Guide to capturing water and installing a rain garden

Why Capture water and Install a rain garden?

Keep contaminants out the waterways

We can help our waterways by diverting rainwater that washes off our roofs and driveways into a rain garden. As rainwater flows over roofs and driveways it picks up metals, dust, bird droppings, oils and detergents. In a rain garden these contaminants are filtered through the soils instead of washing into the nearest stream, river or the sea.

Capture water

With water charges now in place, chlorination taking effect and climate change affecting our seasonal weather now more than ever we need to consider capturing this precious and free resource from our roofs.

What does a rain garden do?

A rain garden slows water down by ponding it and letting it gradually seep into the natural ground or a stormwater drain under the garden. This can help to reduce erosion in the stream bed and, if enough rain gardens were installed, could help to reduce flooding. It more closely mimics the natural water cycle and can help support summer flows in the waterways by topping up the groundwater.

A rain garden is designed to capture rainfall from the biggest storm we might expect to occur over 24 hours once every two years on average. Generally a good size in a home environment is about 1.5m^2 across the base. Bigger storms will overflow onto the lawn, but if it's out of the way of buildings that's not a problem. Even a small rain garden is better than nothing. The small regular flows from our roofs and driveways that would naturally soak into the soil harm the ecology in our waterways.

It is important that rain gardens in locations where an overflow could cause damage are designed with an overflow connected to a stormwater drain.

Do a soil permeability test before you start

A permeability test should be carried out to check if water would drain within 48 hours. This involved digging two holes at your chosen site about 40cm deep and 20cm diameter, filling them with water and checking the water over the next 48 hours. The test should be repeated at least a couple of times.

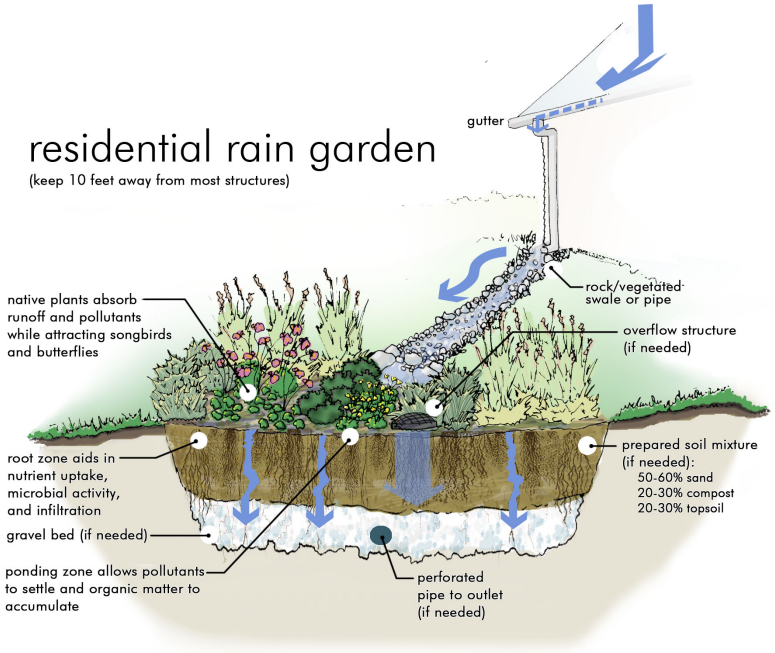
If you are capturing the water first via a rainwater barrel/tank with some spare capacity to capture storm volumes. The rainwater that stays in the barrel/tank and can be used to water

your garden, or even to water the rain garden during dry periods whilst the plants get established!

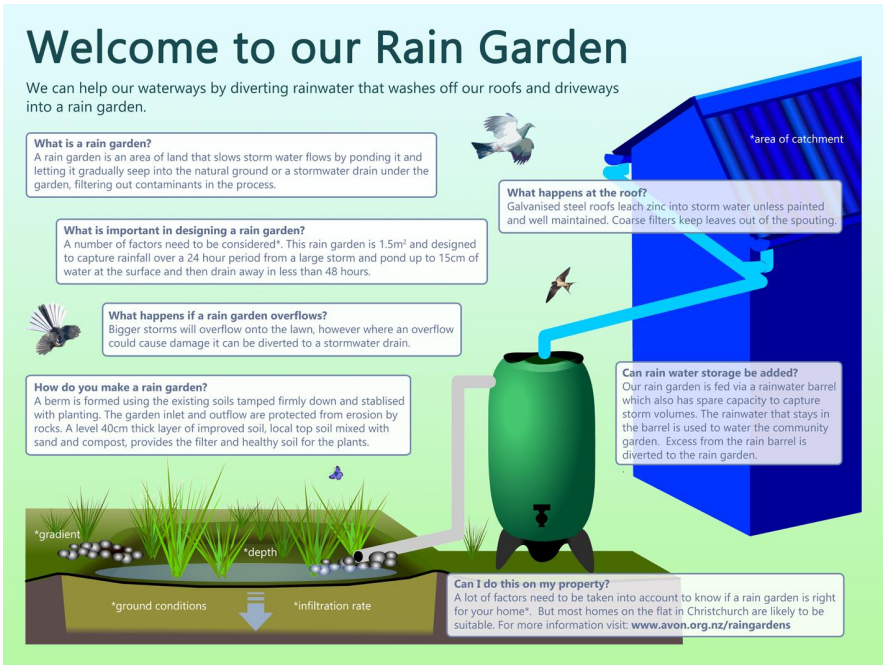
Rain garden construction

Excess rainwater from the rain barrel/tank is diverted to the rain garden where it can soak into the ground. The garden is designed to pond up to 15cm of water at the surface of the garden and then drain away in less than 48 hours. A berm is formed using the existing soils tamped firmly down. Planting on the berm will help to stabilise it. In the short term mulch has been used to reduce the risk of it eroding during rain storms. The inlet to and outlet from the garden are protected from erosion by rocks.

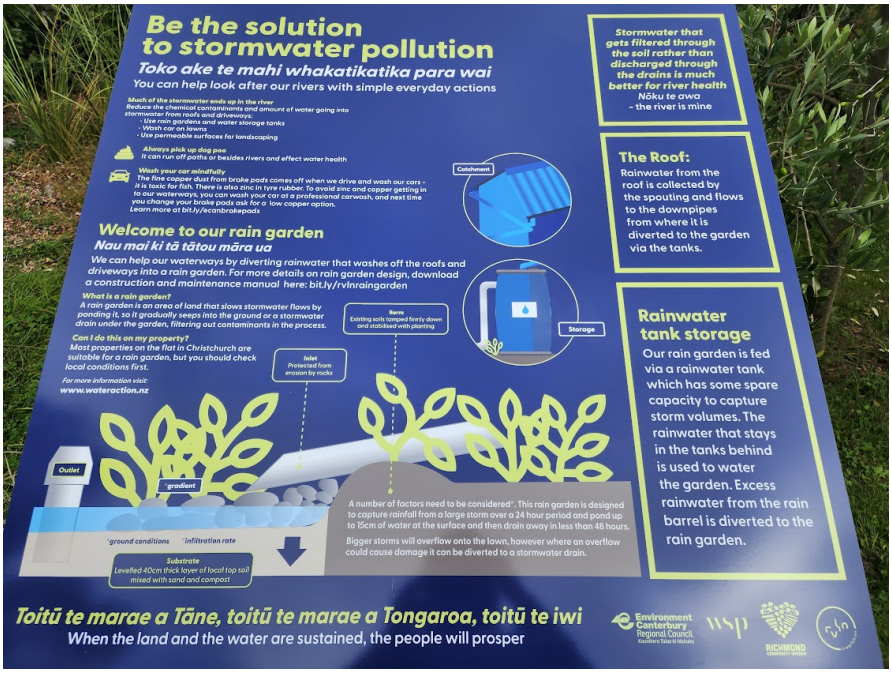
A 40cm thick layer of improved soil – a mix of the local topsoil with sand and compost added – is placed in the garden to create the filter and to provide a healthy soil for the plants to grow in. The natural soils at the base of the improved soil layer are broken up and loosened before being levelled to help the water eventually flow down to the groundwater table.



Rain Garden without a water capture tank



Rain garden and rainwater capture direct from roof



This rain garden feeds the tanks from underground using gravity pressure

Let's talk about soil.

Depending on the results of your permeability test in most cases you will need to excavate the area you are going to create your rain garden and replace the bottom layer of soil with a mix of sand compost (not mushroom or manure) and your topsoil you could use the rest of your topsoil to form a gentle slope into the rain garden or raise the are around it.

In most cases you will be wanting ⅓ topsoil ⅓ compost and ⅓ sand

What plants are best?

The best rain garden plants form a dense, weed suppressing cover and tolerate dry conditions as well as short term flooding - these plants are typically found on the edges of wetlands that dry out in the summer.

This is why native rushes (juncus and Apodasmia/Leptocarpus species) sedges (baumea and Carex Species) and flaxes are commonly used in rain gardens.

Generally the plants will have most of their foliage above the maximum height water will pond, however, where the rainwater is clear (e.g roof run off) shorter groundcovers may be suitable e.g Selliera, Acaena and Leptinella species)

These plants can also be used on the gently sloping edges of rain gardens where the water ponds for short periods - these edges are also suitable for less tolerant of wet feet (eg hebe and muehlenbeckia species) Deciduous plants are not generally used in rain gardens as leaf fall cam block outflows. Trees are generally restricted to bigger rain gardens, and are either naturally cast light shade or are pruned (lifted and thinned to ensure the groundcover plants get enough light to maintain dense growth.

Plant Name	Picture	Description
Ti koika Cabbage tree		Found naturally in wetlands, forest margins and riverbanks, Can grow to 20 metres in height and 2 metres in diameter.

Phorium flax flowers		
Leptinella		High rainfall, rapid growing ground cover with green fern like foliage, small white flowers in the spring summer.
Libertia		NZ Irises, tall stems of pure white flowers are held above the leaves in spring, followed by an attractive golden seed.
Carex Geminata Virgata		High Rainfall hardy grass
Bush Lilly Astelia Grandis		High rainfall arching flax like leaves, good for planting underneath other trees
inkberry		High and low rainfall

Rushes, oioi, baumea spp		High and low rainfall forms a large dense erect clump. Tough and tolerant of extremes
Pratia spp		High rainfall, versatile groundcover with small rounded foliage and tiny white flowers with red berried in autumn
Coprosma Propinqua		High and low rainfall large tough and hardy shrub, produces a bounty of fruit
Marie tawake		High rainfall

Carex flagellifera, comans, testacea		Lower rainfall Hardy evergreen grass with bright sunset orange foliage.
Chionochloa flavicans		Lower rainfall tough low maintenance grasses commonly known as miniature toitoi Drought and wind tolerant
Knobby club rush		Lower rainfall
Wind grass		Lower rainfall graceful grass with orange green foliage
Sand coprosma		Lower rainfall low growing ground cover with a flat habitat

Korokio		Lower rainfall interesting foliage with silvery undersides small yellow flowers bloom in summer
Scrambling pohuehue Muehlenbeckia		Lower rainfall sprawling ground cover with wiry stems and small round leaves and small cream flowers, fast growing

Now for the technical stuff

It is not necessary to go overboard with calculating the Area to filter volume in order to establish the size of your rain garden but if you are that way inclined there are some formulas you can use below.

If using formulas is not for you then the sensible conclusion is to look at the size of the roof area you are capturing from, ensure you have the most appropriate sized barrel to capture as much as you can before it goes into your rain garden, adjust both the rain garden and barrel accordingly i.e if you only have a small area for a rain garden but a large roof then get a bigger barrel or make certain you can backflow to the storm water. Or if you have a large area to create a rain garden then perhaps you do not need to have a capture.

3.2.1 *Calculation of filter area*

The filter area is calculated using Equation (1) below.

$$A_{rg} = 41.67 \cdot \frac{(V_{ff})(d_{rg})}{k(h+d_{rg})t_{rg}} \qquad \text{Equation (1)}$$

Where:

Symbol	Description	Unit	Recommended value
A_{rg}	= filtration area of rain garden	m^2	Calculated
V_{ff}	= first flush or first flush volume	m^3	Determined as per Equation 6-2 in WWDG and using 20mm as the first flush runoff depth
d_{rg}	= filter depth	m	0.6 (includes transition layer)
k	= coefficient of permeability	mm/hr	30
h	= average height of water	m	0.15 (half the recommended extended detention depth (EDD) of 300 mm)
t_{rg}	= time to pass V_{ff} through soil bed	day	One

3.2.2 *Extended detention area*

In addition to the above formula there needs to be control over the minimum size of the rain garden. This is achieved by requiring the above ground storage to be at least 40% of the V_{ff} and this has been adopted in this report. Therefore, in conjunction with the above formula, there needs to be a second formula specifying a minimum rain garden size as follows:

$$A_{EDD} \geq \frac{0.4 \cdot V_{ff}}{(2 \cdot h)} \qquad \text{Equation (2)}$$

Where:

A_{EDD} = Extended detention (storage) area of rain garden (m^2)

8.6 Design procedure

This approach relies on the use of Darcy's Law, which expresses flow through a porous medium. The resulting equations for the surface area (A_s) and infiltration practice volume (V_t) are:

1. Determine water quality storm - take 1/3 of the 2 year-24 hour rainfall at the site location using the separated approach for pervious and impervious surfaces detailed in Chapter 3, Section 3.5.
2. Use TP 108 to calculate the water quality volume
3. Size the practice area to allow complete infiltration within 48 hours, including rainfall falling directly onto the practice. To do this, use the following equation:

$$A_s = \frac{WQV}{((f_d)(i)(t) - p)}$$

where:

A_s	=	Surface area of practice (m^2)
WQV	=	Water Quality Volume (m^3)
f_d	=	Percolation rate (m/hour); measured rate multiplied by 0.5 for factor of safety
i	=	Hydraulic gradient (m/m) assumed to be 1
t	=	Time to drain from full condition (hours) - maximum time 48 hours
p	=	Rainfall depth for water quality storm (m)

4. Size the practice depth to provide storage for 37% of the volume required to infiltrate.

$$V_t = 0.37(WQV + pA)/V_r$$

where:

V	=	Practice volume required with aggregate added
V_r	=	Void space ratio of stone, normally .35 (scoria is rated at .50)

So for a roof area of 75M2 and the various conditions we have established we would do the following equation

Area to filter volume				
Impermeable surface area		75	m2	
Rainstorm depth				Decide on frequency of overflow acceptable - depends on site
2 yr return interval 24h storm		63	mm	
	p	0.063	m	
Vol to be treated	WQV	4.73	m3	
Permeability		20	mm/h	

Percolation rate	fd	0.01	m/h	
a) Filter depth		0.3	m	(Max = 0.6m, Min = 0.3m)
Water storage depth		0.15	m	(Max = 0.3m, Min = 0.1?m)
Average water depth		0.075	m	
Time to pass through soil	t	48	hours	(Max 3 days, standard 2 days, best 1 day)
Hydraulic gradient	i	1		
Surface area of garden	As	11.33		
Minimum volume to store (40%)		2.18		
Storage volume above filter	Va	1.70	m3	
Void ratio in filter	Vr	0.25		
Depth of filter to provide vol	Df	0.17	m	
Garden area proportion to roof area		15%		
		11.3	m2	

Glossary of links

Gutter witch Spouting diverter
https://www.mitre10.co.nz/shop/gutterwitch-spouting-diverter-65mm/p/161898

Gutter whiskers
https://www.mitre10.co.nz/shop/browns-gutter-whiskers-gutter-filter-6-pack-h-900mm-w-105mm-d-105mm-black/p/121711

Trees for canterbury
https://www.treesforcanterbury.org.nz/

Millpond Nursery
https://www.facebook.com/MillparkNursery/

The Tank Guy
https://thetankguy.co.nz/

RX plastics
https://rxp.co.nz/

Richmond Community Garden
www.richmondcommunitygarden.co.nz / admin@richmondcommunitygarden.co.nz