

# Rainwater Gardens

A Guide for Residents



Prepared by the Green Infrastructure and Engineering Teams,  
Woking Borough Council

For more information, please email [green@woking.gov.uk](mailto:green@woking.gov.uk)

[www.woking.gov.uk](http://www.woking.gov.uk)

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## Summary

In urban landscapes, concrete and other impermeable surfaces, together with the removal of vegetation, has resulted in increased surface water runoff. The growing trend to pave over our driveways and front gardens in our towns means that rainwater is directed straight into drains, which can be overloaded in heavy rain and storms. These two factors result in ever more frequent localised flooding.

Rainwater gardens were first developed in the United States in the 1990s. The concept has become popular in helping flood prevention. In their simplest form “they are a shallow permeable planted bed that is designed to receive run-off from a paved area or roof” (*source: treebox.co.uk*).

This Handbook is designed to help residents and businesses install their own rainwater gardens. As well as helping to prevent flooding, rainwater gardens can make attractive ornamental features in front or rear gardens that can also benefit wildlife and attract bees and other pollinating insects.

## Contents

1	Introduction .....	4
1.1	What are rainwater gardens? .....	4
1.2	Why are they so important? .....	5
1.3	What is the Council doing? .....	6
1.4	What can you do? .....	6
2	Designing a rainwater garden .....	7
2.1	How do rainwater gardens work? .....	7
2.2	Where should I install my rainwater garden? .....	9
2.3	Testing for drainage .....	10
2.4	Building your rainwater garden: determining depth and sizing .....	11
3	Construction .....	15
4	Planting and maintaining your garden .....	16
6	References, resources and further reading .....	19

# 1 Introduction



Source: [www.raingardens.info](http://www.raingardens.info)

## 1.1 What are rainwater gardens?

Urban areas aren't always well-equipped for heavy rain. Water easily runs over concrete and other impermeable surfaces, pouring into the drainage system and sometimes overloading it.

This can have serious consequences; the drains fill up and water spills out, endangering people and damaging property.

Rainwater gardens can be part of the solution. By looking to nature, and learning from its drainage systems, we can reduce the threat to our urban areas. They mirror the natural water retention qualities of undeveloped land. By changing our outside space we can help reduce localised flooding and at the same time provide benefit to both wildlife and people.

Our gardens, whether small or large, can also play an additional important part in greening our urban and suburban environments. Research by the Royal Horticultural Society (RHS) shows that 'urban greening' can contribute to storm water mitigation which helps to reduce garden flooding, provide a source of habitats for wildlife and improve water quality (source:

[www.rhs.org.uk/science/gardening-in-a-changingworld/urban-planting](http://www.rhs.org.uk/science/gardening-in-a-changingworld/urban-planting)).

Rainwater gardens are shallow depressions, planted with flowers and vegetation, which are designed to absorb surface runoff. They capture water, slowing the rate at which it enters the drainage system, significantly reducing the risk of flooding.

As surface water runs over impermeable surfaces, it picks up pollutants like oil and fertilisers, washing them into our waterways. But rainwater gardens have an additional benefit that they help recreate the natural water cycle and reduce water quality problems by filtering this poor quality water through their soil and plant roots. This filtration helps remove solid and dissolved pollutants protecting our streams and ditches.



They also create new habitats for wildlife and make our towns and cities greener places to live.

## 1.2 Why are they so important?

Woking has suffered considerably from flooding. In May 2016, 44 properties in the Borough saw internal flooding. Four months later, another event saw at least 11 properties affected.



*May 2016 flood event in Maybury (left) and Byfleet (right), WBC*

Unfortunately, national forecasts suggest that we must prepare for a rise in flood events. Climate scenarios for the south east of England show that by the 2050s we will likely experience changes in seasonal weather characteristics such as drier, warmer summers and colder, wetter winters which will affect local plant and animal life. We will likely experience greater and more frequent extremes in weather events such as drought, heatwave and flooding. Indeed, the Government's UK Climate Change Risk Assessment 2017 Evidence Report (January 2017) presents evidence "that climate change may lead to increases in heavy rainfall and significantly increased risks from fluvial and surface flooding by mid-century" (Jan 2017).

In the natural environment there is very little surface water runoff because it is mostly captured and filters down through the soil or evaporates back into the atmosphere. In urban landscapes concrete, tarmac and other impermeable surfaces, together with the removal of vegetation result in increased surface water runoff. The growing trend to pave over our driveways and front gardens in our towns means that rainwater is directed straight into drains, which can be overloaded in heavy rain and storms. These two factors result in ever more frequent localised flooding.

Flood damage is not inevitable, we can be proactive in protecting our homes and businesses. Rainwater gardens can form an important part of the solution to local flood protection. By providing a "simple intervention designed to receive rainwater which has come from a downpipe or a large domestic paved area" (*source: Rain*

*Garden Guide*) a rainwater garden can reduce the rate at which runoff enters the drainage system, reducing the risk of flooding to your property and the local area.

### **1.3 What is the Council doing?**

The Council is leading a pilot project to install rainwater gardens on highway verges in Maybury and Sheerwater. The rainwater gardens will ease the pressure on the Rive Ditch drainage catchment which runs through this area and much of Woking Town Centre, and where flood events in May and September 2016 saw 44 and 11 properties flooded respectively. The proposals for rainwater gardens here will help to move an estimated 390 properties out of the “very significant” flood risk category, making the Borough a safer place in which to live and work.

Woking Borough Council (WBC) is working on a number of significant flood schemes and flood risk management activities to help reduce the consequences of future flooding in the Borough. For more information, please visit [www.woking.gov.uk/planning/majordevelopments](http://www.woking.gov.uk/planning/majordevelopments).

### **1.4 What can you do?**

The Council has put together this guide to encourage and help residents and business owners to create their own rainwater gardens in front and back gardens.

## 2 Designing a rainwater garden

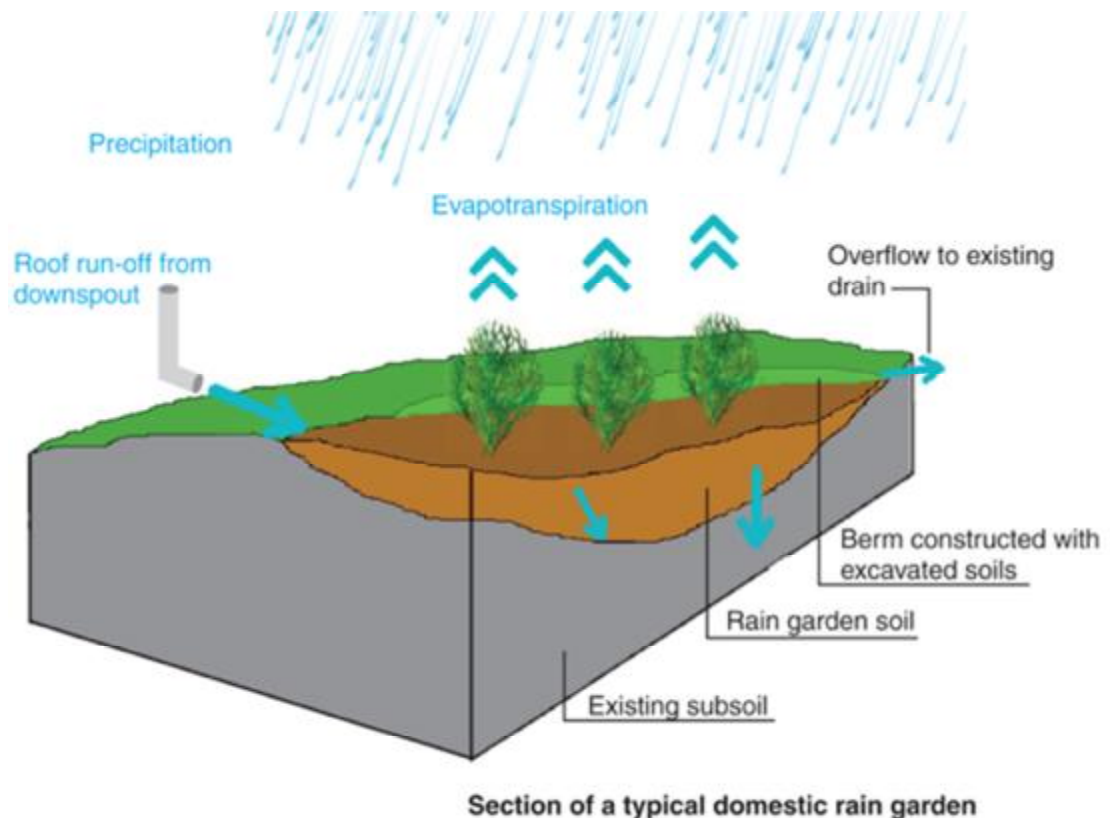
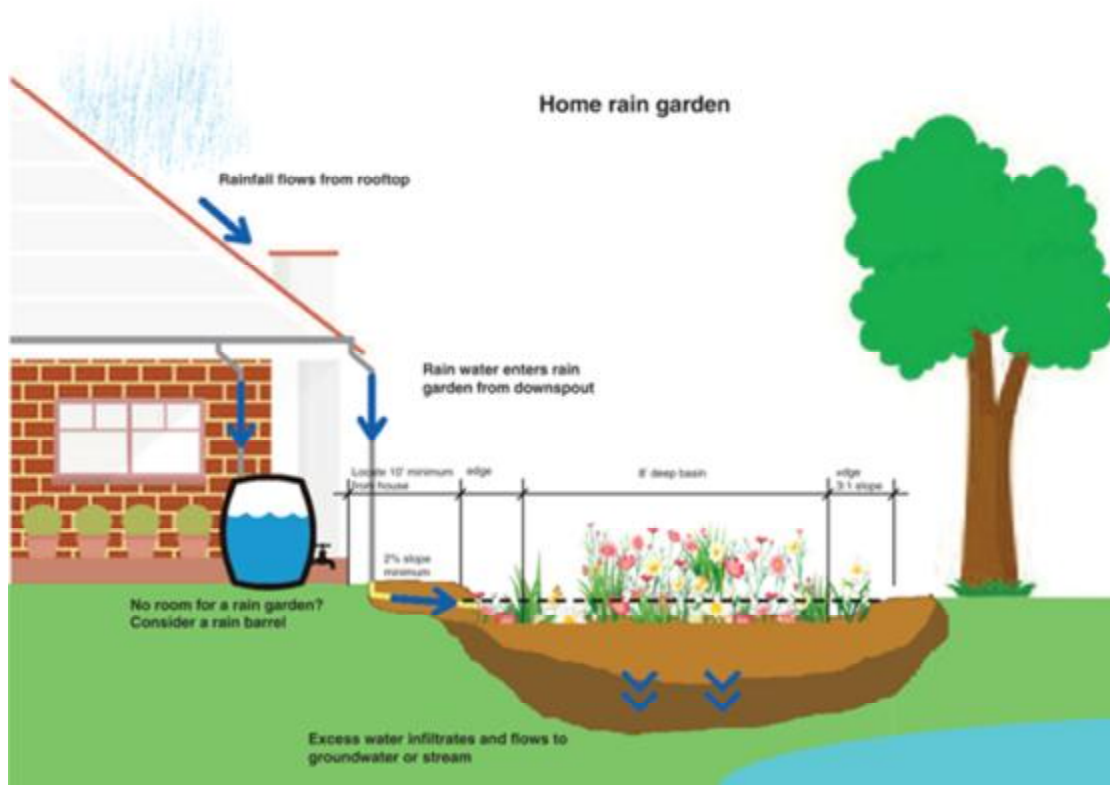


*Ashby Grove Rain Garden, Source: Susdrain*

### 2.1 How do rainwater gardens work?

Rainwater makes its way from roof to drain via a gutter / downspout. Normally this happens without a problem. However, during periods of heavy rain, water can pour into the drain faster than it can flow away, causing flooding.

By redirecting water from your downpipe into a rainwater garden, you can ease the pressure on the drainage system and nourish a healthy bed of vegetation in the process.



In some instances, you'll be able to feed water directly from the downspout to the garden. In others, you'll need to create a channel. The easiest way to do this is via a



rock-lined swale, a small passage which can carry water down an incline to the mouth of the rainwater garden.

The rainwater garden itself is a shallow depression, with a wide mouth running at a right angle to the flow of water. It needs to be dug on a slope, with the downhill end and sides walled around by a soil berm (a raised bank around the garden edge). The berm will hold back water during a storm.

In most cases, the garden will have an overflow provision. This might be an existing drain, or an alternative drain. For this to work effectively, the overflow point will need to be higher than the receiving drain.

See section 3.4 for more details on how to build your own rainwater garden.

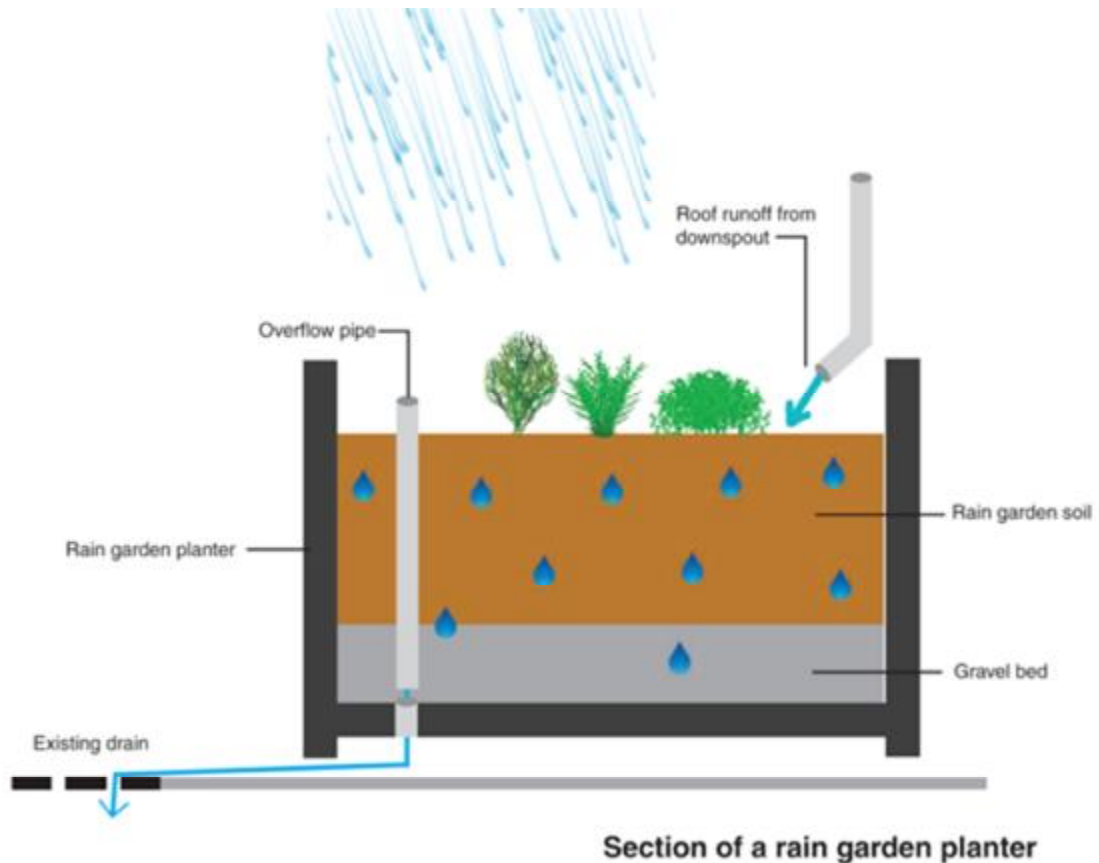
## 2.2 Where should I install my rainwater garden?

Normally, a rainwater garden will be located in an existing flower bed or lawn. The location of your rainwater garden will be guided by the size, shape and landscaping of your front, side or rear garden. However, a rainwater garden **must**:

- Be at least 3m from any structure to prevent damage to foundations.
- Be in direct or partial sunlight.
- Have suitable drainage (we'll explain how to test this).
- Be situated on a gentle slope with no more than a 12% gradient (again, we'll explain how you can work this out).

It **must not**:

- Be dug over a septic system.
- Be dug in an area of the garden where water tends to pool during periods of heavy rain.



If basing your rainwater garden in a planter, it will normally be located below the downpipe and close to the receiving drain.

### 2.3 Testing for drainage

In order for your rainwater garden to be effective, it needs to soak up water. To work out whether your chosen site is appropriate, we recommend this simple percolation test as described in the UK Rain Garden Guide ([www.raingardens.info](http://www.raingardens.info)):

1. Dig a 250mm deep hole.
2. Fill the hole with water until it drains.
3. Fill the hole with water again.
4. Measure the water level every hour until empty. If it drains at a rate of more than 50mm per hour, i.e. it drains fully within five hours your site has suitable drainage.

Water will not drain away quickly enough if the water table is at or very close to the surface or if there is heavy clay in the proposed location. This will become evident when you test for drainage.

## 2.4 Building your rainwater garden: determining depth and sizing

Once you've worked out whether your site has the required drainage capacity, your next step is to work out how big your rainwater garden should be.



*Rain garden, source: designingbuildings.co.uk*

### Area

The size of your rain garden depends on the volume of water that it will be receiving. To calculate this, use the following method. This method, taken from 'A How to Manual for Homeowners'

([www.doe.dc.gov/sites/default/files/dc/sites/ddoe/publication/attachments/RaingardenHow2HomeownerUWExtension.pdf](http://www.doe.dc.gov/sites/default/files/dc/sites/ddoe/publication/attachments/RaingardenHow2HomeownerUWExtension.pdf)), will guide you through how to do this. Although an American document, the same principles apply.

For rain gardens situated **less than 10 metres from the downspout**:

1. Estimate the percentage of the roof which is served by the redirected downspout. This is likely to be very approximate figures e.g. have a look at how many downspouts you have and divide the roof area by this figure to give you an approximate proportion. If you have four downspouts for instance, one downspout is likely to serve 25% of the roof.
2. Find the area of the ground floor of your property, multiplying its length by its width. This is also the approximate roof area.
3. Multiply the roof area by the percentage of the roof channelling to the chosen downspout. This is the relevant **drainage area**.

For rain gardens **more than 10 metres from the downspout**:

1. If there is a significant area of uphill lawn that also drains to the rain garden, you need to account for it.
2. To find the area of the lawn that will drain to the rain garden, stand at your proposed site and identify the part of the lawn sloping into the site.
3. Measure the length and the width of this section of lawn, and multiply these figures to find the relevant uphill lawn area.
4. Add the uphill lawn area to the roof drainage area in order to find the total drainage area.

Once you've made your calculations, your final step is to use the size factor table below to **calculate the ideal area for your garden**.

To do this, you'll need to know the type of soil in your garden.

**Rain gardens less than 10m from downspout:**

	75-100mm deep	150-180mm deep	200mm deep
Sandy soil	0.19 m <sup>2</sup>	0.15 m <sup>2</sup>	0.08 m <sup>2</sup>
Silty soil	0.34 m <sup>2</sup>	0.25 m <sup>2</sup>	0.16 m <sup>2</sup>
Clay soil	0.43 m <sup>2</sup>	0.32 m <sup>2</sup>	0.20 m <sup>2</sup>

**Rain gardens more than 10m from downspout:**

Sandy soil	0.03 m <sup>2</sup>
Silty soil	0.06 m <sup>2</sup>
Clayey soil	0.10 m <sup>2</sup>

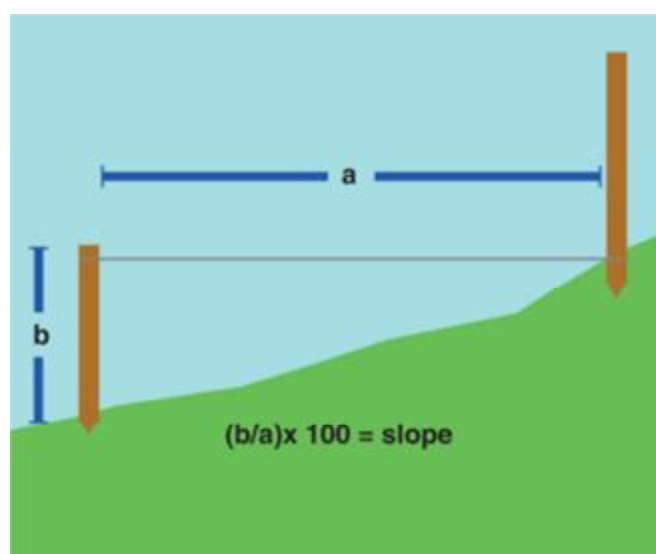
1. Find the relevant size factor for your site.
2. Multiply the size factor by the drainage area to find your recommended rain garden area.
3. If the recommended rain garden area significantly exceeds 25m<sup>2</sup>, divide it into smaller rain gardens.

*Credit: Rain Gardens: A how-to manual for homeowners*

Once you know the area, you need to decide on a width and length. The longer side of your rain garden should face upslope and, as a general rule, should be twice the width.

## Depth:

The following instructions will help you to decide the right depth for your garden:



1. Hammer a stake at the uphill end of your site and another at the downhill end.
2. Tie string to the uphill stake at ground level.
3. Tie the other end of the string to the downhill stake, ensuring the string is level.
4. Measure the distance between the two stakes. This is the width.
5. On the downhill stake, measure the distance between the ground and the string. This is the height.
6. Divide the height by the width and multiply the result by 100 to find the lawn's percent slope.

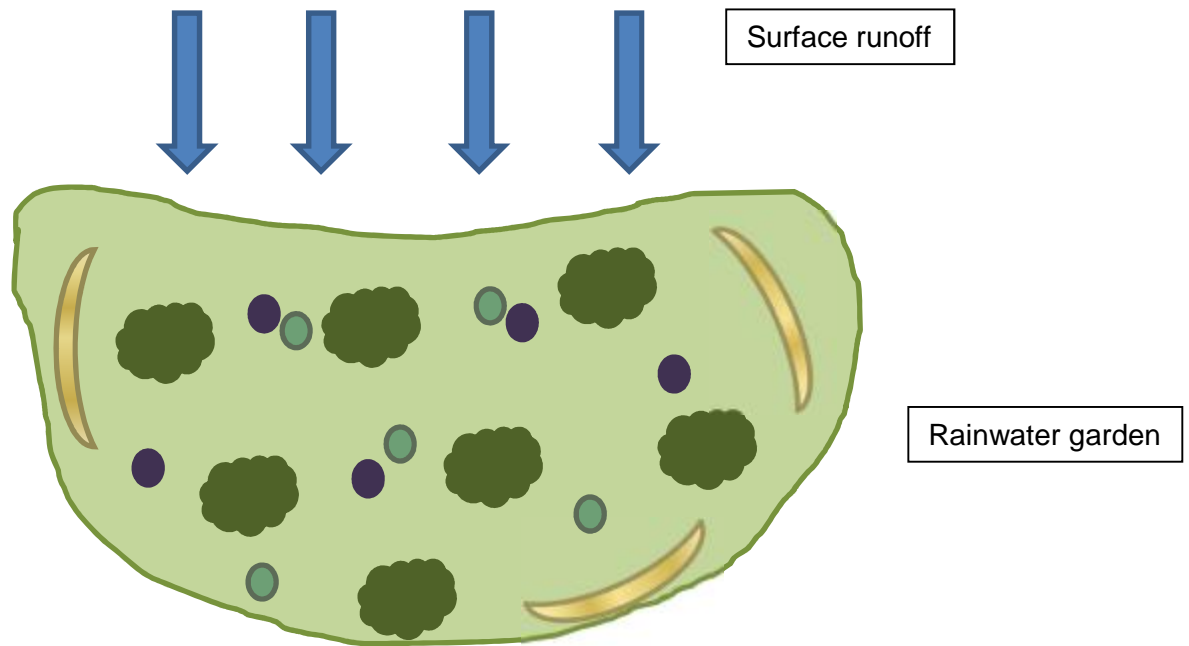
The surface of a rainwater garden must be flat.

- If the slope is less than 4%, it is easiest to build a rainwater garden of roughly 75-100mm depth.
- If the slope is between 5 and 7%, it is easiest to build a rainwater garden of roughly 150-180mm depth.
- If the slope is between 8 and 12%, it is easiest to build a rainwater garden of roughly 200mm depth.
- If the slope is more than 12%, unfortunately this isn't a suitable site for a rainwater garden.



## Design and shape

A rainwater garden can be any shape. The most important factor to bear in mind is that it is wide enough to capture the runoff and that it can be integrated into your existing garden. If the runoff spans across a width, it is advisable that the rainwater garden is wide enough to accommodate this width.

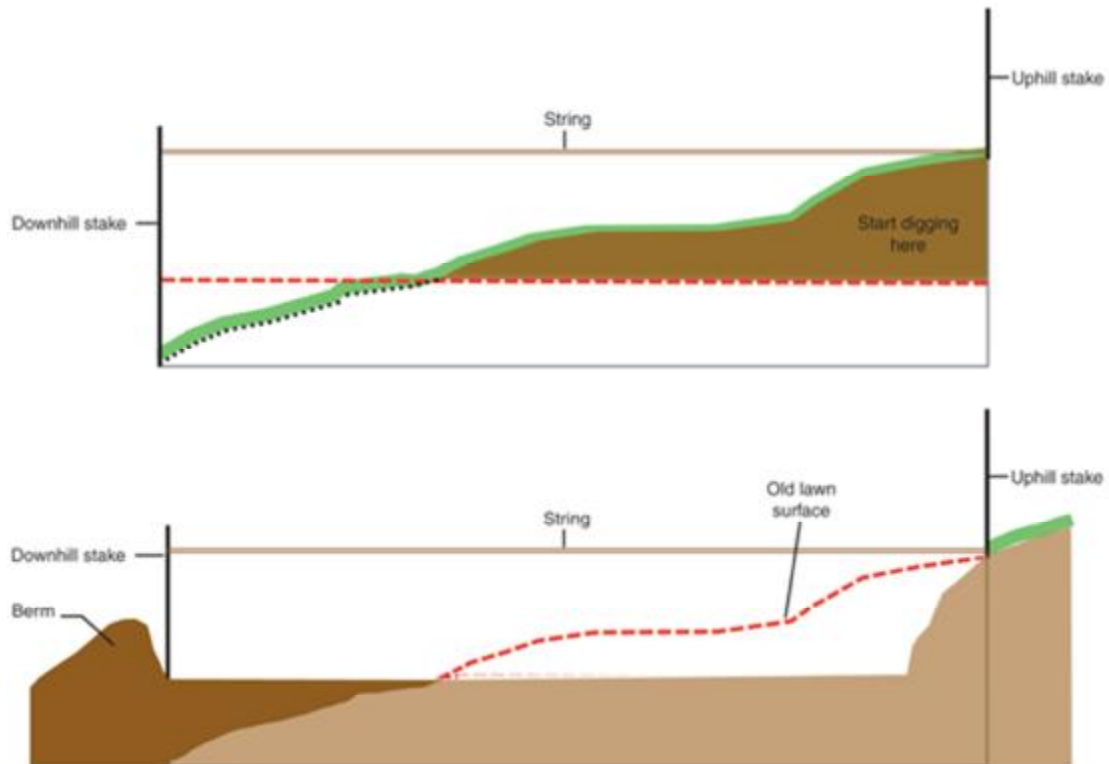


### 3 Construction

Now that you have worked out the dimensions, you're ready to dig. Of course, it's possible to fit a rainwater garden by yourself, but much quicker to enlist the help of friends and family. It's advisable to build your rainwater garden during dry weather as soils could get washed away during the rain.

Follow these steps and it shouldn't take more than a couple of hours:

1. Mark out the edges of your rainwater garden with a length of rope held in place by posts at regular intervals.
2. Start digging at the uphill end of your garden.
3. Ensure that the garden is dug to the same depth throughout. If you're fitting your garden on a particularly steep slope, you may find that the downhill end falls below the required depth. If this is the case, use some of the spoil (excess soil) from the uphill end to raise the base.
4. You may want to add improver to your garden. This will, for example, help drainage if your soil is clay. This could be compost, shredded paper, or rotted bark which can be mixed up with the soil. If you do intend to add improver, you will want to dig the garden slightly deeper.
5. Check that the base of your garden is level by laying a wooden board flat on the ground and using a spirit level to check for any incline.
6. Once you've checked that the base is flat, it's time to build a berm (an artificial ridge) around the sides and downhill end of the garden. You can do this using the spoil but if this isn't enough, you can supplement it with imported soil.
7. Shape the berm so that it is highest at the downhill end and tapers off as it points uphill. Its sides should be gently-sloping so that it blends into the rest of the garden. The Rain Garden Guide by Bray et al recommends that it should be roughly 300mm in width and 100mm high ([www.raingardens.info/wp-content/uploads/2012/07/UKRainGarden-Guide.pdf](http://www.raingardens.info/wp-content/uploads/2012/07/UKRainGarden-Guide.pdf)).
8. Compact the berm by stamping on it or using the back of a shovel.
9. Cover the berm with mulch to prevent erosion.
10. To help direct flow from a downpipe, stones or gravel can be used to make a path to help direct the water and reduce the speed of flow to the rainwater garden.
11. For rainwater gardens that are created in planters, they should have a drainage hole near the base which is close to the receiving drain. Gravel and stones should be used in the base to assist with drainage to a depth of 50mm, as recommended by the Rain Garden Guide (see above link). An overflow pipe at the top rim of the planter will help direct heavy flow away from the planter in the event of it becoming saturated during heavy rains for instance.



## 4 Planting and maintaining your garden

### 4.1 Planting

While your rainwater garden will serve an important function of preventing flooding by slowing surface runoff and improving water quality, it can also be an ornamental and attractive garden feature. It could comprise different species of plants, different colours and textures; and can have wider biodiversity benefits by selecting plants that attract bees and other wildlife.

Rain gardens can support a very diverse range of species, including plants like Rudbeckias, Irises, Miscanthus Grasses and Euphorbias. However, this is by no means a complete list. As long as a plant can withstand occasional periods of inundation as well as normal conditions, it is likely to be suitable. The Royal Horticultural Society has a wealth of information on plant lists ([www.rhs.org.uk/gardening/sustainable-gardening/pdfs/RHS Pollinators Plantlist](http://www.rhs.org.uk/gardening/sustainable-gardening/pdfs/RHS_Pollinators_Plantlist)) and the Wild about Gardens website is also a useful resource ([www.wildaboutgardens.org.uk](http://www.wildaboutgardens.org.uk)).



Source: Wikipedia

There aren't many hard-and-fast rules for how to plant your rain garden, but these tips adapted from Bray et al's Rain Garden Guide will help you achieve a healthy and resilient bed of vegetation for your rainwater garden:

1. Your rainwater garden should be planted with a wide range of species, ideally between six and 10 species planted in two to three clumps per square metre.
2. Plant your garden with nursery-grown vegetation, ideally with one or two year old plants that have developed root systems.
3. Avoid species that cannot withstand occasional flooding or that suffer from root rot. Examples would be plants such as Lavender and Azalea.
4. Once you've worked out what you're going to plant, you'll need to plan where everything is going to go. Before planting, excavate a hole for each plant, twice the size of the root ball.
5. Once you've planned out the garden, begin planting. Make sure that you press the soil firmly around the roots of each plant.
6. Once your garden is planted, spread a thin layer of mulch across the surface.
7. Seed the perimeter berm using a general purpose wildflower grassland mix. This can be left to grow (which encourages bees, butterflies and other insects) or mown.

## 4.2 Maintenance

Once established, rain gardens are fairly low maintenance. But they will need some tending early on.

1. Unless it rains, water your rainwater garden plants after initial planting to help them become established.
2. Weed your garden for the first couple of years.
3. Water plants regularly until they are established.
4. Check for signs of erosion. The berm in particular may require additional compacting.

## 5 Glossary

Berm	An artificial ridge or embankment
Flood mitigation	To prevent flooding
Impermeable	Unable to let water pass through
Impervious	Unable to let water pass through
Infiltrate	To pass through
RWG	Rainwater garden
SUDS	Sustainable Urban Drainage System
Surface Runoff	Water flowing over an impervious surface
Swale	A shallow ditch



## 6 References, resources and further reading

### UK resources

[www.raingardens.info/](http://www.raingardens.info/)

[www.rhs.org.uk/science/gardening-in-a-changing-world/greening-grey-britain](http://www.rhs.org.uk/science/gardening-in-a-changing-world/greening-grey-britain)

[www.bbc.co.uk/blogs/gardening/2011/04/gardening-for-rain.shtml](http://www.bbc.co.uk/blogs/gardening/2011/04/gardening-for-rain.shtml)

[www.susdrain.org/delivering-suds/using-suds/suds-components/infiltration/rain-gardens.html](http://www.susdrain.org/delivering-suds/using-suds/suds-components/infiltration/rain-gardens.html)

[www.telegraph.co.uk/gardening/gardenstovisit/10654626/Wet-weather-Make-a-rain-garden.html](http://www.telegraph.co.uk/gardening/gardenstovisit/10654626/Wet-weather-Make-a-rain-garden.html)

[www.treebox.co.uk/news/gary-grant-rain-gardens.html](http://www.treebox.co.uk/news/gary-grant-rain-gardens.html)

[www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/584281/uk-climate-change-risk-assess-2017.pdf](http://www.gov.uk/government/uploads/system/uploads/attachment_data/file/584281/uk-climate-change-risk-assess-2017.pdf)

[www.rhs.org.uk/science/gardening-in-a-changing-world/front-garden-research](http://www.rhs.org.uk/science/gardening-in-a-changing-world/front-garden-research)

### US rainwater resources

[www.fairfaxcounty.gov/nvswcd/raingardenbk.pdf](http://www.fairfaxcounty.gov/nvswcd/raingardenbk.pdf)

[www.nrcs.usda.gov/Internet/FSE\\_DOCUMENTS/nrcs142p2\\_007154.pdf](http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_007154.pdf)

[www.cityofchicago.org/content/dam/city/depts/cdot/Green\\_Alley\\_Handbook\\_2010.pdf](http://www.cityofchicago.org/content/dam/city/depts/cdot/Green_Alley_Handbook_2010.pdf)

[www.nemo.uconn.edu/raingardens/pdf/rain\\_garden\\_design\\_guide.pdf](http://www.nemo.uconn.edu/raingardens/pdf/rain_garden_design_guide.pdf)

[www.epa.gov/soakuptherain/soak-rain-rain-gardens](http://www.epa.gov/soakuptherain/soak-rain-rain-gardens)

[www.doe.dc.gov/sites/default/files/dc/sites/ddoe/publication/attachments/RaingardenHow2HomeownerUWExtension.pdf](http://www.doe.dc.gov/sites/default/files/dc/sites/ddoe/publication/attachments/RaingardenHow2HomeownerUWExtension.pdf)