Draft urban stormwater management guidance

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EPA acknowledges Aboriginal people as the first peoples and Traditional custodians of the land and water on which we live, work and depend. We pay respect to Aboriginal Elders past and present.

As Victoria's environmental regulator, we pay respect to how Country has been protected and cared for by Aboriginal people over many tens of thousands of years.

We acknowledge the unique spiritual and cultural significance of land, water and all that is in the environment to Aboriginal people and Traditional custodians. We recognise their continuing connection to, and aspirations for Country.

Disclaimer

The information in this publication is for general guidance only. It does not constitute legal or other professional advice and should not be relied on as a statement of the law. Because it is intended only as a general guide, it may contain generalisations.

You should obtain professional advice if you have any specific concern. EPA has made every reasonable effort to provide current and accurate information, but does not make any guarantees regarding the accuracy, currency or completeness of the information.

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Contents

1 Purpose

Uncontrolled urban stormwater runoff poses a risk to the values of waterways and bays. This guide is intended to help improve the management of urban stormwater in Victoria by recognising current science and the risk of harm from urban stormwater flows. It supports minimising the risk of harm to human health and the environment through good environmental practice and provides information that will support the planning and design of new urban stormwater management systems. This guide:

- highlights the risk to waterways and bays the creation of sealed (impervious) surfaces causes
- provides general objectives and information to support risk assessment and minimisation
- explains stormwater management for communities in Victoria.

This guide is provided for developers who create new impervious surfaces, such as roads, subdivisions and other developments. It is also relevant to those who inform infrastructure planning and design, including technical consultants. It supports these parties to minimise the risks to human health and the environment from their design, planning and development activities, as the General Environmental Duty (GED)[1] requires. It also supports those involved in the assessment of urban stormwater treatment proposals.

Relevant parties include:

- the land development industry
- technical consultants advising developers
- 'responsible authorities' as defined in planning legislation, that consider applications for approval of proposed developments, including local government
- public sector entities, including the Victorian Planning Authority, EPA, Melbourne Water, catchment management authorities, the Major Transport Infrastructure Authority and road authorities.

1.1 How to use this guide

You can use this guide to help minimise risks from urban stormwater so far as reasonably practicable. Doing what is reasonably practicable means putting in proportionate controls to minimise the risk of harm to human health and the environment. Reasonably practicable also considers what controls are available and their cost, and considers what an industry generally knows about the risk and control options. The approach and steps you take to do this will also depend on the scale and complexity of your project, the receiving environments, and the nature of the risks you need to manage.

1.2 Scope

The guidance relates to stormwater runoff from urban areas in Victoria. It addresses key environmental risks associated with generating new impervious surfaces, covering pollutant loads and flow impacts on the environment. While it covers a range of environmental risks, it provides environmental objectives for only a subset of these risks.

It does not provide guidance for those parties responsible for the ongoing management and operation of stormwater management systems, or temporary environmental management systems used during the construction phase, or mobile business activities. Information on temporary systems is provided in other EPA guidance and guidance on maintenance by water corporations and some councils.

[1] The *Environment Protection Act 2017*, as amended by the *Environment Protection Amendment Act 2018,* is intended to apply from 1 July 2021. This includes the general environmental duty. 'Minimise' means (a) to eliminate risks of harm to human health and the environment so far as reasonably practicable; and (b) if it is not reasonably practicable to eliminate risks of harm to human health and the environment, to reduce those risks so far as reasonably practicable.

Runoff from rural land is dealt with separately in the *Victorian Rural Drainage Strategy*, which is available from https://www.water.vic.gov.au/water-for-agriculture/rural-drainage/final-strategy.

Urban stormwater can be used as a resource with many benefits for the environment. This guidance does not directly address the maximisation of these benefits, which should be pursued in line with government policy.

1.3 Status

This is not a compliance document. It contributes to the **state of knowledge**[2] — the general body of knowledge about the harm or risks of harm to human health and the environment, including the controls for eliminating or reducing those risks. It is expected that the state of knowledge will improve over time as new knowledge and opportunities to better manage risk are established.

A range of controls apply to stormwater, including under Victoria's planning system[3], and it is your responsibility to ensure your operations comply with all applicable laws. The content of this guidance complements and adds to the state of knowledge established through previous guidance and planning requirements.

[2] See industry guidance: *Supporting you to comply with the general environmental duty* (EPA publication 1741) for information about other kinds of resources that can contribute to your state of knowledge.
[3] This includes Victoria Planning Provisions Clause 53.18 Stormwater management in urban development, 55, 56 and others.

2 Managing urban stormwater risks

This guidance focuses on how to assess stormwater risks and implement associated controls. Its approach is consistent with the risk management framework EPA published (see **Error! Reference source not found.**), with a focus on stages 2 and 3 as is relevant to those planning the development of impervious surfaces.

For information on the hazards associated with uncontrolled urban stormwater land development, see Appendix 1.

Figure 1 – Steps in controlling hazards and risks associated with stormwater

This section provides tools you can consider using to support the assessment and minimisation of the risk of harm. Effective risk management is a continuous and iterative framework. This means considering how the implementation of appropriate controls will reduce the initial risk and what the remaining risk will be, to help determine the need for any further actions.

2.1 Assess risks: factors to consider

Assessing the risks associated with urban stormwater runoff from your site will help you determine the appropriate management controls to design and install.

Consider the following factors to help you understand the risk of harm:

- the general risks from land development as outlined in Appendix 1
- site-specific risks of harm
- any other relevant state of knowledge, including relevant strategies, policies and guidance – for example the CMA/Melbourne Water Healthy Waterways Strategy (or equivalent policy), and place-specific advice from relevant authorities
- the pre-development flow regime
- monitoring and modelling data – including rainfall – to understand stormwater quality and quantity and its potential impact
- the size, scale and location of activities
- potential impacts to sensitive receivers, including aquatic ecosystems
- waterway values, such as those identified in the Environment Reference Standard and relevant regional waterway strategies – this includes ecological, cultural, social and economic values
- controls that are already in place and their effectiveness
- the volume of runoff your site is likely to generate
- the potential presence of pollutants in the runoff your site is likely to generate.

Metrics to assist you to evaluate risk of harm

The following table is an additional tool to assist in evaluating risk of harm. Performance against the objectives in Table 1 can be used as a signal of the level of risk of waterway values being lost or impacted. EPA regards development that does not meet those performance objectives as presenting a high risk of harm. A suitably qualified and experienced professional making an assessment against these objectives enables a better understanding of the risk of harm and the extent of stormwater management that is adequate to support values [in Table 1].

Note that the:

- reduction levels for solids, phosphorous and nitrogen are longstanding and are required to be achieved under other regulatory instruments, such as the Victoria Planning Provisions
- level of stormwater flow reduction to achieve will depend on what is reasonably practicable.

To assess these performance objectives, use an appropriate software tool. For example, the MUSIC (Model for Urban Stormwater Improvement Conceptualisation) can be used for all indicators. The InSite tool also covers all indicators, while the STORM (Stormwater Treatment Objective – Relative Measure) is under review and currently only covers nitrogen indicator. For further information see: www.melbournewater.com.au/planning-and-building/stormwater-management/storm-and-music-tools.

Note: The flow performance objective uses the commonly selected indicator of mean total annual runoff. Other indicators and performance objectives may be used to understand risk of harm to values, including direct connected imperviousness (DCI), Melbourne Water's Healthy Waterways Strategy harvesting and infiltration targets etc. as long as they support an equivalent or better risk assessment.

Table 1: Quantitative performance objectives for urban stormwater

Indicator	Performance objective
Suspended solids	80% reduction in mean annual load (Note:1, 2, 6)
Total phosphorus	45% reduction in mean annual load (Note:1, 2, 6)
Total nitrogen	45% reduction in mean annual load (Note:1, 2, 6)
Baseflow contribution	10% of mean annual rainfall volume to contribute to baseflow (Note: 2, 4, 5)
Flow reduction	50 – 90% reduction in mean annual total runoff volume in priority areas for enhanced stormwater management (Note: 2, 3, 7)
Flow reduction	25% reduction in mean annual total runoff volume in areas that have not been identified as priority areas for enhanced stormwater management (Note: 2, 3)
Litter	70% reduction of mean annual load

Notes to table 1:

(1) 'Reduction in mean annual load' refers to the reduction in load discharged from the development with treatment. This is compared to the load that would be discharged without treatment. Load (or pollutant load) means the mass per unit time of an indicator/pollutant.

(2) These are general objectives and, in some cases, a higher or lower percentage of flow reduction objective may be justified based on scientific evidence.

(3) 'Reduction in mean annual total runoff volume' refers to the reduction in runoff volume discharged from the development, with treatment, compared to the runoff volume that would be discharged without treatment (annually).

(4) This performance objective depends on the combined volume of water that infiltrates from pervious areas and treatment systems, and runoff discharged from the development at a low rate (lower than subsurface flows under pre-development conditions), to be 10 per cent of the mean annual rainfall on the development.

(5) The baseflow contribution performance objective may be inapplicable if the site is subject to requirements in an EPA permission directing that stormwater infiltration be minimised, or is subject to an environmental audit statement that restricts stormwater infiltration. Victoria's planning framework includes requirements to identify potentially contaminated

land at the planning scheme preparation/amendment stage and to manage any potential risks, including via EPA's environmental audit system. More information is available on DELWP and EPA websites.

(6) Compliance requirements apply to some types of development regarding these indicators under the *Planning and Environment Act* 1987: see the Victoria Planning Provisions.

(7) These areas are priority areas for enhanced stormwater management, as identified in the Melbourne Water Healthy Waterways Strategy. They have high ecological value waterways. A transparent process is required to identify priority areas for enhanced stormwater management outside the greater Melbourne area.

2.2 Implementing controls

There are many controls that can be implemented to minimise risks from urban stormwater runoff. Before you select a control, consider how you will use it, and its effectiveness. The controls you select should be proportionate to the risk.

Before you put controls in place, consider your approach to planning and site management. For example:

- Does your site layout help or hinder your control of hazards and risks from stormwater runoff?
- Do your business processes, systems and activities help you prevent harm?

The hierarchy of controls can be used to support the identification and selection of controls by providing a prioritisation framework (Figure 2).

Figure 2: Hierarchy of controlling hazards and risks.

Preventing harm from urban stormwater by minimising pollutants and increased flows involves:

- eliminating specific impervious surfaces where reasonably practicable. For example, use of porous pavement
- capturing stormwater runoff
- eliminating or reducing pollutants such as nutrients, sediment, heavy metals and other toxicants found in stormwater
- infiltrating a portion of stormwater runoff.

Consider the ongoing management requirements to control stormwater risks and try to choose interventions that do not rely on administrative controls to be effective. Controls need to be fit for purpose and installed and maintained correctly, so also consider the information required to support future maintenance and management.

Some examples of stormwater treatments that may be used to minimise risk of harm from urban stormwater runoff include:

- wetlands
- rainwater tanks
- stormwater harvesting
- swales and raingardens
- other water-sensitive urban design features.

Other engineering solutions to adequately capture sediment loads from your site may involve the installation of primary, secondary or tertiary treatment controls listed below. The implementation of the controls should be based on site-specific hazards and the level of risk at the site. A sequence of controls, commonly referred to as a 'treatment train', may be needed if pollutants such as nutrients and fine sediment are encountered:

- **Primary treatment controls** include physical screening of sediment in grassed swales, sediment basins, sediment ponds and litter traps.
- **Secondary treatment controls** consist of fine particle sedimentation and filtration in swales, infiltration trenches, filter bags and porous paving.
- **Tertiary treatment controls** include removal of nutrients and dissolved heavy metals in wetlands and bio-retention systems.

See Section 3 for indicative stormwater treatment examples. As each site is different, an appropriate system to minimise risk of harm may differ for the relevant site, based on any relevant policy or authority's advice. Depending on the scale, this may require developers to engage early with relevant water corporations, planning authorities, catchment management authorities and local councils to identify waterway values. Based on this, a developer would develop appropriate risk management strategies as part of the planning process. Water corporations may have more information on appropriate treatment options relevant to your development site. We recommend that you engage with Melbourne Water in the Port Phillip and Western Port Region for further advice on Healthy Waterways Strategy priority areas.

The design of controls should also consider any risks of the control itself, and options to eliminate or reduce these at the design stage. For example, considering the need to treat sediments for trapped contaminants or limit plant growth to maintain efficient wetland functioning.

In addition to designing and installing an appropriate stormwater management system, it is also important that appropriate controls are implemented during the construction phase to prevent industrial and commercial chemical pollutants and other toxicants entering stormwater. It may also be necessary to manage erosion and sediment from the site. The following EPA publications and resources may be used to inform appropriate controls to implement at the development site and may be useful references for assessing or preparing a permit application:

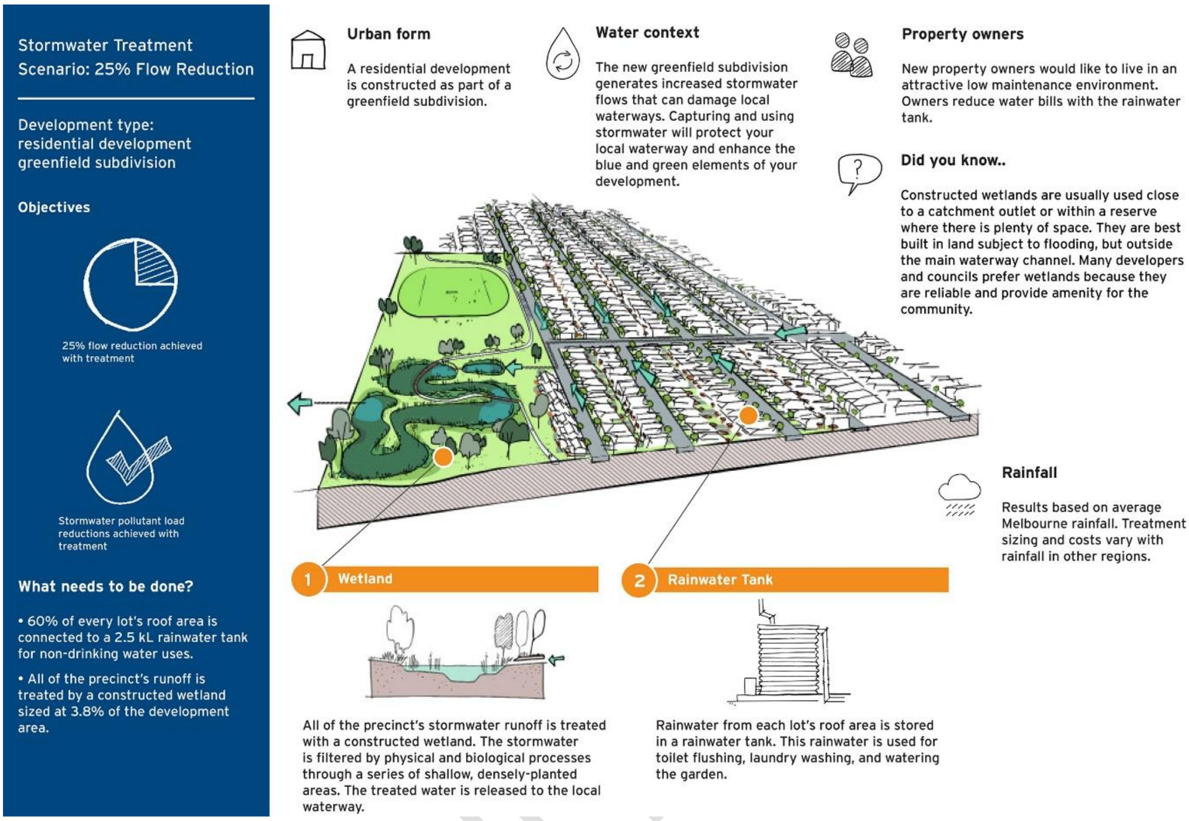
- *Liquid storage and handling guidelines* (publication 1698, June 2018)
- *Solid storage and handling guidelines* (publication 1730, July 2019)
- *Construction - guide to preventing harm to people and the environment* (publication 1820, October 2020)
- Erosion and sediment advice for businesses
- *Doing it right on subdivisions: Temporary environmental protection measures for subdivision construction sites* (publication 960)
- *Environmental guidelines for major construction sites* (publication 480)

Note: EPA publications 480 and 960 are under review and new guidance is being developed.

3 Indicative stormwater treatment scenarios

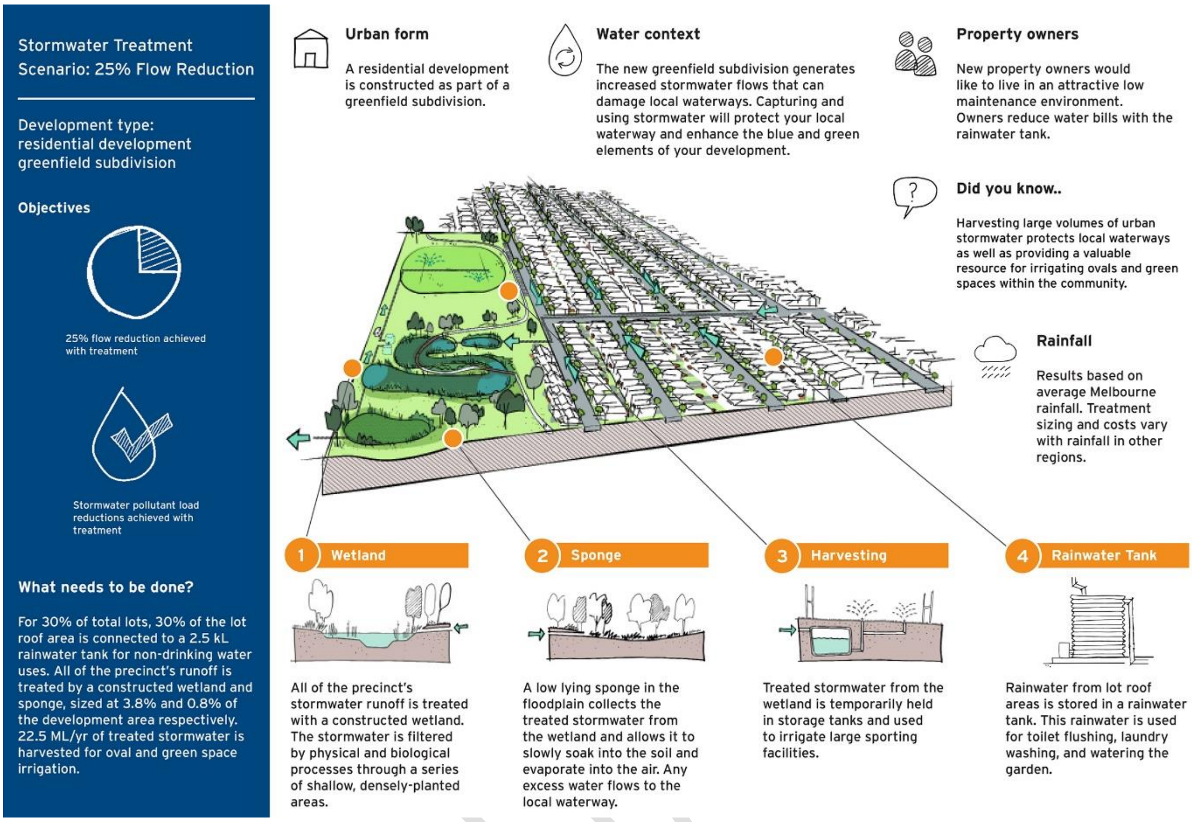
Scenario 1: 25 per cent flow reduction.

Development type: residential development, greenfield subdivision.



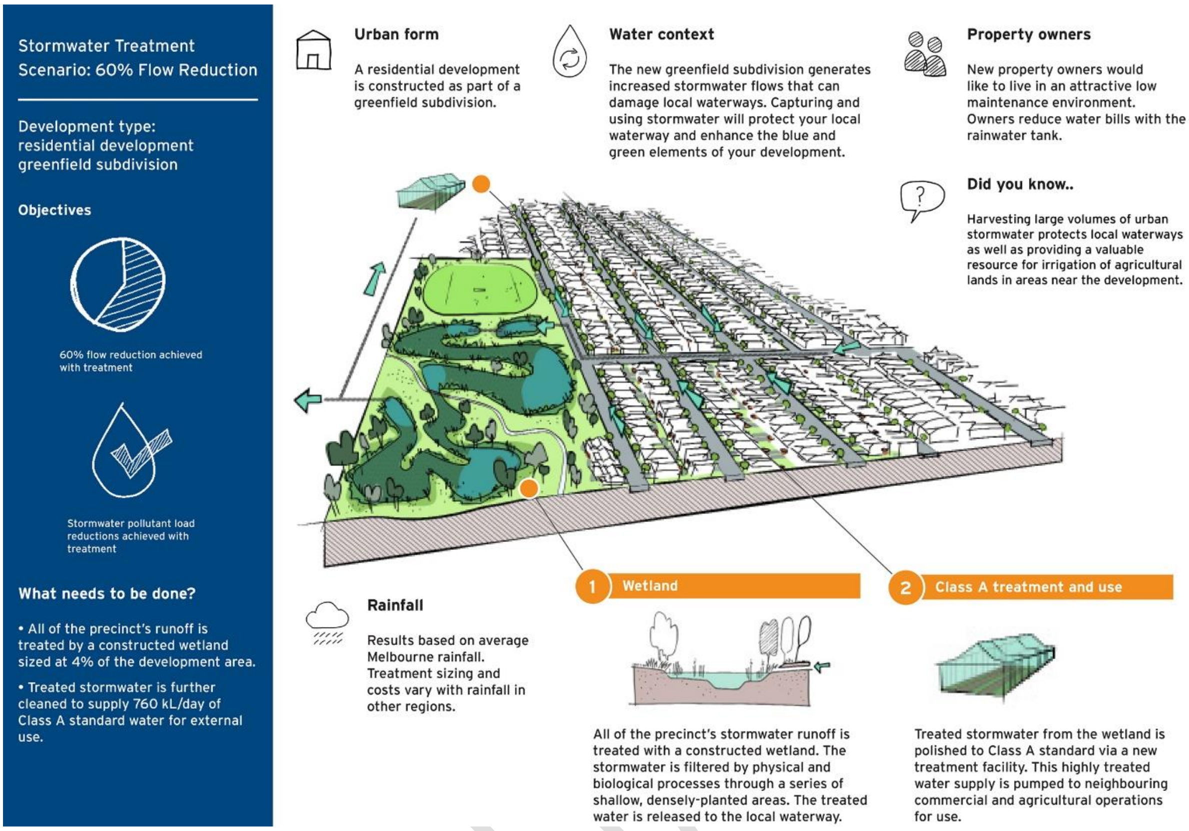
Scenario 2: 25 per cent flow reduction.

Development type: residential development, greenfield subdivision.



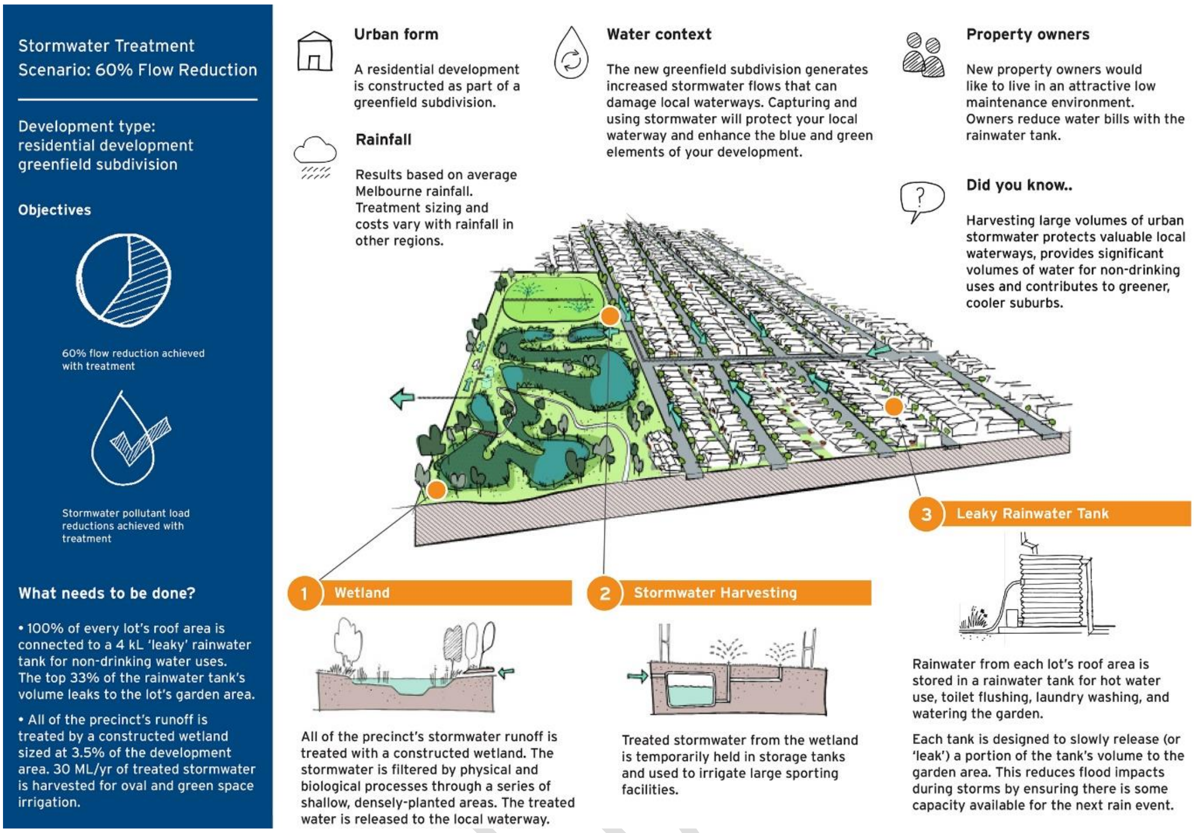
Scenario 3: 60 per cent flow reduction.

Development type: residential development, greenfield subdivision.



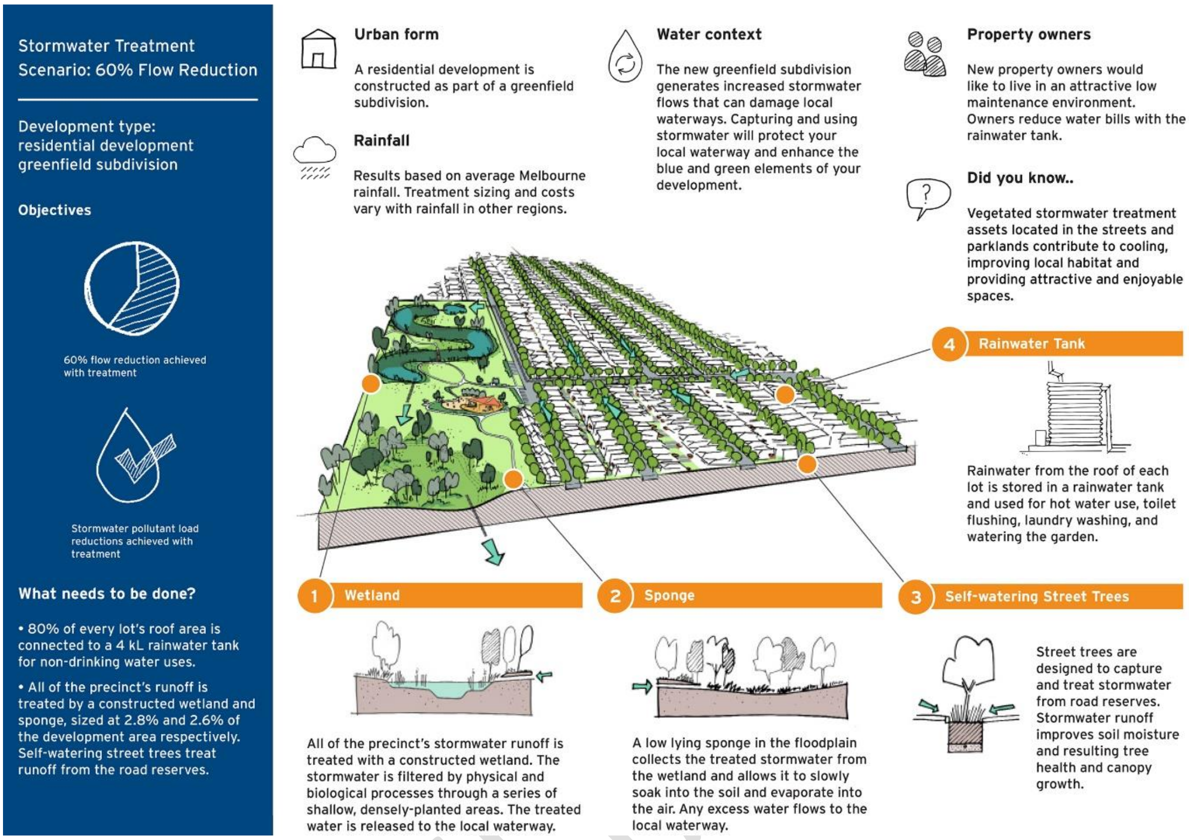
Scenario 4: 60 per cent flow reduction.

Development type: residential development, greenfield subdivision.



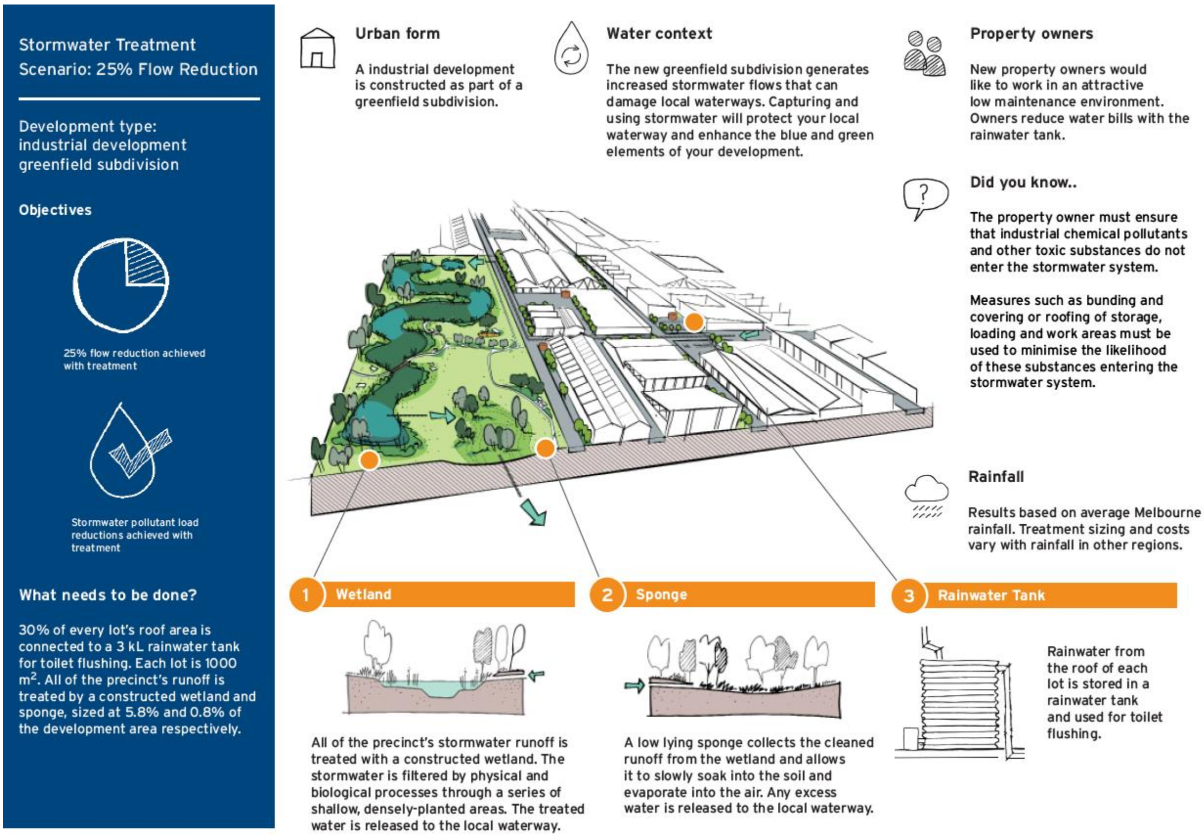
Scenario 5: 60 per cent flow reduction.

Development type: residential development, greenfield subdivision.



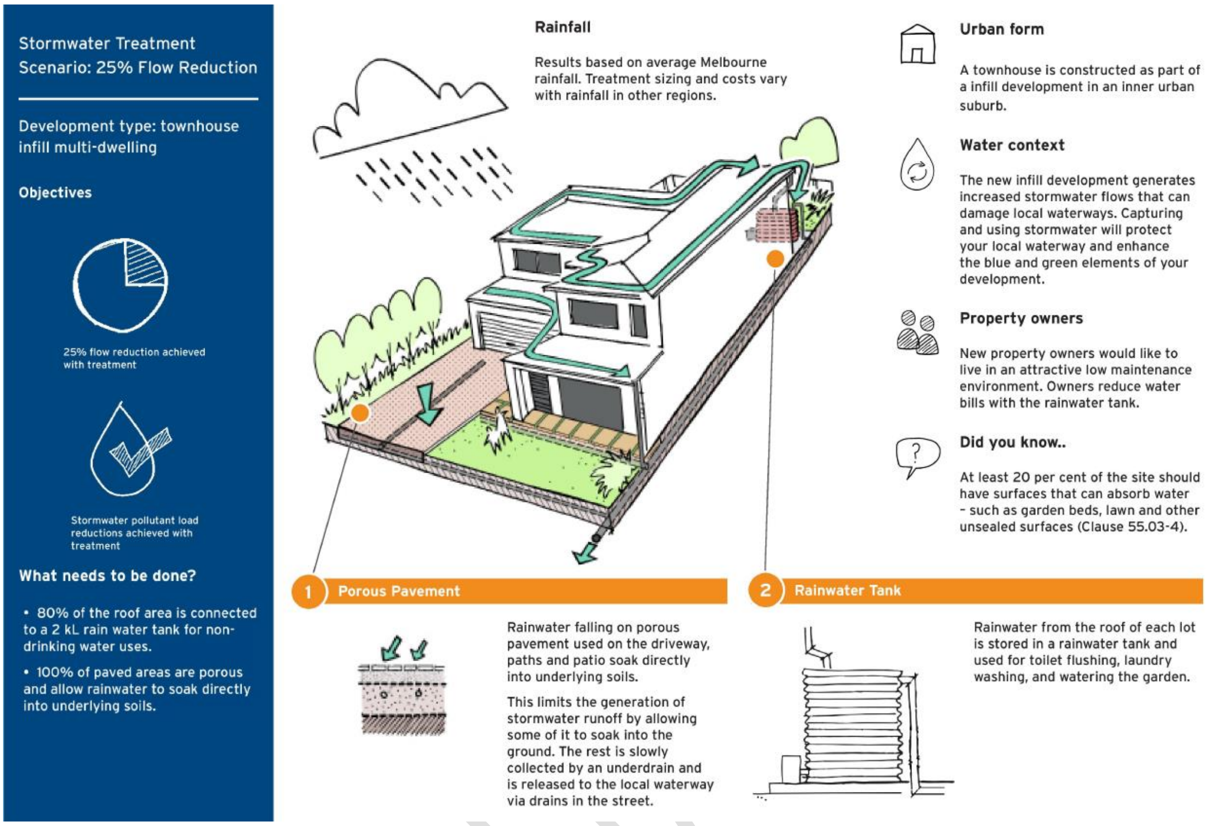
Scenario 6: 25 per cent flow reduction.

Development type: industrial development, greenfield subdivision.



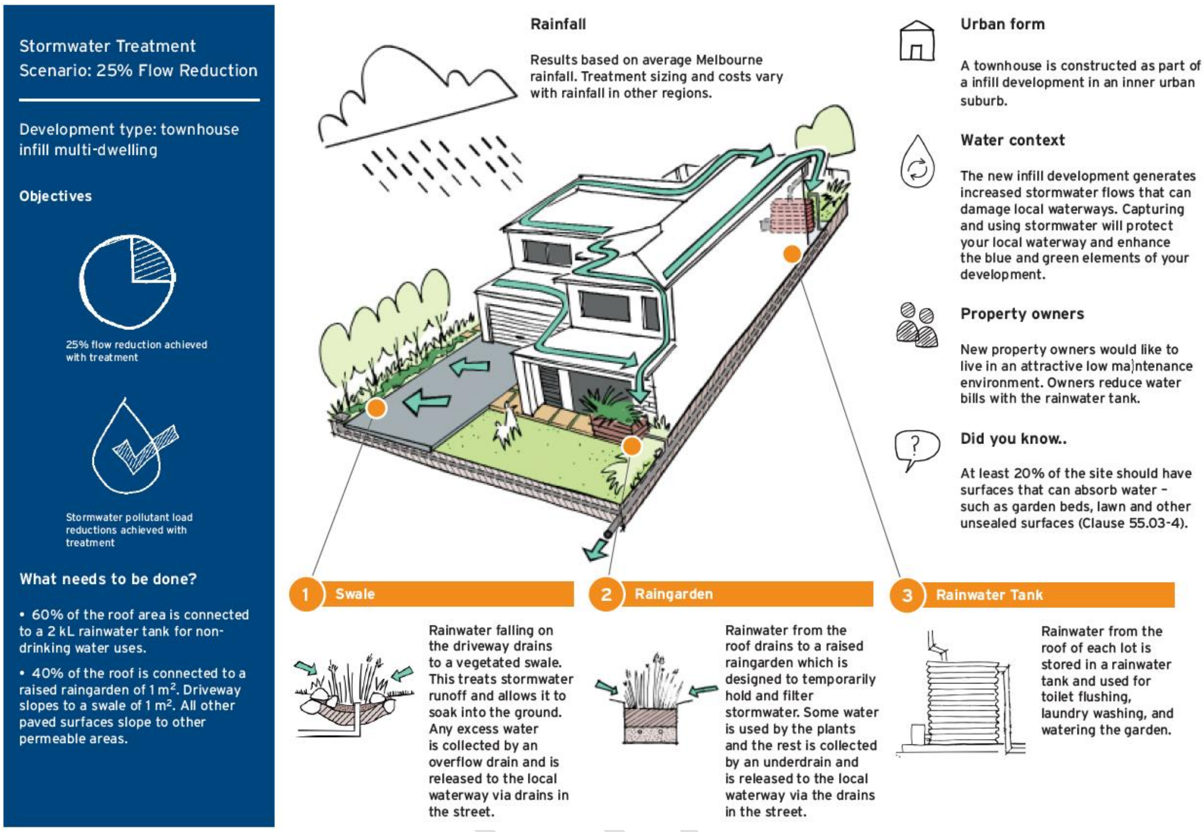
Scenario 7: 25 per cent flow reduction.

Development type: townhouse infill multi-dwelling.



Scenario 8: 25 per cent flow reduction.

Development type: townhouse infill multi-dwelling.



Scenario 9: 25 per cent flow reduction.

Development type: detached house, infill subdivision.

Stormwater Treatment
Scenario: 25% Flow Reduction

Development type: detached house, infill subdivision

Objectives

25% flow reduction achieved with treatment

Stormwater pollutant load reductions achieved with treatment

What needs to be done?

- 100% of the roof area is connected to a 3 kL rainwater tank for non-drinking water uses.
- 100% of paved areas are porous and allow rainwater to soak directly into underlying soils.

Rainfall

Results based on average Melbourne rainfall. Treatment sizing and costs vary with rainfall in other regions.

Urban form

A detached house is constructed as part of a infill development in an urban suburb.

Water context

The new infill development generates increased stormwater flows that can damage local waterways. Capturing and using stormwater will protect your local waterway and enhance the blue and green elements of your development.

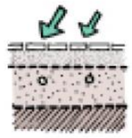
Property owners

New property owners would like to live in an attractive low maintenance environment. Owners reduce water bills with the rainwater tank.

Did you know..

There are many different types of porous paving to suit a range of land uses, existing soils types, aesthetic preferences, and price points.

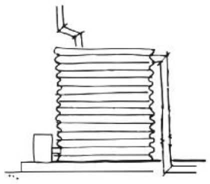
1 Porous Pavement



Rainwater falling on porous pavement used on the driveway, paths and patio soak directly into underlying soils.

This limits the generation of stormwater runoff by allowing some of it to soak into the ground. The rest is slowly collected by an underdrain and is released to the local waterway via drains in the street.

2 Rainwater Tank



Rainwater from the roof is stored in a rainwater tank and used for toilet flushing, laundry washing, and watering the garden.

Scenario 10: 25 per cent flow reduction.

Development type: detached house, infill subdivision.

Stormwater Treatment Scenario: 25% Flow Reduction

Development type: detached house, infill subdivision

Objectives

25% flow reduction achieved with treatment

Stormwater pollutant load reductions achieved with treatment

What needs to be done?

- 60% of the roof area is connected to a 2 kL rainwater tank for non-drinking water uses.
- 40% of the roof area and all paved areas are connected to a 3 m^2 in-ground raingarden.

Rainfall

Results based on average Melbourne rainfall. Treatment sizing and costs vary with rainfall in other regions.

Urban form

A detached house is constructed as part of a infill development in an urban suburb.

Water context

The new infill development generates increased stormwater flows that can damage local waterways. Capturing and using stormwater will protect your local waterway and enhance the blue and green elements of your development.

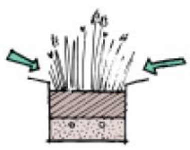
Property owners

New property owners would like to live in an attractive low maintenance environment. Owners reduce water bills with the rainwater tank.

Did you know..

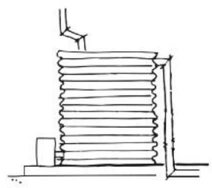
If you install 3 kL rainwater tank for toilet flushing, laundry washing, garden irrigation and internal hot water, you can reduce the area of the raingarden from 3 m^2 to 2 m^2.

1 Raingarden



Stormwater runoff from the driveway, paths and roof drains to an unlined, in-ground raingarden in the front garden. The raingarden is designed to temporarily hold and filter stormwater. Some water is used by the plants and some soaks into the underlying soils. The rest is slowly collected by an underdrain and is released to the local waterway via drains in the street.

2 Rainwater Tank



Rainwater from the roof is stored in a rainwater tank and used for toilet flushing, laundry washing, and watering the garden.

4 Glossary

Baseflow
The component of streamflow groundwater discharge supplies.

Development
Includes construction or carrying out of works, including building and road construction.

Flow regime
The range of flows a waterway experiences throughout the seasons and years, which may include baseflows, low flows, high flows, overbank flow and cease to flow (drying) events.

Impervious
Impermeable; sealed surfaces, such as roofs and roads.

Receptor
Something of value that hazards can harm, including humans and the environment. For example, animals, vegetation and waterways. We use ‘receptor’ and ‘receiver’ interchangeably in this guide.

Sensitive receivers
Sensitive areas or species from a human or environmental context, which include, but are not limited to:

- social surroundings (houses, hospitals, schools, playgrounds, public amenities)
- waterways, streams, sources of drinking water for people or livestock
- parks and recreational areas
- areas of public interest and cultural significance
- land or water with identified flora, fauna, vegetation, ecosystem or environmental value.

Stormwater
Surface runoff from rain and storm events.

Treatment train
A sequence of treatment controls designed to manage potential impacts to the environment.

Urban
Areas that are well developed for residential, industrial or commercial activities, including roads.

Waterway
Has the same meaning as in the *Water Act 1989* and includes a river, creek, lake or other body of water.

5 Appendix

5.1 Identify hazards: why is uncontrolled urban stormwater a hazard?

Urban runoff carries a range of pollutants that degrade waterways, including wetlands, beaches and bays. Changes to waterways' flow regimes that urban stormwater runoff causes also damages aquatic ecosystems and reduces amenity by, for example, erosion and litter transport.

What activities generate urban stormwater?

The creation of impervious surfaces – including roads, residential or commercial development – generates urban stormwater. In forested or vegetated catchments, rain or surface water is taken up by trees and plants, or infiltrates into the soil and travels to waterways as subsurface flows. However, in urban catchments impervious surfaces like roofs and roads replace this natural landscape. Rain runs off these surfaces and drains rapidly transport it into rivers, lakes, estuaries and bays. This runoff is called urban stormwater and has the potential to cause harm to human health and the environment.

The impacts of urban development on the water cycle are shown in Figure 3, which compares the urban water cycle in an undeveloped catchment (left) and an urban catchment (right). It shows the relative scale of evaporation, transpiration and surface runoff in each setting. The size of the arrows represents the volumes of water these processes transport.

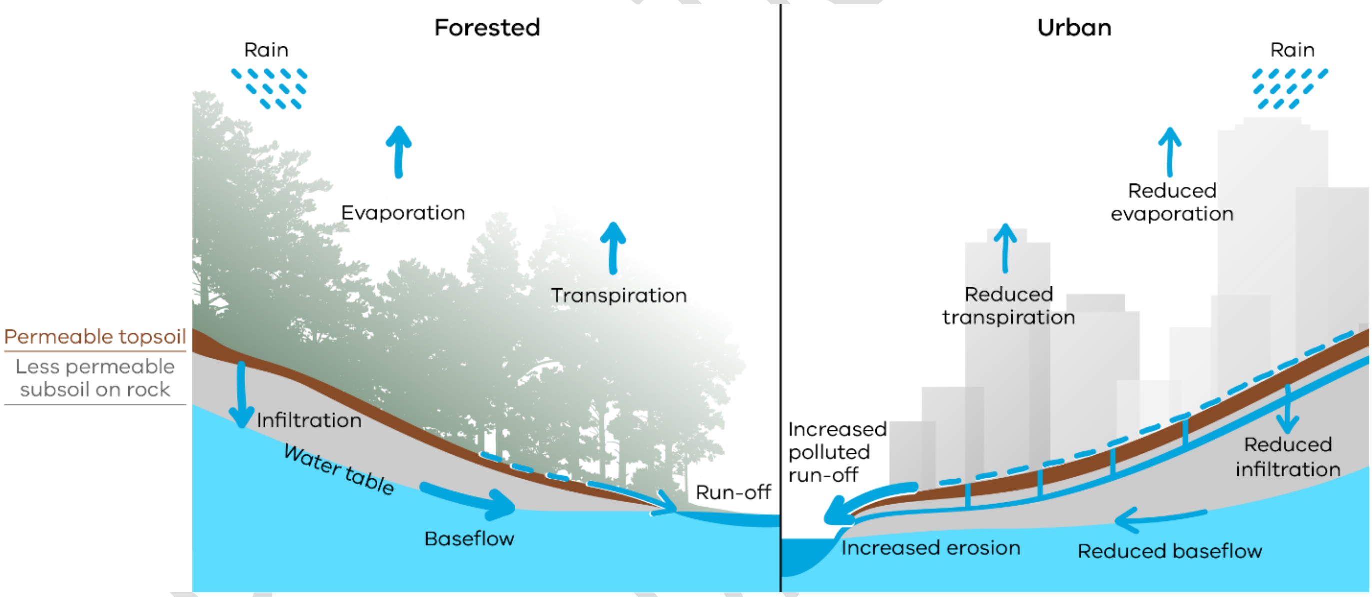


Figure 3: Melbourne Water 2013 (adapted from Walsh et al., 2004).

Potential impacts of urban stormwater discharges

The changes to stormwater volume and quality resulting from urbanisation can have a significant impact on surface waters, including:

- rivers
- streams
- lakes
- estuaries
- wetlands
- bays
- coastal waters.

The increased flows of polluted stormwater can have significant adverse consequences in urbanised areas.

Degradation of urban waterways

Urban stormwater impacts contribute significantly to the degradation of waterway ecologies.[4] Even at low levels of urbanisation, significant adverse impacts can occur when impervious surfaces are connected to urban streams through drainage pipes[5]. These impacts can cause significant harm to aquatic ecosystems, particularly sensitive species of invertebrates and fish, and also platypus.

Modelling suggests that to maintain the ecological values of many relatively healthy streams in Melbourne's growth areas, very high volumes of stormwater would have to be retained or reused. In particular, streams in the northern and western growth corridors are in drier parts of the city, and therefore would need higher stormwater flow reductions to avoid impacts.

Conventional drainage practices transport stormwater to urban waterways as quickly as possible. The continued use of these practices is expected to cause the degradation of an additional 900 kilometres or more of stream length when Melbourne is developed to its urban growth boundary.[6]

Many of Victoria's regional cities and towns are also growing substantially. There is similar potential for degradation of waterways associated with these centres unless stormwater management practices improve.

Degradation of downstream waterbodies

Uncontrolled stormwater runoff can also harm downstream bays, lakes and coastal waters, and pose a risk of harm to human health. For example, urban stormwater runoff is a threat to the values of Port Phillip and Western Port bays, as it carries sediments, nutrients, toxicants, pathogens and litter.

The *Port Phillip Bay Environmental Management Plan* emphasises the need to control the levels of pollutants that stormwater carries to the bay to avoid increases in pollutant loads as Victoria's population and urbanisation continue to expand.

Heavy storms can flush stormwater and other forms of pollution into bays, lakes and streams, making them less safe for swimming, as evidenced by beach advisories in Port Philip Bay following storms.

Catchment management authorities develop regional waterway strategies identifying priority waterways and management actions to reduce the threat of poor water quality.

Economic impacts

There are other adverse impacts associated with urban stormwater's degradation of urban waterways and downstream water bodies. These include economic impacts on tourism, commercial fishing and aquaculture. These impacts are likely to grow along with Victoria's population levels. If current management scenarios continue it is expected there will be:

- greater stormwater-related flooding
- reduced public safety
- damage to community infrastructure and private property.

[4] Fletcher, T.J., et al. 2011
[5] Walsh, C. J., et al. 2005
[6] Vietz, G. J., et al. 2014

Social impacts

The conventional drainage practices that transport stormwater to urban waterways as quickly as possible result in lost opportunities to use stormwater more productively, for example:

- mitigating the 'urban heat island' effect (discussed below)
- reducing potable water consumption. For example, through open space watering
- supporting greener, more pleasant urban landscapes
- maintaining vegetation in community spaces during extended periods of low rainfall.

The urban heat island effect refers to the general increase in temperatures in urban areas, compared with surrounding rural land.[7] There is evidence that this effect exacerbates the increased mortality and morbidity associated with extreme heat events.[8] Effective use of stormwater has been identified as a way to mitigate the urban heat island effect, including by increasing evapotranspiration and increasing the availability of water to support urban vegetation.[9]

In summary, conventional stormwater management can cause:

- significant harm to receiving environments
- additional financial costs for the community and waterway managers
- waste of a useful resource, in particular for urban green spaces.

Without changes in management practices, these impacts on the environment and human health will continue.

[7] Arnfield, A. J. 2003.
[8] Alexander, L. V. and Julie M. A. 2009.
[9] Mitchell, V.G., et al. 2008, and Coutts, A. M., et al. 2013.

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