best place to live, work and enjoy life'.

Our Vision

Committed to being the best place to live, work and enjoy life

The five focus areas for the delivery of our vision are:



We support diversity, health and well-being, community cohesion and connections, and create opportunities to learn and enjoy the local area.

We ensure housing, urban development and infrastructure contribute to attractive and safe neighbourhoods, and how we travel in and beyond our area.



Council ensures its services lead to quality outcomes and exceptional experiences for our community.

We protect and conserve the natural environment, reuse and recycle resources, support biodiversity and respond to climate change.



We support jobs, businesses and industries to generate local economic growth and activity.

This Strategy has linkages with key plans, policies and legislative frameworks:

Council -

The City of West Torrens 'Community Plan 2030' - Council's lead document in its suite of strategic management plans.

Asset Management Plans - Council's suite of Asset Management Plans includes a plan for 'Stormwater'.

Community Land Management Plans - Council's suite of Community Land Management Plans includes a plan for 'Drainage Lands'.

Council's financial management plans.

Open Space Plan - highlights the importance of creating a greener and cooler movement network.

Public Realm Design Manual - supports integrated, safe and appealing neighbourhoods and presents a range of Water Sensitive Urban Design (WSUD) techniques.

Adaptwest Climate Change Adaptation Plan - aims to build resilience and respond positively to the challenges of a changing climate across the western Adelaide region, such as cooling urban heat.

State Government -

Local Government Act 1999 - includes general stormwater management functions of local councils.

Environment Protection Act 1993 - administered by the SA Environment Protection Authority, responsible for the control of stormwater pollution.

Environmental Protection (Water Quality) Policy (2015) - addresses issues in relation to 'environmental harm' and general environmental duty.

Planning, Development and Infrastructure Act 2016 - a new planning and development scheme that replaced the previous scheme operating under the Development Act 1993.

Landscape South Australia Act 2019 - provides for natural resources protection, including the management and allocation of water resources.

Green Adelaide - established under Landscape South Australia Act 2019, is focused on urban environmental issues and is a key stakeholder in developing this Stormwater Management Plan.

30-Year Plan for Greater Adelaide - sets out how Adelaide will grow and become more liveable, competitive and sustainable over the next 30 years, with policies and targets to measure progress.

State Planning Policies (SPPs) - sets out objectives and policies for climate ready development; coast and marine protection; water security (including WSUD principles); and natural hazards resilience.

Planning and Design Code - the rule book for planning and development in SA, replacing Council development plans.

State Government's 'WSUD – Creating more liveable and water sensitive cities in South Australia' - sets out the overall aim, objectives, principles, targets and implementation actions for WSUD.

Stormwater Pollution Prevention Codes of Practice - aims to prevent stormwater pollution.

Our city and community

West Torrens comprises 37 square kilometres of Adelaide's western metropolitan area and is situated between the Adelaide Central Business District (CBD) and Gulf St Vincent. As a result, its location makes it a sought after place to live and work.

The region, its plants, animals and waterways, including the River Torrens (Karrawirra Pari) have continuing cultural and spiritual significance to Kaurna people. The river is not only a special place for Kaurna, but is also valued for its natural landscape appeal, biodiversity and open space and recreation activities.

West Torrens has a strong European heritage significance, which played a key role in establishing the Colony of South Australia.

Almost 62,000 residents live in West Torrens and the need for residential properties increases each year. The influx of people to our city means that the need for services and amenities are always changing and, as a result, a large portion of Council's annual budget is earmarked for upgrades and maintenance, as well as the development of new infrastructure and provision of services.

Existing land use across the study area for the Plan is predominantly residential, with other land uses including commercial and industrial land uses. The topographic landscape is relatively flat, with a general gradient to the west, and some low lying land that can be prone to flooding issues.

West Torrens is in a state of population growth, economic change and experiencing a high level of urban infill development activity, and redevelopment of significant land parcels with new housing construction, roads and shopping facilities. These changes bring many opportunities, however, land division, urban development and larger development footprints are replacing garden spaces with more hard impervious surfaces, leading to more runoff and placing the stormwater system under increased pressure.

Construction of the underground stormwater drainage system in the study area began in the 1930s, and has been added on to since then. It now comprises of a network of approximately 165 km of stormwater pipes, associated stormwater infrastructure, open channels, pump stations and detention basins. There are also constructed detention basins/wetlands, gross pollutant traps, streetscape raingardens and infiltration wells which help slow down flows and improve water quality, whilst also serving as a source of water of water infiltration and passive water supply for plants and landscapes.

West Torrens is currently at risk of, and experiences, flooding from time to time. Some flooding is fairly minor in nature and is more of a nuisance consideration, while other events can cause more serious implications to people, property and businesses.

What is Stormwater

Urban stormwater is rainwater that falls onto surfaces such as roofs, roads and footpaths and then flows away from where it originally fell. Due to the impervious nature of these surfaces the rainwater cannot soak into the ground and instead it is ideally carried away through a network of roads, drains and pipes to receiving systems of waterways, creeks and rivers, usually ending up in the ocean.

Historical stormwater management has focused on the needs to managed excess stormwater flow rates and quantities which can cause flooding, especially if it is a large rainfall event. Over time stormwater management practices have become equally concerned with the quality of stormwater runoff and the removal of pollutants which can be harmful to the environment, and the community's amenity and economic enjoyment of these environments.

Although it is now common practice to consider stormwater management and underground drainage infrastructure in the development of new suburbs and major land divisions, this was not as common during the original establishment of some areas of West Torrens. As such some area of West Torrens will be serviced by stormwater drainage systems which do not perform to current ideals and expectations.

As the practices and processes for the management of urban stormwater flows matured through the 1950s and 1960s, the idealistic principles of the 'major and minor stormwater' system approach were advanced.

This approach outlines a stormwater network design that utilises the stormwater inlet placement and spacing, in conjunction with the underground pipe networks to predominantly be designed and sized to provide safety and convenience to pedestrians and vehicles during frequent or nuisance stormwater flows - being the minor system.

The major system then becomes the designed and controlled utilisation of roadway corridors and allocated land corridors to safely transport overland movement of stormwater flows exceeding the capacity of the minor system, during predominately larger storm events, in a manner which protects properties and critical infrastructure from inundation and flooding.

What is a Stormwater Management Plan

A stormwater management plan (SMP) is a strategic planning document that aims to help alleviate the risk of flooding to provide an acceptable level of protection, and also serves to seek opportunities to improve water quality and ecosystem health, reuse stormwater, identify any recreational uses and enhance amenity.

In South Australia, responsibility for stormwater management is shared between the state government, local government and private landowners. Reflecting this shared responsibility, the South Australian Government and the Local Government Association (LGA) of South Australia have partnered in the formation of the Stormwater Management Authority (SMA). The SMA drives an integrated approach to urban stormwater water management in collaboration with key stakeholders, so that they maximise social, environmental and economic outcomes.

To achieve a consistent and holistic approach to stormwater management planning across the state, Stormwater Management Planning Guidelines have been issued by the SMA.

Preparation of this Stormwater Management Plan

The preparation of the Plan has been jointly funded by the City of West Torrens, the SMA and Green Adelaide, and follows the SMA's Stormwater Management Planning Guidelines.

Council engaged specialist consultants at Southfront to develop the Plan, in collaboration with staff at the City of West Torrens. In addition to Council staff, the Plan has been prepared in consultation with technical advisors for the SMA, staff at Green Adelaide, and staff from the City of Adelaide and the City of Charles Sturt.

Council regularly receives feedback and ideas from the community on what matters most to them and how well we are providing service, and this has been a source of valuable information for preparing the Plan. Stormwater, flooding, and coastal/waterway health are importance issues raised by the community.

The likely future urban development has been considered in developing the Plan. Infill development leads to an increase in impervious areas resulting in more runoff and peak flow rates. This puts strain on existing stormwater systems.

The impacts of climate change have also been considered in the development of the Plan. Climate change is projected to increase the frequency and severity of storm events and alter rainfall patterns. As a result, flooding patterns are predicated to change.

Technical studies for this Plan have included:

- Climate change projections and urban development scenarios to examine and determine flood risk.
- Computerised modelling and mapping has been used to assess the performance of the drainage system and enable flood mapping.
- Future flood risk maps help inform the likely extent and depth of flooding, water quality and stormwater reuse opportunities.

Goals for the Stormwater Management Plan

The goals for stormwater management are listed below:

- Flood protection
- Improve water quality
- Harvest and use stormwater runoff
- Maintain a healthy ecosystem
- Sustainable stormwater management and maintenance
- Desirable planning outcomes for new development and management of open space, recreation, and amenity
- Effective community engagement and education on stormwater practices and risks

Characteristics of the catchment

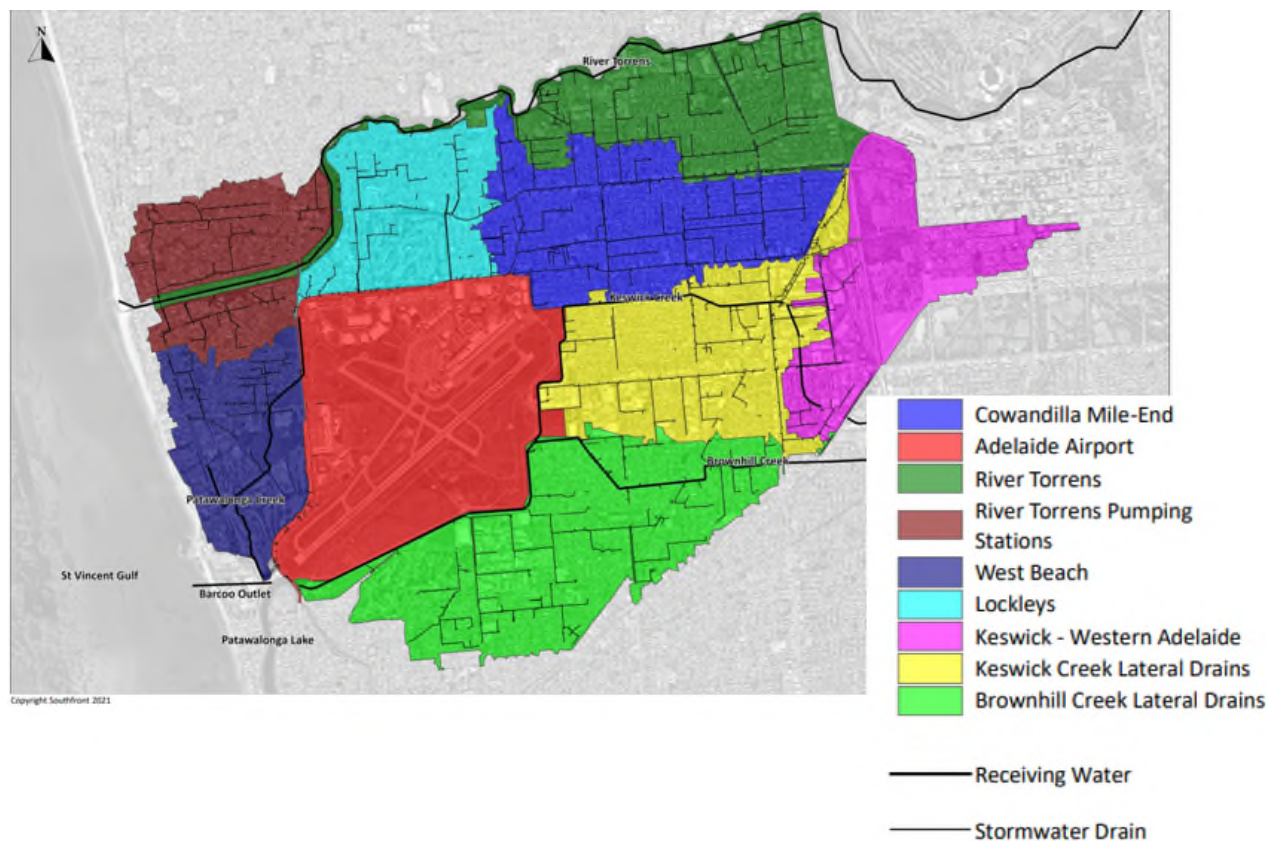
The Plan focuses on the majority of the local drainage networks in West Torrens, and also includes small portions of the City of Adelaide and the City of Charles Sturt.

Local systems with the City of West Torrens which drain to the Sturt River (representing about 10% of the Council area) are being considered as part of a separate SMP project and hence have not been included within the Plan. It is also important to note that the Plan does not directly consider the major creeks or waterways which border or cut through the West Torrens area, this includes the River Torrens, Brown Hill Creek, Keswick Creek, Sturt River and Patawalonga Lake.

The study area, also known as the catchment area for the Plan, has been grouped into nine different drainage sub-catchments, which discharge into different receiving water bodies, before ultimately entering the Gulf St Vincent, as listed below:

1. Cowandilla Mile End Scheme (discharges into Patawalonga Creek)
2. Airport (discharges into Patawalonga Creek)
3. River Torrens sub-catchment (discharges into River Torrens)
4. River Torrens Pumping Stations (discharges into River Torrens)
5. Lockleys (discharges into Patawalonga Creek)
6. West Beach (discharges into Patawalonga Creek)
7. Keswick – Western Adelaide (discharges into Keswick Creek)
8. Keswick Creek Lateral Drains (discharges into Keswick Creek)
9. Brown Hill Creek Lateral Drains (discharges into Brown Hill Creek)

Study area



The sub-catchments are used to distinguish the different costs, damages and benefits of the multiple drainage and water quality strategies proposed. The boundaries of the study area and these drainage catchments are shown on the 'Study area' map on Page 13.

The majority of the local drainage networks within this study direct stormwater via the street drainage systems to receiving drainage channels and watercourses such as Keswick Creek, Brown Hill Creek, Cowandilla-Mile End outfall channel, Adelaide Airport channel, and Patawalonga Creek. All of these systems ultimately flowing to the Patawalonga Lake and through the Barcoo Outlet to the Gulf St Vincent.

A small amount of the northern parts of West Torrens and the study catchments have local drainage networks which discharge into the River Torrens before entering the Gulf St Vincent.

Although West Torrens is a semi-coastal Council, there are now stormwater systems within this study which discharge directly to the Gulf St Vincent.

Previously undertaken major flood mitigation works on the lower sections of the River Torrens and the Sturt River have elevated the banks of these rivers higher than the adjacent suburban areas. As a result, many of the stormwater systems within this Plan which discharge into these rivers (in Fulham, West Beach and Glenelg North) are also reliant on pump stations and buffer stormwater storages to manage larger flows or discharge of local stormwater during high river flow events.



Emerging issues for stormwater management

The Plan aims to address emerging issues and to continually improve upon our network and services.

Issues affecting system capacity and performance

A number of issues have emerged that are progressively reducing the performance of the stormwater network. These include:

- Aging infrastructure - The age of the stormwater system varies throughout West Torrens, and aging stormwater infrastructure has implications for drainage performance. Further information on asset condition and age profile of the system is provided in the West Torrens Stormwater Asset Management Plan, available on Council's website - <https://www.westtorrens.sa.gov.au/files/sharedassets/public/objective-digitalpublications/external-website/management-plans/cwt-stormwater-asset-management-plan-2021.pdf>
- Capacity of the system - In the eras when many of our suburbs were established, the original combination of underground stormwater system and surface movement of excess stormwater flows was not considered to cater for flood risk and stormwater flows to the same degree or standards which are currently considered appropriate. Therefore there is a mix of pipe capacities (and surface overflow abilities) across the study area, with some having greater capacity to manage larger flows and floods than others.
- Increasing density of development - New infill land division and development typically have greater proportions of impervious site coverage (roofs and surface paving). As a result these sites are generating much more stormwater runoff than would have previously occurred. Substantial further development of this nature is projected to occur within the study area, typical of the trend occurring across much of greater metropolitan Adelaide.

Many areas in the study are already vulnerable in larger flood events and the increase in stormwater runoff volume and peak rates from infill development poses a further risk to the network's carrying capacity and heightens the risk of flooding. The performance of the stormwater networks in the study area have been examined in the Plan to determine their effectiveness under future development scenarios.

- Climate change - An increase in rainfall intensity is anticipated, leading to an increase in flood risk. Several climate scenarios have been adopted to assess the performance of the existing stormwater network and proposed upgrade strategies, as well as a range of likely urban development scenarios.
- Environmental opportunities - Developing this Plan also explored opportunities to harvest and use stormwater, such as for irrigation, to alleviate mains water supplies which may be affected from overall drier conditions as a result of climate change. These opportunities can have the added benefit of removing some stormwater runoff from the system, or at least slowing the rate of stormwater runoff from portions of a catchment.

Water quality

The health of downstream waterbodies and the Gulf St Vincent is an important aspect of stormwater management. There is a range of water quality features in the study area that help to enhance the quality of stormwater, such as constructed wetlands, gross pollutant traps, streetscape raingardens and tree infiltration wells. These provide a stormwater filtering function as well as enhancing the local visual amenity via greening.

Opportunities to enhance water quality to reduce pollutants from West Torrens, and the study area, from entering downstream water bodies has been examined in developing the Plan.

It is noted that West Torrens Council has, for around the last decade, been one of the most prolific adopters of retrofitting WSUD measures within established urban areas. This has primarily been achieved through the inclusion of raingardens within programmed drainage and road reconstruction works.



Stormwater harvest and reuse

Stormwater is considered to be a valuable resource and so opportunities to capture and reuse stormwater have been explored during development of the Plan.

There are two major existing Managed Aquifer Recharge (MAR) schemes within the study area located at the Adelaide Airport and Glenelg Golf Club. Both draw water from Brown Hill Creek and are privately operated, with no direct relationship to Council.

West Torrens does operate some other smaller scale existing storage and reuse schemes in within the study area including:

- Holland Street Plaza raingarden harvest, storage and irrigation system
- Streeters Road / Gardner Street raingarden harvest, storage and irrigation system
- Thebarton oval wetland and MAR (small scale) and use system

There are also many raingardens and other streetscape stormwater soakage and use installations across West Torrens, offering passive irrigation to roadside vegetation, reducing stormwater flows in minor events and reducing the need for piped irrigation.

Developing this Plan has explored opportunities to harvest and use stormwater, such as for irrigation, to alleviate mains water supplies which may be affected from overall drier conditions as a result of climate change.



Flooding hotspots

Development of the Plan has involved the preparation of floodplain maps which show current and predicted future risks from flooding for a range of storm events. These have factored in the effect of future urban development and climate change conditions.

Floodplain mapping based on the current stormwater networks, rainfall patterns and developed condition of the catchments demonstrated that there is an existing risk, of reasonable scale, to the community from stormwater flooding.

In relation to future urban development, a detailed assessment of the current urban planning context and future development potential was undertaken by specialist consultants Infraplan to appropriately inform the development of this Plan. Future development impacts have been closely aligned with the State Government's 30 year plan for Greater Adelaide 2016.

The impacts of future urban development are considered to be the single greatest contributing factor to the projected increase in future stormwater flows and flood risk (above existing levels) over the study area.

The impacts of climate change are anticipated to result in changes in rainfall patterns and intensity. The assumed climate future outlook taken was predictions to the year 2090, which indicates lower annual rainfall, increase in rainfall intensity, higher temperatures, with much drier conditions by then. This climate future is anticipated to result in increased peak stormwater flows, flood risk and change the availability profile for when stormwater can be harvested and use.

Floodplain mapping for the Plan shows that future development and climate change scenarios resulted in larger flood extents and depths, as would be expected. The floodplain mapping identifies flood prone areas across the width and breadth of the study area, from smaller storm events through to larger storm events.

Based on the existing stormwater networks across the study area and including allowances for projected future impacts of development and climate changes, the following table outlines the number of properties anticipated to be impacted by 'over floor' flooding for different scale storm events (the catchments referenced in the below table align with the 'Study area' map on page 13) -

Properties inundated

Catchment	Number of properties inundated EY = Exceedances per year AEP = Annual Exceedance Probability		
	0.2 EY flood (1 in 5 year)	5% AEP flood (1 in 20 year)	1% AEP flood (1 in 100 year)
West Beach	3	19	50
River Torrens Pumping Station	44	107	233
Lockleys	18	83	234
River Torrens	27	72	189
Cowandilla Mile End	46	367	1,022
Keswick Creek Lateral Drains	133	297	588
Keswick - Western Adelaide	2	12	20
Brown Hill Creek Lateral Drains	102	194	390
Adelaide Airport	0	1	9
Total	375	1,152	2,735

Based on a scale and distribution of impact similar to that outlined in the above table, the Plan considers the anticipated direct community damages cost which could occur from various storm events across the study area, with the value for such ranging from \$31.5 million for a 0.2 EY flood event (1 in 5 year flood) through to \$160.3 million for a 1% AEP flood event (1 in 100 year flood).

With consideration of the likely impact of flooding and associated damages across a spectrum of storm events, the following table represents the anticipated Average Annual Damages (AAD) of direct flood damages to community in each of the catchments in the study area.

Damages

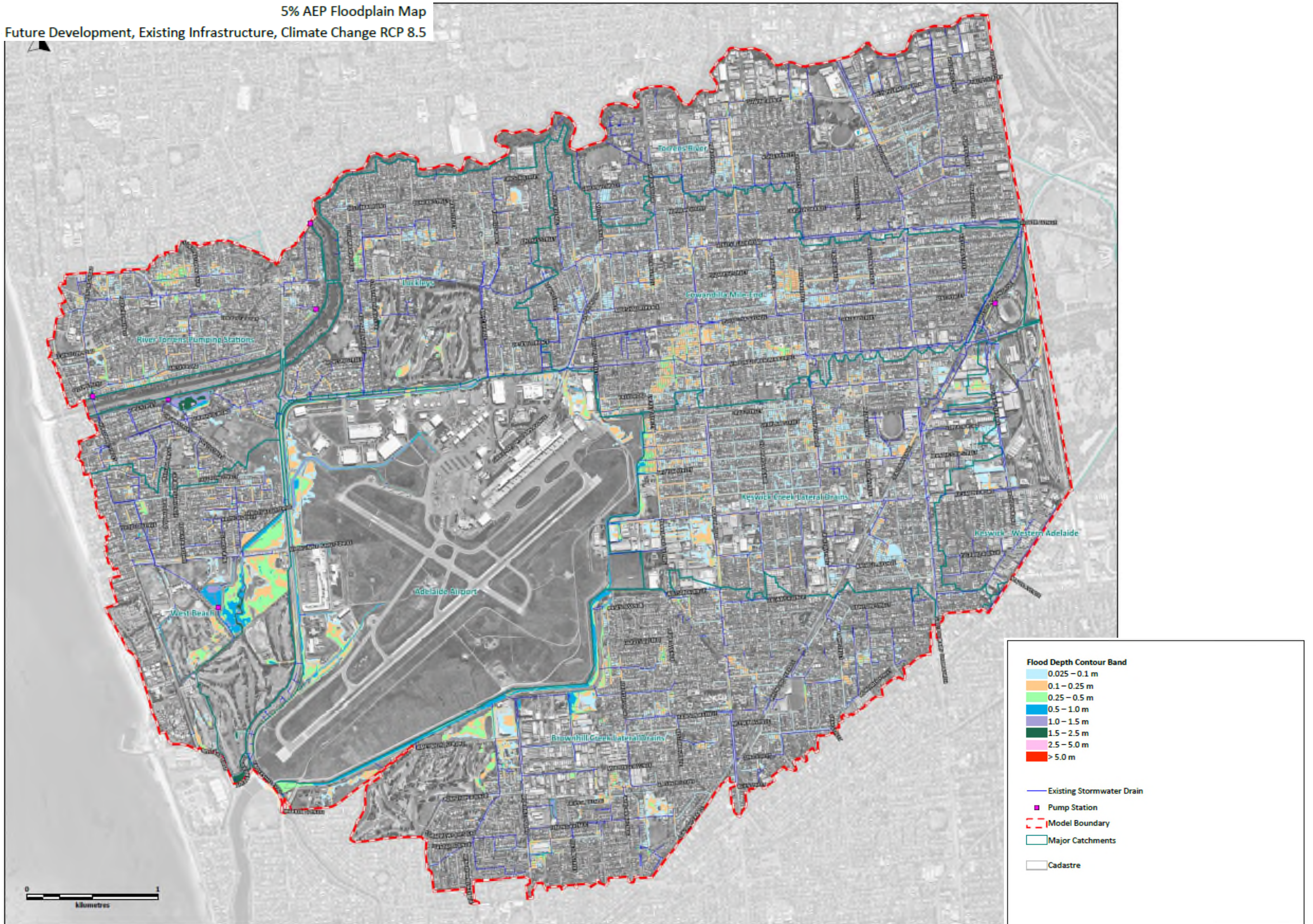
Catchment	Average Annual Damages Value (\$ at 2020 value)
West Beach	\$280,000
River Torrens Pumping Station	\$1,090,000
Lockleys	\$670,000
River Torrens	\$2,760,000
Cowandilla Mile End	\$2,850,000
Keswick Creek Lateral Drains	\$7,960,000
Keswick - Western Adelaide	\$1,230,000
Brown Hill Creek Lateral Drains	\$4,190,000
Adelaide Airport	\$190,000
Total	\$21,090,000

If no works were to be undertaken to improve the existing stormwater infrastructure, the extent and depth of anticipated flooding across the study area is shown in the following maps. These maps include the existing stormwater infrastructure, with consideration of future urban development and climate change. They represent the flooding in a 5% AEP flood (1 in 20 year flood) and the 1% AEP flood (1 in 100 year flood).



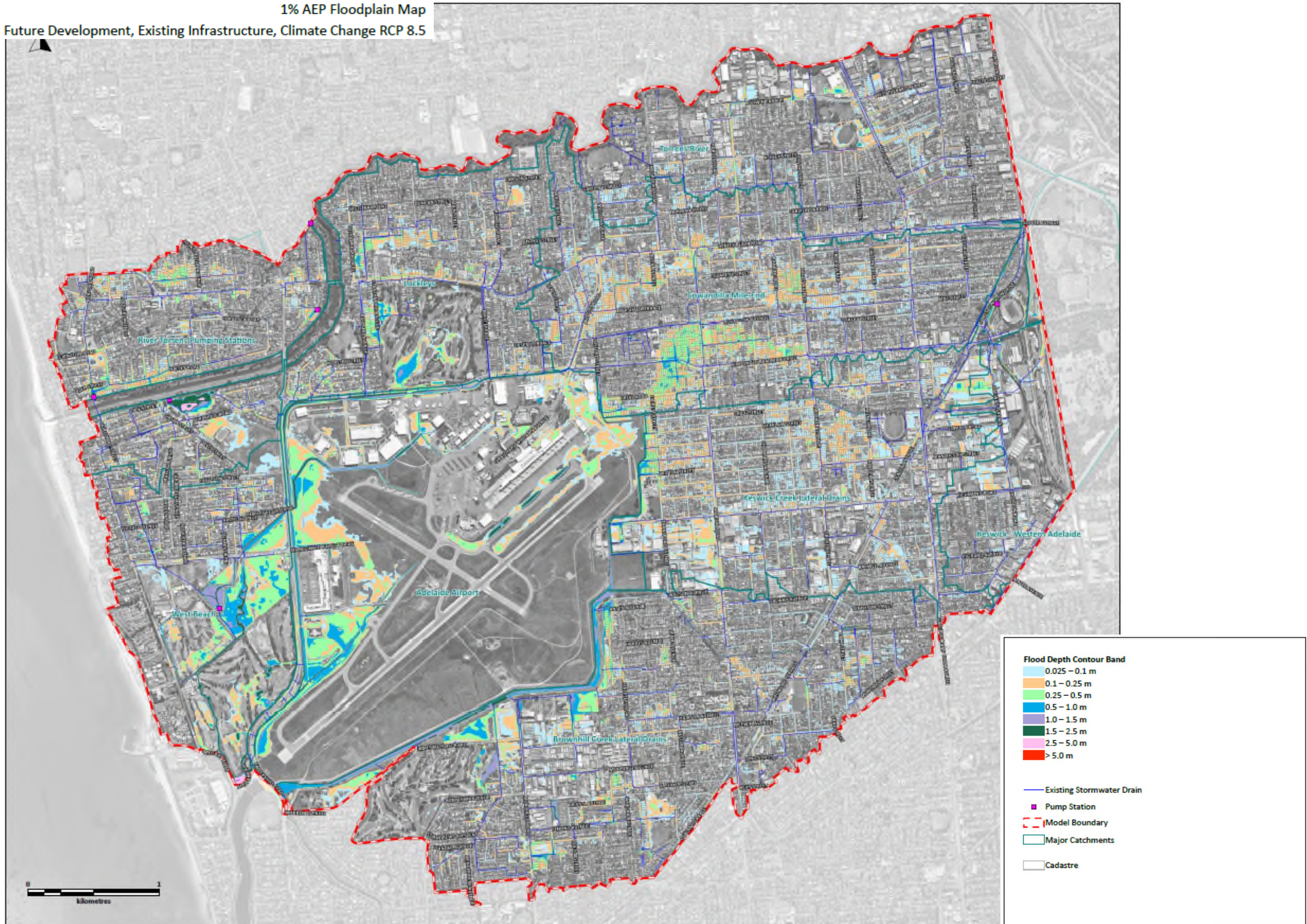
5% AEP Floodplain Map

Future Development, Existing Infrastructure, Climate Change RCP 8.5



1% AEP Floodplain Map

Future Development, Existing Infrastructure, Climate Change RCP 8.5



Proposed stormwater management strategies

Flood mitigation

Flood mitigation strategies have been developed with a view to maximising the level of flood protection that can be achieved within practical constraints.

The proposed upgrades to infrastructure have been designed with consideration of future urban development and an increase to rainfall intensity due to climate change. Council owned land and public space was prioritised for upgrade strategies. Acquisition of private land was not considered unless an obvious opportunity was identified.

Although it is aspirational to provide protection for the 1% AEP flood (1 in 100 year), the following factors were considered to determine if that would be infeasible or cost prohibitive:

- Pipe or culvert sizes required commonly would struggle to physically fit in the available space or road reserve.
- Pipe or culvert sizes required commonly would result in inevitable service clashes with significant services that would be extremely costly to relocate.
- Where resolution of localised upstream solutions would also require excessive whole of system (downstream) upgrades.

Early strategy development and modelling clearly indicated that reaching the 1% AEP (1 in 100 year ARI) standard was not practical due to the sizes and numbers of drains required, and hence a 5% AEP (1 in 20 year) aspirational flood standard has been applied.

The West Torrens Drainage Catchments SMP is not the only 'established urban catchment' SMP in Adelaide to adopt an aspirational flood standard of 5% AEP. This is becoming more common as many parts of established metropolitan Adelaide have similar characteristic challenges, including flat topography, era of original establishment, approaches to original stormwater networks establishments, nature of projected infill development and climate change impacts.

A series of structural works have been identified to mitigate against this flood risk. Of the many upgrades proposed, the four most major packages of works would focus on the following areas;

- Henley Beach South to Fulham,
- Cowandilla to Mile End,
- Marlestone to West Richmond, and
- North Plympton.

An overview map showing the proposed drainage works is presented in the following figure. Further information on the proposed works is provided in the full technical report by Southfront, which will be available on Council's website.

Due to the volume of stormwater seeking to be managed and the typical absence of large areas of open space suitably located to establish new stormwater detention basins, the vast majority of the proposed flood mitigation works focus on introducing new and larger underground pipe and culvert construction.

Proposed Flood Mitigation Works - Overview

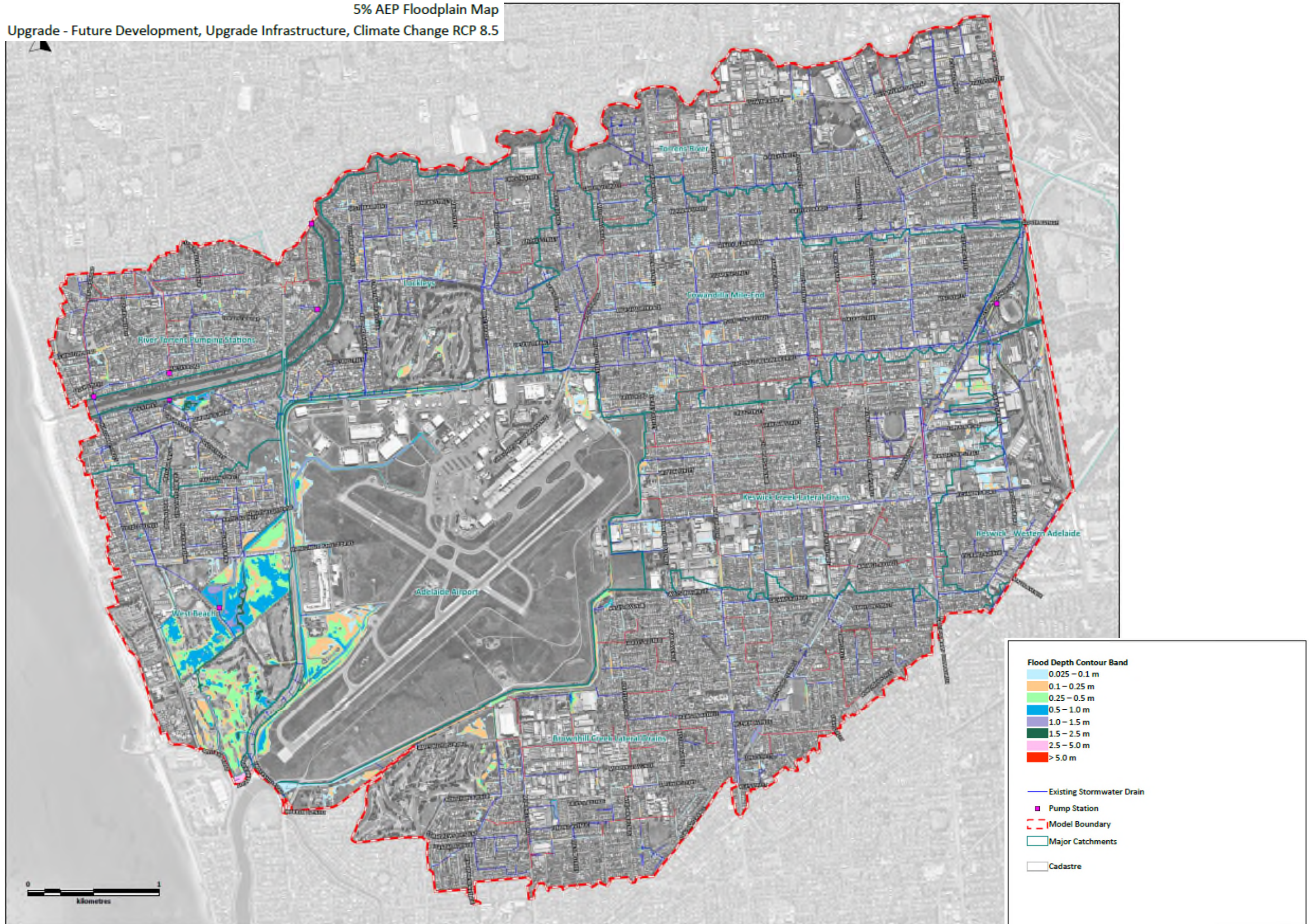


The anticipated improvements from the proposed flood mitigation works are demonstrated on the following map. This is shows the 5% AEP flood event (1 in 20 year flood) with future development and climate change scenarios factored in.

This is followed by a map showing the anticipated improved flood managed for the 1% AEP flood event (1 in 100 year flood) with future development and climate change scenarios factored in.

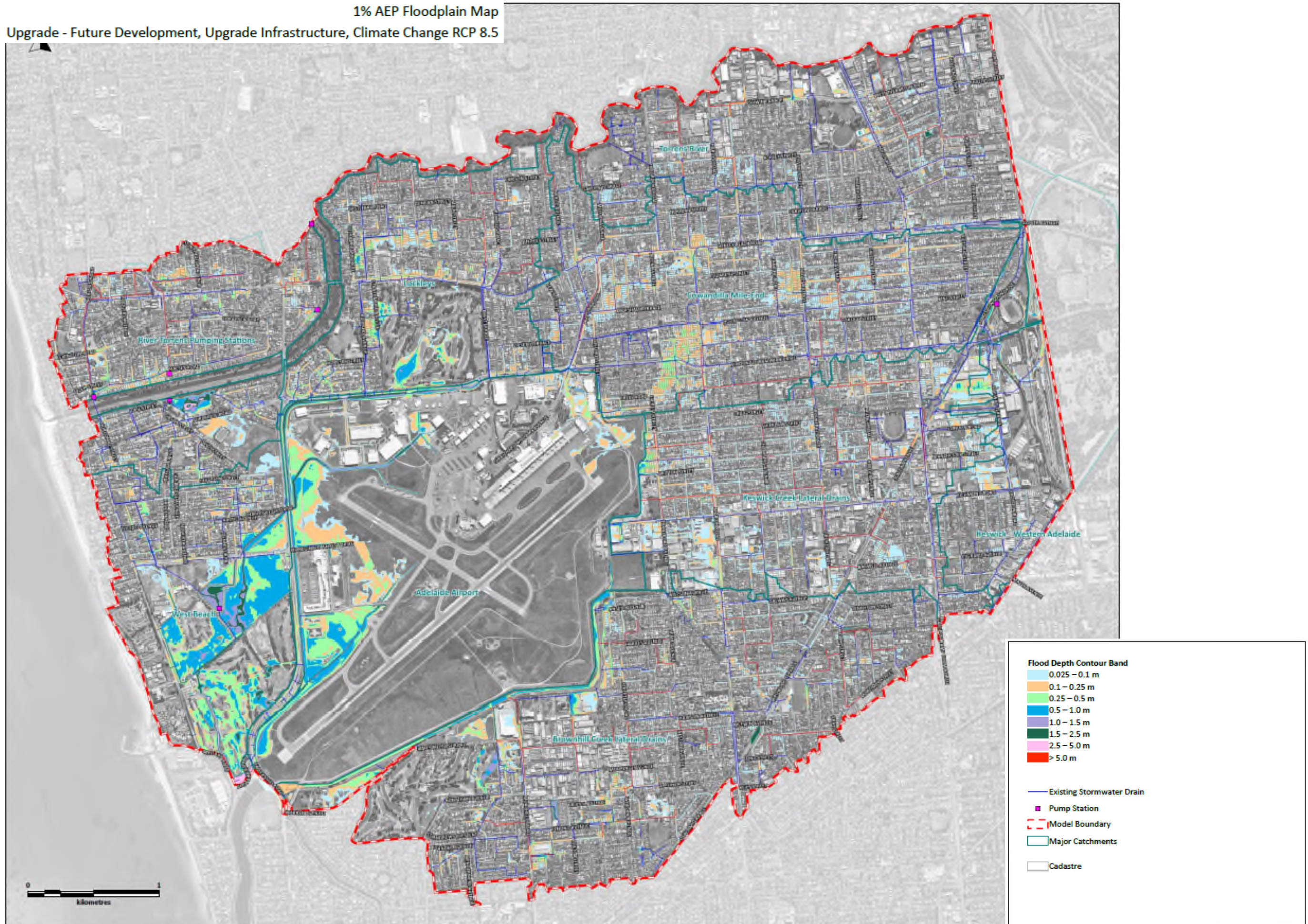
5% AEP Floodplain Map

Upgrade - Future Development, Upgrade Infrastructure, Climate Change RCP 8.5



1% AEP Floodplain Map

Upgrade - Future Development, Upgrade Infrastructure, Climate Change RCP 8.5



The proposed upgrades will reduce the number of properties anticipated to be impacted by 'over floor' flooding for different scale storm events.

The following table demonstrates the comparison of anticipated flood impacted properties (before and after implementation of flood mitigation works) for the various catchments within the study area, with allowances for future impacts of development and climate changes.

(The 'Before' data is the same as that reflected in the table on page 18, with the catchments referenced aligning with the 'Study area' map on page 13.)

Impact of the proposed infrastructure upgrades on reducing flooding to properties

Catchment	Number of properties inundated					
	EY = Exceedances per year					
	AEP = Annual Exceedance Probability					
	0.2 EY flood (1 in 5 year)		5% AEP flood (1 in 20 year)		1% AEP flood (1 in 100 year)	
	*Before	**After	*Before	**After	*Before	**After
West Beach	3	2	19	17	50	48
River Torrens Pumping Station	44	0	107	19	233	132
Lockleys	18	11	83	44	234	188
River Torrens	27	8	72	16	189	82
Cowandilla Mile End	46	6	367	52	1,022	484
Keswick Creek Lateral Drains	133	13	297	40	588	253
Keswick - Western Adelaide	2	2	12	12	20	20
Brown Hill Creek Lateral Drains	102	9	194	23	390	186
Adelaide Airport	0	0	1	0	9	5
Total	375	51 (86% reduction)	1,152	223 (81% reduction)	2,735	1,398 (49% reduction)

***Before = without upgrading infrastructure **After = upgraded infrastructure in place**

As would be anticipated the scale in reduction of flood impacted properties across the spectrum of storm events will result in a reduction in the anticipated value of community damages for the various storm events, as well as the overall Average Annual Damages.

The direct community damages cost which would be occur after the implementation of all proposed flood mitigation works would range in value from \$10.2 million for a 0.2 EY flood event (1 in 5 year flood) through to \$95.8 million for a 1% AEP flood event (1 in 100 year flood). These represents a reduction in damages of 67% and 40% respectively, as compared to if no flood mitigation works were to be undertaken.

With consideration of the likely impact of flooding and associated damages across a spectrum of storm events, the following table represents the anticipated Average Annual Damages (AAD) of direct flood damages to community in each of the catchments in the study area.

Damages Comparison (before and after flood mitigation work)

Catchment	Average Annual Damages Value (\$ at 2020 value)		Percentage Reduction
	Before Flood Mitigation	After Flood Mitigation	
West Beach	\$280,000	\$150,000	46%
River Torrens Pumping Station	\$1,090,000	\$200,000	82%
Lockleys	\$670,000	\$480,000	28%
River Torrens	\$2,760,000	\$1,440,000	48%
Cowandilla Mile End	\$2,850,000	\$1,160,000	59%
Keswick Creek Lateral Drains	\$7,960,000	\$3,190,000	60%
Keswick - Western Adelaide	\$1,230,000	\$1,230,000	0%
Brown Hill Creek Lateral Drains	\$4,190,000	\$800,000	81%
Adelaide Airport	\$190,000	\$80,000	58%
Total	\$21,090,000	\$8,750,000	59%

Non-structural flood mitigation measures

Non-structural flood mitigations can complement the structural options. They are typically low cost (relative to structural measures) and hence are extremely cost effective with respect to the flood damage reductions that they achieve. These are summarised below:

- Community Flood Response and Preparedness - the State Emergency Service (SES) deliver their FloodSafe and StormSafe program in schools and the community throughout the area, often in partnership with local councils, to help build community resilience and understanding about flood risk. Initiatives include articles in Council's newsletters, street corner meetings, community group meetings, internet sites, brochures, and school education.
- Council's Community Emergency Management Plan - in relation to flooding this plan provides information on how the community should prepare for a flood emergency arising. Council may also elect to make the floodplain mapping for the West Torrens Stormwater Management Plan publicly available via their website, along with advice to residents on measures they can take to reduce their flood risk and steps to take to prepare a Personal Flood Action Plan.
- Development controls - in relation to floor levels it is recommended that all new development has a floor level that provides at least 200 to 300 mm elevation above the 1% AEP (1 in 100 year) floodplain of nominated flood mapping. At present there is no 'local drainage' floodplain mapping (of nature equivalent to the Plan) reflected in the relevant planning provisions for the study area. The finalisation and formal approvals of the Plan will provide the opportunity for the floodplain mapping associated with this project to be considered for inclusion in the Planning and Design Code.

In relation to on-site detention and retention, the new state wide Planning and Design Code sets out the stormwater detention and retention requirements for new residential developments which requires new developments to incorporate a rainwater and/or stormwater detention tank, or similar equivalent measures.

The desired requirement for stormwater quality improvement measures are also included within the Planning and Design Code for many types of developments.

- Ongoing maintenance and monitoring of Council assets - Council has an Asset Management Plans for managing stormwater infrastructure. It provides a framework for maintenance, monitoring and capital renewal of stormwater assets. It is important for this to be maintained as a 'live' document to be continually updated as issues are identified. It is also recommended that the Councils' GIS systems are continually updated with any new infrastructure as it is constructed and filled in where gaps may exist.

Water quality and water sensitive urban design

One of the objectives of the Plan is to seek opportunities to enhance stormwater quality. The habitats most likely to be impacted by stormwater discharges are Gulf St Vincent and those along the River Torrens and the marine environments of the Patawalonga Lake.

Potential risks from stormwater are increased by suspended sediments, nutrients, metals and other contaminants, as these can have negative impacts on reef and seagrass habitats, and species in the River Torrens. Poor water quality can also create an unsafe swimming environment for the public.

A Water Sensitive Urban Design (WSUD) strategy has been developed within the Plan to reduce the volume and improve the quality of stormwater. The range of WSUD measures that are proposed to be implemented include streetscape raingardens, reserve scale bioretention systems and gross pollutant traps. There are also allotment-level opportunities for beneficial collection and use of stormwater, which will reduce the overall volume of stormwater that is discharged to receiving waters. This includes the provision of rainwater tanks for new developments.

The measures currently in place to improve water quality prior to discharge to the receiving waters (River Torrens, Patawalonga Creek, Brown Hill Creek and Keswick Creek) include wetlands, gross pollutant traps and street scale raingardens. There are several online detention basins throughout the study area which provide some water quality improvement for base flows.

Over 2000 new raingardens have been estimated to provide the required water quality improvements, to be implemented through road reconstruction and drainage construction programs. The capital cost to implement the anticipated number of raingardens would be approximately \$82,740,000, with an ongoing annual maintenance cost of \$1,609,000.

The number of new raingardens could be reduced should other physical works be implemented, such as wetlands. Non-structural measures could also reduce the number of raingardens, as well as help to meet the stormwater management objectives for flooding and water quality improvements, such as community consultation and education, integrating stormwater improvement measures with Council's plans, ongoing maintenance of Council's assets and development controls (where possible).

In addition, basin style raingarden/bioretention systems are proposed to be integrated with the following proposed flood mitigation basins:

- A new detention basin at McArthur Avenue Reserve.
- A new detention basin at the Dove Street Reserve.
- Potential - a new detention basin/underground tank system at Deacon Avenue Reserve if an above ground basin is feasible.
- Potential - a new detention basin/underground tank system at James Congdon Drive / South Road if an above ground basin is feasible.



Construction costs for these integrated raingarden/bioretention systems have been considered in the flood mitigation strategy cost estimates.

Rainwater tanks are included in the strategy as they capture stormwater and reduce pollutant loads and reduce the volume of runoff into the stormwater system.

Gross pollutant traps (GPT) are also included in the strategy, such as a GPT to be constructed upstream of the proposed Burnley Street Pump Station system in Fulham, and GPTs to be installed at each of the proposed drainage upgrades that discharge into the River Torrens.

The opportunity for further measures primarily exists at the private property level, including stormwater harvesting and using site runoff for passive irrigation. Implementation of these measures may be influenced by compliance checks to ensure water quality infrastructure is installed and functioning as intended using the building approvals process.

Non-structural measures can further assist in reaching the pollutant reduction targets, such as:

- Regular maintenance of existing wetlands
- Integrating stormwater works with other capital works programs
- Maximise the uptake of WSUD on private property through community education and promotion of WSUD
- Investigate how receiving watercourses can be improved for other Council uses such as stormwater detention, stormwater treatment, greening, cooling and to improve their use for recreation and amenity.
- Community based environmental enhancement activities - support local community groups through grant programs, assisting with communication with the wider community, and providing facilities for community group events

Stormwater harvesting and reuse opportunities

Stormwater harvesting and reuse enables Council to reduce the reliance and use of mains water and allows irrigation to occur without the restrictions that may be imposed on mains water use on occasions (E.g. during drought periods), and helps to create cooler spaces through regular irrigation.

Providing irrigation to areas currently not irrigated and providing more reliable irrigation in summer to those areas that are irrigated will increase the recreational experience of the community, in addition to the direct stormwater management benefits.

Many parks and reserves in West Torrens are currently irrigated by the Glenelg to Adelaide Parklands (GAP) Recycled Water Scheme and Glenelg to Adelaide Airport Class A Recycled Water Scheme. There is some scope to extend these GAP recycled water schemes to irrigate more green spaces.



The Plan identifies the most compelling area for a large stormwater harvest and use scheme (within the study area) is in the north-eastern area of Adelaide Shores.

No other sites have been deemed suitable for large scale stormwater harvest and use. However smaller scale stormwater storage and use schemes could be considered when designing raingardens, similar to that at Holland Street Plaza, or the Streeters Road/Gardner Street. More streetscape soakage and infiltration technologies could be installed across the study area where possible, such as soakage pits, infiltration trenches and tree pits and inlets.

Cost estimates

Budget cost estimates have been prepared for the proposed flood mitigation works. The budget cost estimates include allowances for design, modification to existing services, construction preliminaries and contingencies.

They are also based upon historical cost information and experience, and do not allow for latent or market conditions (i.e. competition, escalation) or land acquisition.

An initial estimate values the total drainage system upgrade costs, including flood mitigation and stormwater quality improvement works, at around \$200 million (capital costs estimated in 2020 \$).

The full delivery of these works is considered to be a long term implementation of 30 to 50 year, to reflect and align with the progressive nature of change in catchment development and environmental conditions.

A Benefit Cost Analysis was carried out, considering the annual average damages (AAD) for the existing and upgrade scenario. These were undertaken on the catchment breakdowns as reference in earlier maps and tables (refer to Study area map on page 13).

For the majority of the proposed flood mitigation upgrade works in the individual catchments, the Benefit Cost Analysis investigations indicate that, in financial terms, the benefits of undertaking the upgrade works well outweighs the cost of the implementation of the works.

For a couple of the catchment areas (River Torrens Pumping Station and Lockleys) the Benefit Cost Analysis investigations returned results which were slightly less than the measure which would typically be considered to represent clear financial benefit in the works. However, this is not unusual for flood mitigation proposals, particularly where the benefits being measures are only the 'direct' benefits of 'over floor' flooding damage. The Plan still recommends that works in these catchment of the scale and nature proposed would be appropriate to under.

Budget and rates impacts

If the proposed scope of flood mitigation and stormwater quality improvement works as outlined in the draft Plan were to be implemented over a 50 year delivery period, then it has been estimated that this would closely align with Council's existing long term financial plans for value and manner of stormwater management. This approach is unlikely to result in increased rates revenue requirements (based on current day considerations).

Several factors could be considered which change the scale of works or timeline to implement these works, as per below:

- Grant funding could facilitate a quicker implementation of works or greater scope of works and standard of flood protection.
- Increased Council rates could facilitate a quicker implementation of works or greater scope of works and standard of flood protection.
- Greater reliance on development related stormwater quantity, flow rate and quality improvement measures could enable reduced scope and scale of upgrade works and hence costs.

Priorities and timeframes

The actions outlined in this Plan will require implementation to be scheduled across many decades, in order to be accommodated sustainably within Council budgets, and other potential funding partners such as the Stormwater Management Authority (SMA).

A consolidated list of prioritised actions is presented from page 35, together with a brief description of the benefits realised and objectives addressed. Actions that are potentially eligible for Stormwater Management Authority funding support (typically co-funding on a 50/50 basis with Local Government for projects with a contributing catchment area greater than 40 hectares) have been highlighted. It should be noted that meeting the eligibility for SMA funding does not guarantee the awarding of funding from the SMA.

Consultation on this Plan

This overview has been prepared to provide a concise and transparent overview of the Plan for consultation purposes.

The consultation program has involved discussion with the Stormwater Management Authority (SMA), Green Adelaide and impacted councils. It is now timely to seek feedback from the community. That feedback will be used to inform development of the final Stormwater Management Plan.

Once endorsed by project partners (Council, SMA and Green Adelaide), the Plan will be made available on Council's website for public access.

Implementation and reporting

The Plan will be utilised to inform future Capital works programming, updating of Council's Stormwater Asset Management Plan and Council's budgets and long term financial planning.

Progress on delivering the final Plan will be reported on regularly such as via departmental Activity Reports and annual reporting mechanisms.

Floodplain mapping produced and approved as part of the Plan will be considered for inclusion within the Planning and Design Code to be used for influencing and protecting future development.

Stormwater Management Plans are intended to be reviewed at regular frequencies to update and review the inputs and assumption, as well as outputs, of the study. Although there is discussion of a duration of implementation of improvement works in the order of 50 years, it is likely that the Plan would be reviewed, reconsidered and updated several times over this duration.

An example of the importance and benefit of regular review of the Plan would be the updating of floodplain mapping to reflect the stormwater network upgrade works undertaken. The adoption within planning regulations of this updated floodplain mapping, which would demonstrate less properties impacted from potential flooding and a reduced degree of flooding over other areas, would result in reduced impacts and costs to the community.

Summary of proposed stormwater management measures

Priority	Project ID	Project Location / Description	Catchment	LGA	Flood Mitigation Benefit	Water Quality Benefit	Capital Cost (\$ at 2020 value)	Annual Costs (\$ at 2020 value)	Objectives Addressed
0 - 10 years	D9	Lasscock Ave Drainage	River Torrens	WT	✓	✓	\$1,130,000	-	O1, O2, O3
0 - 10 years	D12	Ashwin Parade Drainage	River Torrens	WT	✓	✓	\$2,010,000	-	O1, O2, O3
0 - 10 years	D14	*Ann Nelson Dr to Light Terrace Drainage and Detention Basin with Biofilter	River Torrens	WT	✓	✓	\$3,140,000	-	O1, O2, O3, O5, O9
0 - 10 years	D17	Allen Ave, Lysle St Road Bunds	Cowandilla Mile End	WT	✓		\$32,000	-	O1, O2
0 - 10 years	D20	Milner Rd Drainage and Detention Storage	Keswick Creek Lateral Drains	WT	✓		\$2,060,000	-	O1, O2, O9
0 - 10 years	D21	Arthur St Drainage	Keswick Creek Lateral Drains	WT	✓		\$1,410,000	-	O1, O2
0 - 10 years	D22	Chambers Ave Drainage	Keswick Creek Lateral Drains	WT	✓		\$930,000	-	O1, O2
0 - 10 years	D23	Knight St Drainage	Keswick Creek Lateral Drains	WT	✓		\$1,350,000	-	O1, O2
0 - 10 years	D25	Warwick Ave Drainage	Brown Hill Creek Lateral Drains	WT	✓		\$1,590,000	-	O1, O2
0 - 10 years	D26	Gray St Drainage	Brown Hill Creek Lateral Drains	WT	✓		\$1,770,000	-	O1, O2
0 - 10 years	D27	Harvey Ave Drainage	Brown Hill Creek Lateral Drains	WT	✓		\$1,790,000	-	O1, O2
0 - 10 years	D29	Edward Davies St Drainage	Brown Hill Creek Lateral Drains	WT	✓		\$800,000	-	O1, O2
0 - 10 years	D32	*North Plympton Trunk Drain + Laterals	Brown Hill Creek Lateral Drains	WT	✓		\$14,970,000	-	O1, O2
0 - 10 years	D33	Emma Pl Surcharge Basin Re-shape	Brown Hill Creek Lateral Drains	WT	✓		\$100,000	-	O1, O2

Priority	Project ID	Project Location / Description	Catchment	LGA	Flood Mitigation Benefit	Water Quality Benefit	Capital Cost (\$ at 2020 value)	Annual Costs (\$ at 2020 value)	Objectives Addressed
0 - 10 years	D35	Hoylake St / Albert Ave Drainage	Brown Hill Creek Lateral Drains	WT	√		\$1,720,000	-	O1, O2
0-10 years	D36	Keswick Creek Channel Investigation and Prelim Design	Various	Various			\$200,000		O1
0-10 years	D37	Community Flood Response and Preparedness	N/A	N/A			N/A	\$10,000	O8
0-10 years	D38	Community Flood Response and Preparedness – Council's Community Emergency Management Plan	N/A	All			N/A	N/A	O8
0-10 years	D39	Development Controls – Floor Levels	N/A	All			N/A	N/A	O7
0-10 years	D40	Development Controls – On-site Detention / Retention	N/A	All			N/A	N/A	O7
0-10 years	D41	Ongoing Maintenance and Monitoring of Council Assets	All	All			N/A	N/A	O6
0-10 years	Q3	Rainwater Tanks	Various	WT, CCS		√	N/A	N/A	O4, O7
0-10 years	Q5	Maintenance of existing wetlands	Various	WT		√	N/A	\$110,000 (based on approx. 50 ha of Council maintained wetlands)	O3, O5, O6
0-10 years	Q6	Integration with Council Business Plans	N/A	All			N/A	N/A	O9

Priority	Project ID	Project Location / Description	Catchment	LGA	Flood Mitigation Benefit	Water Quality Benefit	Capital Cost (\$ at 2020 value)	Annual Costs (\$ at 2020 value)	Objectives Addressed
0-10 years	Q7	Community Education and WSUD Promotion	N/A	All			N/A	\$10,000	O4, O7, O8
0-10 years	Q8	Investigating how Receiving Watercourses can be Better Utilised	Various	All			N/A	N/A	O5, O8, O9
0-10 years	Q9	Supporting Community Groups Contributing to the Achievement of the SMP Objectives	Various	All			N/A	\$10,000	O5, O8, O9
0-10 years	R1	Small scale stormwater harvest and reuse	Various	All		✓	Unknown	Unknown	O4
0-10 years	R2	Expanding reserves irrigated by GAP and Class A recycled water	Various	All			Unknown	Unknown	O4
10 - 20 years	D5	Matt St Drainage	Lockleys	WT	✓	✓	\$1,070,000	-	O1, O2, O3
10 - 20 years	D13	Stephens Ave Drainage	River Torrens	WT	✓		\$630,000	-	O1, O2
10 - 20 years	D18	Davenport Terrace Drainage	Keswick Creek Lateral Drains	WT	✓		\$3,040,000	-	O1, O2
10 - 20 years	D19	South Rd Mile End Drainage and Detention Storage	Keswick Creek Lateral Drains	WT	✓		\$1,560,000	-	O1, O2, O9
10 - 20 years	D24	*Marleston to West Richmond Drainage and Detention Storage	Keswick Creek Lateral Drains	WT	✓		\$18,370,000	-	O1, O2, O9
10 - 20 years	D30	Glenburnie Tce Drain and Detention Basin with Biofilter	Brown Hill Creek Lateral Drains	WT	✓		\$2,160,000	-	O1, O2, O3, O5, O9
10 - 20 years	D31	Spring St Drainage	Brown Hill Creek Lateral Drains	WT	✓		\$670,000	-	O1, O2
10 - 20 years	D34	Penong Ave Drainage	Brown Hill Creek Lateral Drains	WT	✓		\$1,150,000	-	O1, O2
20 - 30 years	D2	*Burnley Pump Station + Drainage	River Torrens Pumping Station	WT, CCS	✓		\$16,140,000	\$8,000	O1, O2, O3

Priority	Project ID	Project Location / Description	Catchment	LGA	Flood Mitigation Benefit	Water Quality Benefit	Capital Cost (\$ at 2020 value)	Annual Costs (\$ at 2020 value)	Objectives Addressed
20 - 30 years	D4	Frontage Rd Drainage	Lockleys	WT	✓		\$950,000	-	O1, O2, O3
20 - 30 years	D6	Douglas St Drainage	Lockleys	WT	✓		\$730,000	-	O1, O2
20 - 30 years	D7	Malurus Ave Drainage	Lockleys	WT	✓		\$460,000	-	O1, O2
20 - 30 years	D8	Grant Ave Drainage	Lockleys	WT	✓		\$900,000	-	O1, O2, O3
20 - 30 years	D11	Sherriff North Drainage	River Torrens	WT	✓		\$910,000	-	O1, O2, O3
20 - 30 years	D15	*Cowandilla, Mile End to Keswick Creek Drainage	Cowandilla Mile End	WT	✓		\$23,040,000	-	O1, O2
20 - 30 years	D16	Airport Rd, Mellor Ave Drainage	Cowandilla Mile End	WT	✓		\$3,150,000	-	O1, O2
30 - 40 years	D3	Riverway Drainage Upgrade	River Torrens Pumping Station	WT	✓		\$2,750,000	-	O1, O2
30 - 40 years	Q1	Streetscape raingardens / bioretention	Various	All		✓	\$82,740,000	\$700 per raingarden	O3, O4, O5
40+ years	D1	*Henley Beach Sth Pump Station Upgrade + Drainage	River Torrens Pumping Station	WT, CCS	✓	✓	\$4,330,000	\$2,000	O1, O2, O3
Included in corresponding flood mitigation strategy	Q2	Reserve / Detention Basin Bioretention Systems	Various	WT		✓	Cost included in corresponding flood mitigation strategy	\$1000 per biofiltration system	O3, O5, O9
Included in corresponding flood mitigation strategy	Q4	Gross Pollutant Traps	Various	WT		✓	Cost included in corresponding flood mitigation strategy	\$2,000 per GPT	O3, O5

Priority	Project ID	Project Location / Description	Catchment	LGA	Flood Mitigation Benefit	Water Quality Benefit	Capital Cost (\$ at 2020 value)	Annual Costs (\$ at 2020 value)	Objectives Addressed
Complete	D10	Sheriff South Drainage + Raingardens	River Torrens	WT	√	√	\$280,000	-	O1, O2
Complete	D28	Packard St Drainage	Brown Hill Creek Lateral Drains	WT	√		\$1,090,000	-	O1, O2
						Total	\$201,120,000		

* Potential for SMA funding

Stormwater Management Plan Objective Review

The proposed strategies meet a range of stormwater management goals and objectives. These are summarised below.

Objective ID	Goal	Objective	Relevant Strategies/Actions	Objective Achieved?
O1	Provide an acceptable level of flood protection to the community and both private and public assets from flooding	Aspire to achieve no above floor inundation of properties for all events up to and including the 1% AEP (100 year ARI) storm. Where this is not practically achievable, a 5% AEP (20 year ARI) standard shall be sought. New developments to achieve a minimum 300mm freeboard to the 1% AEP flood level.	- New stormwater infrastructure recommended – flood mitigation strategies D1 through to D36. - Non-structural flood mitigation strategies D39 and D40 relating to new development controls.	The flood mitigation strategies recommended provide a 5% AEP flood protection to the existing flooding hotspots. Through consultation with Council, a 5% AEP flood standard was agreed upon due to practical/financial constraints with achieving a 1% AEP standard.
O2	Provide an acceptable level of performance in the minor (underground) drainage system and pits	Aspire to achieve minimum service standards for new or upgraded drainage systems as follows: Hydraulic grade line (HGL) for 0.2 EY storms to be minimum 150 mm below gutter level	Flood mitigation strategies D1 through to D36.	The flood mitigation strategies recommended have been designed to provide a 0.2 EY underground standard (>150mm freeboard to gutter level).
O3	Improve the quality of runoff and reduce the impact of stormwater on receiving waters.	Aspire to reduce pollutant loads discharged from the catchment by the following averages: - Suspended solids 80% - Phosphorous 60% - Nitrogen 45%	- Flood mitigation strategies D14 and D30 which include detention basins with biofiltration (also labelled Q2) - Streetscape raingardens (Q1) - Gross pollutant traps recommended for all new outlets into the River Torrens (Q4, D1, D2, D4, D5, D8, D9, D11, D12, D14)	The proposed solutions demonstrate (through MUSIC modelling) that the pollutant loads discharged from the catchment do reach the reduction targets.

Objective ID	Goal	Objective	Relevant Strategies/Actions	Objective Achieved?
		- Gross Pollutants 90% Integrate water quality improvement goals into Council development requirements.	Maintenance of existing wetlands (Q5)	
O4	Make beneficial use of stormwater.	Identify precinct-level opportunities for beneficial reuse of stormwater where economically viable. Expand on street-scale civic reuse activities. Encourage landowners to implement allotment-level opportunities for the retention and reuse of stormwater.	- Streetscape raingardens (Q1) - Streetscape raingardens (Q1) - Rainwater tanks (Q3) - Community Education and WSUD promotion (Q7) - Small scale stormwater harvest and reuse (R1) - Expanding reserves irrigated by GAP and Class A recycled water (R2)	No viable large scale precinct level opportunities were identified in the West Torrens Catchment. The Adelaide Shores area (not owned by Council) is the best candidate. Expanding the large GAP and Class A recycled water systems is recommended. Streetscape raingardens are recommended to be used for storage and reuse where viable. Rainwater tanks are promoted as an important addition to new developments to achieve allotment-level opportunities for the retention and reuse of stormwater.
O5	Provide conditions which would allow desirable (improved) end-state values for	Support ongoing strategies seeking to restore and sustain the ecological processes, environmental values and productive capacity of the River Torrens, Patawalonga Creek and Brown Hill Keswick Creek by minimising the	- Flood mitigation strategies D14 and D30 which include detention basins with biofiltration (also labelled Q2) - Streetscape raingardens (Q1)	Each of these strategies do seek to restore and sustain the ecological processes, environmental values and productive capacity of the River Torrens, Patawalonga Creek and Brown Hill Keswick Creek by

Objective ID	Goal	Objective	Relevant Strategies/Actions	Objective Achieved?
	receiving waterways to be achieved.	urban runoff volume and nutrient loads discharged into these receiving watercourses.	- Gross pollutant traps recommended for all new outlets into the River Torrens (Q4) - Maintenance of existing wetlands (Q5) - Investigating how Receiving Watercourses can be better utilised (Q8) - Supporting Community Groups Contributing to the Achievement of the SMP Objectives (Q9)	either minimising the urban runoff volume and nutrient loads or recommending increased support for the community to be further invested in their local environments.
O6	Sustainable management of stormwater infrastructure, including maintenance	Stormwater infrastructure will be resilient in consideration of the likely impacts of climate change. Ensure appropriate monitoring and asset management plans are in place to maintain infrastructure and public safety.	- Ongoing Maintenance and Monitoring of Council Assets (D41) - Maintenance of existing wetlands (Q5)	Both these strategies provide recommendations for Council to ensure the sustainable management of stormwater infrastructure is achieved.
O7	Desirable planning outcomes associated with new development and management of open space, recreation, and amenity.	Ensure new development complies with stormwater management development requirements, designed to achieve outcomes that are complementary to the SMP objectives and goals. Maximise the use of open space for stormwater/rainfall infiltration WSUD and/or stormwater reuse.	- Development Controls – Floor Levels (D39) - Development Controls – On-site Detention / Retention (D40) - Rainwater tanks (Q3) - Community Education and WSUD promotion (Q7)	These strategies have been recommended so Council can go towards achieving the SMP objectives through development controls and private landowner participation.

Objective ID	Goal	Objective	Relevant Strategies/Actions	Objective Achieved?
O8	Effective communication and consultation with catchment stakeholders, businesses, and community members.	Effectively engage with the community on stormwater management issues and proposed strategies including WSUD and stormwater reuse opportunities where possible. Raise awareness to enable businesses and the community to respond efficiently to extreme weather and flood warnings. Identify opportunities for partnerships with the community and agencies in the development and implementation of strategies. Achieve increased alignment between the goals of the SMP and the activities of stakeholders and community volunteers.	- Community Flood Response and Preparedness (D37) - Community Flood Response and Preparedness – Council’s Community Emergency Management Plan (D38) - Community Education and WSUD promotion (Q7) - Investigating how Receiving Watercourses can be better utilised (Q8) - Supporting Community Groups - Contributing to the Achievement of the SMP Objectives (Q9)	Together, these proposed strategies recommend increasing communication, education, and support for the community to ultimately achieve the goals of the SMP.
O9	Multi-objective outcomes for stormwater management projects involving open space.	Maintain the existing use of open space and provide new opportunities for public access and recreation where it is safe and practical to do so. Provide opportunities for sustainable landscaping, increased biodiversity, stormwater treatment and passive reuse. Maximise linkages with pedestrian and cycle networks.	- Flood mitigation strategies D14, D19, D20, D24, and D30 which all include detention basins to be integrated with in public open spaces. - Integration with Council Business Plans (Q6) - Investigating how Receiving Watercourses can be better utilised (Q8) - Supporting Community Groups - Contributing to the Achievement of	These recommended strategies all contribute to multi-objective outcomes for stormwater management projects involving open space. Landscaped detention basins in public reserves can provide amenity and an interactive space for the community.

Objective ID	Goal	Objective	Relevant Strategies/Actions	Objective Achieved?
		Develop flood mitigation solutions that minimise the frequency of inundation of active recreation areas and permit more frequent inundation of passive recreation areas.	the SMP Objectives (Q9)	Investigating how watercourses can be better utilised includes reviewing opportunities for: - public access and recreation, - sustainable landscaping, - increased biodiversity, - stormwater treatment and passive reuse Community groups focused on stormwater issues provide many perspectives and ideas to achieving multi-objective outcomes for stormwater management. Supporting these groups is beneficial to Council and the achieving the SMP objectives.