Trenches and Soakaways

Whether you go incognito with a soakaway pit or chamber, or celebrate your runoff by routing it through a dry riverbed — or both — these tools equip you with nearly infinite possibilities to move around, slow down, and soak-in runoff.

Benefits of Trenches and Soakaways

Low maintenance. With gravel and rock features, you only need to keep the inlets and surfaces clear of debris.

Flexible. Any shape can work, and you can expose or bury features as needed.

Traditional. Soakaway pits and infiltration trenches have been around for a long time. No special knowledge or unusual tools are needed to include these features.

Trenches and Soakaways are Best...

When you don't have space for a rain garden. Soil, plants, and occasional water on the surface are better at cleaning water and providing habitat than either gravel or an empty chamber. But sometimes a rain garden just doesn't fit in to the available space.

When you have high flows or an erosion risk. Larger gravel and cobbles resist movement.

When you would rather dig down than out. If you want to have a vertical orientation to your storage, a soakaway is a good solution.

When you want to camouflage the surface. Trenches and soakaways give you the freedom to move water around without seeing it.

If you like the aesthetic of a dry riverbed or a rock garden. If you like the look of rocks and are prepared to keep weeds and debris at bay, these are great amenities.

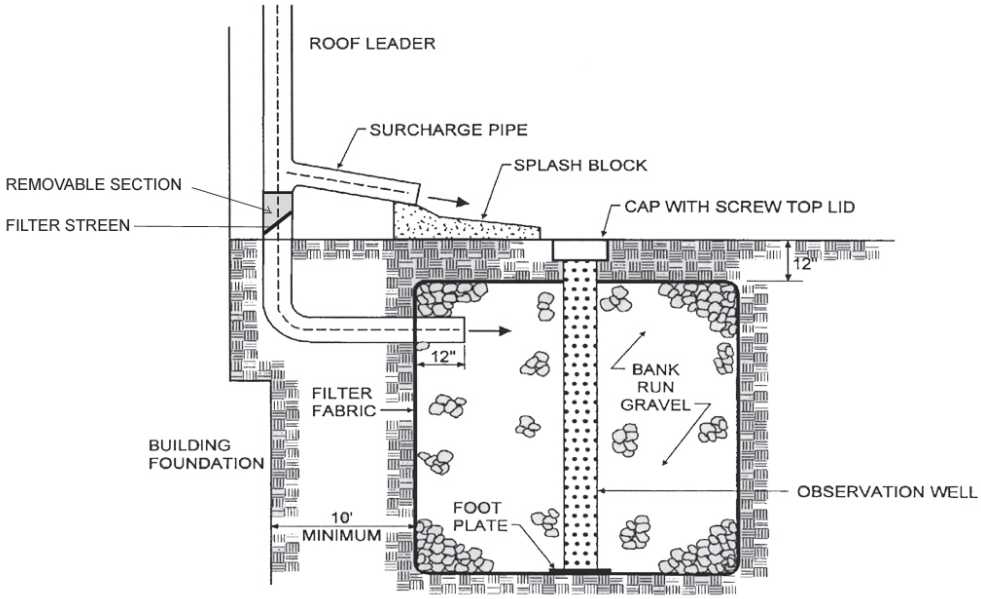
When you want to connect other runoff management features on your lot. An overflow from a rain barrel to a dry riverbed or trench is a common treatment.

LEFT: Soakaway pit under construction, showing the top of a square chamber covered in non-woven *geotextile* (filter fabric) and surrounded by clean, angular rock, nearly ready to be buried. Geotextile should also be placed between the native soil and the clean fill and be topped off with gravel separation layers (see the components topic later in this section) in order to keep small soil and subsoil particles from clogging the drain rock. The white observation well to the top of the photo will be cut to height after the final grade is achieved.

CREDIT: Sustainable Technologies Evaluation Program https://wiki.sustainabletechnologies.ca/wiki/File:2012_07_24_020.jpg#filelinks

Soakaways and Infiltration Chambers

These underground reservoirs store runoff and allow it to slowly soak into the surrounding soil. When filled with washed gravel, the reservoir is usually called a *soakaway pit* or *dry well*. Hollow, manufactured reservoirs are usually referred to as *infiltration chambers*. They may be camouflaged with plants or decorative rocks or may be placed below turf, permeable pavers and other hard surfaces — provided that load-bearing considerations are met.



ABOVE: Profile of a soakaway pit.

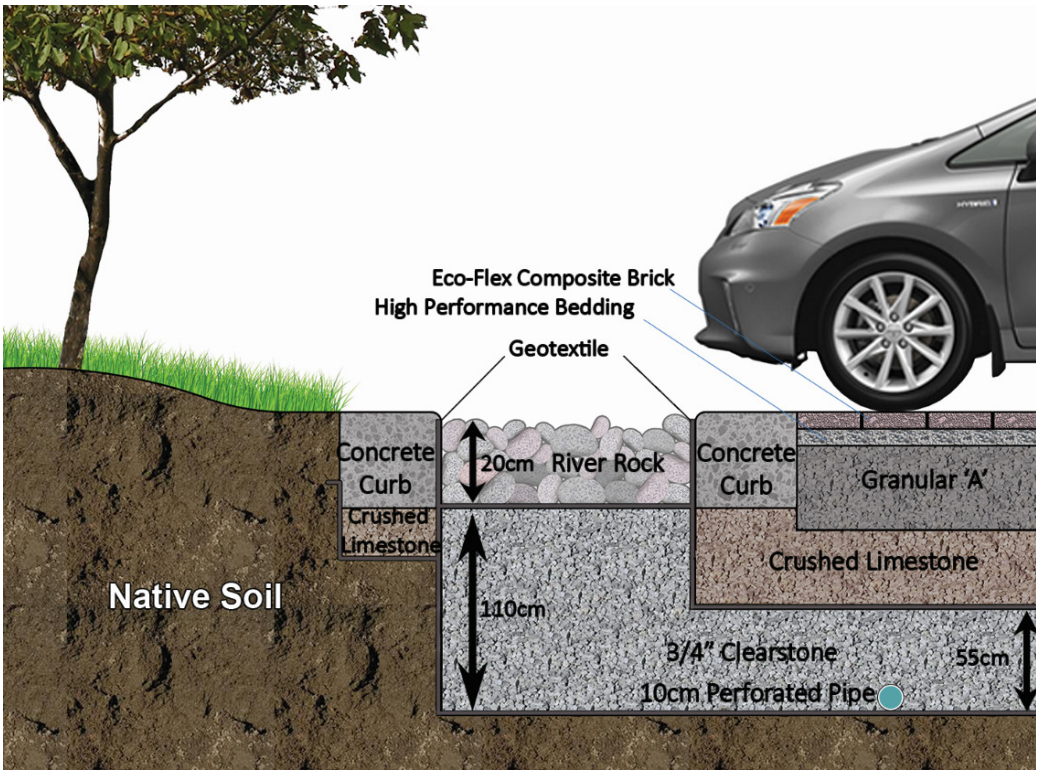
CREDIT: Barr Engineering Co. for the Twin Cities Metropolitan Council Minnesota Urban Small Sites BMP Manual

Infiltration Trenches and Dry Riverbeds

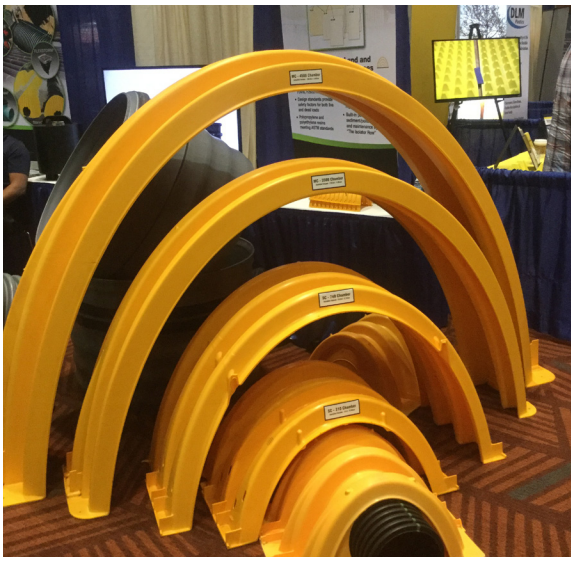
Compared to their boxier, deeper soakaway cousins, these features are long and narrow. Trenches may be underground or exposed to the surface, however spring performance will typically be delayed by about two weeks if covered with soil and turf, as these take longer to thaw. They are easy to combine with perforated pipe or other weeping tile products in order to control and combine drainage needs with infiltration opportunities. Dry riverbeds are an artistic treatment of the trench concept, used more for moving water, with limited storage in the comparatively smaller amount of gravel, often used to direct flows to rain gardens.

FACING PAGE: Arch-style chamber profiles and a modular crate-style chamber on display. The arch style comes in many sizes, shown here cut-off for display purposes. The modular example has accessibility for passing cleaning equipment through. Avoid lattice-web styles that lack this capability.

BELOW: Infiltration trench profile at a paver monitoring installation at the Kortright Centre, Toronto area, ON. Permeable pavers and underground retention or infiltration are common combinations, as long as pretreatment or low contributions of contaminants can be achieved. Monitoring shows that many contaminants are remediated by these types of installations, although certain contaminants may increase, for example, Total Dissolved Solids.



CREDIT: https://wiki.sustainabletechnologies.ca/images/1/13/Kortright_trench.PNG
CC BY-NC-ND 4.0 https://creativecommons.org/licenses/by/4.0/



Components of Infiltration Facilities

Pretreatment. Preventing leaves and sediment from getting in will improve water quality and prevent clogging. It's no different from what you would do for rainwater harvesting, if the source is runoff from a roof. If the runoff source includes driveways, pretreatment to remove oil and grease and bacteria is recommended. This is usually accomplished with a rain garden as part of a treatment-train approach (see the Landscaping module for an explanation of the treatment train). If de-icing chemicals are used, plants for the rain garden must be salt-tolerant.

Chamber. Many options are available. Modular styles are popular as they can be packed flat for minimum transport costs and then assembled on site. Half-circle styles are also popular, especially when you want to keep the depth of digging to a minimum. Chambers have a much greater void space compared to gravel.

Gravel. If you aren't using a chamber, angular (crushed) drain rock, usually 2 to 4 cm in diameter, is a common choice for gravel fill. Larger rocks or other clean fill with good void space can be used. Functionality comes from the water storage space available in the gaps between particles of the fill material.

Separation layers. If soil for planting is to be put on top, you'll need to keep the soil from migrating into the storage space. A non-woven *geotextile* (filter fabric) is usually added for this reason. While great for separating native soil from drain rock on the bottom and sides, it is not recommended to wrap the entire storage area, since experience shows that clogging eventually reduces the ability of water to pass into the storage area. **A better alternative** for going from soil above to a soakaway below is to install two 10-cm thick layers of progressively smaller rock — for example, one 10-cm thick layer of 2-cm-diameter gravel above a second 10-cm thick layer of 1-cm diameter gravel.

Overflow. In all cases, a soakaway or infiltration trench needs to have a way for excess runoff to escape during severe storm events or if the system becomes clogged. If you notice the overflow spilling more often (in smaller storms), your soakaway or infiltration trench is either undersized or needs to be cleaned out.

Things to Consider

Distance from building foundations. As with rain gardens, soakaways and trenches should be positioned 2 to 3 metres away from basements and crawlspaces. Dry riverbeds need to have an impermeable liner under them or other means to prevent infiltration where they are near buildings.

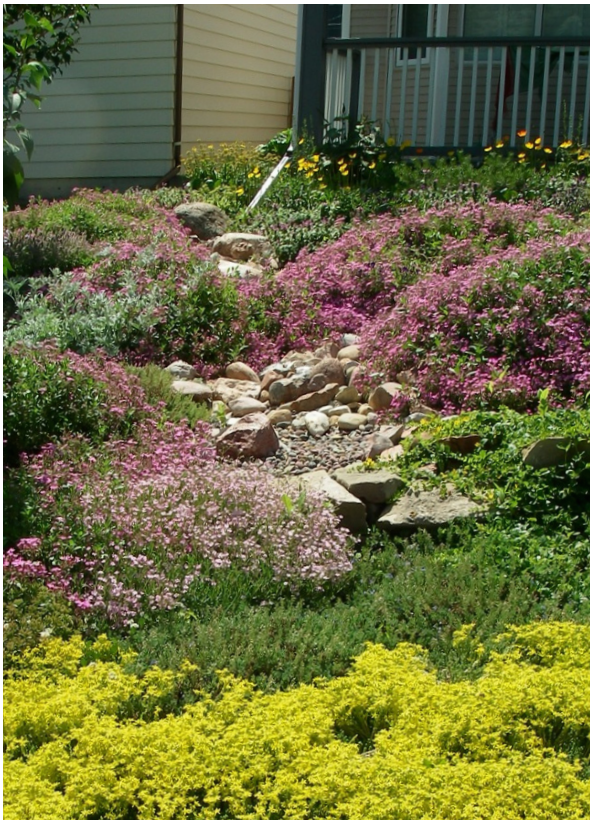
Slope stability. Soakaways and infiltration trenches should not be built on slopes steeper than 25 percent (4 horizontal to 1 vertical). A geotechnical analysis by a professional engineer may be required on slopes over 15 percent or if located within 60 m of the top of a slope steeper than 40 percent, or in a landslide hazard area.

Proximity to groundwater. To allow adequate depth for soil processes to cleanse runoff, maintain a one-metre-depth separation between the bottom of the facility and the highest seasonal groundwater level. (If you have to run a sump pump in August to keep your basement dry, you have high groundwater.)

Groundwater contamination. The risk of contamination from single-family residential is low, especially if the runoff originates from roofs and landscaped areas. Runoff originating from driveways should first pass through a pretreatment area (a rain garden or vegetated area) to remove oil, grease, bacteria and other contaminants. Snow from sanded or de-iced surfaces should not be stored on top of open infiltration facilities. Never put anything but rainwater into an infiltration facility.

Infiltration rate. To prevent water standing too long, as a rule-of-thumb, the minimum infiltration rate should be at least 15 mm per hour. This means that however large the facility is, if it has a depth of 15 mm of water in it, it will drain in one hour. The facility may still work for lower infiltration rates, however, this may require the services of a professional to evaluate if the footprint needs to be increased to provide more surface area for water to soak in or if the contributing area needs to be smaller. Professional percolation tests may cost in excess of $1000. Home percolation tests, in our experience, significantly overestimate infiltration rates.

These townhouses have a shared infiltration trench running along their backyards between houses and garages. **FACING PAGE LEFT:** Construction of the infiltration trench. **FACING PAGE RIGHT:** Close-up showing holes in the perforated drain pipe, drain rock, and non-woven geotextile separating native soil from the trench. **BELOW:** Finished back yard. Note the slight depression on the surface of the trench where flows from the downspouts on both the house and garage can accumulate before soaking in. The infiltration trench continues along the whole length of the block under the fences. Located in Calgary.



ABOVE: Low-maintenance groundcovers accentuate the path of this dry riverbed, softening the lines. This could easily have a deeper gravel layer to provide additional storage capacity.

CREDIT: Laureen Rama, Eco-yards

HOW TO DO A HOME SOIL-PERCOLATION TEST

IN SIX (EASY) STEPS

1. **Dig a 30-cm diameter hole, down to the bottom of the planned depth of the facility.**
2. **Place a ruler in the bottom of the hole that is long enough to reach to the top of the hole.**
3. **Fill the hole with water several times in order to saturate the soil. If you have clayey soil this make take several hours or overnight.**
4. **Start the test. Fill the hole with water. When the hole is empty, note the time and calculate the time needed to drain the hole.**
5. **The infiltration rate is equal to the depth of the hole divided by the time needed to drain the hole.**
6. **Repeat. Take the average as the infiltration rate (add the two rates and divide by 2).**

Caution: Our experience is that home percolation tests significantly overestimate infiltration rates.

Call Before You Dig

Before you start digging your trench — or do any sort of ground-disturbing landscape work — you need to "know what's below." Damage to buried utility lines can cause loss of essential services for you and your neighbours, or even serious injury or death. You are responsible for the cost of repairing any damage you cause to buried service lines. Contact **Alberta One-Call** well ahead of time (at least two full days, more during the busy spring and fall seasons) to locate and mark buried utilities on your property. You can reach them at **1-800-242-3447** or **albertaonecall.com**

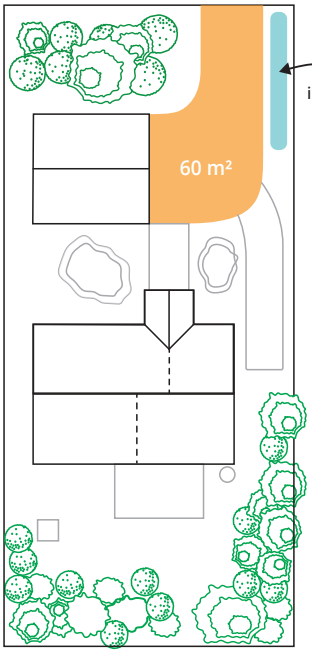
ABOVE LEFT: Downspout fitted with a dual drain to provide a winter surface bypass for drainage that is routed below the surface through a solid round pipe near the home, and then into a perforated pipe with a filter sock on it. A flagstone pathway was later added that runs over the perforated pipe to provide unimpeded access to the side yard. Once construction was complete, the end of the filter sock was trimmed off. Runoff enters the dry riverbed at this point. (The smaller black conduit to the left carries soil moisture sensors that are monitoring the performance of this garden.) **ABOVE RIGHT:** Arrangement of the summer flow pipe (behind with the leaf guard) and the winter bypass pipe (forward - regular downspout) **BELOW RIGHT:** Close-up of the leaf guard and diverter control. **FACING PAGE:** The finished dry riverbed, which is bermed at the end, creating a hybrid solution. Runoff is retained at the lower end and part way up the channel and seeps very effectively into the surrounding landscaped beds. In really large storms the system will overflow to the street. This example shows how concepts can be blended into functional, beautiful high performance landscape solutions.

Rain Gardens vs. Soakaways and Trenches

Rain gardens are similar to soakaways and infiltration trenches as far as their ability to soak in runoff. Rain gardens are filled with soil and plants and have a depressed surface, and are always something you see, while soakaways and trenches may be visible or invisible. Rain gardens may or may not store as much volume of runoff as soakaways and trenches, but they provide better habitat value. The larger surface storage that rain gardens have is capable of retaining the most sudden rainstorms, similar to chamber systems. Dry riverbeds usually have a slope whereas rain gardens are flat.

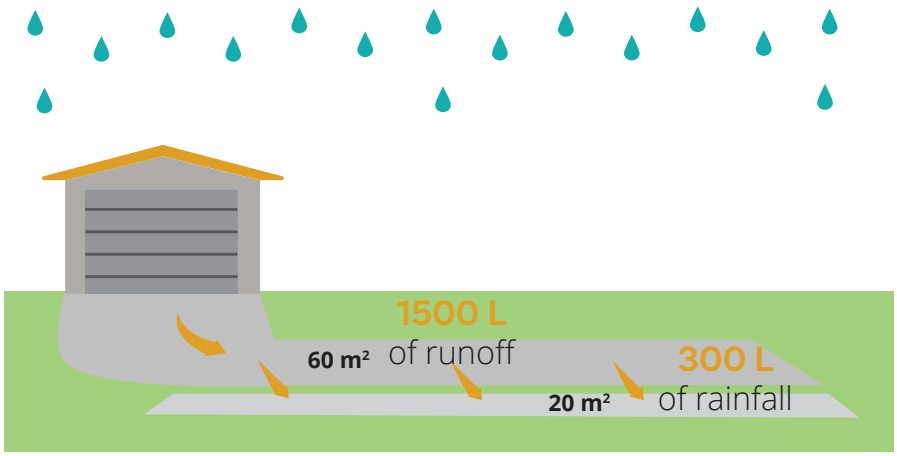
CONSIDER THIS EXAMPLE

EXAMPLE PLAN



HOW MUCH RUNOFF?

From the driveway, and including rainfall on the trench itself, a 2.5-cm rain event generates...



IDEAS

Our example lot includes an **infiltration trench** beside the driveway. The driveway is sloped so that runoff goes through a vegetated pretreatment buffer first. We have about 20 m of length. A 30-cm² trench is too small, but a 60 cm² trench will do the trick. A soakaway could work from a quantity perspective, but it would be difficult to get the necessary pretreatment.

450 L

20-m long 30 cm² infiltration trench

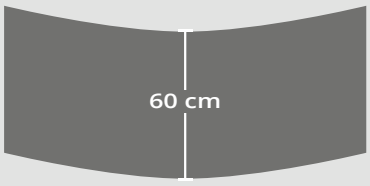
Phone a Good Friend

(difficulty: intermediate)

$$$

1,800 L

20-m long 60 cm² infiltration trench



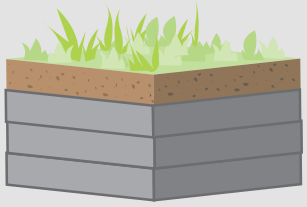
Call the Pros

(difficulty: intermediate)

$$$$

1,875 L

2.5 x 3.0 x 1 m gravel soakaway



Call the Pros

(difficulty: intermediate)

$$$$

Have you evaluated your site yet? Our **Evaluate Your Site** section walks through the steps of identifying source flows, calculating runoff volumes, identifying opportunities to reduce runoff, and sizing your solutions.

Put a fine point on it

Your turn to do the math! The sizing tables below will help you determine how big your gravel trench or soakaway needs to be. For example, say the contributing area of half your roof and your driveway totals about 100 m^2. To capture all 2,500 L of runoff generated with an infiltration trench, a 60-cm-by-60-cm (2x2 foot) gravel trench would need to be 28 metres long. Chances are, the property cannot accommodate that. To capture the runoff, consider a deeper or wider trench, modular chamber, or combination with another measure like an attractive rain garden, or routing flows to an existing natural area. Let your creativity — and your calculations — be your guide!

Gravel Soakaway Sizing

Contributing Area	Generated Runoff from 2.5-cm Rain Event	Minimum Gravel Soakaway Storage Volume Needed	Example Dimensions
10 m^2	250 L	1 m^3	1 m x 1 m x 1 m
20 m^2	500 L	2 m^3	1 m x 1 m x 2 m
50 m^2	1250 L	5 m^3	2.5 m x 2 m x 1 m
100 m^2	2500 L	10 m^3	2.5 m x 2 m x 2 m

Gravel Trench Lengths

Contributing Area	Generated Runoff from 2.5-cm Rain Event	LENGTH NEEDED FOR DIFFERENT WIDTHS AND DEPTHS				
		15-cm width/ 15-cm depth	15-cm width/ 30-cm depth	30-cm width/ 30-cm depth	30-cm width/ 60-cm depth	60-cm width/ 60-cm depth
10 m^2	250 L	44 m	22 m	11 m	6 m	3 m
20 m^2	500 L	89 m	44 m	22 m	11 m	6 m
50 m^2	1250 L	222 m	111 m	56 m	28 m	14 m
100 m^2	2500 L	444 m	222 m	111 m	56 m	28 m
150 m^2	3750 L	667 m	333 m	167 m	83 m	42 m

NOTE: It is beyond the scope of this guide to provide more sophisticated calculations that account for the additional capacity created by infiltration that will occur over well-percolating soils. In addition, the gravel void space has been calculated at 25 percent, which is conservative. Depending on the size of the fill, the void space may actually be larger. Gravel may be closer to 35 or 40% void space. The calculation is simply length x width x depth (in cubic metres) x per-cent void space x 1000 to convert cubic metres to Litres. See the *Evaluate Your Site* module for more calculations.

Products and Suppliers

Contech ES supplies ChamberMaxx.
https://www.conteches.com/stormwater-management/detention-and-infiltration/chambermaxx

Layfield supplies the modular Brentwood StormTank.
https://www.layfieldgroup.com/StormWaterProducts.aspx

Armtec supplies arch-style chambers.
https://armtec.com/stormwater-management/cultec-stormwater-chambers/

Terrafix Geosynthetics supplies Triton chambers.
https://terrafixgeo.com/product/stormwater-management/triton-stormwater-management-system/

Barr Plastics supplies Ecobloc.
https://www.barrplastics.com/stormwater-retention-detention-management.html

Chambers can usually be wrapped in waterproof membranes to create rainwater harvesting storage, or left open on the bottom for infiltration. These are example products only, there are many others.

More Information

For additional details on planning and building your trench or soakaway, as well as design inspiration, check out these resources.

Resilient Landscaping Canada (prairie-focused, a resource of the ALIDP)
resilientlandscaping.ca

Pigeon Lake Watershed Association
plwa.ca

Credit Valley Conservation's Soakaways Fact Sheet (downloadable PDF)
bit.ly/cvc_soakaways

Sustainable Technologies Evaluation Program wiki
https://sustainabletechnologies.ca/home/urban-runoff-green-infrastructure/low-impact-development/soakaways-infiltration-trenches-and-chambers/

PIGEON LAKE WATERSHED ASSOCIATION
ALIDP Alberta Low Impact Development Partnership
This project was undertaken with the financial support of:
Ce projet a été réalisé avec l'appui financier de :
Environment Canada / Environnement Canada
Land Stewardship Centre

Put a fine point on it

Your turn to do the math. As in the rest of this guide, the amount of runoff to retain is calculated based on the 2.5 cm rain event, which is the amount needed to protect our water bodies from excess runoff and pollution.

The table below shows the calculation of storage capacity of gravel base assemblies of varying thicknesses. This type of assembly can be used under a variety of surface treatments presented in this guide.

Storage Volumes of Open-graded Gravel Bases

Runoff generated from 2.5 cm rain event over these surface areas	Total Volume of Runoff during a 2.5 cm rain event	Stormwater Stored for Different Gravel Thicknesses of the same size as the generating surface area		
		10 cm thick Gravel Base	15 cm thick Gravel Base	20 cm thick Gravel Base
5 m²	125 L	75 L	112.5 L	150 L
10 m²	250 L	150 L	225 L	300 L
25 m²	500 L	300 L	450 L	600 L
50 m²	1250 L	750 L	1125 L	1500 L
100 m²	2500 L	1500 L	2250 L	3000 L

The above assumes:

1. the gravel base has 15% storage capacity.
2. the installation has a base of aggregate about 2 cm in diameter, over a 5-cm aggregate sub-base, over subsoil with a slow infiltration rate (clay).

According to these calculations, if the goal is absorption of all stormwater that hits the surface area of the pavement, the gravel base will need to be about 18 cm thick. If it's expected to accommodate flows from additional areas, the gravel depth should increase and cleaning frequency will increase unless its a clean source such as a roof. If you want a gravel base less than 15 cm, then other tools adjacent to the permeable pavement should be considered to make up the difference.

Gravel storage is not the only option. There are structural, modular chambers for use under sidewalks and driveways. A new garage can easily be built with the parking surface structurally supported over a poured-in-place cistern/ base. Soakaways and rainwater harvesting have many potential synergies with surface treatments such as permeable pavements. Refer to the other modules in this guide for more info.

Products and Suppliers

Unilock
unilock.com/permeable-pavers/

Belgard
belgard.com/products/permeable-pavers/

Romex Canada
romexcanada.com/permeable-paving/

Home Supply Centres

Eagle Lake Landscape Supply - Hahn Plastics, Grasscrete, pavers
eaglelakelandscape.com

Steam 'n' Weeds
steamnweeds.com

Permavoid modular structural storage
https://www.abtdrains.com/products/environmental-products/permavoid/

DeepRoot modular structural storage
https://www.deeproot.com/products/silva-cell.html

Citygreen modular structural storage
https://citygreen.com/product-category/soil-structure-systems/

Rainstore3 modular structural storage
https://www.invisiblestructures.com/

Brock White Construction Materials - Invisible Structures grasspave, gravelpave, turfstone, Rainstore3
brockwhite.com

More Information

Resilient Landscaping Canada (prairie-focused, a resource of the ALIDP)
resilientlandscaping.ca

Pigeon Lake Watershed Association
plwa.ca

City of Calgary Technical Guidance Module - in depth guidance for design considerations and achieving stormwater management objectives
http://www.calgary.ca/UEP/Water/Documents/Water-Documents/ud-bulletin-low-impact-development-permeable-pavement-module.pdf

Interlocking Concrete Pavement Institute - many many detail drawings and other resources
icpi.org/permeable-interlocking-concrete-pavement-drawings

PIGEON LAKE WATERSHED ASSOCIATION
ALIDP Alberta Low Impact Development Partnership
This project was undertaken with the financial support of:
Ce projet a été réalisé avec l'appui financier de :
Environment Canada Environnement Canada
Land Stewardship Centre