WATER USE CALCULATOR GUIDE

JANUARY 2025

This guide is to be used for the Water Use credit in Green Star Buildings NZ

Document Information

For information on this document, please contact:

New Zealand Green Building Council
(09) 379-3996
greenstarnz@nzgbc.org.nz

This document is updated regularly. It can be found at www.nzgbc.org.nz/.

Change Log

Release	Date	Description of changes
Green Star - Design & As Built and Green Star Interiors v1.0	16/10/2014	Initial release.
Green Star – Design & As Built and Green Star Interiors NZv1.0	11/04/2019	Initial release in New Zealand.
Green Star – Design & As Built and Green Star Interiors NZv1.1	02/09/2022	New Zealand GS D&AB v1.1 update
Green Star - Buildings	15/01/2025	NZ GS Buildings update

Use of Trademarks

Intellectual Property Rights & Confidentiality

Table of Contents

1 INTRODUCTION

The New Zealand Green Building Council (NZGBC) has developed a Potable Water Calculator (the Calculator) used in *Green Star – Buildings* to estimate potable water consumption associated with projects. The Calculator returns the number of points awarded for the Green Star credit 'Water Use' under the modelled performance pathway. This guide should be used in conjunction with the Potable Water Calculator in the *Green Star - Buildings* rating tool.

1.1 The Potable Water Calculator

The Calculator determines the points awarded based on the usage of reclaimed water, if any, and the usage of potable water in:

- Sanitation
- Whitegoods
- HVAC system heat rejection
- Washdown facilities
- Landscape irrigation
- Swimming pools
- Process cooling
- Fire Test Water
- Dead legs on hot water runs

The water demand associated with the above uses, which are applicable to the project, are calculated monthly and prorated daily.

$$V_{Total} = V_{sanitation} + V_{whitegoods} + V_{HVAC} + V_{washdown} + V_{irrigation} + V_{pool} + V_{process} + V_{fire} + V_{deadleg}$$

Where:

$V_{Total} =$ daily water demand

$V_{sanitation} =$ daily sanitation water demand

$V_{whitegoods} =$ daily whitegoods water demand

$V_{HVAC} =$ daily HVAC system heat rejection water demand

$V_{washdown} =$ daily washdown water demand

$V_{irrigation} =$ daily landscape irrigation water demand

$V_{pool} =$ daily swimming pool water demand

$V_{process} =$ daily process cooling water demand

$V_{fire} =$ daily fire test water demand

$V_{deadleg} =$ daily hot water dead leg water wastage

The available non-potable water (i.e. the reclaimed water) is subtracted from the daily consumption figure to calculate a daily potable water demand.

$$V_{pot,total} = V_{Total} - V_{non-pot,total}$$

Where

$V_{pot,total} =$ daily potable water demand

$V_{Total} =$ daily water demand

$V_{non-pot,total} =$ daily supply of nonpotable water (rain, grey, black, storm and off site supply)

A daily calculation time step has been implemented to provide sensitivity to the calculator's rain water reuse calculation in relation to tank overflow. Other seasonally dependent uses such as HVAC system heat rejection and landscape irrigation are calculated on a monthly basis but prorated daily. The daily time step has been applied to any water recycling and reuse systems included in the project.

It should be noted that the NZGBC assumes that thorough calculations and dimensioning of all components in water reuse systems have been undertaken in addition to the Green Star submission. The NZGBC will not accept any responsibility for the dimensioning and functionality of the water recycling and re-use designs that are being assessed under *Green Star - Buildings* tool.

1.2 Definitions

Proposed Project

The project to be rated by the *Green Star - Buildings* rating tool, as designed and modelled by the project team.

Reference Project

A hypothetical project of the same configuration and with the same facilities as the proposed project but whose water supply services characteristics are based on a *S*tandard Practice water usage.

Standard Practice water usage

A benchmark water usage which represents water usage for a project system designed to the level of Standard Practice. Descriptions of how standard practice water efficiency is defined for each service are included in each section of this guide.

2 THE WATER CATEGORY

2.1 How points are awarded in Potable Water

Up to six (6) points are awarded for reductions in potable water usage in the Proposed Project compared to the water usage in a Reference Project with Standard Practice water efficiency. Different point thresholds are set depending on if the building contains more than 50% sleeping areas, such as age care, dormitory or hotel.

Table 1 Points Allocation for Potable Water Use Reduction credit

Percentage Reduction (sleeping area <50%)	Percentage Reduction (sleeping area >=50%)	Points awarded
15	10	No points
25	20	1
30	25	2
35	30	3
40	35	4
50	45	5
60	55	6

It should be noted that, as percentage reductions are rewarded with Green Star points, the absolute water consumption for the benchmark varies depending on the project's characteristics.

PROJECT OCCUPANCY, AREAS AND OPERATION

An estimation of how many people are occupying the project and how much time they spend in the project is done to determine how often the fixtures and fittings in the project are used and how much greywater and blackwater is available for re-use. These parameters are estimated based on the Project's design.

Where a Project's purpose is to cater for sporting activities, where the users will need and use shower facilities (e.g. swimming pool or sports facility), the project team are required to provide an estimation of the number of users per day and the number of days per year the project operates in this capacity.

2.2 Calculation methodology

To calculate the water demand from fixtures and fittings, it is necessary to estimate how many people are occupying the project, as well as how much time they spend in the project. The concept of person-hours is used in this calculation methodology. A person-hour means that one person has spent one hour in the space. The number of person-hours per month for each space is calculated as follows:

$$Hours_{person} = \frac{A_{space}}{Occupancy_{design}} \times Hours_{Equivalent}$$

Where:

$Hours_{person}$ = Person hours per month

$A_{space} = area\ of\ space$

$Occupancy_{design} = maximum\ design\ occupancy\ of\ A_{space}$

$Hours_{Equivalent} = Equivalent\ hours\ at\ max\ occupancy\ in\ month$

And:

$$Hours_{Equivalent} = (Hours_{Equivalent,peak} \times Days_{peak}) + (Hours_{Equivalent,offpeak} \times Days_{offpeak})$$

Where:

$Hours_{Equivalent,peak} = Equivalent\ hours\ at\ maximum\ occupancy\ in\ a\ peak\ day\ (hours)$

$Days_{peak} = Number\ of\ peak\ days\ per\ month$

$Hours_{Equivalent,offpeak} = Equivalent\ hours\ at\ maximum\ occupancy\ in\ an\ offpeak\ day\ (hours)$

$Days_{offpeak} = Number\ of\ offpeak\ days\ per\ month$

The equivalent hours at maximum occupancy in a peak or off-peak day is calculated by summing the percentages in the relevant occupancy profile. This figure represents the equivalent number of hours that the space is occupied at maximum design occupancy. For example, the first occupancy profile shown in Table 3 (the NCC Table 2b 'peak day' profile) describes a space that is occupied from 7am until 9pm. The occupancy in this space varies from 15% at 7am, up to 100% at 9am down to 5% at 8pm. By summing the percentages, we calculate that the equivalent hours at maximum occupancy is 9.5 hours on a 'peak' day for this space type.

The number of occupants present at peak and off-peak times during the day is needed to estimate the water demand from occupants' showers. The following calculation is for a peak day, the same is undertaken in the spreadsheet for off-peak days:

$$Staff_{peak} = \frac{A_{space}}{Occupancy_{design}} \times \%_{occupancy} \times \%_{Staff}$$

Where:

$Staff_{peak} = Number\ of\ staff\ present\ on\ a\ peak\ day$

$A_{space} = area\ of\ space$

$Occupancy_{design} = maximum\ design\ occupancy\ of\ A_{space}$

$\%_{occupancy} = Maximum\ percentage\ of\ design\ occupancy\ present\ during\ peak\ day$

$\%_{Staff} = Percentage\ of\ occupants\ who\ are\ staff\ (that\ use\ the\ space\ as\ their\ primary\ place\ of\ work)$

The exception to the above is the showers installed for sports facilities, where the water demand is more closely related to patronage engaging in sporting activities. The daily patronage of occupants engaging in sports activities is multiplied with the number of days the facility operates, in order to estimate the annual water consumption associated with shower amenities installed for sports participants. The monthly water consumption is then determined by dividing the annual water consumption by the number of days in a year and multiplying the result by the number of days for each month.

2.3 Data entry requirement

The project should be divided into space types with different occupancy levels and patterns. For more information on how to do this, refer to the appendix of the *Green Star – Energy Use Calculation Guide*. The following data must be entered for all occupied[1] space types

0. General Section

1. **Area** - Entered in m^2
2. **Peak days of operation** – Selecting the number of 'peak' days of operation per typical week the space is occupied as described in the relevant 'peak' occupancy profile. The remaining days are assumed to follow the off-peak profile.
3. **Occupancy profile** – The way the space is occupied must be entered by either:
   a. Selecting one of the four sets of default occupancy profiles in the dropdown list (the default occupancy profiles are based on those included in Section J of the NCC 2016); or
   b. Entering peak and off-peak profiles into the spreadsheet manually. This option should be used where none of the existing profiles are suitable for the space type (see Figure 1)

   The profiles used in this Calculator must correlate with those used in the *Energy Use Calculator*, except where the project team can demonstrate that periods of occupancy would not result in water use (e.g. sleeping people).
4. **Maximum design occupancy used in water calculations** – the maximum design occupancy must be entered by either:
   a. Entering the proposed building maximum design occupancy manually; or

[1] Occupied spaces include all spaces in the project except for those with no or low/transient occupancy such as stairwells, corridors and storage rooms.

b. Selecting one of the default design occupancy values based on those included in Section J of the NCC 2016 ;

5. Percentage of building users who occupy the space continually for periods greater than one hour.

   This figure needs to be determined by the design team. It is used to estimate the number of occupants in the project, a parameter required to calculate the water demand from showers. It is assumed that only continuous project users will use the shower facilities.

   Where multiple spaces are provided for the same project users, only one space should be considered as continually occupied to avoid double counting occupant water consumption as they move about the project.

   This section is about determining the number of building occupants who *might* have access to the showers, not use them. For example, in the case of a residential building, 100% of occupants will have access to showers and 100% will use them. In the case of a retail space, the “long-term” occupant population (rather than visitors) might be 5% of the maximum population density, but the number of long term occupants that use cyclist facilities might only be 15% of that 5% (because the cyclist facilities are limited to that many users).

   The maximum population with access to the showers is calculated from inputs and is essential to capture the change in water demand from showers for projects where the cyclist facilities may be increased/decreased from the census average within the transport calculator.

   Example:

   A project has 100m^2 each of residential, commercial and café area.

   The residential space would be 100% for both standard practice and reference shower demands.

   The commercial and café reference shower demand would be equivalent to the reference in the *Movement and Place Calculator*. In this example, Adelaide CBD rate of 3.3% is assumed.

   The proposed shower demand for the commercial and cafe reflects what is being provided in terms of the percentage of the occupant population that has access to cyclist facilities within the building (let’s say 15% for the purpose of this example). To enter this into the water calculator would require an averaging of the percentages across area as follows:

   $\textit{Reference shower demand (F83)} = (100m2 \times 100\% + 200m2 \times 3.3\%)/\,300m2 = 35.5\%$

   $\textit{Proposed shower demand (F84)} = (100m2 \times 100\% + 200m2 \times 15\%)/\,300m2 = 43.3\%$

Table 3 Default occupancy profiles included in the calculator

Time period	NCC Table 2b (Class 5 Project, Class 8 laboratory or Class 9a clinic, Day surgery or procedure unit)		NCC Table 2c (Class 6 shop or shopping centre)		NCC Table 2d (Class 6 restaurant or cafe)		NCC Table 2f (Class 9b theatre or cinema)	
	Peak	Off-peak	Peak	Off-peak	Peak	Off-peak	Peak	Off-peak
12:00am to 1:00am	0%	0%	0%	0%	0%	0%	0%	0%
1:00am to 2:00am	0%	0%	0%	0%	0%	0%	0%	0%
2:00am to 3:00am	0%	0%	0%	0%	0%	0%	0%	0%
3:00am to 4:00am	0%	0%	0%	0%	0%	0%	0%	0%
4:00am to 5:00am	0%	0%	0%	0%	0%	0%	0%	0%
5:00am to 6:00am	0%	0%	0%	0%	0%	0%	0%	0%
6:00am to 7:00am	0%	0%	0%	0%	5%	0%	0%	0%
7:00am to 8:00am	15%	0%	10%	0%	5%	0%	0%	0%
8:00am to 9:00am	60%	0%	20%	0%	5%	0%	20%	0%
9:00am to 10:00am	100%	0%	20%	0%	5%	0%	80%	0%
10:00am to 11:00am	100%	0%	15%	0%	20%	0%	80%	0%
11:00am to 12:00pm	100%	0%	25%	0%	50%	0%	80%	0%
12:00pm to 1:00pm	100%	0%	25%	0%	80%	0%	20%	20%
1:00pm to 2:00pm	100%	0%	15%	0%	70%	0%	80%	80%
2:00pm to 3:00pm	100%	0%	15%	0%	40%	0%	80%	80%
3:00pm to 4:00pm	100%	0%	15%	0%	20%	0%	80%	80%
4:00pm to 5:00pm	100%	0%	15%	0%	25%	0%	80%	80%
5:00pm to 6:00pm	50%	0%	5%	0%	50%	0%	20%	20%
6:00pm to 7:00pm	15%	0%	5%	0%	80%	0%	20%	20%

7:00pm to 8:00pm	5%	0%	0%	0%	80%	0%	80%	80%
8:00pm to 9:00pm	5%	0%	0%	0%	80%	0%	80%	80%
9:00pm to 10:00pm	0%	0%	0%	0%	50%	0%	80%	80%
10:00pm to 11:00pm	0%	0%	0%	0%	35%	0%	80%	80%
11:00pm to 12:00am	0%	0%	0%	0%	20%	0%	10%	10%
Equivalent hours at maximum occupancy	9.5	0	1.85	0	7.2	0	9.7	7.1

Table 4 Default occupancy profiles included in the calculator – Part 2

Time period	NCC Table 2a (Class 3 or class 9c aged care)		NCC Table 2a (Class 3 or class 9c aged care)		Class 1,2, or 3 residential	
	Peak	Peak	Peak	Off-peak	Peak	Off-peak
12:00am to 1:00am	85%	85%	85%	85%	0%	0%
1:00am to 2:00am	85%	85%	85%	85%	0%	0%
2:00am to 3:00am	85%	85%	85%	85%	0%	0%
3:00am to 4:00am	85%	85%	85%	85%	0%	0%
4:00am to 5:00am	85%	85%	85%	85%	0%	0%
5:00am to 6:00am	85%	85%	85%	85%	0%	0%
6:00am to 7:00am	85%	85%	85%	85%	85%	10%
7:00am to 8:00am	85%	85%	85%	85%	50%	10%
8:00am to 9:00am	50%	50%	85%	85%	20%	10%
9:00am to 10:00am	20%	20%	85%	85%	20%	10%
10:00am to 11:00am	20%	20%	85%	85%	20%	10%
11:00am to 12:00pm	20%	20%	85%	85%	20%	10%
12:00pm to 1:00pm	20%	20%	85%	85%	20%	10%
1:00pm to 2:00pm	20%	20%	85%	85%	20%	10%
2:00pm to 3:00pm	20%	20%	85%	85%	20%	10%
3:00pm to 4:00pm	30%	30%	85%	85%	30%	10%
4:00pm to 5:00pm	50%	50%	85%	85%	50%	50%
5:00pm to 6:00pm	50%	50%	85%	85%	50%	50%
6:00pm to 7:00pm	50%	50%	85%	85%	50%	70%
7:00pm to 8:00pm	70%	70%	85%	85%	70%	70%
8:00pm to 9:00pm	80%	80%	85%	85%	80%	80%
9:00pm to 10:00pm	80%	80%	85%	85%	80%	85%

10:00pm to 11:00pm	85%	85%	85%	85%	0%	0%
11:00pm to 12:00am	85%	85%	85%	85%	0%	0%
Equivalent hours at maximum occupancy	14.3	14.3	20.4	20.4	6.7	4.8

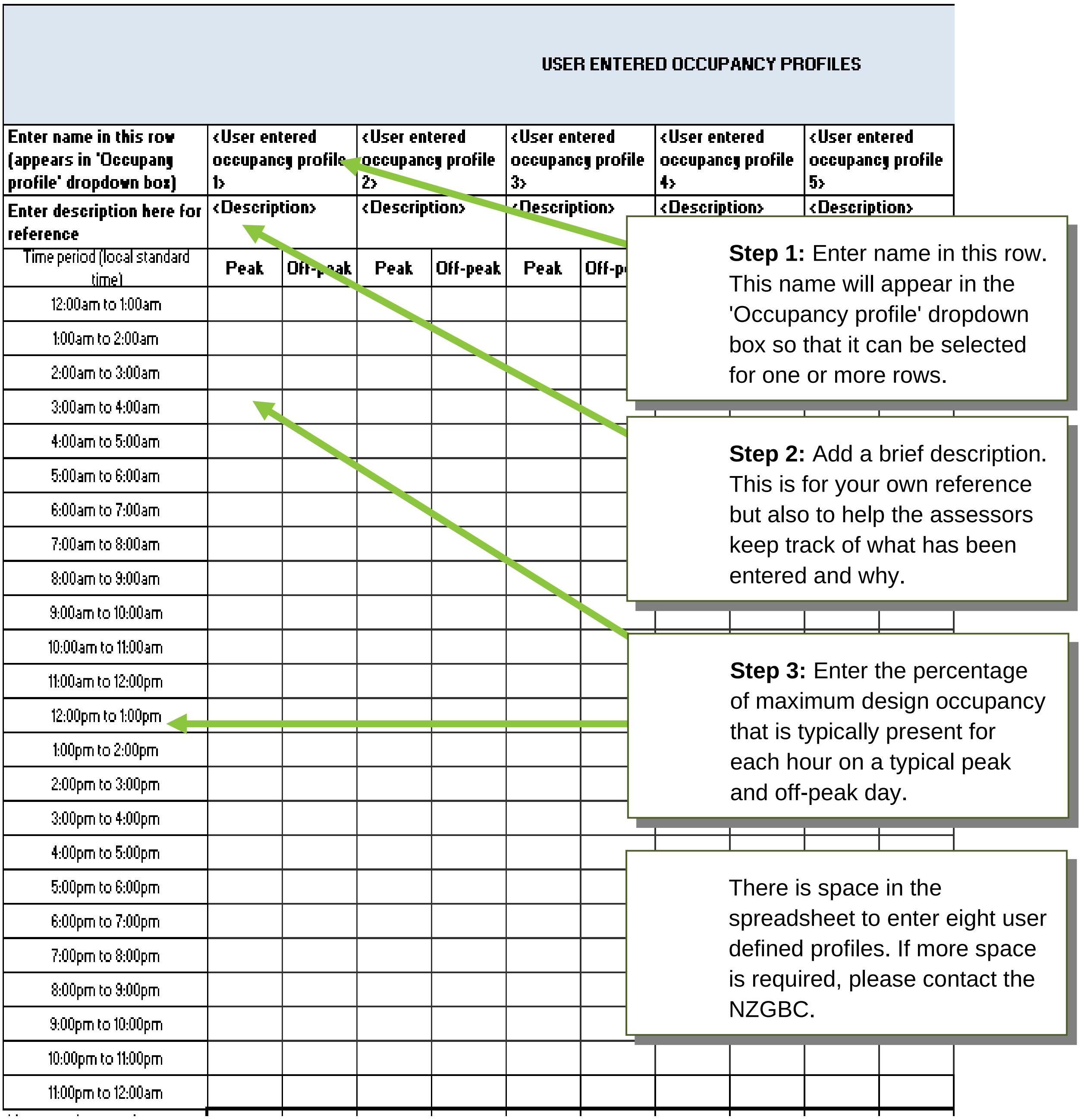

Figure 1 How to enter profiles manually into the spreadsheet

3 PROJECT CHECKLIST

The Project Checklist asks a series of yes/no questions in order to determine the inputs required throughout the remainder of the Calculator. This information is also used to help determine the boundaries of the Reference Project's water consumption. All questions must be answered. The table below briefly elaborates on the questions asked within the Calculator.

Project Checklist Question	Comments
1. Sanitation	
Are fixtures and fittings provided for Project occupant sanitation?	Select 'yes' where the project includes any toilets, urinals, taps or showers.
Does the project provide for sports activities?	Select 'yes' where the project includes a sporting facility as a part of the rated project. For example, the project might include a swimming pool, a gym or a basketball court.
Have showers been installed for post/pre activity use?	Select 'yes' where additional shower and/or change room facilities have been installed to support the installation of the sports facility.
2. White Goods	
Does the project include any dishwashers or clothes washing machines?	Select 'yes' where the project will include the specification and installation of dishwashers or clothes washing machines. This includes both domestic and commercial applications of these two items.
3. Heat Rejection	
Does the project utilise water based heat rejection (Project cooling)?	Select 'yes' where the project is utilising water-based heat rejection equipment. This includes conventional cooling towers, in addition to hybrid air/water cooled equipment. Select 'no' if the project will utilise an air-based heat rejection system.
Does the project have cooling towers?	Select 'yes' where the project is utilising conventional water-based cooling towers.
Does the project contain any other water cooled systems that are not conventional cooling towers?	Select 'yes' where the project is utilising other hybrid air/water cooled equipment for heat rejection. The Calculator permits project teams to enter a combination of these system types for the Proposed Project.
4. Washdown	
Does the project include wash down areas?	Select 'yes' where the project includes a wash down area.

5. Landscape Irrigation	
Are there any landscaped areas within the project?	Select 'yes' where landscaped areas have been included in the project. All landscape areas should be considered here whether irrigated or not. This includes xeriscape gardens.
Are any irrigation systems included in the project?	Select 'yes' where irrigation systems are included within the project.
6. Swimming Pools	
Are there any swimming pools within the project?	Select 'yes' where any swimming pools or spas are included within the project.
8. Process Cooling	
Does the project include any water based process cooling?	Select 'yes' where the project includes equipment that requires water for process cooling.
7. Test Fire Water	
Is there a retention tank on site?	Select 'yes' where a retention tank is included within the project.
Will test fire water be captured in the retention tank?	Select 'yes' where tank captures fire test water.
9. Dead Legs on Hot Water Runs	
Has the position of the hot water flow been utilized to reduce wait time for hot water at the tap?	Select 'yes' where the potable water system has been designed reduce the length of dead legs in hot water piping
Have pipe diameters been reduced from standard?	Select 'yes' where pipe diameters of potable hot water systems have been reduced.
10. Condensate Recovery	
Are water based air conditioning systems provided?	Select 'yes' where water based heat rejection systems are within the project.
Is there a retention tank on site?	Select 'yes' where a retention tank is included within the project.
11. Water Reclamation	
Does any water collection, reclamation and/or reuse occur on the project site?	Select 'yes' where any form of reclaimed water capture is present on the project.

Does the project include rainwater capture and reuse systems?	Select 'yes' where the project includes a rainwater tank for the capture and reuse of rainwater on site.
Does the project include greywater capture, treatment and reuse systems?	Select 'yes' where the project includes greywater collection and treatment for reuse on site.
Does the project include blackwater capture, treatment and reuse systems?	Select 'yes' where the project includes blackwater collection and treatment for reuse on site.
Does the project include a condensate recovery capture, treatment and reuse system?	Select 'yes' where the project includes condensate collection and treatment for reuse on site.
Does the project include other stormwater reuse or an off-site supply of non-potable water?	Select 'yes' where either stormwater is captured for reuse, or a recycled water supply is available for use within the project.

4 SANITATION FIXTURES AND FITTINGS

4.1 Calculation methodology

The total water demand from fixtures and fittings is calculated as follows:

4.1.1 Monthly water demand from toilets, urinals and taps

The following calculations are for toilets, the same calculations are done for urinals and taps. The monthly results described by the following methodology are prorated daily as discussed in Section 3 Table 3 and 4.

$$\dot{V}_{fixture\ or\ fitting,month} = Uses_{fixture\ or\ fitting,month} \times Efficiency_{fixture\ or\ fitting}$$

Where:

$\dot{V}_{fixture\ or\ fitting\ ,month}$ = Monthly water demand from fixture or fitting (l/month)

$Uses_{fixture\ or\ fitting,month}$ = Number of fixture or fitting uses per month

$Efficiency_{fixture\ or\ fitting}$ = Average water efficiency of fixture or fitting (L/use, L/min, etc)

And:

$$Uses_{fixture\ or\ fitting,month} = Hours_{person} \times Usage_{fixture\ or\ fitting}$$

Where:

$Hours_{person}$ = Number of person hours per month

$Usage_{fixture\ or\ fitting}$ = Usage rate (as per Table)

And:

$$Efficiency_{fixture\ or\ fitting} = (\%_A \times \dot{V}_A) + (\%_B \times \dot{V}_B) + \ldots$$

Where:

$\%_x$ = Percentage (fixture or fitting x)

$\dot{V}_x$ = Water consumption (fixture or fitting x)

Table 5 Assumed usage rates of toilets, urinals and taps

Fixture/Fitting	Number of uses per person per day (based on data for 9.5[2] hour work day)	Uses per person-hour
Toilet - no urinals	2.3	0.24
Toilet with urinals	1.3	0.14
Urinal	2	0.21
Taps	2.5	0.26

[2] This is the equivalent hours at maximum occupancy for an office space as defined in NCC Table 2b Occupancy and operational profiles of a Class 5 Project, Class 8 laboratory or Class 9a clinic, Day surgery or procedure unit.

4.1.2 Monthly water demand from occupant showers

$$\dot{V}_{occupant\ shower,month} = Uses_{occupant\ shower,month} \times Efficiency_{occupant\ shower} \times Length_{occupant\ shower}$$

Where:

$\dot{V}_{occupant\ shower,month} = Monthly\ water\ demand\ from\ occupant\ showers\ (L/month)$

$Uses_{occupant\ shower,month} =$ Number of occupant shower uses per month

$Efficiency_{occupant\ shower} =$ Average $occupant\ shower$ water efficiency (L/minute)

$Length_{occupant\ shower} = Average\ length\ of\ occupant\ shower(minutes)$

And:

$$Uses_{occupant\ shower,month} = Occupant_{peak} \times \%_{occupant,shower} \times Days_{peak} + Occupant_{off\ peak} \times \%_{Occupant,shower} \times Days_{off\ peak}$$

Where:

$Occupant_{peak} =$ Number of uses on peak or off peak days per month

$\%_{occupants\ ,shower} =$ Percentage of occupants who shower (as described below)

$Days_{peak} =$ Number of peak or offpeak days per month

And:

$$Efficiency_{Occupant\ shower} = (\%_a \times \dot{V}_a) + (\%_b \times \dot{V}_b) + ..$$

$\%_x =$ Percentage ($occupant\ shower$x)

$\dot{V}_x =$ Water consumption ($occupant\ shower$x)

And:

$$Length_{occupant\ shower} = 5min$$

The percentage of project occupants that cycle is to be entered into the calculator in accordance with the mode share percentage for both the standard practice and proposed (current) project mode share percentages for cycling (refer output from sustainable transport initiatives calculator). This recognises the additional water use from having additional occupants using the shower facilities and encourages the project team to come up with innovative means to amortise the additional water consumption. If the project does not target any point for end of trip facilities under the *Movement and Place* credit, the % benchmark in the *Movement and Place* credit should be used unless a Technical Question is submitted to justify a different percentage of project occupants that cycle.

4.1.3 Monthly water demand from sports showers

$$\dot{V}_{sport\ shower,month} = Uses_{sport\ shower,month} \times Efficiency_{sport\ shower} \times Length_{sport\ shower}$$

Where:

$\dot{V}_{sport\ shower,month} = Monthly\ water\ demand\ from\ sport\ showers\ (L/month)$

$Uses_{sport\ shower,month} =$ Number of sport shower uses per month

$Efficiency_{sport\ shower} =$ Average $sport\ shower$ water efficiency (L/minute)

$Length_{sport\ shower} = Average\ length\ of\ sport\ shower(minutes)$

Where:

$$Uses_{sport\ shower,month} = \frac{Days_{open}}{365} \times Days_{month} \times Patronage_{average}$$

Where:

$Days_{open}$ = Number of days sporting facilities used per year

$Days_{month}$ = Number of days per month

$Patronage_{average}$ = Average daily patronage by sport participants

$$Efficiency_{sport\ shower} = (\%_a \times \dot{V}_a) + (\%_b \times \dot{V}_b) + \ldots$$

$\%_x$ = Percentage ($sport\ shower$x)

$\dot{V}_x$ = Water consumption ($sport\ shower$x)

And:

$$Length_{sport\ shower} = 5min$$

4.1.4 Total monthly water consumption

Total monthly water consumption = Monthly water consumption (Toilets) + Monthly water consumption (Urinals) + Monthly water consumption (Taps) + Monthly water consumption (Occupant Showers) + Monthly water consumption (Sports Showers).

4.2 Data entry requirement

Data about the fixtures and fittings included in the project should be entered into the 'Sanitation Fixtures and Fittings' section. The following information is required for each type of toilet, urinal, tap and shower being installed in the project:

1. The water efficiency of the fitting – this can be entered by **either:**

   a. Selecting the WELS Star Rating from the drop down menu. In this case, the corresponding water efficiency is automatically generated in the adjacent grey cell. A WELS star rating is awarded when the efficiency of a fixture is between a defined maximum and minimum water efficiency for that star rating; the efficiency with the highest water usage allowed for that particular WELS star rating is generated by the Calculator; **Or**

   b. Manually entering the actual water efficiency, if known.

2. The percentage of fittings of this type that are to be installed with this water efficiency.

Additional information required for urinals

3. Are urinals to be installed? – Select yes or no from the drop down menu.
   For urinals on autotimer, the following information is required (if no urinals on autotimer are being installed, leave these sections blank).

   a. Average water efficiency (L/flush).

   b. Number of urinals on autotimer being installed.

   c. Percentage of all urinals in the Project that are on autotimer.

For projects where the project team does not consider the provision of urinals to form part of the standard practice project design the project team should select no from the drop down menu against the question “Would urinals normally be installed in the project type?” The project team must include justification for this selection in their submission template.

Additional information required for occupant showers:

4. Level of occupant shower demand – determine the mode share corresponding to cyclists in the sustainable transport initiatives calculator and enter the value for both the proposed and standard practice projects into the potable water calculator.

Additional information required for sport showers:

5. Average expected patronage by sports participants.
6. Expected number of days per year that sporting facilities are open for use.

4.3 Standard Practice Water Efficiency – Sanitation

The water efficiency of fixtures and fittings used to determine the total standard practice water consumption is presented in Table 6.

Table 6 Standard Practice water efficiency - Sanitation

Fixture/fitting	Water efficiency WELS rating and water consumption
Toilet	3 Star (4L/flush)
Urinals	3 Star (2L/flush)
Taps	4 Star (7.5L/min)
Showers	3 Star (9L/min)

For residential and hotel projects, the Standard Practice Water efficiency for Showers is 2 Star.

4.4 Additional Guidance

Water Efficiency Labelling and Standards (WELS) Scheme

The water efficiency of all fixtures and fittings sold in New Zealand is registered in the Water Efficiency Labelling and Standards (WELS) scheme. The WELS scheme awards each fixture or fitting with a star rating from one to six stars (with six representing the most efficient). The WELS ratings of all fittings and fixtures sold in New Zealand are publicly available from a database administrated by the Australian Federal government. The water consumption is displayed on the WELS label on the registered products.

For further information about the WELS rating scheme and the water efficiency thresholds for each star band, please refer to AS/NZS 6400:2016 Water Efficient Products – Rating and Labelling and www.waterrating.gov.au.

The calculator automatically assumes that a shower designated as 3 star WELS will perform at 9L/min. Project teams are advised to manually input the shower flow rate (if less than 9L/min) rather than the WELS star rating to ensure that the reduced flow rate is accounted for.

Exclusions

For the purposes of this credit, the following fixtures and fittings may be excluded, as the water consumption will not be altered significantly by reducing the water flow:

- Bath taps, Laboratory taps and taps dedicated for cleaning and facility management.

5 WHITE GOODS

The water consumption by white goods is split into two sections, the water consumption by washing machines and the water consumption by dishwashers

5.1 Calculation methodology

The total water demand for whitegoods is calculated annually and prorated daily as follows:

5.1.1 Daily water demand from washing machines

$$V_{WM,Daily} = \frac{V_{WM,annual}}{365}$$

Where:

$V_{WM,Daily}$ = Daily demand from washing machines (L)

$V_{WM,annual}$ = Annual demand from washing machines (L)

And:

$$V_{WM,annual} = Capacity_{WM,x} \times Efficiency_{WM,x} \times Cycles_{WM,x}$$

Where:

$Capacity_{WM,x}$ = Machine capacity (kg/Load)

$Efficiency_{WM,x}$ = Machine efficiency (L/kg)

$Cycles_{WM,x}$ = Number of cycles per year

5.1.2 Daily water demand from dishwashers

$$V_{DW,Daily} = \frac{V_{DW,annual}}{365}$$

Where:

$V_{DW,Daily}$ = Daily demand from dishwashers (L)

$V_{DW,annual}$ = Annual demand from dishwashers

And:

$$V_{DW,annual} = Efficiency_{DW,x} \times Cycles_{DW,x}$$

Where:

$Efficiency_{DW,x}$ = Machine efficiency (L/cycle)

$Cycles_{DW,x}$ = Number of cycles per year

Total daily water consumption

Total daily water consumption = Daily water consumption (washing machines) + Daily water consumption (dishwashers).

5.2 Data entry requirement

Data about the whitegoods included in the project should be entered into the 'Whitegoods' section. The following information is required for each type of clothes washing machine and dishwasher being installed in the project:

1. The water efficiency of the whitegoods – this can be entered by **either:**
   a. Selecting the WELS Star Rating from the drop down menu. In this case, the corresponding water efficiency is automatically generated in the adjacent grey cell. A WELS star rating is awarded when the efficiency of a fixture is between a defined maximum and minimum water efficiency for that star rating; the efficiency with the highest water usage allowed for that particular WELS star rating is generated by the Calculator; **Or**
   b. Manually entering the actual water efficiency, if known.
2. The capacity of the whitegoods, in either the nominal kg/load capacity of the clothes washing machine or the number of place settings for the dishwasher.
3. The number of each type of whitegoods

5.3 Standard Practice Water Efficiency – White goods

The water efficiency of whitegoods used to determine the total standard practice water consumption is presented in Table 7. These values have been taken from a combination of the minimum allowable WELS ratings under AS 6400:2016 Water efficient products—Rating and labelling, and the NZGBC's recommendations for the baseline performance of these appliances within the rating tool.

Table 7 Standard Practice water efficiency – White goods

White Goods	Water efficiency WELS rating
Clothes washing machine	3 Star (5kg capacity or greater) 2.5 Star (capacity less than 5kg)
Dishwasher	3.5 Star

The baseline for both the clothes washing machine and dishwasher will scale based on the capacity of the machine entered by the project team. In the case of the clothes washing machine, this is related to the weight of clothing that can be accommodated per cycle. For dishwashers, the baseline is linked to the number of place settings that the machine can accommodate in one cycle.

5.4 Additional Guidance

The water efficiency of all whitegoods sold in New Zealand is registered in the Water Efficiency Labelling and Standards (WELS) scheme. The WELS scheme awards each whitegoods with a star rating from one to six stars (with six representing the most efficient). The WELS ratings of all fittings and fixtures sold in New Zealand are publicly available from a database administrated by the Australian Federal government. The water consumption is displayed on the WELS label on the registered products.

For further information about the WELS rating scheme and the water efficiency thresholds for each star band, please refer to AS/NZS 6400:2016 Water Efficient Products – Rating and Labelling and www.waterrating.gov.au.

6 HEAT REJECTION WATER

This section of the Calculator quantifies the water demand in cooling towers. The calculation methodology used is based on:

- AIRAH Best Practice guidelines for water conservation in cooling towers
- AIRAH Manual 1997
- AS 3666.1:2011 Air-handling and water systems of buildings—Microbial control

6.1 Calculation methodology

The annual water demand is calculated by summing the water demand for heat rejection for each month during a year. The monthly total is then prorated daily to align with the calculator time step.

Monthly water demand for heat rejection is calculated as follows:

$$\dot{V}_{make\ up} = \dot{V}_{evap} + \dot{V}_{drift} + \dot{V}_{bleed}$$

Where:

$\dot{V}_{make\ up} = volume\ of\ make\ up\ water$

$\dot{V}_{evap} = volume\ of\ evaporated\ water$

$\dot{V}_{drift} = volume\ of\ drift\ water$

$\dot{V}_{bleed} = volume\ of\ bleed\ water$

6.1.1 Evaporation is calculated as follows:

$$Evaporation = \dot{m}_{air}\left(\omega_{leaving} - \omega_{entering}\right)$$

Where:

$\dot{m}_{air} = the\ mass\ of\ air\ entering\ the\ cooling\ tower$

$\omega_{leaving} = the\ moisture\ content\ of\ the\ air\ leaving\ the\ cooling\ tower$

$\omega_{entering} = the\ moisture\ content\ of\ the\ air\ entering\ the\ cooling\ tower$

6.1.2 Drift is calculated as follows

$$Drift = C_{Drift} \times \dot{V}_{condenser}$$

Where:

$C_{Drift} = \text{Drift Coefficient}$

$\dot{V}_{condenser} = Monthly\ \text{Total Condenser Water Flow (L)}$

And:

$$\dot{V}_{condenser} = \frac{Q_{cooling} \times 3600}{C_{p,water} \times \Delta T_{condenser}}$$

Where:

$Q_{cooling} = \text{Total cooling load (kWh)}$

$C_{p,water}$ = Specific Heat of Water (4.18 kJ/(kg.°C))

$\Delta T_{condenser} = Condenser\ water\ temperature\ difference$

6.1.3 Bleed is calculated as follows:

$$Bleed = \frac{Evaporation}{COC - 1}$$

Where:

$Bleed = Bleed\ water\ (L)$

$COC = Number\ of\ cycles\ of\ concentration$

The following constants are used:

Table 8 Heat rejection water constants

Constants	Value
Specific Heat of Water (kJ/(L.°C))	4.180
Density of water @25°C (kg/l)	0.997

6.2 Data entry requirements

Data about heat rejection is entered into either the conventional water-based heat rejection section or the non-conventional water-based heat rejection section.

6.2.1 Conventional Water-based Heat Rejection

Where the project is using conventional cooling towers, the following data must be entered to complete the Heat Rejection Water section of the calculator:

1. **Project elevation above sea level (m)**
   This is used to derive the local atmospheric pressure.
2. **Cooling tower air flow (L/s)**
   The combined volumetric flow rate through the project's cooling towers
3. **The peak project cooling load (kW)**
   The peak anticipated heat load to be rejected by the project's cooling towers
4. **Standard Practice Building HVAC System**
   a. Select the project type from the drop down menu
   b. Enter the cooling tower combined flow (L/s) and the peak project cooling load (kW) for the Reference Project. The project cooling load shall be the same value as that established by modelling for the *Energy Use Calculator.* In some cases this will be the same as the Proposed Project. In cases where a Reference Project model has not been produced (such as for NABERS Energy modelling), then these values should be the same as the Proposed Project.
5. **Monthly cooling load (kWh thermal /month)**
   The thermal Cooling Load for each month in the Proposed Project and the Standard Practice

Benchmark Project (Reference Project) should be entered. The thermal Cooling Load for each month must be determined by the energy modelling required as part of the Energy Use calculator.

6. **Average monthly dry bulb temperature (°C)**
   The monthly average dry-bulb temperature for the project location. This data can be obtained from the National Climate Database, hosted by NIWA. (https://cliflo.niwa.co.nz/) Where this is reported at 9AM and 3PM, the project team should take the average of the two reported figures. If 9AM and 3PM data is not available, it is sufficient to use the monthly mean maximum temperature.
7. **Average relative humidity (RH%)**
   The monthly average relative humidity for the project location. This data can be obtained from the National Climate Database, hosted by NIWA. (https://cliflo.niwa.co.nz/) Where this is reported at 9AM and 3PM, the project team should take the average of the two reported figures.
8. **Condenser water (ΔT in °C)**
   A predicted average Condenser Water Temperature Difference ΔT should be entered in °C.
9. **Drift coefficient (%)**
   The predicted drift coefficient should be entered in %. A default value of 0.002% is given. This is based on the requirement in section 4.4 of AS/NZS 3666.1 Air-handling and water systems of projects—Microbial control. If a value different from the default value is to be used; the drift coefficient must be determined as per AS 4180.1 Drift loss from cooling towers - Laboratory measurement
10. **Cycles of concentration**
    The proportion of Total Dissolved Solids (TDS) in the cooling tower water in proportion to the makeup water

6.2.2 Non-conventional Water-based Heat Rejection

Where the project is using air-cooled heat rejection, low water flow cooling towers or non-potable water cooling systems (harbour heat rejection systems etc.), the following inputs are required by the Calculator:

1. **Standard Practice Building HVAC System**
   a. Select the Project type from the drop down menu
   b. Enter the cooling tower combined flow (L/s) and the peak project cooling load (kW) for the Reference Project. The project cooling load shall be the same value as that established by modelling for the *Energy Use Calculator*.
2. **Average monthly dry bulb temperature (°C)**
   The monthly average dry-bulb temperature for the project location. This data can be obtained from the National Climate Database, hosted by NIWA. (https://cliflo.niwa.co.nz/) Where this is reported at 9AM and 3PM, the project team should take the average of the two reported figures. If 9AM and 3PM data is not available, it is sufficient to use the monthly mean maximum temperature.
3. **Average relative humidity (RH%)**
   The monthly average relative humidity for the project location. This data can be obtained from the National Climate Database, hosted by NIWA. (https://cliflo.niwa.co.nz/) Where this is reported at 9AM and 3PM, the project team should take the average of the two reported figures.
4. **Monthly cooling load (kWh/month)**
   The Cooling Load for each month in the Reference Project should be entered. The Cooling Load

for each month must be the same value as that is established by energy modelling for the Energy Use Calculator.

5. **Monthly water demand (kL/month)**
Enter the monthly water demand for non-conventional cooling towers.
Where more than one heat rejection system is used to meet the cooling demand; the cooling load should be apportioned to each of the systems. The method for apportioning could be based on the capacity of the system or the cooling demand of the spaces which the different systems are serving. The cooling demand in the Reference Project is always assumed to be met by a water-based heat rejection system with the characteristics described in Section 7.3.

6.3 Standard Practice Water Efficiency – Heat Rejection

The Standard Practice water efficiency is based on the following:

Table 9 Standard Practice water efficiency – Heat rejection

Monthly cooling load	The same value as that is established by energy modelling for the Energy Use Calculator
Condenser Water ΔT	5.5°C (as per the requirements in the Energy Use guide)
Drift coefficient (%)	0.002% as required in AS/NZS 3666.1 Clause 4.4
Cycles of concentration in cooling tower water	6 cycles of concentration in alignment with previous Green Star versions' compliance requirements

6.4 Additional guidance

The evaporation calculation operates under the principles of energy-mass balance. The project team provide the average relative humidity and temperature data from which the calculator can determine the enthalpy of the air entering the cooling tower. As the project team know the heat rejection rate from the tower, the theoretical leaving air enthalpy can be determined. Assuming that the air leaving the tower is saturated (i.e. RH = 100%), the calculator looks up the leaving air enthalpy from the saturated vapour tables (ref. 1997 ASHRAE handbook) and determines the leaving air moisture content.

Using the ideal gas laws the calculator also determines the mass of air entering the tower and assuming the air flow to be incompressible at speeds well below Mach 0.8, the mass of air leaving the tower should be approximately equal to that entering the tower. On this basis the calculator can derive the quantity of moisture removed from the tower and the makeup water demand associated with this is determined.

7 WASHDOWN WATER

The washdown water calculation methodology uses a simple calculation that assesses the hose flow rate, number of hoses, and the average daily use to calculate the proposed daily water consumption. The standard practice project uses the same methodology, but with a set flow rate of 12L/min.

The calculation used to determine the water consumption of wash down is:

$$\dot{V}_{washdown,daily} = FlowRate \times \#of\ hoses \times Uses_{minutes,daily}$$

Where:

$\dot{V}_{washdown\ daily}$ = Daily water demand from hoses (l/day)

$FlowRate$ = Flow rate of each hose (L/min)

$\#of\ hoses$ = Number of hoses included within the development for Washdown

$Uses_{minutes,daily}$ = Number of minutes the hose is used each day (minutes)

8 LANDSCAPE IRRIGATION

This methodology uses site specific input parameters to determine the monthly and annual volume of water demand from irrigation. It simultaneously determines the performance of a Reference Project in the same location.

8.1 Calculation methodology

The irrigation requirement for the site is calculated for each month of the year, for each landscaped 'zone' in the site (a zone being a landscaped area that has the same soil type, irrigation system, microclimate, plant density and, as far as possible, types of plants). The irrigation requirement for each zone is calculated in three steps as described below:

Step 1: The irrigation requirement for each zone is calculated for each month of the year as follows:

$$Irrigation\ requirement = \frac{Demand_{plant} - Rainfall}{Efficiency_{irrigation}}$$

Where:

$Demand_{plant}$ = Plant water demand (mm)

$Rainfall$ = Rainfall available for plants (mm)

$Efficiency_{irrigation}$ = Application efficiency of the irrigation system (%)

And:

$$Demand_{plant} = Epan_{month} \times K_C$$

Where:

$Epan_{month}$ = Monthly point potential Evapotranspiration (mm)

K_C = Weighted average Crop Coefficient

And:

$$Rainfall = Rainfall_{month} \times Efficiency_{rain} \times (1 - \%_{Undercover})$$

Where:

$Rainfall_{month}$ = Monthly rainfall (mm)

$Efficiency_{rain}$ = Application efficiency of rainfall (%)

$\%_{Undercover}$ = Percentage of zone undercover (%)

A zone's monthly irrigation requirement is calculated by determining how much water the plants in the zone require, how much water will be provided naturally by rainfall and therefore how much water must be provided from an irrigation system, taking into account how efficient the particular irrigation system is at delivering water to the plants.

Step 2: The irrigation requirements for each month are then added together to calculate the total annual irrigation requirement (mm).

Step 3: The annual irrigation requirement, in mm, is then multiplied by the area of the zone, in m^2, to calculate the zone's annual irrigation requirement in litres.

Table 10 Landscape irrigation definitions and further Information

Parameter	Description	Further information
Application efficiency of irrigation system (%)	The percentage of water applied via an irrigation system which is taken up by the plants.	9.2.6
Application efficiency of rainfall (%)	The percentage of rainfall that is assumed to be taken up by the plants.	9.2.6
Crop Coefficient	The crop coefficient is an agronomic multiplier used to determine the water usage requirement for a particular plant type.	9.2.5
Monthly point potential Evapotranspiration (mm)	Point potential evapotranspiration data from The National Climate Database, hosted by NIWA.	9.2.1
Monthly rainfall (mm)	Rainfall data from The National Climate Database, hosted by NIWA.	9.2.1
Percentage of zone undercover (%)	This refers to the total percentage of the zone that will receive very little or no rainfall, as a result of being undercover.	9.2.4

8.2 Data entry requirements

All landscaped areas in the project that are to receive water via irrigation should be divided into zones; each zone should have the same soil type, irrigation system, microclimate, plant density and as far as possible, types of plants.

The following data is required to be entered for each zone:

1. Climate data (monthly rainfall data, monthly evapotranspiration data);
2. Zone name and description;
3. Area of zone (in m^2);
4. Percentage of zone undercover;
5. Weighted average Crop Coefficient in the zone. This reflects the water usage of the plant types in the zone. Crop Coefficients for various plant types are available in Appendix A;
6. Application Efficiency of irrigation system.

8.2.1 Climate data

The monthly average rainfall and point potential evapotranspiration data must be obtained from The National Climate Database, hosted by NIWA. It should be noted that ‘evapotranspiration’ and ‘evaporation’ are not the same. ‘Point potential’ evapotranspiration data should be used.

For rainfall, the project team are to use the data set used for the rainwater reuse calculations. The calculator will automatically calculate the monthly average rainfall and populate the table. For projects that do not include rainwater reuse initiatives the relevant data must still be procured and input into the calculator to determine the monthly rainfalls

An example of monthly rainfall and point potential evapotranspiration are given below. This data is for the grid coordinates -37.87 (Latitude) and 145.26 (Longitude).

Table 11 Sample rainfall and point potential evapotranspiration data from the BoM for grid coordinates -37.87 (Latitude), 145.26 (Longitude)

Month	Grid-point average data for rainfall (mm)	Grid-point average data for point potential evapotranspiration (mm)
January	54	190
February	48	160
March	61	135
April	73	88
May	91	47
June	67	33
July	75	38
August	86	56
September	77	82
October	83	124
November	71	147
December	72	164
Annual	873	1264

The climate data can be obtained from the NIWA website by downloading the regional climatology report based on the project location at the following link:

https://niwa.co.nz/climate-and-weather/regional-climatologies

8.2.2 Zone name and Description

Each zone should be named and described in enough detail for Green Star Certified Assessors to locate it on drawings.

8.2.3 Area of Zone (m^2)

The area of each zone should be entered in m^2.

8.2.4 Percentage of zone undercover (%)

This refers to the total percentage of each zone that will receive very little or no rainfall, as a result of being undercover. This applies to areas which are completely covered e.g. by roofs, significantly covered e.g. under awnings, or under dense vegetation such as trees with thick foliage.

8.2.5 Crop coefficient (K_c)

The crop coefficient is an agronomic multiplier used to determine the water usage requirement for a particular plant type. The **area weighted average** crop coefficient for the zone should be entered into the calculator. Crop Coefficients (K_c) for various plant types are available in Appendix A.

8.2.6 Application Efficiency

Many factors impact the application efficiency of an irrigation method including uniformity, runoff, wind drift, and evapotranspiration. For example, sprays have fixed application of water and generally cover short distances, sprinklers have rotating streams and cover larger distances, and underground drip systems are less affected by wind than above ground systems. The average values in Table 12 reflect the differences between various irrigation system types. The system used in each zone should be selected from a drop-down menu in the calculator.

Table 12 Application efficiencies of common irrigation systems

Irrigation Method	Average Application Efficiency
Sprinklers – Day	65%
Sprinklers – Night	75%
Sprays – Day	65%
Sprays – Night	70%
Micro sprays – Day	60%
Micro sprays - Night	65%
Drip – Bare soil	80%
Drip – Under mulch	85%
Subsurface drip (SDI)	90%
Hand watering	50%

Where the irrigation efficiency is different from any of the standard values, the available irrigation efficiency can be entered manually. Where a user determined application efficiency figure is used, additional compliance documentation is required to prove that such efficiency can be achieved. The application efficiency of rainfall is assumed to be 60%.

8.3 Standard Practice Water Efficiency

The Standard Practice water efficiency is based on the following:

Table 13 Standard Practice Water efficiency Landscape irrigation

Monthly ‘point potential’ evapotranspiration	As Proposed Project
Monthly Rainfall	As Proposed Project
Total landscaped area of the zone	As Proposed Project
Percentage of zone undercover	As Proposed Project
Weighted average Crop Coefficient in the zone	0.6
Application Efficiency of irrigation system	75% (night time sprinklers)

9 SWIMMING POOLS

A separate tab is provided for use if a project contains one or more swimming pools. All inputs must be made within this tab but results will automatically be added to the overall water use calculation.

9.1 Reference Pool

The reference pool section of the calculator automatically constructs pools of the same size and purpose to the proposed pools. Design decisions that influence the potable water usage are assumed to be the worst-case scenario for that pool, allowing the proposed pools to implement decisions that comparatively improve the potable water consumption. The overall potable water consumption for the reference pools is compared to the overall proposed pools consumption such that the benefits of good design decisions can be quantified and subsequently rewarded.

The reference pools table is entirely automated. Each cell automatically populates as entries are made in the proposed pools table, following each inputted detail. For the reference pools, some parameters are directly mirrored from the proposed pools as they are inherent to the purpose or physical constraints of the pool and are not the result of water saving design decisions. Other parameters involve design decisions that affect the potable water consumption but do not impact the purpose of the pool. For these parameters, the reference pools assume the worst case, compliant option or the standard practice seen across NZ pools.

The following parameters of the reference pools assume the worst-case situation relative to the proposed pool. All other parameters are directly mirrored from the proposed pools.

- Cover usage; assumed no covers (standard practice)
- TDS bleed control type; assumed to be manual where TDS bleed applies (worst case)
- Pre-washing of bathers; assumed no pre-washing (standard practice)
- Pool hall air setpoints (temperature and relative humidity); assumed 26°C (standard practice) and 40% RH (worst case/in line with historical HVAC systems that control humidity poorly)

9.2 Multiple Pools

The proposed and reference pools tables use a row for every pool, supporting up to 12 pools. This limit on pools can be expanded by an editor of the spreadsheet but is not expandable by the user.

Input cells are provided for every relevant parameter of the proposed pools. When all relevant input cells are populated for a pool, the daily potable water consumption is automatically calculated and displayed. The same is done automatically for the corresponding reference pool. The overall consumption for every pool combined is displayed as the “Proposed Total” and “Reference Total” in L/day. Individual pool consumption is rounded to the nearest 10 L/day and the proposed total is rounded to the nearest 100 L/day.

9.3 SHAH

The evaporation model used in the calculator for indoor pools is based off research papers published by Mirza Mohammed Shah (PE, PHD) in both 2014 and 2018. This research included discussion on evaporation from indoor swimming pools (occupied and unoccupied) and provided formulas for calculating this evaporation. The models proposed were shown to agree with all available test data.

9.4 Indoor / Outdoor Pools

There are many factors that influence the evaporation rate of pool water. Two of these factors are the air temperature and humidity. These are drastically different for indoor and outdoor pools, so the calculator has a drop-down option to reflect this. The environment for each individual pool can be set as “Indoor” or “Outdoor”, which then respectively unlocks options to set either the pool hall air condition setpoints or the average outdoor air conditions.

9.4.1 Indoor Pools

The evaporation of the pool water for indoor pools is dependant on the more easily measurable and controllable pool hall temperature and relative humidity. For this calculator, pool water evaporation for indoor pools assumes a pool hall environment with temperature and humidity perfectly controlled to the setpoints inputted by the user. This is a simplification compared to real pool halls which lack the mechanical plant and/or controls capability to perfectly control these conditions. This simplifying assumption is required for the usability of the spreadsheet as a more realistic representation of indoor air conditions (and thus evaporation rates) requires advanced modelling and comprehensive data on the mechanical plant, control, and weather conditions.

9.5 Pool Covers and Daytime / Night-time Modelling

The environment and operation of pool halls and pools can differ significantly between open and closed hours. Factors that influence differing day and night pool water consumption include usage of pool covers, number of bathers, and differing day and night-time air temperature/humidity setpoints. To reflect this, each pool requires an input for open hours between 0 and 24 hours.

Pool covers significantly reduce the evaporation rate of the pool in any environment. To reflect the difference between using pool covers outside of open hours, a drop-down box is added for each pool. It is assumed that pools that use covers will have a 90% reduced evaporation outside of open hours.

Pool halls can have different temperature and humidity setpoints during closed hours that will affect daily water consumption. For improved usability, it is assumed that this was not the case. Typically, NZ pool halls use the same or similar air temperature and humidity setpoints.

9.6 TDS Bleed Estimation

The TDS, or total dissolved solids, bleed is the largest contributor to potable water consumption in pools. TDS is a measure of dissolved foreign content in the body of water. This value must be controlled below a threshold for a body of water to be deemed safe for swimming. There are three ways that TDS is typically controlled: No bleed (requires regular replacement of pool water), manual bleed, and controlled bleed. TDS bleed rates are also significantly affected by bathers showering before using pools. The baseline bleed rate and the effects of controlled bleed and pre-showering were estimated for each pool type based on design experience. Table 1 below summarises the TDS bleed rates for each pool type.

Table 14 TSA Bleed Summary

Pool Type	Manual (Baseline)	Controlled Factor	Preshowering Factor
Lap Pool	0.5% per day	-0.20%	-0.20%
Programmes Pool	10% per day	-3%	-4%
Leisure Pool	10% per day	-3%	-4%
Toddlers Pool	15% per day	-3%	-3%
Spa Pool	20% per day	-5%	-5%
Dive Pool	1% per day	-0.25%	-0.25%

10 FIRE PROTECTION TESTING

The fire protection testing section assesses the following:

- The quantity of water discharged and capture for reuse during sprinkler system testing, and
- The daily demand attributable to the testing of such systems.

10.1 Calculation Methodology

The annual consumption is determined by the discharge from the fire protection system during testing and the amount that is captured for reuse. The indicated reuse component is then incorporated into the calculations to contribute to the project's water reuse
The annual fire system water demand is prorated daily to be incorporated into the daily demand calculation.
Daily water demand from fire protection systems:

$$Daily\ Demand \quad = V_{annual}/365$$

Where: $V\text{annual} = \text{Annual fire system discharge } (L)$

10.2 Data Entry Requirement

Data about the fire protection system should be entered in the 'Test Fire Water' section.
The following information is required for fire protection systems being installed in the project:

- Whether the project captures any fire test water
- The size of a retention tank
- The quantity of water discharged per test
- Confirmation as to the quantity of discharged water that is captured for reuse.

10.3 Standard Practice Water Efficiency

The amount of water used for testing will always be the same between the Proposed and Reference Building, so no water savings can be claimed this way.

11 PROCESS COOLING

The process cooling section assesses the following:

- The nature of process cooling loops
- The daily demand attributable to these.

11.1 Calculation methodology

Where the system is closed loop, the calculator makes the assumption that annual water use will be minimal, hence if the project team indicates that process cooling is provided by closed loop systems, the annual water consumption will be assumed to be zero.

Where the project team identifies open loop process cooling systems in the project the following calculations are applied to determine the daily system demand

Daily water demand from open circuit process cooling systems:

$$Daily\ demand = (Evap + Discharge) \times \%_{potable}$$

Where:

$Evap = Evaporation\ losses\ (L)$

$Discharge = Water\ discharged\ to\ sewer\ (L)$

$\%_{potable} = Proportion\ of\ daily\ demand\ that\ is\ potable\ (\%)$

11.2 Data entry requirement

Data about the process cooling systems should be entered in the ‘Process Cooling’ section.

The following information is required for process cooling systems being installed in the project:

1. The proportion of the daily water demand that is potable
2. The daily evaporation losses from the system
3. The daily discharge to sewer by the system

11.3 Standard Practice Water Efficiency

The standard practice water efficiency for process cooling systems has been retained from *previous* Green Star rating tools. The credit requires that either all equipment requiring process cooling is served by a closed-loop system, or that open loop systems are supplied with greater than 95% non-potable water.

12 DEAD LEGS ON HOT WATER RUNS

Water-saving initiatives to reduce the water wasted waiting for hot water demand to come through shower and tap fittings. The primary objective is to reduce water consumption of domestic hot water fixtures within buildings.

12.1 Data Entry Requirement

The only data required is the amount of water that is used in the proposed building

12.2 Standard Practice Water Efficiency

The New Zealand Building Code accepts 2L of water to be run before hot water arrives at the faucet and that people will wait for hot water.

13 CONDENSATE RECOVERY

Condensate recovery represents a purposeful and systematic approach to collecting, treating, and reusing condensed water vapour, often referred to as "condensate," within industrial processes and systems. The primary intent behind condensate recovery is to optimise resource utilisation and enhance overall operational efficiency by capturing and recycling water that would otherwise be lost as waste.

13.1 Data Entry Requirement

The amount of condensate available for collection is related to moisture in the air generated by occupants within the space, and that which is extracted from the outside air when cooling it to indoor conditions. Occupancy data entered in the General section will automatically be carried over to this section. Indoor and outdoor environment conditions must be entered into the Calculator, which will the calculate the amount of condensate available for collection.

14 RECLAIMED WATER USE

Reclaimed water use refers to the use of on-site rainwater, greywater, blackwater, stormwater or the use of a reclaimed water supply.

The calculator uses three steps in determining the impact of any reclaimed water use on the reduction in potable water consumption.

- The first step in determining how much reclaimed water is used on site is to establish the water demand that could be met with reclaimed water. The methodology used to establish the demands is given in Section 12.1 *Demand for Reclaimed Water*.
- The second step is to calculate how much reclaimed water is available to be collected on-site, in the case of rainwater, greywater, and blackwater. For the off-site supply of recycled water, this involves defining the maximum volume of water available from this source. The methodology used to establish these quantities is given in section 12.2.
- The third step looks at whether the available reclaimed water can be utilised by the daily demands on site. This involves looking at the water balance between the available sources and their competing demands. Where there is not enough reclaimed water to meet a demand, it is assumed that mains potable water will be used instead.

Additional information in regards to entering inputs for central shared resources is given in section 12.4.

14.1 Demand for reclaimed water

The demand for reclaimed water sets the **upper limit** to reclaimed water use; it is the maximum potential demand. The demand for 'mains water only' is also calculated. This defines the minimum quantity of mains water used. Therefore, regardless of how much reclaimed water is available, if the water uses are not connected to the reclaimed water system, reclaimed water will not be used.

The Water Calculator also allows the project team to enter any demands for non-potable water that have not already been included in the Calculator. The Calculator assumes that water demands from any 'Non-Potable Water' uses are met before the 'Potable Water' water uses.

The demands are established separately for each of the following water sources:

1. Rainwater systems;
2. Greywater systems
3. Blackwater systems
4. Stormwater and off-site reclaimed water systems;
5. Condensate Recovery and
6. Mains water only.

Where water uses are supplied with water from more than one source, it is assumed that they are first supplied with water from any greywater and blackwater systems, followed by rainwater, stormwater and off-site reclaimed water systems. This is to ensure the maximum potential of and greywater and blackwater systems can be claimed within the Calculator.

14.1.1 Data entry requirements

To establish the Potable Water reclaimed water demand:

1. Enter the percentage of each potable water use connected to an on-site rainwater system, greywater system, blackwater system, condensate recovery, or off-site supply of recycled water;
2. Enter the percentage of each potable water use connected to mains water only.

Notes:

a. Where a water use has only a limited portion of fixtures connected to a reclaimed water system, it is possible to enter a percentage between 0% and 100% to account for this. For example, a refurbished project where only 80% of urinals were able to be plumbed into a recycled water system. The balance must be entered under the 'Mains Water Only' input column. This scenario is illustrated in Figure 2.

b. It is possible to enter more than one source of reclaimed water for each of the water uses. This is shown in the included example, where both toilets and urinals are served by rainwater and greywater sources.

Water use (assessed in Potable Water, Credit 18)	Percentage of fittings/systems connected to the following water sources				
	Rainwater	Greywater	Blackwater	Stormwater recycling or other off-site reclaimed water	Mains water only (this column must be completed - please enter a figure of between 0% and 100% for each water use)
Toilets	100%	100%			0%
Urinals	80%	80%			20%
Indoor Taps					
Showers - occupants					
Showers - sports					
Laundries					
Dishwashers					
Heat rejection					
Wash down					
Landscape irrigation					
Fire system water					
Swimming pools					
Process cooling					

Figure 2 Percentage of water uses connected to reclaimed water sources

Following this methodology, where the demand from a particular water use can be met by water supplied from more than one source, the total reclaimed water demands can add up to more than 100% of the actual demand. This is not an error as the 'mains water only' demand is also calculated, which limits the reduction in potable water demand from reclaimed systems. Therefore, regardless of how much reclaimed water is available, if the water uses are not connected to the reclaimed water system, the reclaimed water will not be used.

The daily demand for reclaimed water by Non-potable water uses (such as water demands for wash down) is calculated in the same way as for potable water uses. The total monthly water demands are however entered directly into the calculator rather than being determined in the Water Demand section of the Calculator. These are then prorated daily for inclusion in the calculations.

To establish the Non-Potable Water reclaimed water demand:

1. Enter the monthly water demand (kL/month) for each non-potable water use (wash down, etc.) as shown in Figure 3 (this value will be prorated daily). The project team should also enter a description of the non-Potable Water use. This description will carry over to the following table where percentages of water sources are entered;
2. Enter the percentage of each non-Potable water use connected to an on-site rainwater system, greywater system, blackwater system, or off-site supply of recycled water;
3. Enter the percentage of each non-Potable water use connected to mains water only.

	Monthly water demand (kL/month)		
	Loading Dock Washdown	<Enter description of any other uses of rainwater or re-used water>	<Enter description of any other uses of rainwater or re-used water>
January	1.2		
February	1.2		
March	1.2		
April	1.2		
May	1.2		
June	1.2		
July	1.2		
August	1.2		
September	1.2		
October	1.2		
November	1.2		
December	1.2		

How are the water demands from the Non-Potable water uses met?

Water use	Rainwater	Greywater	Blackwater	Stormwater recycling or other off-site reclaimed water	Mains water only (this column must be completed - please enter a figure of between 0% and 100% for each water use)
Loading Dock Washdown	100%				0%
<Enter description of any other uses of rainwater or re-used water>					
<Enter description of any other uses of rainwater or re-used water>					

Figure 3 Monthly demand and percentage of non-potable water uses connected to reclaimed water sources

14.1.2 Standard Practice for reclaimed water

The Reference Project does not include any water re-use systems therefore any use of reclaimed water in the Proposed Project will be an improvement over standard practice.

14.2 Availability of Reclaimed Water

The quantity of reclaimed water available is established by requesting inputs from the project team on:

- Climate data;
- Rainfall collection areas;
- Storage tank sizes;
- Percentage of water uses that are collected on-site for recycling;
- Volume of water collected from any non-Potable water uses;
- Water that is available from any off-site recycled water supply.

The following section looks at the inputs required for each reclaimed water source.

14.2.1 Data entry requirements – rainwater collection

The quantity of rainwater collected on site depends on the quantity of rainfall available for collection, the size of the rainwater storage tank and the collection area. The calculations for rainwater availability are done on a daily basis to account for daily variations in rainfall, and the seasonal variation in demand for rainwater, (for example where rainwater is used for cooling systems or irrigation) as well as the ability of the rainwater tank to store water where supply exceeds demand from one day to the next.

To establish the maximum amount of rainwater collected the following inputs are required:

1. Rainfall collection area (m^2)
   The area where rainwater is collected should be entered in square metres.
2. Run-off coefficient
   The type of roof should be selected and then the associated run-off coefficient (see Table 14) will be displayed.

Table 14 Run-off coefficients. Source: BSI British Standards (2009), Rainwater Harvesting Systems – Code of Practice

Run-off coefficient for different roof types:	
Pitched roof with profiled metal sheeting	0.9

Pitched roof with tiles	0.8
Flat roof without gravel	0.8
Flat roof with gravel	0.65
Green roof, intensive	0.5
Green roof, extensive	0.7
Permeable pavement – Granular media	0.7
Permeable pavement – Plastic crates	0.8

1. **Storage capacity (kL)**
   The size of the total storage capacity for rainwater should be entered in kilolitres.
2. **Rainwater tank reliability**
   The rainwater tank reliability indicator is provided for indicate the consistency with which the rainwater tank will service the project's rainwater requirements. A low percentage efficiency indicates a tank that is continually unable to satisfy rainwater demand (for example, the project location has very dry summers and wet winters).

Rainwater collection:

Rainfall collection area (m2)		
Run-off co-efficient	Pitched roof with profiled metal sheeting	0.9
Storage capacity (kL)		
Rainwater tank reliability %		

3. **Rainfall data**
   The project team is to select project location in the table provided in the Calculator. If the project isn't located in those listed cities, the project team should select "custom" in the table and follow instruction given in the tabs shaded in yellow in the Calculator where additional datasets are available.

RAINFALL DATA

Please choose the location of the project. If the project isn't located in thos

Location	Select Location
Date	10-Year Average (mm)
1 January	
2 January	
3 January	
4 January	
5 January	
6 January	
7 January	
8 January	
9 January	
10 January	
11 January	
12 January	
13 January	
14 January	
15 January	
16 January	
17 January	
18 January	
19 January	
20 January	
21 January	
22 January	
23 January	
24 January	
25 January	
26 January	
27 January	
28 January	
29 January	
30 January	

10 Year Average Rainfall data (2011-2020)				
Auckland	Christchurch	Dunedin	Hamilton	Wellington
10-Year Average (mm)	10-Year Average (mm)	10-Year Average (mm)	10-Year Average (mm)	10-Year Average (mm)
0.0	0.0	0.4	5.6	0.0
15.8	0.2	0.0	0.0	0.0
18.4	0.0	21.4	0.0	0.0
0.0	0.0	0.4	0.0	0.0
0.0	1.4	0.0	0.0	0.0
0.0	0.6	0.8	0.0	0.0
0.0	0.0	7.6	0.0	0.2
0.0	4.2	4.4	0.0	0.0
29.8	0.0	0.0	19.8	0.0
0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.4	0.0	0.0
1.2	0.0	0.0	0.0	0.0
3.6	0.8	0.0	0.0	5.8
0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0
0.0	0.8	0.4	0.0	0.0
0.0	0.0	0.0	4.8	0.0
11.2	26.2	16.2	0.0	13.2
0.0	0.0	2.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0
0.0	10.2	0.0	0.0	0.2
0.0	9.6	0.0	0.0	1.8
0.0	0.0	0.0	0.0	38.6
0.0	0.0	0.0	0.0	0.6
0.0	0.0	0.0	0.0	0.0
0.0	0.0	8.0	0.0	0.0
46.6	0.0	0.0	0.6	0.0
0.6	2.0	7.0	0.0	0.8
0.2	2.0	0.2	0.0	4.4
0.0	0.0	11.4	0.0	0.0
0.8	0.0	0.2	0.0	0.0

Figure 4 Rainwater collection and rainfall data inputs to determine availability

14.2.2 Data entry requirements – greywater and blackwater collection

The quantity of greywater and blackwater collected, treated and used on site is established by determining the percentage of water uses that are collected on-site for reuse, in addition to any non-potable water uses that are collected. The calculations for both greywater and blackwater availability are performed on a daily basis taking into account the varying demand for this water seasonally.

To establish the maximum amount of greywater and/or blackwater available daily, the following inputs are required:

1. The percentage of discharge from toilets, urinals, taps, showers, whitegoods, heat rejection bleed, swimming pool backwash, fire system test water and process cooling discharge that is collected and treated for reuse on site. A percentage between 0 and 100 should be entered for all uses.
2. The daily collection of greywater and/or blackwater from other sources such as chiller condensate, cooling tower wash down or sewer mining etc.

Grey Water Collection

	% discharge water collected for re-use
Toilets	
Urinals	
Indoor taps	
Showers - occupants	
Showers - sport	
Washing machines	
Dishwashers	
Cooling tower bleed +other heat rejection	
Washdown	
Fire system test water	
Swimming pools filter cleaning	
Process Cooling	

Other sources e.g. Chiller condensate, cooling tower wash down or sewer mining etc...

	<Enter description of any other sources of greywater>	<Enter description of any other sources of greywater>	<Enter description of any other sources of greywater>	kL/month greywater collected for re-use from other sources
January				0.0
February				0.0
March				0.0
April				0.0
May				0.0
June				0.0
July				0.0
August				0.0
September				0.0
October				0.0
November				0.0
December				0.0

Figure 5 Percentage of water uses collected for greywater recycling

14.2.3 Data entry requirements – stormwater or off-site recycled water source

Using stormwater (collected either on or off-site) or an off-site recycled water source is an acceptable way to achieve reductions in potable water consumption in Green Star provided that it can be demonstrated that the relevant local authority has given approval for its use. Any reclaimed water system must be operational at the time of practical completion of the project.

Both stormwater and any off-site recycled water source should be entered in kilolitres for each month. For stormwater the calculation methodology in the Stormwater credit should be followed. For any off-site water supply, the monthly volumes entered into the calculator require validation by the water supply authority.

Stormwater and Off-site reclaimed water supply

	Stormwater collected for re-use (kL/month)	Off-site reclaimed water supplied to site (kL/month)
January		
February		
March		
April		
May		
June		
July		
August		
September		
October		
November		
December		

Figure 6 Monthly volume of stormwater or off-site reclaimed water source available

14.2.4 Data entry requirements – condensate water source

14.3 Utilisation of reclaimed water

The method for calculating the utilisation of reclaimed water has been linked between each of the water uses and reclaimed water sources. This is to allow the Calculator to account for water uses that might be utilising reclaimed water from more than one source, such as the example originally given in Figure 2, where toilets and urinals were served by a combination of rainwater and greywater.

The following section describes the Calculator’s process for establishing the reclaimed water utilised on the project. The inputs entered for reclaimed water demand and availability are used in this section. No additional inputs are required.

14.3.1 Calculation methodology

The maximum potential demand for reclaimed water for a particular water use (be it from rainwater; greywater and blackwater; or stormwater and off-site reclaimed water systems) is calculated on a daily basis using the total daily water demands from each water use, and the percentages of the water uses connected to each type of reclaimed water system.

The calculation methodology follows a number of steps for each day of the year as follows:

Step 1 – Establish rainwater tank volume at day one;

Step 2 – Establish the total volume of reclaimed water demand (regardless of source) for the first water use;

Step 3 – Establish the volume of reclaimed water available from each reclaimed water source on day one, after subtracting the non-potable water reclaimed water demands – rainwater (established at step 1 for day one), greywater, blackwater, off-site recycled water;

Step 4 – Establish the volume of reclaimed water required from each water source to meet the demands of the first water use;

Step 5 – Calculate the volume of reclaimed water utilised from each water source to meet the demands of the first water use

Step 6 – Repeat Steps 2 to 5 for each additional water use in the project. The availability of a reclaimed water source will subtract any reclaimed water utilised by a previous water use in the sequence;

Step 7 – Establish the volume of the rainwater tank at the end of day one. This then becomes the volume of the rainwater tank at the beginning of day two after any additional rainfall has been added to the tank. It has been assumed that treated greywater and blackwater can only be held for 24 hours due to health requirements, therefore where the full volume is not used within a day it is rejected to sewer.

14.3.2 The calculation methodology in detail

Step 1 - Establish rainwater tank volume on day one

To ensure that a fair assessment of rainwater reuse is undertaken, the tank is first initialised by undertaking a full year of daily rainwater calculations to determine the volume of the rainwater tank on day one.

The quantity of rainwater available for use depends on the amount of rainwater that is already in the tank left over from previous days, the rain that can be collected in the day in question minus a certain volume of rainwater that must be diverted from the tank at each rain event to prevent contaminants polluting the tank (referred to as a 'first flush[3]'). The amount of rain that can be collected depends on the monthly rainfall and the size, pitch and absorbency of the collection area. The first flush is always assumed to be 0.5L/m^2 (HB 230-2008 Rainwater Tank Design and Installation Handbook). First flush reductions are only ever applied on days when rainfall events occur.

In the event that the maximum capacity of the tank is reached as a result of one or more heavy rain events, no further water will be added to the tank and at the end of the day the remaining volume will be equal to the tank capacity. This ensures that undersized tanks do not provide a false indication of rainwater reuse.

The equation used to determine the rainwater available is:

$$Rainwater_{available} = Rainwater_{prev} + Rainwater_{new} - Rainfall_{FF}$$

Where:

$Rainwater_{available}$ = Rainwater available for use on day (x) (L)

$Rainwater_{prev} = Rainwater\ already\ in\ tank\ from\ previous\ day's\ rainfall\ (L)$

$Rainwater_{new} = Rainfall\ on\ collection\ area\ on\ day\ (x)\ (L)$

$Rainfall_{FF}$ = Rainwater diverted as first flush (L)

And:

$$Rainwater_{prev} = 0\ \big(for\ day\ (x)\big) or, Result\ from\ step\ 7\ (previous\ day)$$

And:

$$Rainwater_{new} = Day_x \times A_{collection} \times C_{runoff}$$

---

[3] **First Flush**: The first rainfall event may contain higher than average amounts of accumulated dust, industrial pollutants, bird and animal droppings, leaves and other debris. Rainwater collection systems typically divert this initial rainfall to drain to ensure the good quality of collected rainwater.

Where:

$Day_x = 10\ year\ average\ daily\ data\ for\ each\ day\ (mm)$

$A_{collection}$ = Collection area (m^2)

C_{runoff} = Runoff coefficient

And:

$$Rainfall_{FF} = 0.5 \times A_{collection}$$

Step 2 – Establish the total volume of reclaimed water demand for the first water use

Step 2 sets maximum reclaimed water demand for each water use. Starting with toilets on the 1st of January, the maximum demand for reclaimed water for toilets is calculated as follows:

$$Reclaimed\ Water\ Demand_{toilets\ max} = \left(Demand_{toilets} \times (1 - \%_{toilets})\right)$$

Where:

$Reclaimed\ Water\ Demand_{toilets\ max}$ = Maximum potential demand for reclaimed water for toilets on 1st of January

$\%_{toilets}$ = Percentage of toilets served by mains potable water

$Demand_{toilets}$ = Water demand from toilets on 1st of January

Step 3 – Establish the volume of reclaimed water available from each reclaimed water source on day one

Step 3 calculates the reclaimed water available from each of the reclaimed water sources that could be used to meet the demand. The calculation of rainwater availability is covered under Step 1 and so will not be repeated here. Greywater and blackwater use a similar method to calculate the reclaimed water available for reuse. The greywater available on the 1st of January for use is calculated as follows:

$$Greywater\ available = \left(Demand_{toilets} \times \%_{grey\ toilet} + Demand_{urinals} \times \%_{grey\ urinals} + \cdots\right) - Greywater_{non\ Wat-1}$$

Where:

$Greywater\ available$ = Greywater available on 1st of January

$Demand_{toilets}$ = Water demand from toilets on 1st of January

$\%_{grey\ toilets}$ = Percentage of toilets from which greywater is collected for reuse

$Demand_{urinals}$ = Water demand from urinals on 1st of January

$\%_{grey\ toilets}$ = Percentage of urinals from which greywater is collected for reuse

$Greywater_{non\ Wat-1}$ = Greywater demand from other non Wat − 1 uses

Stormwater and off-site recycled water source availability is calculated differently as values are entered directly as a kL/month value. For these two inputs the monthly value is prorated to a daily kL/day available to meet demand.

Step 4 - Establish the volume of reclaimed water required from each water source to meet the demands

Step 4 looks at the demand requirements for each of the reclaimed water sources independently. Using this method, where the demand for a particular water use could be met by water supplied from more than one source, the total reclaimed water demands of each independent source can add up to more than 100% of the total reclaimed water demand calculated at Step 2. This is not an error, as the demand calculated at Step 2 then provides a limit for Step 5 of the calculation.

The calculation for each of the reclaimed water sources is similar to the example given below for rainwater. Starting with toilets on the 1st of January, the maximum demand for rainwater for toilets is calculated as follows:

$$Rainwater\ Demand_{toilets\ max} = (Demand_{toilets} \times \%_{toilet\ rain\ max})$$

Where:

$Rainwater\ Demand_{toilets\ max}$ = Maximum potential demand for rainwater for toilets on 1st of January

$Demand_{toilets}$ = Water demand from toilets on 1st of January

$\%_{toilets\ rain\ max}$ = Maximum percentage of toilets served by rainwater

Step 5 - Calculate the volume of reclaimed water utilised from each water source to meet the demands

The daily calculations are undertaken in a cascading manner, checking that for each water use the nominated reclaimed water source has capacity to service the demand before allowing potable water to be substituted with reclaimed water. Where a reclaimed water source has met the limit of its capacity and no other source is available, the remaining demand is assumed to be met by mains potable water.

Greywater water is the first reclaimed water source assessed, followed by blackwater, rainwater, and then off-site and stormwater sources. The logic flow representing this assessment is best demonstrated by the flow chart in Figure 7

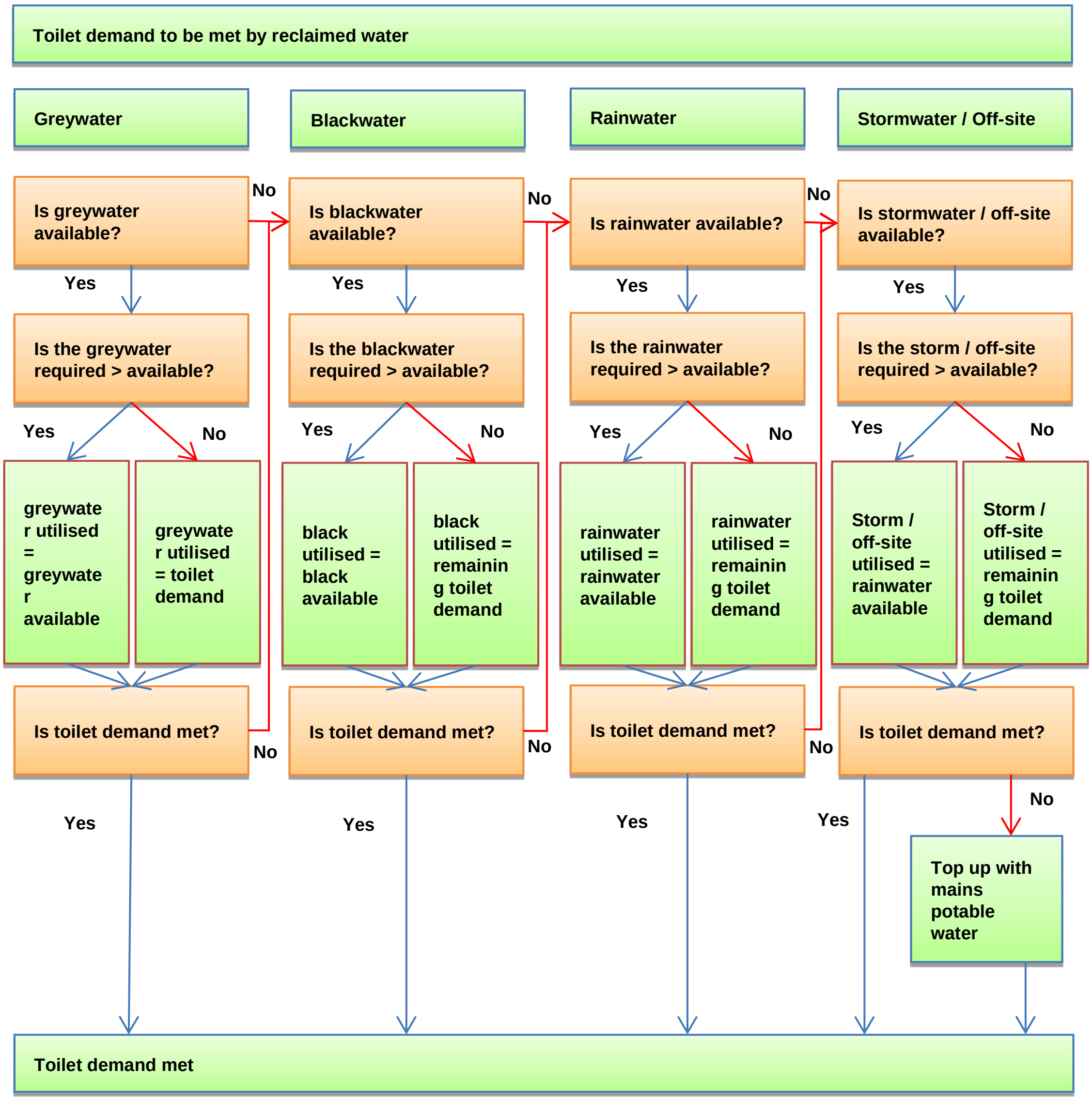

Figure 7 Flowchart showing the reclaimed water utilisation methodology

Step 6 - Repeat Steps 2 to 5 for each additional water use in the project

The calculations described in Steps 2 to 5 describe how the Water Calculator establishes the reclaimed water utilised for the first water use, but does not address any of the other subsequent water uses such as urinals, irrigation, or heat rejection etc. The calculations are essentially the same for each ensuing water use, with the exception of Step 3 where the availability of each of the reclaimed water sources is reassessed.

For each of the following water uses, the reclaimed water available becomes the reclaimed water remaining:

$$Greywater\ remaining = Greywater\ available\ - Greywater\ utilised_{toilets+\cdots}$$

Where:

$Greywater\ remaining$ = Greywater available after subtracting greywater utilised by previous water uses

$Greywater\ available$ = Greywater available on 1st of January

$Greywater\ utilised_{toilets+\cdots}$ = Greywater utilised by previous water uses

Step 7 – Establish the volume of the rainwater tank at the end of the day

After repeating Steps 2 to 5 for all water uses, a summary of the reclaimed water sources utilised is calculated. The volumes must then reset again for the next day of the daily calculations. The following equation establishes the volume of the rainwater tank on the next day:

$$Rainwater_{available} = Rainwater_{prev} - Rainwater_{demand,x} + Rainfall_{new} - Rainfall_{FF} - Rainwater_{non\ Wat-1}$$

Where:

$Rainwater_{available}$ = Rainwater available for use on day (x) (kL)

$Rainwater_{prev} = Rainwater\ in\ tank\ at\ start\ of\ previous\ day\ (kL)$

$Rainwater_{demand,x} = Rainwater\ used\ on\ previous\ day\ (kL)$

$Rainfall_{new} = Rainfall\ on\ collection\ area\ on\ day\ (x)\ (kL)$

$Rainfall_{FF}$ = Rainwater diverted as first flush (kL)

$Rainwater_{non\ Wat-1}$ = Rainwater demand from other non Wat − 1 uses (kL)

In undertaking the above calculation, the Water Calculator also reviews whether the rainwater tank reaches its capacity with any new rainfall added to the tank.

$$Volume_{day\ start} = MAX\ [0\ AND\ MIN\ of\ [Cap_{tank}\ AND\ Rainwater_{available}]]$$

Where:

Cap_{tank} = Tank storage capacity (kL)

14.4 Multiple Buildings Single Rating Guidance

This credit is applicable to the entire site within the project scope. Points will be allocated using the *Green Star Potable Water Calculator*.

There may be instances where a development includes multiple projects and a single central reclaimed water source that serves these multiple projects, but rated under separate Green Star ratings. Therefore one or more of these projects and their water consumption may fall outside of the immediate rating's project scope.

Projects that have multiple buildings sharing a central reclaimed water source must follow this additional guidance in order to account for the benefit of shared central services within the Calculator.

14.4.1 Shared Rainwater Collection and Reuse

Projects that have multiple buildings sharing a central rainwater tank must follow the following procedure for calculating the amount of rainwater available for the rated project site:

- Enter the total rainfall collection area (m^2) for the central rainwater tank into the calculator.
- Enter the total storage capacity (kL) for the central rainwater tank into the calculator.

Rainfall collection area (m2)		3000
Run-off co-efficient	Pitched roof with profiled metal sheeting	0.9
Storage capacity (kL)		200
Rainwater tank reliability %		

- The project team are required to undertake separate calculations that cover all projects served by the central rainwater system. These calculations are used to calculate the overall demand for rainwater based on the demand from all projects and ancillary services (such as landscaping) being served, given the collection area and storage tank capacity.
- Under part 11 of the Calculator ‘Reclaimed Water – water demands not assessed in the credit’, include the monthly rainwater demand (kL) from the other projects that will utilise the central rainwater tank.

	Monthly water demand (kL/month)		
	Central Rainwater tank- other building demands	<Enter description of any other uses of rainwater or re-used water>	<Enter description of any other uses of rainwater or re-used water>
January	50		
February	50		
March	50		
April	50		
May	50		
June	50		
July	50		
August	50		
September	50		
October	50		
November	50		
December	50		

- In the following table, indicate that 100% of the non-potable water will be met by rainwater. The Calculator will assume that these demands are met first before allocating remaining rainwater to the uses nominated within the rated project site.

How are the water demands from the Non-Potable water uses met?

Water use	Rainwater	Greywater	Blackwater	Stormwater recycling or other off-site reclaimed water	Mains water only (this column must be completed - please enter a figure of between 0% and 100% for each water use)
Central Rainwater tank- other building demands	100%				0%
<Enter description of any other uses of rainwater or re-used water>					
<Enter description of any other uses of rainwater or re-used water>					

14.4.2 Shared Greywater or Blackwater Collection and Reuse

Projects that have multiple buildings or fitouts sharing a central greywater or blackwater treatment plant must follow the following procedure for calculating the amount of greywater or blackwater available for the rated project site. As the procedures are essentially the same for both these water sources, the example focuses on greywater, but can also be used for blackwater:

- The project team are required to undertake separate calculations that cover all projects served by the central greywater system. These calculations are used to calculate the overall demand for greywater based on the demand from all projects and ancillary services (such as landscaping) being served, given the collection sources utilised.

- Where the central greywater treatment system collects from additional sources outside of the rated project site, the additional water collected can be entered under the greywater section of the calculator in monthly inputs (kL/month).

Other sources	e.g. Chiller condensate, cooling tower wash down or sewer mining etc...			
	Central greywater treatment - other building input	<Enter description of any other sources of greywater> (kL/month)	<Enter description of any other sources of greywater> (kL/month)	kL/month greywater collected for re-use from other sources
January	15			15.0
February	15			15.0
March	15			15.0
April	15			15.0
May	15			15.0
June	15			15.0
July	15			15.0
August	15			15.0
September	15			15.0
October	15			15.0
November	15			15.0
December	15			15.0

- Where the central greywater treatment system is used to meet additional demands outside of the rated project site, these demands should be entered under part 8 of the Calculator 'Reclaimed Water – water demands not assessed in the credit, include the monthly greywater demand (kL) from the other projects that will utilise the central greywater treatment plant.

	Monthly water demand (kL/month)		
	Central greywater treatment - other building demands	<Enter description of any other uses of rainwater or re-used water>	<Enter description of any other uses of rainwater or re-used water>
January	50		
February	50		
March	50		
April	50		
May	50		
June	50		
July	50		
August	50		
September	50		
October	50		
November	50		
December	50		

- In the following table, indicate that 100% of the non-potable water will be met by greywater. The Calculator will assume that these demands are met first before allocating remaining greywater to the uses nominated within the rated project site.

How are the water demands from the Non-Potable water uses met?

Water use	Rainwater	Greywater	Blackwater	Stormwater recycling or other off-site reclaimed water	Mains water only (this column must be completed - please enter a figure of between 0% and 100% for each water use)
Central greywater treatment - other building demands		100%			0%
<Enter description of any other uses of rainwater or re-used water>					
<Enter description of any other uses of rainwater or re-used water>					

15 SEWERAGE CALCULATION

The sewerage calculation does not require any additional data input from the user. All required data is entered into the *Potable Water Calculator* and then exported to the Sewerage component of the *Potable Water Calculator.*

16 GREEN STAR - ENEGY USE CALCULATOR

The Energy Use Calculator is designed to assess reductions in energy use compared to a Reference Project.

The energy consumption associated with water heating for taps, showers, dishwashers and washing machines in the Project (domestic hot water) is a required input of the Energy Use Calculator. The methodology that must be used to determine the energy consumption associated with domestic hot water is included in the *Energy Use Calculator Guide*; it requires the demand for domestic hot water as an input. The methodology shows that reductions in energy can be achieved by installing more efficient fittings and fixtures as well as installing an efficient hot water system and/or a solar hot water system.

The domestic hot water demand figures that must be used are calculated and displayed in the Potable Water Calculator. The calculator assumes that 50% of the water used in taps and showers in the Proposed and Reference Project is hot water. The proportion of hot water used in washing machines and dishwashers is defined in accordance with the usage of the whitegoods' "normal" or default cycle which the project team should support with manufacturer's documentation. The water efficiency of taps, showers dishwashers and washing machines in the Proposed Project are as entered by the project team in the Potable Water Calculator. The water efficiency of the fittings of the Reference Project is based on the standard practice fittings described in 'Standard Practice Water Efficiency – Sanitation' and for whitegoods in 'Standard Practice Water Efficiency – White goods.' The hot water consumption figures are displayed in the Results Section of the Potable Water Calculator.

17 REFERENCES

- Allen, R G. Pereira, L S, Raes D, Smith, M (1998) Crop evapotranspiration - Guidelines for computing crop water requirements - FAO Irrigation and drainage paper 56, Food and Agriculture Organization of the United Nations
- Parsons, R A (ed.), (1997) 1997 ASHRAE fundamentals handbook
- AS 3666.1:2011 Air-handling and water systems of buildings—Microbial control
- AS 6400:2016 Water efficient products—Rating and labelling
- ACT planning and land authority (ACTPLA) design and siting requirements for water efficiency
- Standards Australia,(2008) HB 230—2008 Rainwater Tank Design and Installation Handbook
- British Standards Institution, (2009) BS 8515:2009 Rainwater harvesting systems – Code of practice
- Aherne, V J (2009) AIRAH Best Practice Guidelines: Water conservation in cooling towers, AIRAH/State Government Victoria
- AIRAH(2007) AIRAH technical handbook
- United Nations Environment Programme (2006) Electrical Energy Equipment: Cooling Towers

APPENDIX A: PROJECT EXAMPLES

Crop coefficient (K_c)

The crop coefficient is an agronomic multiplier used to determine the water usage requirement for a particular plant type. The **area weighted average** crop coefficient for the zone should be entered into the calculator.

The table below provides crop coefficients based on the general plant type e.g. native trees, exotic trees, native shrubs etc. and the expected water use of that general plant type. Examples of specific plants that belong in the crop coefficient category are also provided. For plants that do not appear on the list, project teams should pick a plant category that most closely matches the plants in the zone, based on the examples provided. Where a crop coefficient cannot be determined, a Technical Question may be submitted to the NZGBC.

Table 15 Tree crop coefficient

1. Trees	Crop Coefficient
1.1 Native trees	
1.1.1 Very Low Water Use	**0.1**
Banksia (Silver) (Banksia marginata)	
Eucalypt (Yellow Gum) (Eucalyptus leucoxylon)	
Eucalyptus (Sugar Gum) (Eucalyptus cladocalyx)	
Eucalyptus (Red Iron Bark) (Eucalyptus tricarpa)	
She-Oak (Drooping) (Allocasurina verticillata)	
Wattle (Cootamundra) (Acacia baileyana)	
Willow leaf Hakea (Hakea salicifolia)	
1.1.2 Low Water Use	**0.25**
Bottlebrush (Weeping) (Callistemon viminalis)	
Melaleuca (Melaleuca stypheliodes)	
Oak (Silky) (Grevillea robusta)	
1.1.3 Moderate Water Use	**0.5**
Ash (Mountain) (Eucalyptus regnans)	
Fig (Moreton Bay) (Ficus macrophylla)	
Cabbage Tree Palm (Livistonia australis)	

Umbrella Tree (Schefflera actinophylla)	
Lilly Pilly (Acmena Smithii)	
White Peppermint (Eucalyptus pulchella)	
1.1.4 High Water Use	**0.7**
None	
1.2 Exotic trees	**Crop Coefficient**
1.2.1 Low Water Use	**0.35**
Pear (Ornamental) (Pyrus calleryana	
Chinese Elm (Ulmus parvifolia)	
Crab Apple (Malus “plena”)	
Crepe Myrtle (Lagerstroemia indica)	
Monterey Pine (Pinus radiata)	
1.2.2 Moderate Water Use	**0.6**
Golden Ash (Fraxinus excelsior “Aurea”)	
Golden Poplar (Populus x canadensis “Serotina Aurea”)	
Pin Oak (Quercus palustris)	
Pencil Pine (Cypressus sempervirens)	
Magnolia (Magnolia grandiflora)	
Jacaranda (Jacaranda mimosifolia)	
1.2.3 High Water Use	**0.85**
Douglas Fir (Pseudotsuga menziesii)	
Paperbark Maple (Acer griseum)	
Maple (Japanese) (Acer palmatum)	
Rubber Plant (Ficus elastica)	
Silver birch (Betula pendula)	

Table 16 Shrub crop coefficient

2. Shrubs	**Crop Coefficient**
2.1 Native shrubs	
2.1.1 Low Water Use	**0.25**
Banksia (Heath) (Banksia ericifolia)	
Bottlebrush (Splendens) (Callistemon citrinus "Splendens")	
Saltbush (Rhagnodia spinescens)	
White Correa (Correa alba)	
2.1.2 Moderate Water Use	**0.5**
Banksia (Swamp) (Banksia robur)	
Boronia (Red) (Boronia heterophylla)	
Flame Pea (Chorizema cordatum)	
Snowy Daisy Bush (Olearia lirata)	
Native Heath (Epacris impressa)	
2.1.3 High Water Use	**0.7**
Creamy Candles (Stackhousia monogyna)	
Birds Nest Fern (Asplenium australasicum)	
Soft Tree Fern (Dicksonia australis)	
Weeping Fig (Ficus benjamina)	
2.2 Exotic shrubs	
2.2.1 Low Water Use	**0.35**
Abelia (Abelia x grandiflora)	
Oleander (Nerium oleander)	
Euphorbia (Crown of Thorns) (Euphorbia milii)	
Lantana (Lantana camara)	
Sedum (Ice Plant) (Sedum spectabile)	

Yucca (Spannish Dagger) (Yucca gloriosa)	
Hebe	
2.2.2 Moderate Water Use	**0.6**
Camellia (Camellia sasanqua)	
Daphne (Winter) (Daphne odora)	
Japanese Honeysuckle (Lonicera japonica)	
Japanese Wisteria (Wisteria floribunda)	
Dogwood (Buddleia davidii))	
Pittosporum (Diamond leaf) (Pittosporum rhombifolium)	
Viburnum (Viburnum x burkerwoodii)	
Rose (Rosa spp)	
Azalea	
2.2.3 High Water Use	**0.85**
Hibiscus (Scarlet Rose-mallow) (Hibiscus coccineus)	
Hydrangea (Hydrangea x macrophylla)	
Rhododendron (Rhododendron hybrid)	
Gardenia	

Table 2 Climber crop coefficient

3. Climbers	**Crop Coefficient**
3.1 Native climbers	
3.1.1 Very Low Water Use	**0.1**
Clematis (Small Leaved) (Clematis microphylla)	
Kennedia (Kennedia macrophylla)	
Native Sarsparilla (Hardenbergia violacea)	
3.1.2 Low Water Use	**0.25**

Pandorea (Bower of Beauty) (Pandorea jasminoides)	
3.1.3 Medium Water Use	**0.5**
3.2 Exotic climbers	Crop Coefficient
3.2.1 Very Low Water Use	**0.25**
Vine (Glory) (Vitis cultivar)	
3.2.2 Low Water Use	**0.35**
Ornamental grape (Vitus vinifera)	
Star Jasmine (Trachelospermum jasminoides)	
Wisteria (Chinese) (Wisteria sinensis)	
3.2.3 Medium Water Use	**0.6**
Banksia Rose (Rosa banksiae "Lutea")	
Carolina Jasmine (Gelsemium sempervirens)	
Virginia Creeper (Parthenocissus quinquefolia)	
3.2.4 High Water Use	**0.85**
None	

Table 18 Grasses and ornamentals crop coefficients

7. Turf	**Strong growth, Good condition**	**Vigorous growth, Lush condition**
7.1 Warm Season Grasses	**0.6**	**0.85**
couch		
kikuyu		
buffalo		
Zoysia		
7.2 Cool Season Grasses	**0.85**	**1**

Kentucky blue		
Ryegrass		
Tall Fescue		
Bentgrass		
8. Ornamentals	**0.8**	**0.95**