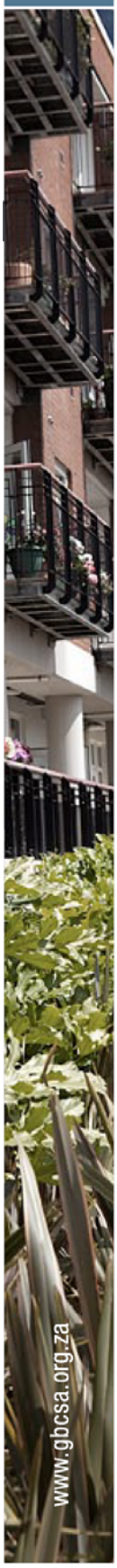
Green Star SA - Multi Unit Residential v1

POTABLE WATER & SEWAGE CALCULATOR GUIDE

Version 1.0



GREEN BUILDING COUNCIL
OF SOUTH AFRICA

Green Star SA Multi Unit Residential v1

Potable Water & Sewage Calculator Guide

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Change Log

Date	Changes

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1 Introduction

The Potable Water Calculator (the 'Calculator') estimates the occupant amenity potable water consumption based on the water efficiency of fittings (such as WCs, baths, kitchen and basin taps, and showers) and the reduction in potable water consumption achieved through rainwater, greywater or blackwater harvesting and recycling systems (where applicable).

The Calculator is used in the Green Star SA - Multi Unit Residential v1 rating tool to estimate the consumption of potable water for occupant amenity uses within multi unit residential developments, and forms the basis for points awarded in the *Wat-1 Occupant Amenity Water* credit within the Water Category and the *Emi-6 Discharge to Sewer* credit within the Emissions Category. The Calculator allows different multi unit residential developments to be compared on an equal basis, which is essential for equitable Green Star SA assessment. The Calculator is built for Green Star SA – Multi Unit Residential v1 assessment purposes only and should not, in any way, be used for sizing sanitary fittings and water reticulation systems.

The estimated potable water consumption of a multi unit residential development is compared to set benchmarks to determine the efficiency of water use and hence the points achieved. The benchmarks used in this credit are based on fittings that are, for the most part, currently available in South Africa. Green Star SA does, however, intend to drive market transformation to more efficient products which may not currently be available in the South African market.

The Calculator is divided into two parts, *Part 1: Demand-Side Efficiency* and *Part 2: Supply-Side Efficiency*. Part 1 establishes the predicted occupant amenity water consumption based on the specified, or installed, fittings and fixtures. The maximum number of points awarded in this part is 2 (two). Part 2 calculates the predicted potable occupant amenity water savings (toilet flushing use only) in the building due to water harvesting recycling; rainwater, greywater and blackwater. The maximum number of points awarded in this part is 3 (three). Points achieved in either Part 1 or Part 2 are automatically inserted in the Water Category sheet within the Green Star SA – Multi Unit Residential v1 spreadsheet tool.

2 Acknowledgements

The Green Star SA – Multi Unit Residential v1 Potable Water and Sewage Calculators and this guidance document are based on those of the Australian Green Star – Multi Unit Residential rating tool. The Green Building Council of South Africa acknowledges the work of technical consultant ARUP in adapting these items to the South African Green Star SA – Multi Unit Residential v1 rating tool.

3 Part 1: Demand-Side Efficiency (Predicted Water Consumption)

The predicted potable occupant amenity water consumption is based on the overall average water consumption per occupant based on the fixtures and fittings specified, or installed, in the development.

IMPORTANT NOTE: *The results from the Calculator may not be accurate representations of the actual water consumption of the development when occupied. The use of the Calculator is strictly for benchmarking purposes in Green Star SA – Multi Unit Residential v1 only and* ***MUST NOT be used for wet services design in any way****.*

3.1 Assumed usage patterns

For the purposes of benchmarking, it is necessary to assume occupant behaviour and use of the fixtures and fittings provided within a dwelling. The assumed usage characteristics of fixtures and fittings included within the scope of the credit are outlined in Table 1. Water efficiency improvements through water efficient appliances (i.e. clothes and dish washers) are not rewarded by the Calculator as the Calculator assesses occupant amenity water use associated with permanent fixtures and fittings only.

Type	*Water Efficiency Metric*	*Assumed Usage Per Occupant*
WC	L/flush (average)	4.8 flushes
Bath	Bath capacity (L)	0.4 full volume (where shower installed) 1.0 full volume (where no shower installed)
Shower	Flow rate (L/min)	5 minutes x 0.6 (where bath installed) 5 minutes x 1.0 (where no bath installed)
Kitchen Sink Tap	Flow rate (L/min)	4 x 30 seconds
Basin Tap	Flow rate (L/min)	7 x 9 seconds

Table 1: Per occupant usage data for benchmarking

For dwellings where both bath(s) and shower(s) are installed, a combined usage pattern is assumed and diversity factors are applied as indicated in Table 1.

The data in Table 1 are default values and may not be an accurate representation of the actual usage patterns or behaviour of the occupants of the development. They are only intended for benchmarking purposes for Green Star SA – Multi Unit Residential v1 assessments only.

3.2 Occupancy

Two different occupancy rates may be assumed within the Green Star SA – Multi Unit Residential v1 rating tool;

- 'Private' dwellings; The assumed number of occupants is two people for the first bedroom and one per each additional bedroom per dwelling type.
- 'Shared' dwellings; The assumed number of occupants is two people per bedroom for all bedrooms.

Please refer to the Green Star SA – Multi Unit Residential v1 Technical Manual for further details on these two occupancy types.

The occupancies assumed by the Calculator for each dwelling type are automatically entered into the Calculator from the 'Building Input' page of the Green Star SA – Multi Unit Residential v1 rating tool spreadsheet. The Calculator is designed for equitable comparison of multi unit residential developments. The Calculator does not consider the time occupants spend within the dwellings.

3.3 Fittings and Fixtures

To complete the necessary calculations to award points in Part 1, both the performance and quantity of the specified, or installed, fixtures and fittings must be entered into the Calculator for each Dwelling Type, as entered into the 'Building Input' sheet within the Green Star SA – Multi Unit Residential v1 spreadsheet tool. For further information on Dwelling Types, please refer to the Green Star SA – Multi Unit Residential v1 Technical Manual.

The water efficiency performance must be entered in the metric as indicated in Table 1. Any water efficiency performance data entered into Calculator must be justified through manufacturer product data. It is not acceptable to estimate such performance data and the 'Documentation Requirements' of the Wat-1 credit require this information to be submitted. Figure 1 displays where the water efficiency performance data must be entered in Part 1.

	Toilet (L/flush)			Shower (L/min)			Bath (L)			Basin Taps (L/min)			Kitchen Taps (L/min)		
Fitting Type	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Average Flush (litres)	3.5	4.5													
Flow rate (litres/min)				9.0	12.0					6.0	4.5		9.0	16.0	
Capacity (litres)							200.0								
Daily use/person factor	4.8			1 or 0.6			1 or 0.4			7			4		
Usage factor	1			5			0.4			0.15			0.50		

Figure 1: Fitting & fixture water efficiency performance data entry

Up to three "types" of fittings can be filled into the Calculator as Type A, B or C. The criteria that differentiates types is water efficiency performance. Each can be filled into the calculator for each particular sanitary fitting. For example, a dwelling may have two basin tap sets, one using 6 L/min and one using 4.5 L/min, which would be considered as two types. However two basin taps which look different, yet have the same flow rate would be considered one type only. Where more than three types of any fixture or fitting occur in a development, the Project Team should contact the GBCSA for guidance.

The quantity of fixtures and fittings entered into the Calculator must be the actual number per dwelling type (not total within the development). Only fittings and fixtures which are within the scope of the credit should be entered. Miscellaneous fittings (e.g. outside garden taps, taps for dishwashers or clothes washers, etc.) should be excluded. Figure 2 (over page) displays where the quantity of fixtures and fittings must be entered into the Calculator.

Number of this types	Assumed occupants	Number of Sanitary Fittings of Each Type															
		Toilet			Shower			Bath			Basin Taps			Kitchen Taps			
		A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	
5	2	1			1						1			1			
14	2	1			1						1			1			
7	3	1			2							2		1			
15	3	1			2							2		1			
4	5	1				3		2				5		2	1		

Figure 2: Fitting & fixture quantity entry

Users of the Calculator are to ensure that all quantities entered are correct. Be aware that if no baths or no showers are installed, no quantities should be entered. Where the Calculator determines a non-zero input into a column where no (or zero) fixture or fitting performance data has been entered, it may alter the output of the Calculator given the diversity factors indicated in Table 1.

3.4 Reference Consumption & Improving Performance

For the purposes of benchmarking water efficiency, a 'reference consumption' (per occupant) has been determined fixtures and fittings of moderate water efficiency performance. This reference consumption is the benchmark daily water consumption of a single occupant. The reference consumption does not reflect current existing performance, however is intended to reflect a dwelling where fixtures and fittings of the worst, or least water efficient, performance have been avoided. Please note that the reference consumption is the occupant daily consumption averaged over all dwellings in the development, not on a single dwelling type basis (i.e. not pass-fail per dwelling).

Therefore, although the 'reference consumption' has been determined excluding baths, this does not indicate that baths cannot be provided within dwellings. If baths are provided in several or all dwelling types, the increase in water consumption due to this fixture must be accounted for elsewhere, such as increased water efficiency performance of toilets and showers etc., to remain within the benchmark.

To improve the development's water efficiency performance and be awarded 1 point or two 2 points, fixtures and fittings with improved water efficiency performance must be used. Table 2 (over page) demonstrates the water efficiency performance of the reference consumption and suggested scenarios which would achieve 1 or 2 points.

Type	Reference Consumption (Ave.)	1 point scenario	2 point scenario
Toilets/WCs	5.5 L/min	4.5 L/min	3.2 L/min
Bath(s)	0.0 L	0.0 L	0.0 L
Shower(s)	10.0 L/min	9.0 L/min	7.5 L/min
Kitchen Tap(s)	8.0 L/min	6.0 L/min	5.5 L/min
Basin Tap(s)	8.0 L/min	6.0 L/min	4.5 L/min
Consumption:	100.8 L/day/occupant	84.9 L/day/occupant	68.6 L/day/occupant
% Reduction:	-	≈ 15%	≈ 30%

Table 2: Occupant amenity Reference consumption and performance improvement

A system for labelling efficiency of water fittings is still under development in South Africa water efficiency performance data will need to be sourced from suppliers or manufacturers.

3.5 Part 1 Output Results

Based on the data input into the Calculator and the information from the Building Input sheet, the Calculator determines the average daily total amenity water consumption for the development. The assumed occupancy of the development is then used to normalise that data to a per occupant consumption figure. This figure is then compared to the benchmarks and points awarded accordingly. The output results of Part 1 of the Calculator are displayed in in Figure 3 below.

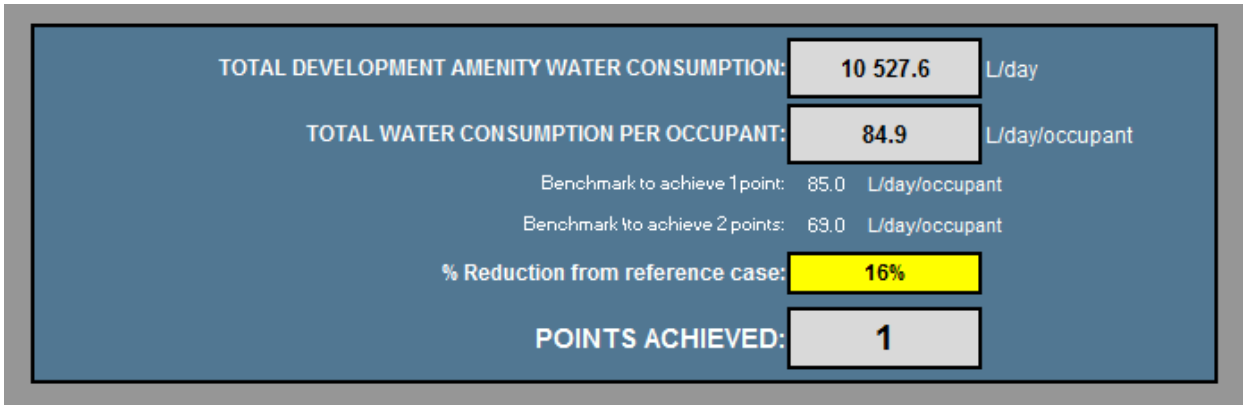


Figure 3: Part 1 output results panel.

The Calculator also indicates the percentage reduction from the reference case achieved for amenity water efficiency initiatives, highlighted in yellow. For visual presentation of the breakdown in amenity water demands, the Calculator automatically produces a chart of the amenity demands. This is displayed in Figure 4 (over page).

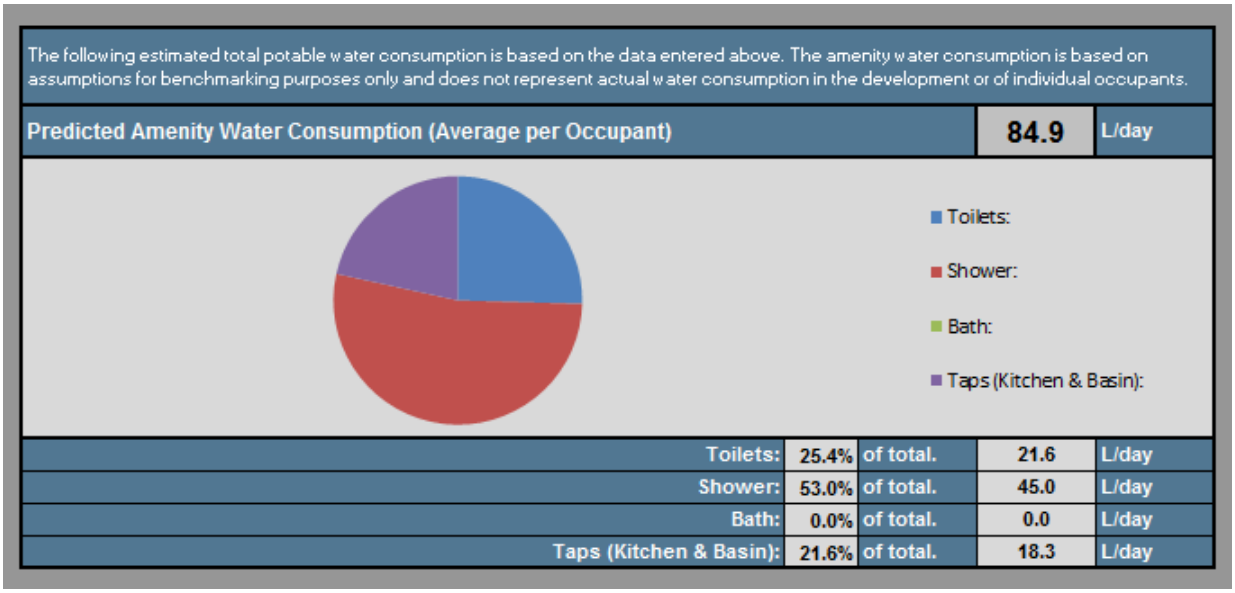


Figure 4: Part 1 amenity breakdown panel.

3.6 Notes

Dual Flush Toilets / WCs

The average litres used for flushing a dual flush WC should be calculated by averaging 1 full flush and 4 half flushes. For example a 6 litre full-flush/3 litre half-flush WC should be entered as (6x1+3x4)/5 = 3.6 litres average/flush. For WCs with flush valves, the valve flow rate (in litres/sec) must be multiplied by the flush duration (in seconds) to find the litres/flush. A minimum flush duration of 7 seconds must be assumed. For example, a flush valve with a valve flow rate of 1.08 litres/second (65 litres/min) would be entered as 1.08 x 7 = 7.58 litres/flush.

Flow Controlling Devices

Flow controlling devices can only be considered for this credit if they are an "intrinsic" attribute of the fitting or fixture. Flow restrictors, aerators or other flow controlling devices which can only be removed from a fixture or fitting through the use of specialist equipment or tools commonly used by wet services sub-contractors, plumbers or building maintenance staff, are considered an "intrinsic attribute" of the fixture or fitting. Similar devices which can be removed without the use of such tools (i.e. by hand) are not deemed intrinsic and cannot be used to claim water efficiency improvements within the Calculator. For fixtures and fittings with such 'intrinsic' devices, product literature or manufacturer datasheets must clearly state the necessary water efficiency performance of the complete assembly with the flow controlling device.

4 Part 2: Supply-Side Efficiency (Water Harvesting & Recycling)

Part 2 is where all the data on any non-potable harvesting and recycling systems is entered to reduce the consumption of potable (or mains/municipal water). There is no minimum prerequisite of a score in Part 1, however amenity water demands should be minimised through water efficient initiatives before harvesting and recycling initiatives are considered.

IMPORTANT NOTE: *The results from the Calculator may not be accurate representations of the actual water consumption of the development when occupied and the use of the Calculator is strictly for benchmarking purposes in Green Star SA – Multi Unit Residential v1 only and* ***MUST NOT be used to size and specify water harvesting and recycling systems****.*

4.1 Non-Amenity Recycled Water Demand

Where recycled water is supplied to other demands within the development (e.g. landscape irrigation, clothes washing, fire system test water, swimming pool top-up, wash-down areas etc.), these demands must be entered into the 'Other Predicted Recycled/Harvested Water Demands' section of the Calculator.

The quantities of these demands are used to calculate the quantity of non-potable water which will be available to reduce demand for potable occupant amenity water use. Annual demands should be calculated and converted to values in litres per day (L/day) and entered into these fields, as shown in Figure 5.

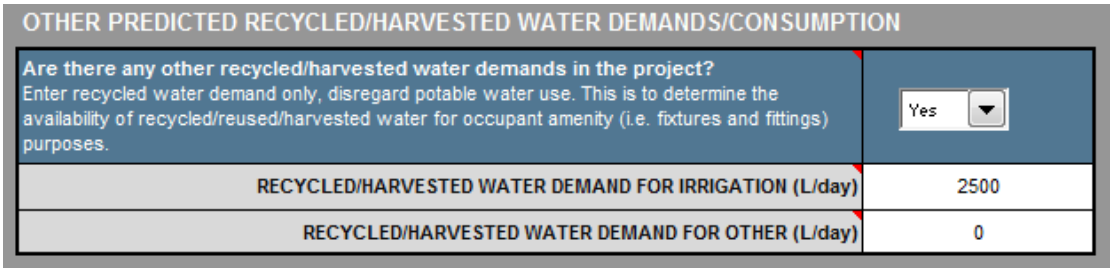


Figure 5: Non-amenity recycled water consumption inputs.

It is essential for a Green Star SA submission that quantities claimed in the Calculator correlate exactly to those claimed in other credits within the Water category. Please note that all daily demands must be calculated based on total days (i.e. 365 days per year).

As described in the following sections, the source of non-potable recycled water (i.e. rain, grey or black water) which is supplied to the non-amenity demands can be nominated.

4.2 Rainwater Harvesting & Recycling

The Calculator produces an estimate of the amount of rainwater that could be collected and used to replace part or all of the potable water demands entered elsewhere in the Calculator.

The calculations completed are not a dynamic analysis of inflows and outflows, however is a simplistic analysis for the purposes of benchmarking. The calculations of rainwater harvest are based on:

- Site location;
- Monthly rainfall;
- Collection area;
- Run-off coefficient;
- Annual number of rainy days; and,
- Storage capacity.

Table 3 displays the run-off coefficients for rainwater collection systems used in the Calculator:

Roof Type	*Run-Off Coefficient*
Steel roof (>30° angle)	0.9
Non-absorbent roof (>30° angle)	0.9
Flat non-absorbent roof (<30° angle)	0.8
Flat gravel or turf roof (<30° angle)	0.65

Table 3: Roof run-off coefficients

Projects may include rainwater harvested from surfaces other than those given in the run-off coefficient table above. However, the run-off coefficient of 0.65 for 'Flat gravel or turf roof (<30° angle)' must be used. Project teams wishing to use an alternative rainwater run-off coefficient for such surfaces may submit a Credit Interpretation Request (CIR) clearly justifying the alternative run-off coefficient.

To complete the rainwater component of the Calculator, all relevant data must be entered and selections made. Figure 6 (over page) displays the data fields of the rainwater calculator.

The user of the Calculator must select what demands the harvested rainwater is to be used for (e.g. 'Irrigation' and 'Toilet Flushing' as in Figure 6).

Rainfall data is automatically populated once the site location is selected from the drop-down menu.

The total storage capacity is the storage capacity for rainwater only. Where common storage is used for multiple non-potable sources (e.g. rainwater and treated greywater), the storage must be apportioned between the sources to avoid 'double counting' of storage capacity.

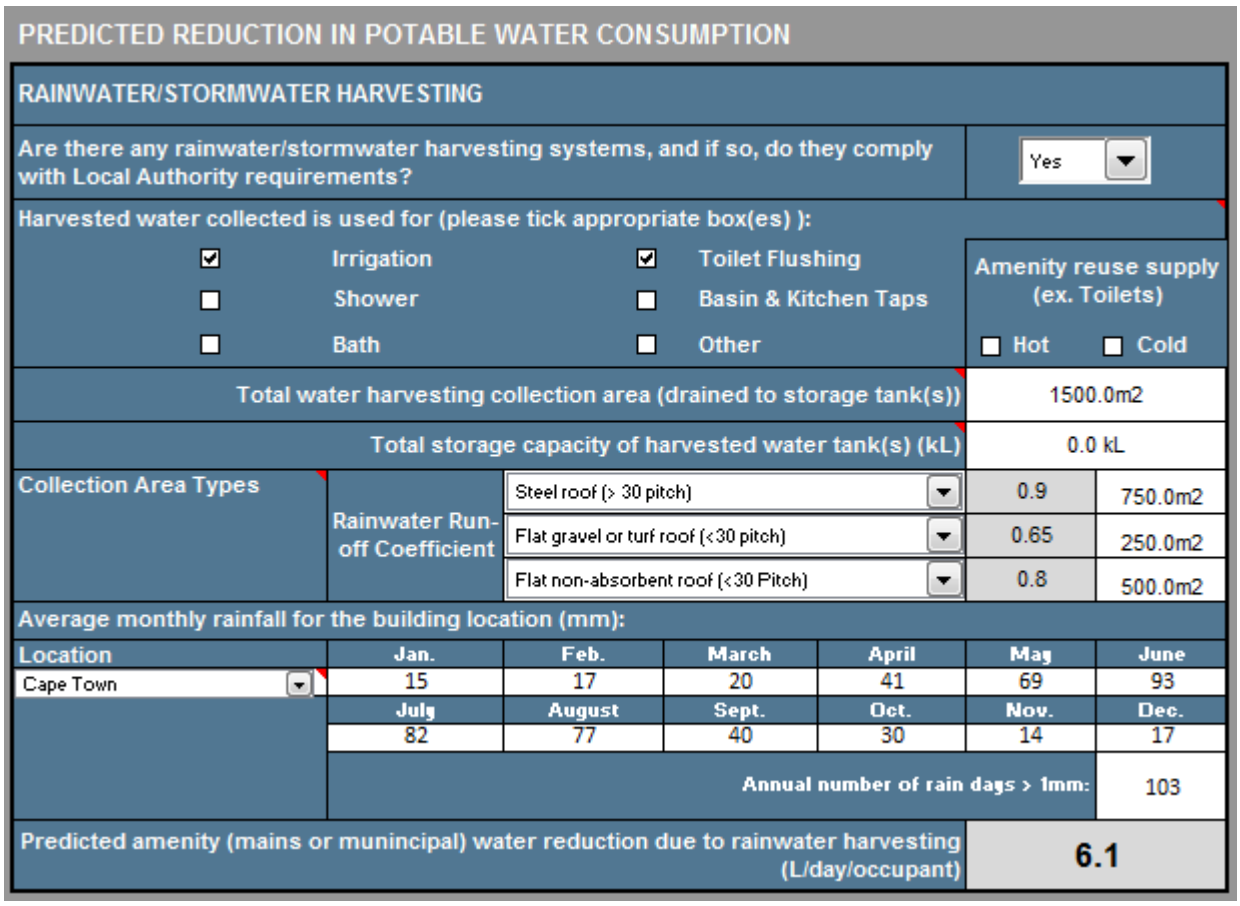


Figure 6: Rainwater harvesting input panel

The Calculator computes the potable water reduction on a per month basis, sums and divides by the total number of days in the month to attain the daily volume. The Calculator also assumes a 20 litre/100m2 "first flush" volume of water is lost for each rain event/day. The first flush volume is the volume of water diverted from the storage tank at the beginning of a rain event, due to the large quantity of initial debris and pollutants.

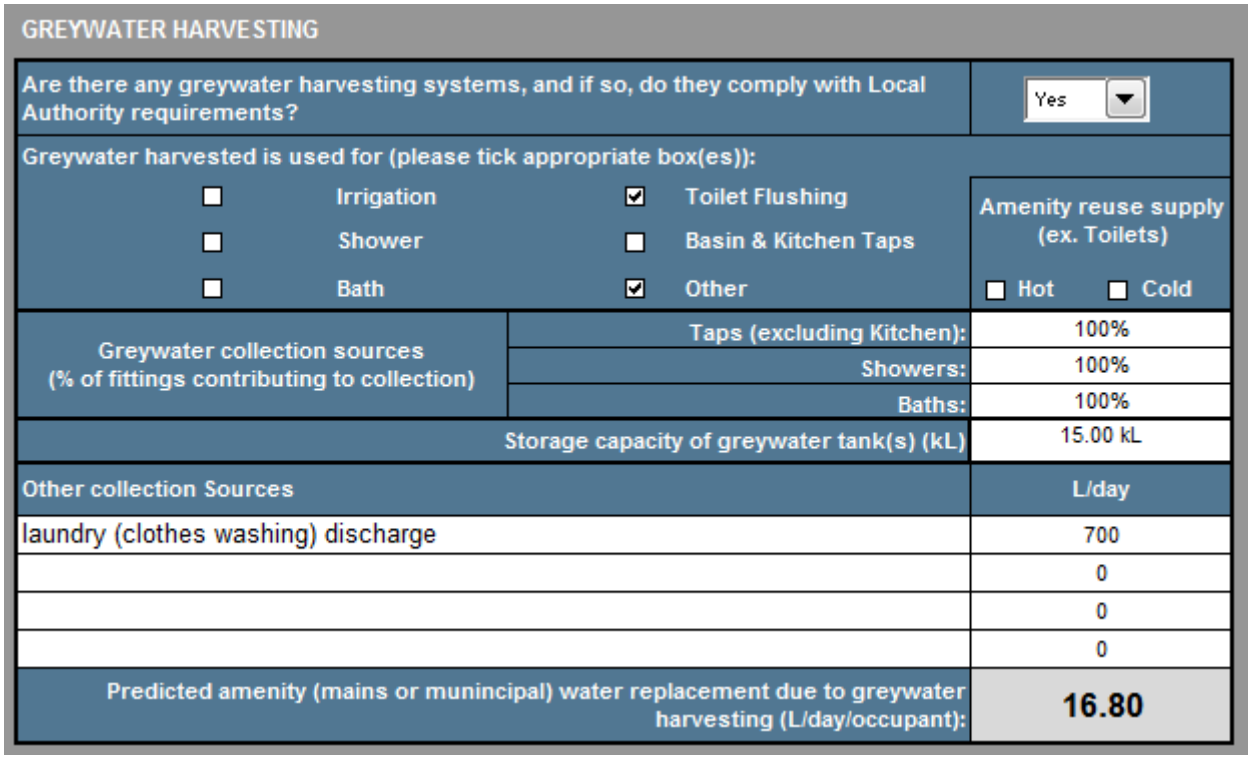
If there is no rainwater harvesting of the project, move onto the greywater and blackwater sections of the Calculator, if applicable.

IMPORTANT NOTE: *The Calculator has been designed to be flexible as to what demands (potable and non-potable) are met by the harvested or recycled water. However Project Teams must ensure that all demands met with harvested rainwater comply with all relevant National and Provincial Standards and Legislation pertaining to the use of recycled water. As such, the 'Amenity reuse supply (ex. Toilets)' checkboxes 'Hot' and 'Cold' should only be selected (as appropriate) where non-potable water is supplied to amenity uses (e.g. rainwater to showers).* Within the Green Star SA – Multi Unit Residential v1 rating tool, the only demand met by non-potable water rewarded is toilet flushing. Due to current standards/legislation, the supply of harvested or recycled water to other amenity uses is considered innovative and likely to attract 'Innovation' points. Please refer to the Green Star SA – Multi Unit Residential v1 Technical Manual for further details.

4.3 Greywater & Blackwater Recycling

The Calculator estimates the volume of grey and/or black water available for collection on site (measured in L/day). The total volume of grey and/or black water available for use is then calculated based on the demands for which recycled is supplied.

The greywater harvesting input panel is displayed in Figure 4 and the blackwater harvesting panel displayed in Figure 5.



GREYWATER HARVESTING

Are there any greywater harvesting systems, and if so, do they comply with Local Authority requirements?					Yes
Greywater harvested is used for (please tick appropriate box(es)):					
☐	Irrigation	☑	Toilet Flushing	Amenity reuse supply (ex. Toilets)	
☐	Shower	☐	Basin & Kitchen Taps		
☐	Bath	☑	Other	☐ Hot	☐ Cold
Greywater collection sources (% of fittings contributing to collection)			Taps (excluding Kitchen):		100%
			Showers:		100%
			Baths:		100%
			Storage capacity of greywater tank(s) (kL)		15.00 kL
Other collection Sources					L/day
laundry (clothes washing) discharge					700
					0
					0
					0
			Predicted amenity (mains or munincipal) water replacement due to greywater harvesting (L/day/occupant):		**16.80**

Figure 7: Greywater harvesting input panel

The blackwater section of the Calculator requires the same inputs (see Figure 8, over page).

The user of the Calculator must select what demands the recycled grey and/or blackwater is to be used for (e.g. 'Irrigation', 'Toilet Flushing' and 'Other' as in Figure 7).

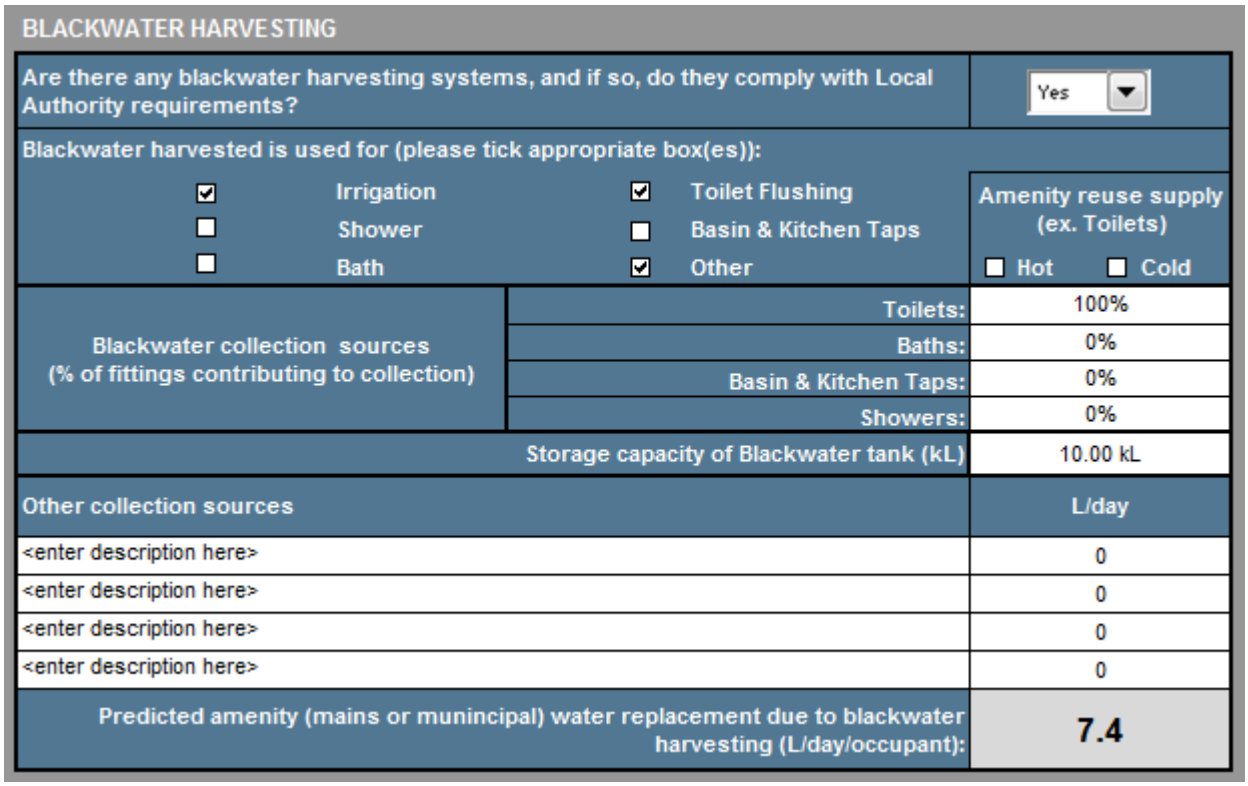
The user must also enter the percentage of applicable fixtures/fittings (of each type) which are used to collect grey and/or black water for recycling. For example, where a development has 13 showers within 7 dwellings, yet only 5 showers are connected to the greywater recycling system, the percentage entered into the greywater panel of the Calculator would be (5/13 x 100) = 38%. The greywater inflows are then adjusted accordingly.

The storage capacity is the storage capacity for either black or grey water only. Where common storage for multiple non-potable sources (e.g. rainwater and treated greywater) is provided, the storage must be apportioned between the sources to avoid 'double counting' of storage capacity.

The Calculator considers potential greywater sources as;

- Basin taps;
- Showers;
- Baths; and,
- 'Other' sources.

Kitchen waste water, although not containing human waste, is not considered greywater due to its typically high organic content.



BLACKWATER HARVESTING

Are there any blackwater harvesting systems, and if so, do they comply with Local Authority requirements?			Yes
Blackwater harvested is used for (please tick appropriate box(es)):			
☑ Irrigation	☑ Toilet Flushing		Amenity reuse supply (ex. Toilets)
☐ Shower	☐ Basin & Kitchen Taps		☐ Hot ☐ Cold
☐ Bath	☑ Other		
Blackwater collection sources (% of fittings contributing to collection)		Toilets:	100%
		Baths:	0%
		Basin & Kitchen Taps:	0%
		Showers:	0%
		Storage capacity of Blackwater tank (kL)	10.00 kL
Other collection sources			L/day
<enter description here>			0
<enter description here>			0
<enter description here>			0
<enter description here>			0
Predicted amenity (mains or munincipal) water replacement due to blackwater harvesting (L/day/occupant):			7.4

Figure 8: Blackwater harvesting input panel

For blackwater sources, the Calculator assumes all of the above sources, and kitchen taps and toilets as potential sources of inflow to a harvesting and recycling system.

'Other' collection sources may be included within either the grey or black water input panels in the Calculator. Other sources may include laundry (i.e. clothes washing) water, swimming pool backwash water, condensate water. Similar to non-amenity recycled water demand as described in Section 4.1, to enter other collection sources, annual source quantity should be calculated and converted into a daily figure (L/day, based on 365 days).

The 'Other' source quantities must be robustly calculated with justification of all assumptions. It is not acceptable to nominally estimate such quantities without justification or supporting documentation. See 'Notes' below.

IMPORTANT NOTE: *The Calculator has been designed to be flexible as to what demands (potable and non-potable) are met by the harvested or recycled water. However Project Teams must ensure that all demands met with recycled water comply with all relevant National and Provincial Standards and Legislation pertaining to the use of recycled water. As such, the 'Amenity reuse supply (ex. Toilets)' checkboxes 'Hot' and 'Cold' should only be selected (as appropriate) where recycled water is supplied to amenity uses .* Within the Green Star SA – Multi Unit Residential v1 rating tool, the only demand met by non-potable water rewarded is toilet flushing. Due to current standards/legislation, the supply of harvested or recycled water to other amenity uses is considered innovative and likely to attract 'Innovation' points. Please refer to the Green Star SA – Multi Unit Residential v1 Technical Manual for further details.

4.4 Part 2 Output Results

Based on the data input into the Calculator and the demands estimated in Part 1, the Calculator determines the harvested/recycled water available to offset mains/municipal potable water consumption for amenity uses. The output results of Part 2 of the Calculator are displayed in in Figure 9 below.

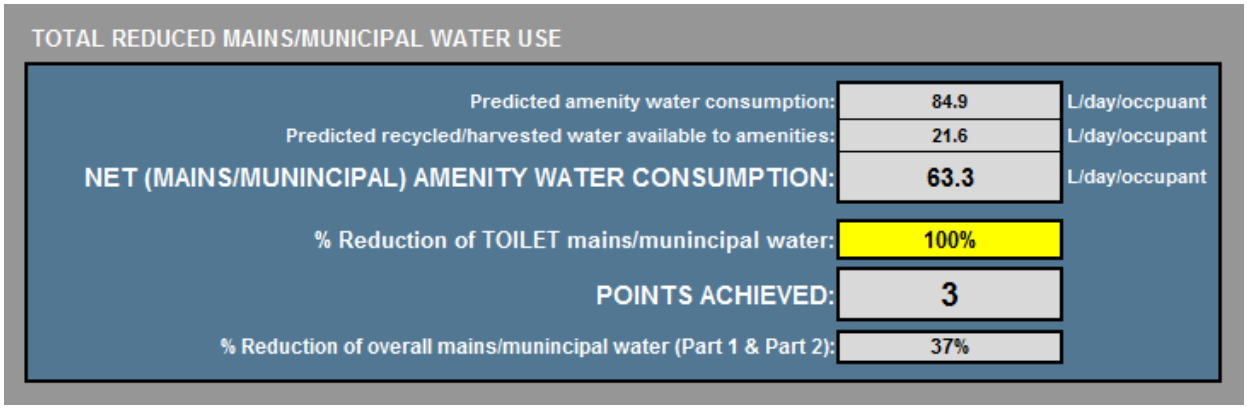


Figure 9: Part 2 output results page

The Calculator determines the percentage of the toilet flushing demand meet by non-potable recycled water (highlighted in yellow), and awards points accordingly. It also determines the overall amenity water reduction from the reference case (Part 1 with no recycling system) and indicates the percentage reduction.

For visual presentation of the breakdown of the non-potable water recycled, the Calculator automatically produces charts of the total non-potable resources available, and what is consumed. This is displayed in Figure 10.

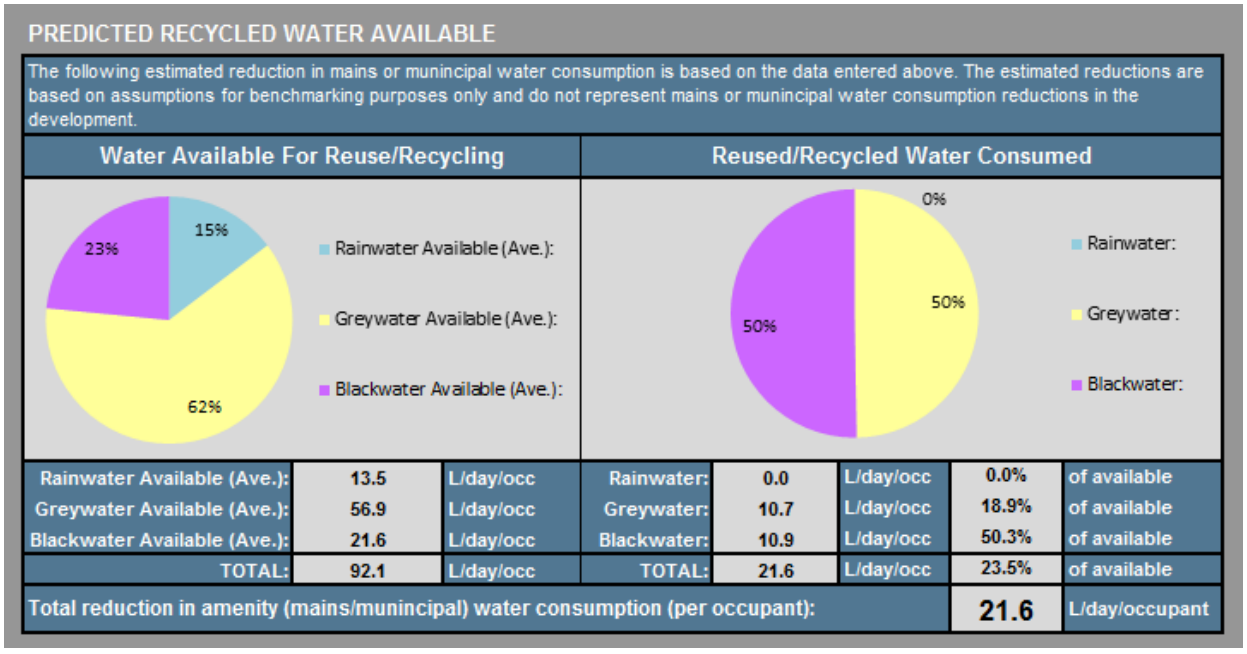


Figure 10: Part 2 harvested / recycled source and consumption breakdown panel

4.5 Notes

Clothes Washing Machines

Where non-potable water is being provided to clothes washing machines, or where discharge from clothes washing machines is being claimed as 'Other' sources for grey or black water harvesting and recycling systems, Project Teams must assume a full-load usage factor of 4 washes per month per occupant.

Pool Backwash / Top-Up

Where backwash water from pools is being claimed as 'Other' sources for grey or black water harvesting and recycling systems, for the purpose of benchmarking, the following parameters must be used to calculate the available backwash water;

- Pool turnover time (complete volume) = 4.0hrs (where applicable)
- Backwash period (manual control) = 2.5mins (backwash & rinse)
- Backwash period (automatic control) = 1.5mins (backwash & rinse)
- Backwash frequency = 1 cycle per 70hrs pump runtime (this is based on 1 cycle every 2 weeks @ 5hrs per day)

Equally, where non-potable water is provided for pool top-up (i.e. 'Other' demand), the above parameters must be used to calculate pool water loss for backwashing, and calculations must be completed for evaporation loss.

Dishwashers

For any calculations pertaining to the water consumption or discharge of dishwashers, Project Teams must assume a full-load usage factor of 1 wash per day, per dwelling.

Landscape Irrigation

Where non-potable water is provided for landscape irrigation, the calculations and data enterer into the Calculation must be identical to those completed for the Wat-3 Landscape Irrigation credit.

5 Sewage Calculator

The Sewage Calculator is simply a reporting tool which does not require any user input. Data entered to the Potable Water Calculator is used to report on expected amenity flow to the municipal sewerage system. The flow is then compared to flow reduction benchmarks that are set against the reference case. Efficient fittings, as well as grey water and blackwater recycling systems, reduce flow to sewerage.

REDUCED SEWER DISCHARGE

The following estimated discharge to sewer is based on the data entered above and does not represent actual discharge to the sewer in the development.

	L/day/occupant
Predicted amenity water consumption:	84.9
Less total recycling reduction:	32.9
Estimated amenity discharge to sewer:	**52.0**
Percentage reduction from benchmark:	48%
POINTS ACHIEVED:	**1**

Figure 11: Sewage calculator

6 Hot Water Energy Calculator

Reduction in the volume of domestic hot water usage is one efficient way to reduce greenhouse gas emissions associated with buildings. It is assumed that 55% of the water used in these applications is hot water and the volume of water used in the Potable Water Calculator is fed into the Hot Water Energy Calculator. Greenhouse gas emissions reduction can be achieved by installing more efficient hot water system such as solar hot water.