WSUD 06

WATER SENSITIVE SA

InSite Water Tool

Stormwater management for small-scale development

USER MANUAL

December 2019

This *User Manual* aims to provide a user-friendly guide to inform water efficiency and stormwater design for small-scale developments – introducing the Water Sensitive SA InSite Water Management Tool (Insite Water), an online stormwater assessment tool, to facilitate and streamline the assessment process.

This manual will help users of Insite Water to assess the performance of the proposed water efficiency, water sensitive urban design (WSUD) and flood control elements of a development against the design criteria pre-set within the Tool.

This document should be read in conjunction with the *Water Sensitive SA Guide for Water Sensitive Urban Design* (WSSA 2018) which outlines the general principles for using Water Sensitive Urban Design on small sites, and other relevant documents such as the *South Australia Water Sensitive Urban Design Policy* (Department of Environment, Water and Natural Resources 2013).

This manual is part of a suite of resources that have been created to support development applications, serving as an ancillary technical document with respect to water conservation and efficiency, and stormwater runoff flow, volume and quality management.

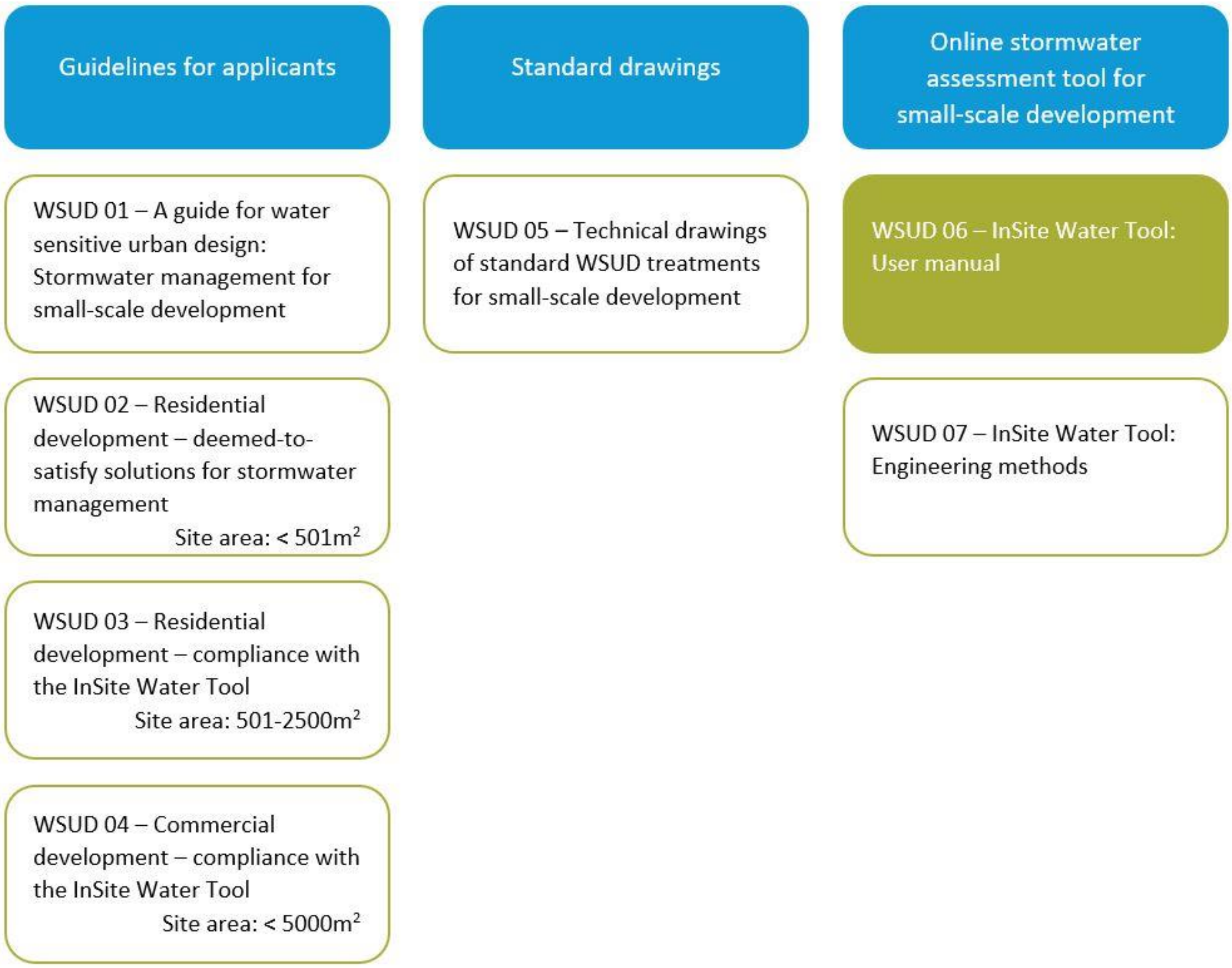

Figure 1: Water sensitive urban design resources for development applicants

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Overview

Incorporation of water sensitive urban design (WSUD) is required to be considered in all new urban developments. The Insite Water Management Tool (the Tool) provides an efficient and technically robust method to demonstrate whether the design features of small-scale developments have met performance criteria for:

- water conservation and efficiency
- the quality, volume and flow rates of stormwater runoff discharged to waterways and marine environments, via Councils drainage system.

This tool makes it easier to design a stormwater management strategy to meet development plan policy, and Building Code of Australia (SA) and Council engineering requirements in an integrated manner, including the *South Australia Water Sensitive Urban Design Policy* (Department of Environment, Water and Natural Resources, 2013).

To ensure that developments meet WSUD performance benchmarks, several best practice and management guidelines have been adopted.

What type of development can be assessed using the Tool?

The Tool can be applied to small-scale development sites (less than 5,000 m^2) in South Australia. Note: for sites larger the 5000 m^2, or very complex developments, the eWater MUSIC software or other equivalent stormwater design package can be used for stormwater design to demonstrate compliance with performance criteria for stormwater runoff quality[1].

The Tool is suitable for the design of stormwater management solutions for:

- additions
- single dwellings
- dual occupancies
- townhouses
- apartments
- commercial, retail and light industrial developments.

Across Australia, Councils are contending with the stormwater management challenges associated with the cumulative impacts of small-scale developments within highly urbanised areas. Increasing urban density intensifies stormwater impacts of flooding, scouring downstream creeks and rivers. Increasing impervious areas overwhelm existing pipes and infrastructure, and accelerates destruction of aquatic and riparian habitat through changing the flow regimes in waterways. They also prevent infiltration of water that would otherwise help sustain deep rooted vegetation, such as trees.

WSUD principles that inform the Tool

The stormwater drainage systems within established suburbs have not, in most cases, been designed to accommodate the density of urban renewal being experienced in Adelaide's suburbs and some South Australian regional centres. The higher proportions of impervious areas directly connected to Council stormwater systems within medium- to high-density developments presents a challenge. As it is often not feasible to upgrade existing drainage systems, a shift in approach to source control of stormwater is needed to:

[1] MUSIC is a commercial software package produced by eWater – https://ewater.org.au

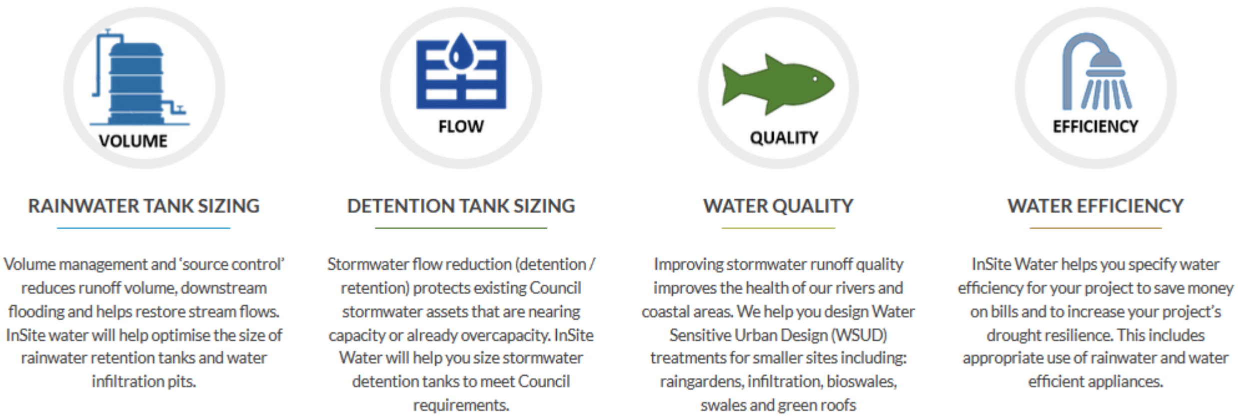
- reduce the frequency of local nuisance flooding
- reduce overall catchment flood risk by reducing volumes of stormwater
- protect minor stormwater system assets
- reduce pollutants entering watercourses and marine environment
- reduce the urban heat island effect providing enhanced microclimate through evapotranspiration and by enabling tree growth.

WSUD elements modelled by the Tool

This simple tool will assist state and local government and the development industry to assess the adequacy of the size of proposed WSUD elements, in particular stormwater management solutions.

The Tool operates via a website interface platform that allows the user to optimise:

- rainwater retention tank size
- detention tank size
- infiltration systems
- stormwater runoff quality treatments, such as raingardens
- water savings through efficient appliances and plumbing products, and/or substitution of mains water demand with alternative water sources:
  - rainwater – for toilets, laundry cold taps, hot water services (HWS) and outdoor uses
  - treated stormwater or recycled wastewater – for toilets and outdoor uses.



This User Manual should be read in conjunction with the associated *Water Sensitive SA Guide for water sensitive urban design: Stormwater management for small-scale development*, which details a variety of WSUD features that may be incorporated within developments.

Limitations and disclaimer

The conceptual design functions of the InSite Water Tool are of a general nature, suited for planning approval stage only. Advice from a suitably qualified professional should be sought for your circumstances. Depending on each unique situation, there may be occasions where compliance is not achieved.

Note: For sites larger the 5000 m^2, or very complex developments, the eWater MUSIC software or other equivalent stormwater design package can be used for stormwater design to demonstrate compliance with performance criteria for stormwater runoff quality[2].

The following is outside the scope of this guide; and it is important that all designers consider the following:

- Detailed design including placement and sizing of pits, pipes and stormwater devices, and design of overland flow paths will still need to be undertaken after InSite Water analysis.
- Manage expectations and risks around occasional surface water and ponding.
- Ensure that uncontrolled stormwater does not flow over property boundaries or otherwise cause a nuisance.
- Plan for major flood pathways – locate away from, adapt (raise floors above predicted flood levels) and defend buildings against potential major flooding.
- Plan to reduce annual average damages and safety risks.
- Consider local conditions such as slope, topography and soils (type, reactivity, permeability, water table level, salinity, dispersiveness, acid sulphate soils, etc.).
- Ensure that soil moisture and building clearance is considered in areas of reactive clays or where varying soil moisture levels could damage buildings.
- For steeper sites, ensure the design includes geotechnical considerations such as slope stability with varying soil saturation levels.
- Compliance with other Australian Standards, regulations and Council requirements.

[2] MUSIC is a commercial software package produced by eWater – https://ewater.org.au

1 Tool methodology

Tool features

An objective of the InSite Water Tool is to get the balance right between a simple user interface and technically robust engineering numbers. The web-based platform provides:

- Optimisation of stormwater management solutions for:
  - commercial developments less than 5,000 m^2
  - residential developments of up to 2,500 m^2
    Note: Residential development >2,500 m^2 is likely to include a public road, making the solution too complex for this simplified tool.
- The ability for users to create a unique login, to create multiple projects and to save their work.
- A pre-programmed database tailored to the stormwater requirements of specific areas, including performance targets, rainfall and IFD data, and default storm durations for detention/retention sizing.
- Streamlined reporting for a development proposal including ability to generate a simplified compliance report that can be downloaded or submitted directly for compliance checking.

Tool performance criteria

InSite Water enables optimisation assessment against the performance targets for the following parameters:

Table 1: Typical stormwater management solutions that can meet the performance objectives

	VOLUME	FLOW	QUALITY	EFFICIENCY
Objective	Harvest or infiltrate stormwater	Control peak discharge flows	Improve stormwater runoff water quality	Increase drought resilience
Target	No increase in annual average runoff volume (post-development compared with pre-development) (a 10% increase is allowed as a margin of error in the tool)	Increase in peak discharge flows (post-development compared with pre-development) less than or equal to zero.	Achieve a pollution reduction score of 100[1] or more [1]A score of 100 is equivalent to achieving a 45% reduction in nitrogen runoff	Greater than 25% potable water use reduction
Typical solutions				
Rainwater (retention) tanks	✓	✓	✓	✓
On-site detention (OSD)		✓		
Permeable paving	✓	✓	✓	
Infiltration systems	✓	✓	✓	
Unlined swales	✓		✓	
Biofiltration, e.g. raingardens			✓	
Water efficient fixtures with high WELS ratings				✓
Recycled water plumbed to toilets and outdoor uses				✓
Water efficient irrigation systems				✓

Acknowledgements

The equations in the Insite Water Tool are based on Melbourne Water's *Water Sensitive Urban Design (WSUD) Engineering Procedures* (CSIRO Publishing 2005), the Melbourne Water STORM tool, the new *Australian Rainfall and Runoff Guide* (ARR 2016) as well Australian stormwater industry best practices such as the retention sizing developed by John Argue OA[3] and the Natural and Built Environments Research Centre, University of South Australia.

We would also like to acknowledge the analysis by Peter Coombes and Michael Barry (2008) that utilises continuous simulation (using PURRS modelling[4] software) and virtual storage volumes to determine antecedent conditions in rainwater tanks for storm events.

[3] Argue J (2013) *WSUD – Basic handbook for Australian practice.* Published by Engineering Education Australia

[4] Coombes PJ and Barry ME (2008) *Determination of available storage in rainwater tanks prior to storm events*. Water Down Under 2008

1.1 Method overview

Project Details

- Site details including project name, type and size
- Ability to select Council area and enable the tool to pre-load appropriate IFD and local area rainfall data. 2016 IFD curves will be used from the Bureau of Meteorlogy (BoM).
- Ability to select site address using the visual Google Maps API, and determine the latitute and longitude of the site for further data lookups
- Determination of pre- and post-development runoff coefficients depending on the pre-development size and land use selected and post development impervious areas, respectively.

Volume Reduction

- Volume reduction methodology based on the principles in the 2016 Australian Rainfall and Runoff Guide (ARR 2016).
- Water balance calculations using daily precipitation, evaporation, water demand, overflow and rainwater capture area calculations.
- Continuous simulation of rainwater tanks using daily rainfall data. Water tank performance evaluated for retention and beneficial uses.
- Option to calculate size of groundwater infiltration system to reduce runoff volume and help restore stream flows wherever practicable.

Water Quality

- Require water sensitive urban design (WSUD) treatments in new developments wherever feasible targeting nitrogen reductions of 45% of the typical annual urban load.
- Available treatment systems included are rainwater tanks, raingardens, infiltration systems, permeable paving, green roofs and buffer swales.
- Water quality equations in the Tool are based on Melbourne Water's *Water Sensitive Urban Design (WSUD) Engineering Procedures* (CSIRO Publishing 2005).
- Calculations include the water quality benefits of the water tanks based on the volume reduction in the previous section.

Flow Reduction

- By default the tool calculates the required volume to capture a 1-in-5-year ARI 30 minute duration storm.
- If a volume retention strategy is used , Councils can nominate that if a volume retention strategy is used, either regime-in-balance or yield minimum approach be used by applicants (see "Local Catchment Details" section below)
- If an OSD strategy is preferred, Councils can nominate a detention systems calculator is applied by applicants instead. The detention calculator uses the rational method (Boyd's Equation) including: (a) volume calculation for storage system, and (b) detention calculations that confirm required detention storage volume
- Detention tanks are sized accounting for probabilistic initial airspace (PIA) volume retention from rainwater tanks.

Water Efficiency

- The water balance calculator determines water demand by using accepted standards for building occupancy rates, based on building type and floor area (excluding garages and carparks).
- Ability to select water efficiency of fittings and appliances.
- Irrigation demand calculator uses daily evapotranspiration data to determine daily irrigation demand.
- Uses the WELS standard, including standardised behavious assumptions contained in the WELS standards to estimate water demand based on occupancy and fitting and appliance water demands.

Figure 2 : Insite Water stormwater management tool methodology high level outline

2 Registration and navigation

2.0 Version and legal

Visit the following webpages for more information on InSite Water's:

- Website disclaimer
- Privacy policy
- Website terms and conditions

The Tool is still in the beta testing phase and further comment is encouraged on:

- Tool default stormwater design criteria
- Typical development scenarios to be addressed in the deemed-to-satisfy and general guidelines
- Online user interface accessed.

All feedback or issues should be lodged via https://www.watersensitivesa.insitewater.com/. Select 'Support' from the menu bar and use the "Contact us" form to send a message.

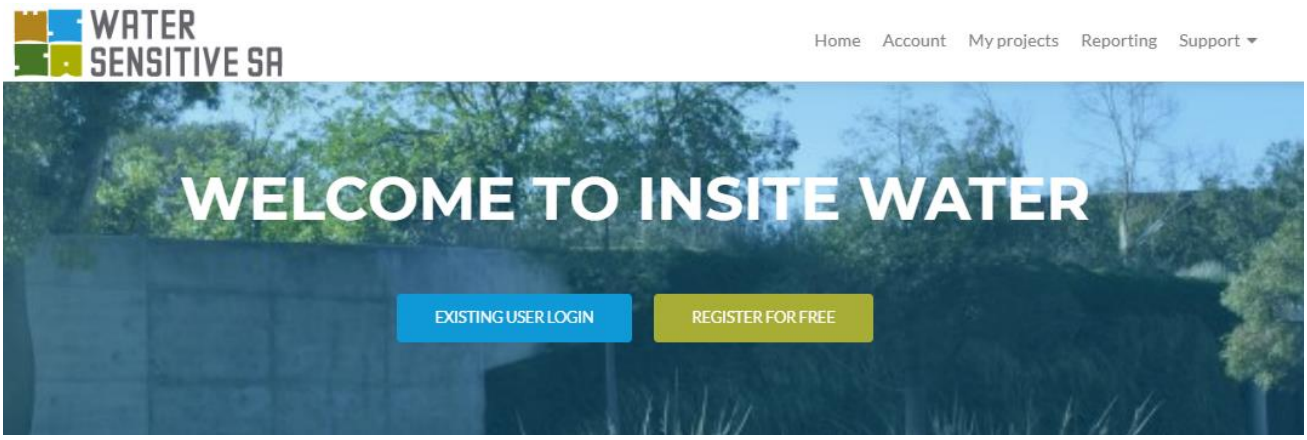


Figure 3: Screen shot of InSite Water tool home page (2019)

2.1 Registration and account details

To get started visit https://www.watersensitivesa.insitewater.com/
Register with your email and set up your user password.
Account details may be changed under the 'Account' section, access via the main menu at the top of the webpage.

2.2 'My projects'

To start a new project, click on the 'Create a new project' button.
Complete the three pages of the web-based Tool and submit the project to be able to generate reports that indicate the relative performance of the proposed development against the target criteria.
The process to complete a Project Assessment is discussed in Section 4.

You can save a draft, or return and edit a project at any time.

Note: Whilst inputting relevant details, please ensure to save progress using the:

(i) 'Save draft' button in the Tool or

(ii) 'Update' button on the fourth page when completing or updating an assessment.

To view current and previous projects submitted, go to 'My Projects' in the main menu at the top of the webpage.

Hitting the 'return' or 'enter' key on your keyboard will save and submit the form regardless of whether you have completed entering the project information; use the 'tab' key or your mouse to navigate through the form until you are ready to submit.

2.3 'Reporting'

To generate reports, go to the 'Reporting' section located in the main menu at the top of the webpage. See *Section 8 Producing reports* of this manual for more details.

2.4 'Support'

Navigate to 'Training and guides', via 'Support' located in the main menu at the top of the webpage, to find the latest copy of this manual, *A Guide to water sensitive urban design: Stormwater management for small-scale development (the Guide)*, and other information such as tutorial videos. Please use the contact form in 'Support' to advise of any bugs, or if you have suggestions for the next upgrade.

3 Undertaking a project assessment

3.0 Getting started

The following section details the steps required to complete an assessment for a particular project/ development.

Note: Deemed-to-satisfy solutions developed using the InSite Water Tool and *Minister's Specification 78AA Onsite retention of stormwater* are provided for sites less than 600 m^2/new allotment within the guideline *WSUD 02: Residential development – deemed-to-satisfy solutions for stormwater management.* That guide should be referred to in order to determine if the InSite Water tool is required to support an assessment application or whether a simplified solution is possible.

The use of InSite Water is considered to be favourable when assessing applications submitted to Council for:

(i) larger sites (above 600 m^2/dwelling, outside of the deemed-to-satisfy solutions) up to 5,000 m^2, that do not propose to include a public road. Sites larger than this should use other engineering analysis toolkits.

(ii) applicants seeking greater flexibility and choice in how the performance targets are met and sites whereby the deemed-to-satisfy provision approaches are unsuitable.

3.1 Project details (Screen 1)

Having determined the suitability to use InSite Water, go to 'My projects' in the main menu, at the top of the webpage and click on the 'Create a new project' button as indicated in Figure 4.

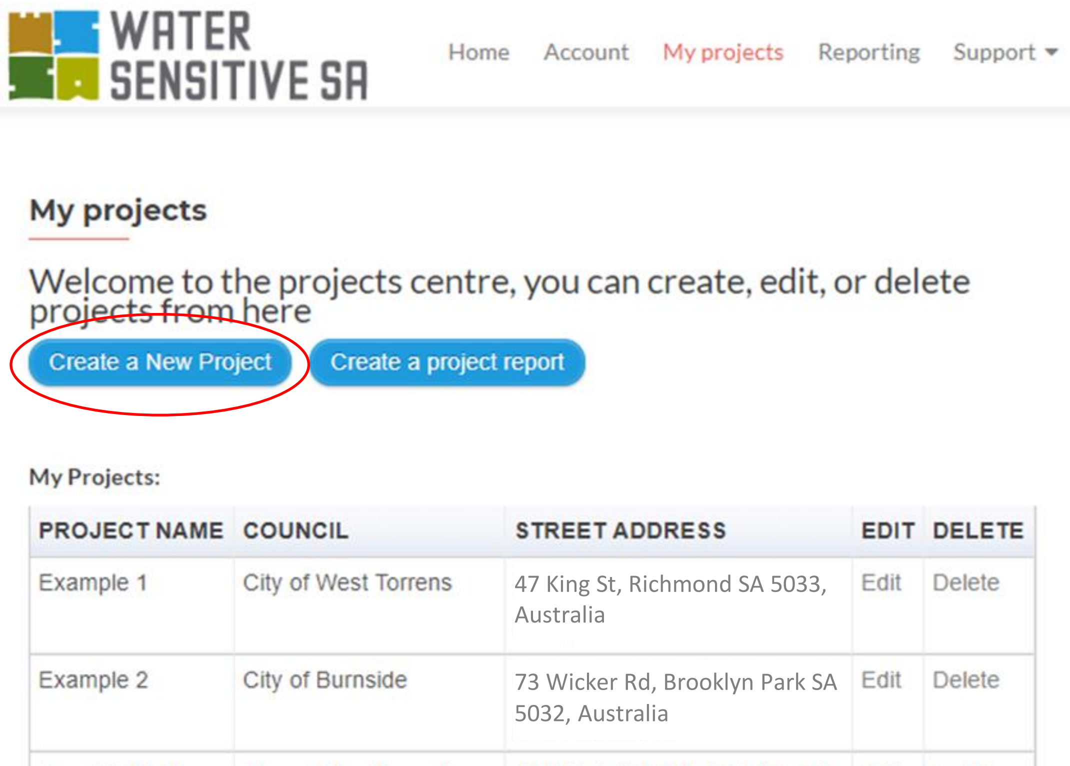


Figure 4: Creating a new project

Users will need to create an account and log in before you can create new projects.

3.2 Project details (Screen 2)

Once a new project has been created, complete the general specifications pertaining to the project requiring an assessment. Please note that some fields are mandatory as indicated by the red asterisk (*) and as reflected throughout the Tool. If the fields are greyed out, then they are automatically populated for you.

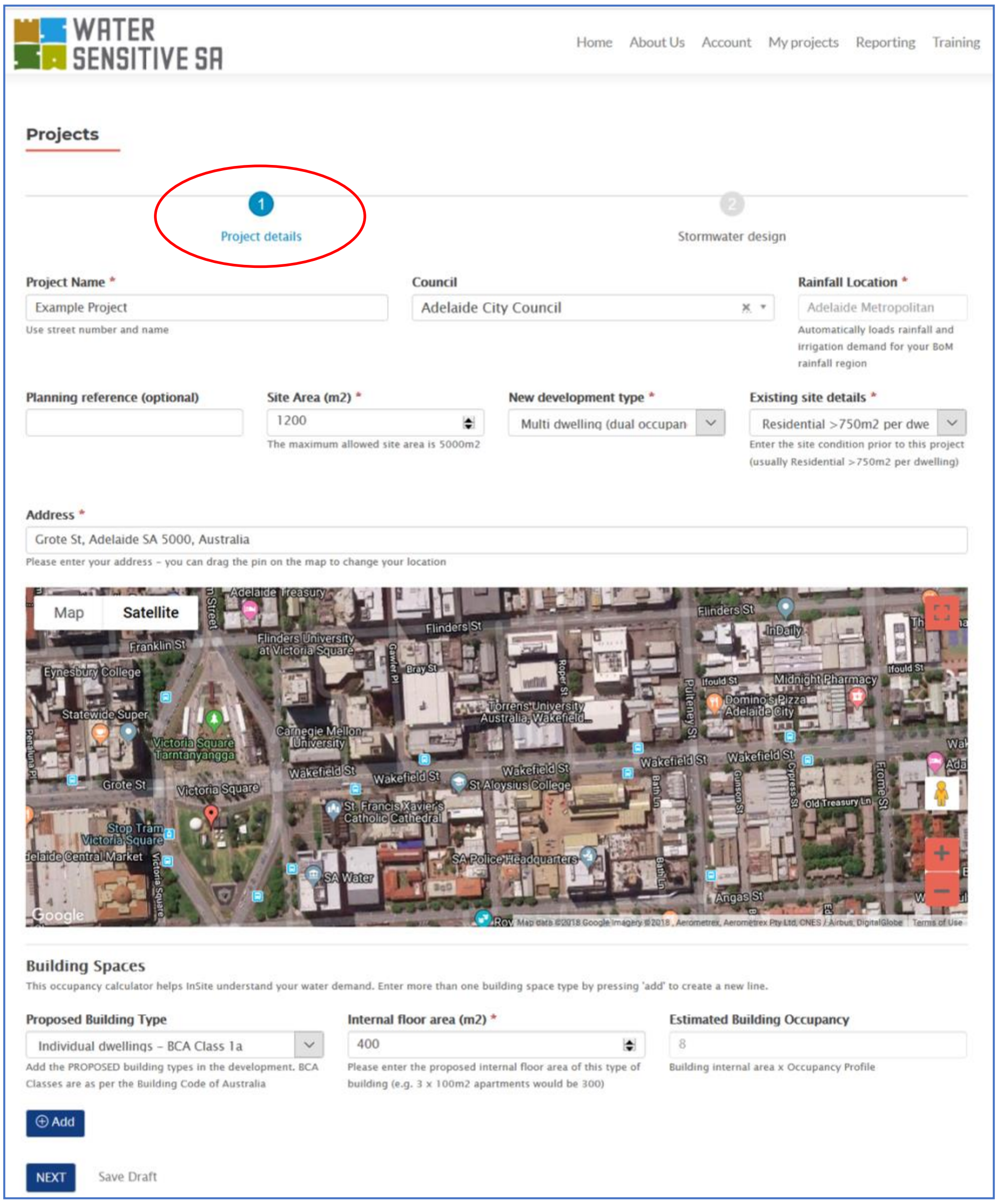


Figure 5: General specifications of the project with the requirement to complete mandatory fields

Site inputs

Key features requiring input to describe the site include:

- Project name
- Council [selecting your Council automatically loads all rainfall, IFD and climate data]
- Rainfall location [read only – this is loaded automatically based on your Council. Rainfall locations are based on Bureau of Meteorology forecast zones[5]. See Figure 2 of the InSite Water Online stormwater management tool for small-scale development: Engineering methods document for more information[6].
- Planning number [optional, as specified by Council]
- Site area (m2) [Enter the size of your site in square meters]
- Project type:

  Options include:
  - Single dwelling
  - Single dwelling extension
  - Multi-dwelling (dual occupancy, townhouse, villa unit etc.)
  - Multi-unit development (apartment building)
  - Non-residential development
  - Mixed use development.

- Address [Google Maps can be used to look up a site – drag the pin to change the location of site, you can also zoom in or out or engage the full screen mode]
- Building spaces
  - This section calculates the likely average occupancy for the site. This is required to understand the water demand, and therefore how a rainwater (retention and use) tank will work for your site.
  - For flexibility, you can enter the total 'Internal floor area' of your project in a single entry (or line), or if you have a mixed use development, you can enter any number of different building types and sizes. Note: The floor area of carparks and garages should be excluded from the 'Internal floor area'.
  - InSite Water will calculate an estimated building occupancy.

- Click 'Next' to go to the main section of the Tool

3.3 Stormwater design (Screen 3)

In addition to conveying stormwater in pipes, stormwater design should:

- reduce the total **volume** of runoff
- manage peak **flow**s so as not to overwhelm local drainage networks
- improve water **quality** flowing into streams and coastal areas
- improve water **efficiency** for drought resilience.

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[5] See http://www.bom.gov.au/sa/forecasts/map.shtml for more information about forecast areas

[6] *InSite Water Online stormwater management tool for small-scale development: Engineering methods*

Figure 6: The four stormwater management performance criteria

3.4 The following general steps are taken to complete the Tool:

STEP 1: Please enter all impervious areas in your site connected to Council or water authority drainage system. Gravel and lawn areas can be excluded. Enter any tank and WSUD treatments connected to each impervious area.

STEP 2: Press 'Calculate' and check which of the stormwater design performance criteria your project has passed.

STEP 3: Optimise your design by changing the impervious areas, tank sizes and/or WSUD treatments. Press 'Calculate' each time you make a change. You can also adjust 'Rainwater and recycled water option' and 'Efficiency settings' from the defaults set in the Tool.

3.4.1 Specify stormwater runoff and management solutions

In this section you are required to enter only the impervious areas in your site connected to Council or stormwater authority drainage system. Do not enter pervious areas like garden, lawn and gravel areas.

Use the buttons in this section of the Insite Water Tool to add or remove impervious areas.

Impervious areas can be individually entered or aggregated. For example: 3 x 100 m^2 roofs connected to 3 x 1000 L rainwater tanks could be aggregated as 300 m^2 of roof connected to 3000 L of rainwater tanks.

Criteria required to be inserted into the Tool is indicated in Table 1, with additional guidance provided where necessary.

Table 1: Stormwater quality relevant input criteria

<table>
<tr><th>Parameter</th><th>Input</th><th>Description</th></tr>
<tr><td>Impervious area</td><td>What sort of impervious area you are entering</td><td>Roof connected to tank [This will show the rainwater tank options of ‘Rainwater tank size’ and Detention tank size, and hide the stormwater treatment options]
Roof NOT connected to tank [Please note that for most residential development it is difficult to connect every downpipe to the water tank. This option allows other treatments to be selected for areas of roof that are not connected to the tank.]
Driveway
Car park
Courtyard
Impervious sporting court
Permeable/porous paving
Other</td></tr>
<tr><td>Impervious area name</td><td>Text</td><td>This is your own optional name for the area, e.g. Unit2 SW 50% roof
Note: The remainder of the roof area not connected to the rainwater tank(s) must be specified, as well as driveways and car parking areas if not composed of gravel or grass materials. Such features (roofs and driveways) may or may not be attributed with WSUD features, however must be specified in order to undertake an effective stormwater quality evaluation of the site.</td></tr>
<tr><td>Impervious area (m^2)</td><td>X m^2</td><td>Specify the size of the ‘Impervious area’ whether treated by a rainwater tank, WSUD feature or not treated.</td></tr>
<tr><td>Treatment type</td><td>This is the treatment type (WSUD element) for treating stormwater – see the Insite Water Guide for a comprehensive description of each treatment type</td><td>A range of WSUD features have been listed.
Please refer to the deemed-to-satisfy provisions for further details regarding each WSUD feature.
Grass buffer strip
Infiltration – sand, sandy loam, sandy clay, medium clay, and weathered or fractured rock [Selecting infiltration will help not only your water quality score, but also your volume score]
Pervious paving
Raingarden
Rooftop garden [Enter the area of rooftop planter boxes, or the area of roof covered with vegetation]
Swale
None [Use this or leave the treatment type blank for no treatment]
Note: If no WSUD feature has been attributed to the ‘Impervious area’, select ‘None’.
Infiltration treatments are chosen depending on their soil hydraulic conductivity. The conductivity for different soil types are as follows[7]:
<table>
<tr><th>Soil type</th><th>AS 2870 Classification</th><th>Soil Hydraulic Conductivity (K_h)</th></tr>
<tr><td>Sandy soils and sandy loam</td><td>Class A</td><td>5×10^{-5} m/s (180 mm/hr) or greater</td></tr>
<tr><td>Sandy clay</td><td>Class S</td><td>between 1×10^{-5} and 5×10^{-5} m/s (36–180 mm/hr)</td></tr>
<tr><td>Weathered or fractured rock</td><td>Class A</td><td>between 1×10^{-6} and 1×10^{-5} m/s (3.6–36 mm/hr)</td></tr>
</table></td></tr>
</table>

[7] Water, Melbourne. *WSUD Engineering Procedures: Stormwater: Stormwater* (Kindle Locations 6606-6609). CSIRO PUBLISHING. Kindle Edition.

Parameter	Input	Description
		Medium clay; Usually Class M / M-D; between 1×10^{-6} and 1×10^{-5} m/s (3.6–36 mm/hr)
		Heavy clay; Usually Class M / M-D; between 1×10^{-8} and 1×10^{-6} m/s (0.036–3.6 mm/hr)
Treatment size (m^2)	**X** m^2	Specify the size of the treatment area that is attributed to the impervious area specified (i.e. a 3 m^2 raingarden servicing a 120 m^2 driveway) Note: Treatments larger than 8% of the adjusted impervious area will not increase performance. Additionally, if 'None' has been specified as the 'Treatment type', input '0' as the 'Treatment size'.
Rainwater retention tank size (L)	Litres	Enter the size of the rainwater retention tank in litres
Detention tank size (L)	Litres	Enter the size of the detention tank in litres. This is provided to help calculate tank-based detention/retention strategies and the detention volume will be credited against the total FLOW storage volume required under the 'FLOW' criteria

3.5 Rainwater tank settings

The rainwater tank settings detail is hidden as a default in the Tool, press 'Click to expand' and view:

(i) Uses (or demand) connected to rainwater retention tanks

(ii) A summary of all retention and detention tank details.

In this summary section, InSite Water incorporates only the roof areas specified earlier in the 'Impervious areas', that are directly connected to the corresponding rainwater (retention and/or detention) tank. The remainder of the roof area that is not connected to the rainwater tank(s) is not considered in this section.

Given that rainwater tanks store stormwater, it is essential that they are connected to all toilet systems and it is beneficial if they are also connected to laundry appliances (cold taps) for water reuse purposes. Additionally, integrating rainwater tanks through the hot water system or for irrigative purposes can be modelled in this section of the Tool.

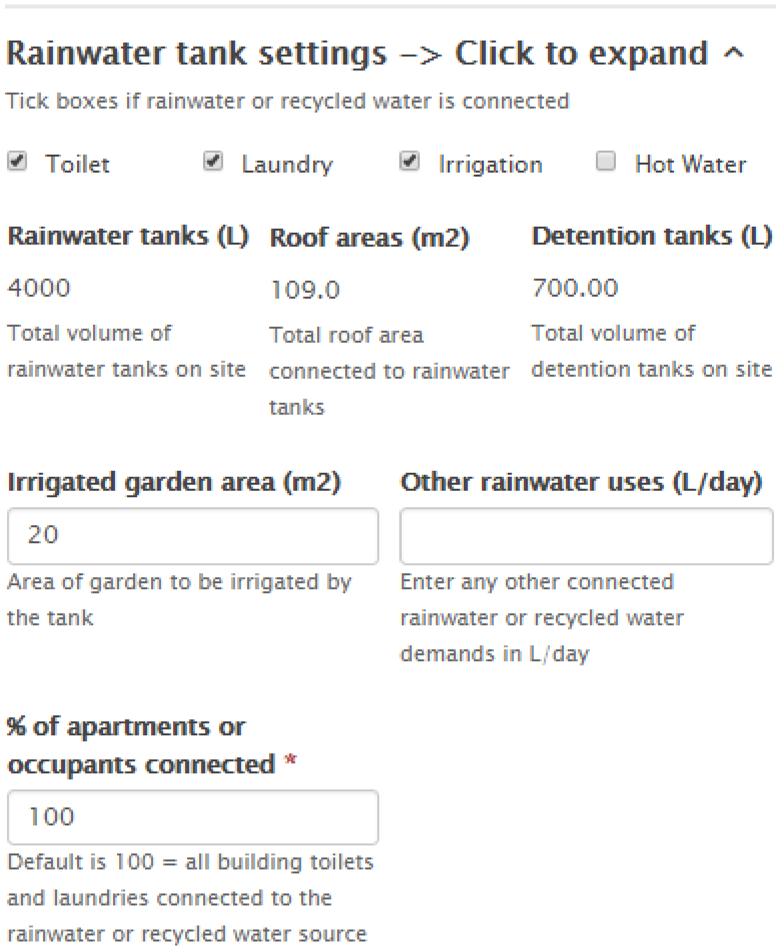


Figure 7: Screenshot of the rainwater tank settings drop-down

Relevant criteria that is required to be inserted into the Tool is indicated in Table 2.

Table 2: Rainwater tanks and recycled water connections relevant input criteria

Parameter	Input	Description
Toilet	☑	Tick box if rainwater or recycled water is connected
Laundry	☑	Tick box if rainwater or recycled water is connected
Hot water service	☑	Tick box if you will use rainwater for the hot water service
Irrigation	☑	Tick box if rainwater or recycled water is utilised
Rainwater tank volume (L)	**X** litres	Total volume of tanks on the development specified in litres (L)
Connected roof area (m^2)	**X** m^2	Total of roof areas connected to tanks specified in metres squared (m^2)
Detention tank volume (L)	**X** litres	Total volume of detention tanks on the development specified in litres (L)
Irrigated garden area (m^2)	**X** m^2	Area of the garden to be irrigated by the rainwater tank or recycled water (see 'Recycled water source') specified in metres squared (m^2)

Parameter	Input	Description
		Note: If there is supply available via a purple pipe scheme, demand will be assumed to always be met by that alternative supply, however if the supply is via a rainwater retention tank, then the model will only assume irrigation demand is met by the tank if the tank has sufficient storage.
Other rainwater uses (L/day)	**X** L/day	Enter any other connected rainwater or recycled water demand in litres per day (L/day). These may include known and predictable commercial or industrial uses, and calculations justifying this number should be appended to your report.
% of apartments or occupants connected	**X** %	Default is 100%, which equates to all building toilets and laundries connected to the rainwater or recycled water source. Some larger apartment or commercial buildings may decide that additional benefit is not gained by connecting more than a certain percentage of toilets.

3.6 Additional detention storage

If additional detention storage, separate to rainwater tank(s), is required on the site to meet peak flow management targets, the "additional site storage" volume provided adjacent to the legal point of discharge for peak flow detention can be entered in the Tool in the location highlighted below.

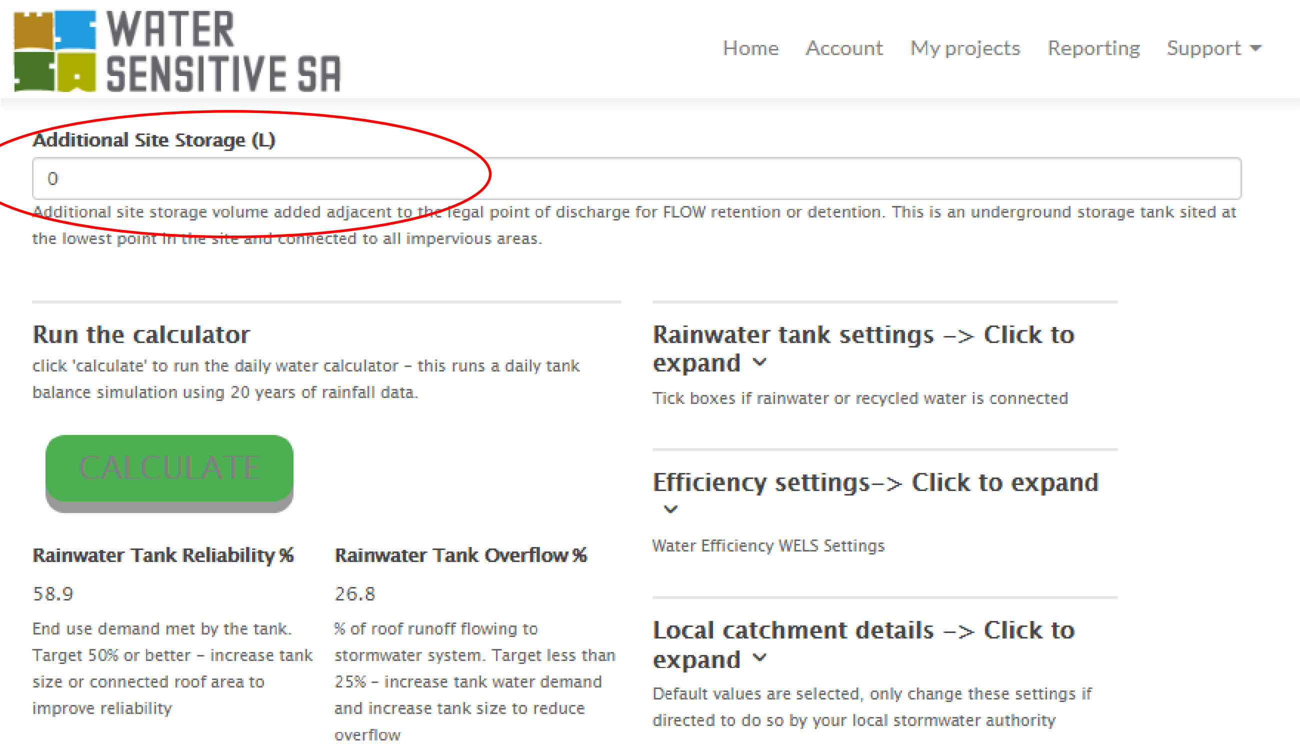


Figure 8: Screenshot of additional site (detention) storage

When a number is entered into 'Additional site storage' the tool will display a diagram. The diagram displayed will be either an infiltration system or a detention system.

- An infiltration system is displayed if the following is selected: Local catchment details -> Flow reduction strategy = Volume retention and / or infiltration.

- A detention system is displayed if the following is selected: Local catchment details -> Flow reduction strategy = Onsite detention (OSD)

3.7 Water efficiency settings

The efficiency settings detail is hidden as a default in the Tool. Press ‘Click to expand’ to view the default settings provided. The default settings are normally adequate to achieve the EFFICIENCY target when a rainwater (retention) tank is also installed. However, some projects may find that fittings and appliances with higher water efficiency may need to be adjusted to pass the efficiency section of the calculator – such as apartments with limited area in which to capture rainwater for all occupants.

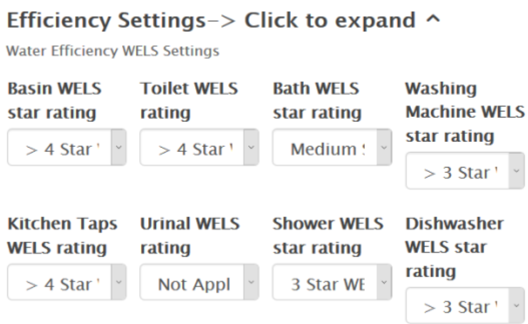


Figure 9: The water efficiency interface indicating the fixtures and respective dropdown menus available to indicate the WELS Rating standard achieved that is linked with intrinsic water savings

Use the dropdown options available to best reflect the fixtures that will be installed within the development. Options are available to reflect unrated or existing fittings, as well as exclude certain fittings as ‘Not applicable’ if they are not relevant to the development (i.e. urinals within a standard single dwelling = ‘Not applicable’).

Relevant fixtures incorporated within the Tool include:

- basins
- kitchen taps
- toilets
- urinals
- baths
- showerheads
- washing machines
- dishwashers.

Upon entering the relevant WELS ratings, results are automatically calculated and represented in the ‘Results’ section. The tool will calculate the difference between the internal water demand (kL/annum of water consumed) versus the typical benchmark water use for a conventional development of similar nature.

The results are available in the ‘Rainwater tank reliability%’ and ‘Rainwater tank overflow%’ section of the Tool and in the ‘Reporting’ Section of the tool.

The data is further transposed and reflected in the ‘Volume’ and ‘Flow’ result in the Tool. The Tool calculates savings from the tank expressed in kilolitres (kL) and as a percentage (%) assuming that rainwater from the tank is used preferentially for non-potable water use demands.

4 Local catchment details

Stormwater retention in rainwater tanks and infiltration into groundwater are encouraged by the ARR 2016 guide as having better outcomes for catchment management and water quality than traditional detention methods. These retention techniques reduce water volume and remove pollution, whereas stormwater detention does not. However, impacts on groundwater levels and quality and beneficial uses need to be assessed.

Strategic use of water efficiency, rainwater, stormwater infiltration and wastewater recycling at multiple scales can supplement the performance of centralised water supply and drainage systems to provide more sustainable and affordable outcomes (ARR 2016). These integrated strategies reduce the requirement to transport water, stormwater and wastewater across regions with associated reductions in costs of extension, renewal and operation of infrastructure. In particular, the concept of volume management has been emphasised (ARR 2016, Book 9, Ch. 4). The historical practice of designing urban stormwater systems has focused on peak flows, stormwater detention, and conveyance in hydraulically efficient pipes and channels. It is now recognised that volume of stormwater runoff, urban amenity and water quality treatment also need to be managed.

Detention is useful for street level asset protection, but a local detention approach has little value for larger catchments in terms of flood protection or water quality. This is because detention tanks are routinely sized on a site time of concentration (5-10 minutes) without reference to the larger time of concentration of the catchment (often 360 minutes or longer).

As stated in the new ARR 2016, Book 9, *Runoff in urban areas*, stormwater volume reduction through rainwater tanks, stormwater infiltration, pervious paving and other WSUD measures are more appropriate treatments for flood reduction than detention as they have wider catchment benefits beyond the local street pipe network.

By default, this tool uses methods pioneered by University of South Australia[8] utilising stormwater retention and infiltration into the ground. Most Councils' legacy stormwater requirements still focus on detention tanks, so we have included this OSD approach in the tool where strict legacy OSD requirements cannot be avoided.

Selecting flow reduction strategy

The 'Local catchment details' are hidden as a default in the Tool, press 'Click to expand' and view the options described below.

This section of the Tool allows Councils to specify which catchment strategy is required. The Tool's flexibility allows for catchment strategy variance from Council to Council. Users should only adjust these options if directed to do so by Council. The strategies are as follows:

Flow reduction strategy

Choose the method your site will use for peak flow reduction. Peak flow reduction reduces downstream flooding during large storm events.

(i) **Volume Retention and/or Infiltration** [This is the default selection. This option takes a volume reduction approach to peak flow management, reducing the total volume of stormwater rather than the flowrate from a site]

- **Catchment strategy required** [This option appears only when a volume reduction strategy is chosen]

[8] Argue, J (2013) *WSUD – Basic handbook for Australian practice*. Published by Engineering Education Australia

- **On-site retention (OSR) of volume to pre-development levels – regime-in-balance** [this strategy means that the volume of stormwater post development is the same as the volume of water prior to development for a 1-in-5-year storm. This option will help to reduce the flooding impacts of new development in an existing drainage scheme] see Argue J (2013)[9]
- **On-site retention (OSR) of entire volume of the design storm – yield minimum** ['Yield minimum' captures the entire volume of a 1-in-5-year storm. This option should be used in ecologically sensitive areas or areas where the drainage system is already at maximum capacity] see Argue J (2013)[10]

Note: Consideration should be given to any potential impacts in areas of high groundwater levels and in proximity to footings and other structures, associated with infiltration solutions

(ii) **On-site detention** (OSD) [This is the conventional method of OSD as outlined in ARR 1987 guide that is familiar to most stormwater engineers. This has been included to assist with compliance for Councils with a strong existing OSD policy]

See *InSite Water Online stormwater management tool for small-scale development: Engineering methods report* for further details on algorithms and background information on OSD versus volume management approaches.

Recycled water source

Tick this box ONLY if recycled water from a local (3rd pipe) scheme used in the building. A third pipe scheme is where a local water authority recycles water and reticulates it as a non-potable water supply. This calculator will assume that:

- **Rainwater (if a tank is connected) will be used preferentially to recycled water**.
- **Recycled water will be connected to limited end uses** (toilets and irrigation).
- **If recycled water is selected, the option to use it for laundry and hot water will disappear.**
- **Recycled water will meet the full demand of the chosen end uses**.

Note: Please seek additional environmental engineering advice if you are using recycled water to ensure you are meeting local, state and national guidelines. A health risk assessment should be undertaken on recycled water quality and suitable end uses to ensure that the design is fit for purpose.

Also, there are likely to be additional maintenance, licencing and backflow prevention requirements outside the scope of the InSite Water Tool and this manual.

If recycled water use from a recycled water treatment system or third pipe scheme is being utilised, relevant water savings are calculated and shown in the calculation report as a kilolitre (kL) saving and as a percentage (%).

5 Running the calculator

Upon entering the relevant information, click the ‘Calculate’ button to run the daily water calculator. A daily tank balance simulation, using 20 years of rainfall data, is calculated using the data inputs provided.

Depending on the results, you may have to adjust items or WSUD elements in your design to meet the stormwater criteria.

[9] Argue, J (2013) *WSUD – Basic handbook for Australian practice*. Published by Engineering Education Australia

[10] Argue, J (2013) *WSUD – Basic handbook for Australian practice*. Published by Engineering Education Australia

Run the calculator

click 'calculate' to run the daily water calculator – this runs a daily tank balance simulation using 20 years of rainfall data.

CALCULATE

Water Tank Reliability %

33.3

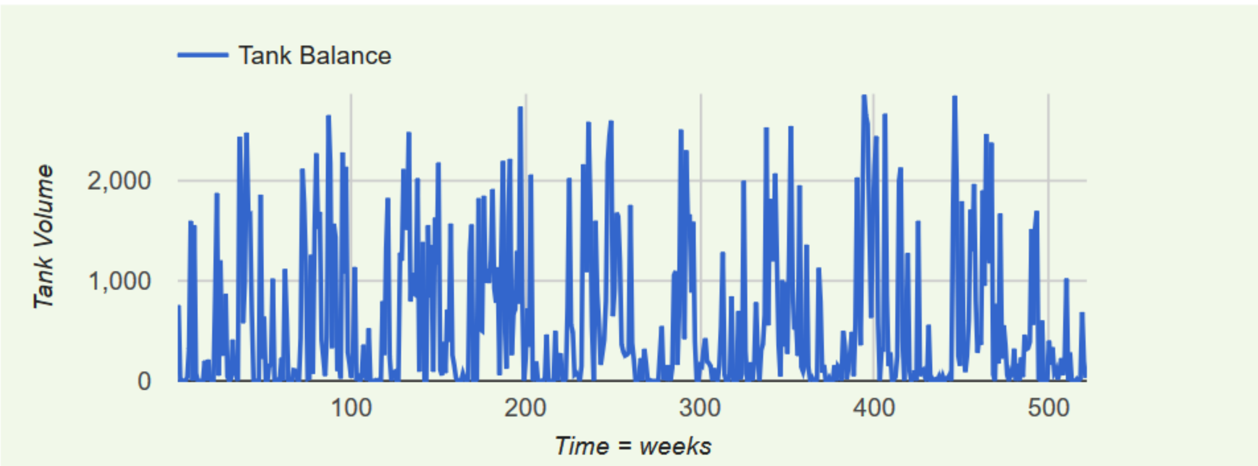
End use demand met by the tank. Target 70% or better – increase tank size or connected roof area to improve reliability

Rainwater Tank Overflow %

16.8

% of roof runoff flowing to stormwater system. Target less than 20% – increase tank water demand and increase tank size to reduce overflow

Water tank performance over time



Drag cursor over a section of the graph to zoom in and view weekly average water tank performance.
Right click on graph to zoom out.

Figure 10: The calculate button must be pressed each time an adjustment is made to the water tank configuration or rainwater end uses

5.1 Water tank reliability and overflow %

The rainwater tank reliability and overflow percentage are optional targets provided to help you optimise the size of the rainwater tank.

- **Rainwater Tank Reliability %** will help you decide if you are meeting enough of the end use needs from the tank. A good target is 50% for an urban tank.

  TIP: To increase reliability, increase tank size and the roof area/number of downpipes connected to a tank. Note: It is easier to achieve reliability for toilets, laundry and HWS, and harder for irrigation uses as irrigation demand is very seasonal.
- **Rainwater Tank Overflow %** helps you understand if a tank is useful to help protect downstream areas during a flood. A good target is 25% overflows for an urban tank.

  TIP: Rainwater tanks that are often close to empty will be helpful in a big storm event, while tanks that continually overflow will not be much use. To reduce overflow %, increase connected end uses and tank size, and consider reducing the area of roof connected to the tank.

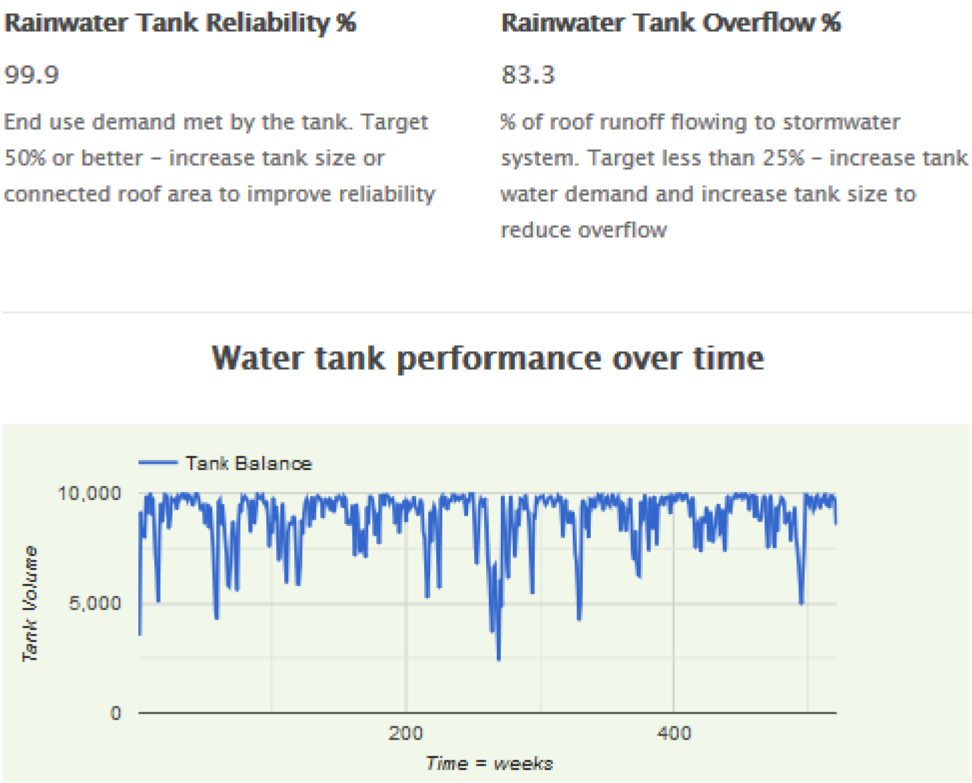


Figure 11: Rainwater storage volume in tank over time – Example 1

This tank is performing poorly as a downstream flooding prevention device, as it is usually overflowing

Rainwater Tank Reliability %

22.5

End use demand met by the tank. Target 50% or better – increase tank size or connected roof area to improve reliability

Rainwater Tank Overflow %

10.8

% of roof runoff flowing to stormwater system. Target less than 25% – increase tank water demand and increase tank size to reduce overflow

Water tank performance over time

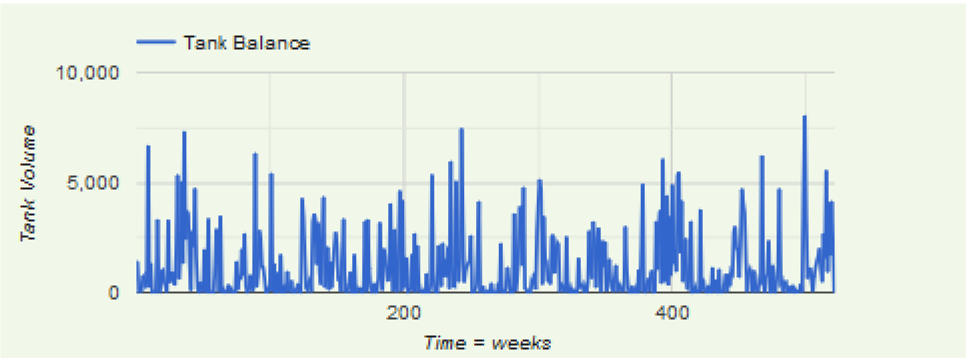
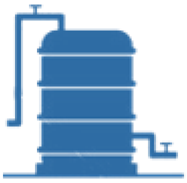
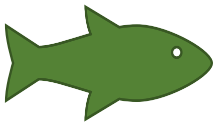
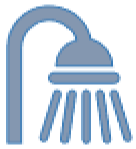


Figure 12: Rainwater storage volume in tank over time – Example 2

This tank is performing well as a downstream flooding prevention device, as it rarely overflows

6 Results

Stormwater criteria	 VOLUME	 FLOW	 QUALITY	 EFFICIENCY
Stormwater objective	Harvest and re-use or infiltrate stormwater	Control peak stormwater discharge	Improve stormwater runoff water quality	Increase drought resilience
Stormwater target	No more than a 10% increase in average annual runoff volume	Increase in peak discharge flows (post development compared with predevelopment) = 0 If greater than zero this is the additional site storage requirement (SSR) volume required. If less than zero, the development complies	Achieve a score of 100 or more	Achieve greater than 25% potable water use reduction
Notes	This is annual average volume, which is not the same as a peak flow rate. Reducing annual average runoff volumes has great broader catchment and river health outcomes.	This section uses the modified rational method to determine how the development behaves during a major storm event. The required storage is reduced by 1/3 of any entered rainwater retention tank volume, plus all entered detention volume. E.g. the below tank sizes would provide a 1700L reduction in required detention storage for the site. **Rainwater tank size (L)**: 3000 — Connected rainwater tank size (if applicable) **Detention tank size (L)**: 700 — Connected detention tank size (if applicable)	A score of 100 is equivalent to achieving a 45% reduction in nitrogen runoff. As nitrogen is the hardest pollutant to remove, it is an indicator that the site is meeting stormwater quality best practice targets.	Water efficiency is a combination of the efficiency of the fittings and fixtures, and also how much potable water is substituted with retained rainwater (or alternative non-potable) water sources).
Tips to improve your score	Increase tank size, area connected to your roof, and number of rainwater end uses. Infiltration systems are also helpful to manage surface runoff volumes or reduce impervious areas using pervious paving.	To pass this section increase rainwater tank size or add dedicated detention volume. Infiltration system volumes will also help achieve this target, provided site soils are suitable.	Increase the amount of rainwater that is harvested and used on-site. Alternatively treat rainwater with other WSUD treatments like raingardens and swales.	Increase the amount of rainwater that is harvested and used on-site. Choose fittings and appliances to increase efficiencies beyond the default settings.

7 Producing reports

Upon clicking 'Next' or 'Update' (in the case of editing a current project), InSite Water offers two types of reports that may be produced as indicated in Figure 13: Report types available to the user on completion or update of an assessment.

Reports should be forwarded to Council, along with relevant sustainable design assessment information as requested by Council.

Reporting

The following report types are available for your convenience.

REPORT TYPE	DESCRIPTION	FEE
Council Certificate Report	PDF Certificate and **short report** outlining design criteria and conditions of approval	Free
Council Certificate and Detailed Report	PDF Certificate and **detailed report** outlining design criteria and conditions of approval and further details for subscribing councils indicating performance against objectives	Free

Figure 13: Report types available to the user on completion or update of an assessment

8 Troubleshooting and contact us

The team at InSite Water offer continual support and invite your feedback to address any queries and issues identified.

If you require technical support or have any queries, please visit the support page.

Glossary of common stormwater design terms

<table>
<tr><th>Term</th><th>Definition</th></tr>
<tr><td>AEP</td><td>Annual exceedance probability is defined as: The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year. With ARI expressed in years, the relationship is: AEP = 1 – exp (-1/ARI). Further discussion of stormwater terminology can be found in Book 1; Chapter 2; Section 2.2 Terminology of ARR 2016 http://arr.ga.gov.au/arr-guideline.
The diagram below shows which terminology should be used with the coloured in number boxes.
Australian Rainfall and Runoff terminology
<table>
<tr><th>Frequency Descriptor</th><th>EY</th><th>AEP (%)</th><th>AEP (1 in x)</th><th>ARI</th><th>Uses in Engineering Design</th></tr>
<tr><td>Very frequent</td><td>12</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td>6</td><td>99.75</td><td>1.002</td><td>0.17</td><td>Water sensitive urban design</td></tr>
<tr><td></td><td>4</td><td>98.17</td><td>1.02</td><td>0.25</td><td></td></tr>
<tr><td></td><td>3</td><td>95.02</td><td>1.05</td><td>0.33</td><td></td></tr>
<tr><td></td><td>2</td><td>86.47</td><td>1.16</td><td>0.50</td><td></td></tr>
<tr><td></td><td>1</td><td>63.2</td><td>1.58</td><td>1.00</td><td></td></tr>
<tr><td>Frequent</td><td>0.69</td><td>50.00</td><td>2</td><td>1.44</td><td>Stormwater/pit and pipe design</td></tr>
<tr><td></td><td>0.5</td><td>39.35</td><td>2.54</td><td>2.00</td><td></td></tr>
<tr><td></td><td>0.22</td><td>20.00</td><td>5</td><td>4.48</td><td></td></tr>
<tr><td></td><td>0.2</td><td>18.13</td><td>5.52</td><td>5.00</td><td></td></tr>
<tr><td></td><td>0.11</td><td>10.00</td><td>10.00</td><td>9.49</td><td></td></tr>
<tr><td>Infrequent</td><td>0.05</td><td>5.00</td><td>20</td><td>20.0</td><td>Floodplain management and waterway design</td></tr>
<tr><td></td><td>0.02</td><td>2.00</td><td>50</td><td>50.0</td><td></td></tr>
<tr><td></td><td>0.01</td><td>1.00</td><td>100</td><td>100</td><td></td></tr>
<tr><td>Rare</td><td>0.005</td><td>0.50</td><td>200</td><td>200</td><td></td></tr>
<tr><td></td><td>0.002</td><td>0.20</td><td>500</td><td>500</td><td></td></tr>
<tr><td></td><td>0.001</td><td>0.10</td><td>1000</td><td>1000</td><td></td></tr>
<tr><td>Extremely Rare</td><td>0.0005</td><td>0.05</td><td>2000</td><td>2000</td><td></td></tr>
<tr><td></td><td>0.0002</td><td>0.02</td><td>5000</td><td>5000</td><td>Design of high-consequence infrastructure (eg major dams)</td></tr>
<tr><td></td><td></td><td></td><td>↓</td><td></td><td></td></tr>
<tr><td>Extreme</td><td></td><td></td><td>PMP</td><td></td><td></td></tr>
</table>
Diagram sourced online from the Bureau of Meteorology
http://www.bom.gov.au/water/designRainfalls/ifd/ifd-faq.shtml</td></tr>
<tr><td>ARI</td><td>Average recurrence interval is defined as: The average, or expected, value of the periods between exceedances of a given rainfall total accumulated over a given duration. The ARR 2016 discourages the use of ARI, however as it is still commonly used in the stormwater industry this guide provides both ARI and the equivalent AEP / EY value.</td></tr>
<tr><td>ARR 2016
ARR 2019</td><td>Australian Rainfall and Runoff (Engineers Australia 2016, published at http://arr.ga.gov.au) is a national guideline document, data and software suite that is the default national standard for the estimation of design flood characteristics in Australia. Note an updated version was published in March 2019.</td></tr>
<tr><td>Deemed-to-satisfy</td><td>A simplified checklist approach to achieving compliance targets (as opposed to a custom designed or software modelled approach).</td></tr>
<tr><td>Detention storage</td><td>The component of a rainwater tank used to store water harvested from rooftops (rainwater) or stormwater runoff from hard surfaces “detained” in a tank for a limited period. Stormwater detention tanks are intended to remain empty, except during periods of rainfall and for a short time thereafter. Unlike retention rainwater storages, the distinguishing feature of a stormwater detention tank is that it is specially fitted with a valve to slowly release water over time.</td></tr>
</table>

Term	Definition
EY	**Exceedances per year** is the number of times an event is likely to occur or be exceeded within any given year.
Infill growth	Growth occurring through densification of existing developed areas.
InSite Water	An integrated water cycle management design toolkit focused on Council approvals for infill growth www.insitewater.com.au
OSD	**On site detention** A common practice of slowing down stormwater release rates into stormwater drains by using a detention tank with a known outflow rate.
PMP	**Probable maximum precipitation** The greatest depth of precipitation for a given duration meteorologically possible for a given size storm area at a particular location at a particular time of year, with no allowance made for long-time climatic trends (World Meteorological Organization).
Rainwater	Rainfall collected from the roofs of buildings.
Rainwater tank	A water tank that is used to collect and store rainwater runoff, typically from rooftops via rain gutters.
Retention storage	The component of a rainwater tank used to store water harvested from rooftops (rainwater). The water retained is used inside the home (e.g. toilets, laundry or hot water services) or for reticulated irrigation OR The component of stormwater runoff from hard surfaces (stormwater) retained in infiltration systems to provide passive irrigation to the surrounding soils, rather than simply discharging to the drainage system.
Soil site classification	Soils site classification is according to *Australian Standard AS 2870/2011 – Residential slabs and footings*[11] Site classifications and movement are based on soil reactivity **Class A** (0-10mm) Stable, non-reactive. Most sand and rock sites. Little or no ground movement likely as a result of moisture changes. **Class S** (10-20mm) Slightly reactive clay sites. May experience slight ground movement as a result of moisture changes. **Class M / M-D** (20-40mm) Moderately reactive clay or silt sites. May experience moderate ground movement as a result of soil conditions and moisture changes. **Class H1 / H1-D** (40-60mm) Highly reactive clay sites. May experience a high amount of ground movement as a result of soil conditions and moisture changes. **Class H2 / H2-D** (60-75mm) Highly reactive clay sites. May experience very high ground movement as a result of soil conditions and moisture changes. **Class E / E-D** (75mm+) Extremely reactive sites. May experience extreme amounts of ground movement as a result of soil conditions and moisture changes. **Class P** (this is approximately 70% of building sites in Australia) Problem sites. Sites may be classified as 'Class P' as a result of mine subsidence, landslip, collapse activity or coastal erosion (e.g. dunes), soft soils with a lack of suitable bearing, cut and/or filled sites, or creep areas. Ground movement as a result of moisture changes may be very severe. If you are building on a Class P site you will need to consult a structural engineer. The '**D**' inclusion (i.e. M-D, H1-D, H2-D or E-D) The 'D' in these classifications refers to 'deep' movements in soil due to deep variances in moisture. These classifications are mostly found in dry areas.
Stormwater	Rainfall that runs off all urban surfaces such as roofs, pavements, car parks, roads, gardens and vegetated open space.
WELS	Australian Water Efficiency Labelling Standards scheme.
WSUD	**Water sensitive urban design** Design principles that aim to reduce the impact of interactions between the urban built form and the urban water cycle including surface water, potable water, groundwater, urban and roof runoff, wastewater and stormwater.

[11] *AS 2870-2011 – Residential slabs and footings* available from SAI Global https://infostore.saiglobal.com/