BUS GoCircular

Shaping a Circular Sustainable Future

Module 5

Water and the Circular Economy

Circular Economy in the Construction Industry

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Summery

The trainer will explore multiple facets of water in construction gaining a general overview of the impact of water in construction and the opportunities that present themselves when correctly implementing water saving and collection methods. This will then be related to the many opportunities associated with water and Multi-functional Green Roofs Facades and Interiors Elements.

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Objectives/Learning Outcomes

- 6 – Replace freshwater use with alternative water sources
- 7 – Enact measures that optimise water use for water efficiency

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Content

- Water in Construction
  - Water and the Circular Economy
- Water and Sustainable Use in Construction
  - Sustainable Drainage Systems
  - Rainwater Harvesting
- Water Management Plan
- Application for Multi-functional Green Roofs Facades and Interior Elements

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Water in Construction

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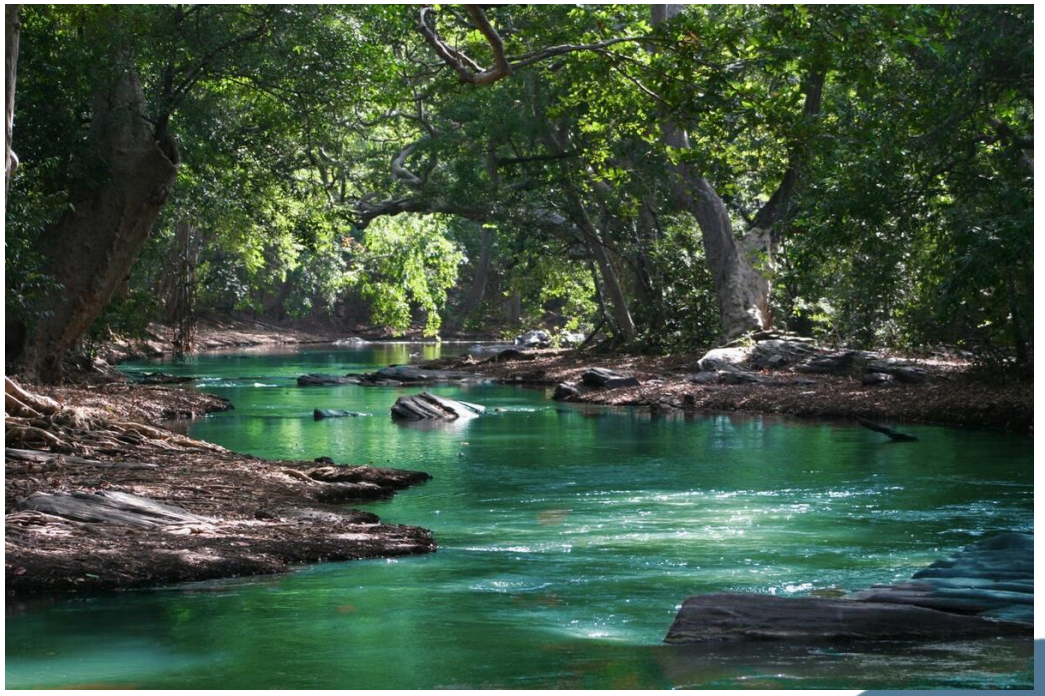
Water in Construction

Construction companies increase their contribution to environmental degradation through their current water practices. Water is a finite resource, meaning it is non-renewable. Oceans, rivers, and lakes may seem large enough to support life on Earth, but much of this water is unusable.

Builders use water for a variety of functions on the job. If companies mismanage this water use, they can increase their environmental impact.



Source: https://www.construction21.org/articles/h/how-construction-sites-can-minimize-water-pollution.html

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Water in Construction

Top uses of water for constructions sites:

- Drinking water
- Supplying onsite facilities
- Concrete Batching
- Grouting
- Hydro-demolition
- Drilling and piling
- Landscaping and pond filling
- Chlorination
- Soakaway testing
- Dust suppression

Source: https://constructionmaguk.co.uk/the-need-for-water-on-construction-sites/

Source: https://theconstructor.org/practical-guide/construction-water-qualityspecification/6012/

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Water in Construction Manufacturing

Manufacturers of construction products rely on water for a wide variety of purposes.

Water must of course also be supplied for staff welfare purposes on any industrial or commercial site, i.e. via the provision of toilets, showers, basin taps and kitchen facilities.

Source: https://www.thomasnet.com/insights/which-industries-use-the-most-water/

Source: https://www.constructionproducts.org.uk/media/87904/water_efficiency_report.pdf

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Water in Construction Manufacturing

Water can serve as:

- a lubricant
- a cleaning agent
- a sealant
- a heat transfer medium
- a solvent
- an air pollution control medium
- plus an array of other uses depending on the material and products being produced.

Source: https://www.constructionproducts.org.uk/media/87904/water_efficiency_report.pdf

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Water in Construction Manufacturing

Different uses of water for manufacturing purposes may also have different requirements of water quality (purity, dissolved material content etc).

For instance some dust suppression activities can use non-potable water, whereas there are strict requirements for drinking water which cover microorganisms, chemicals and metals as well as the way the water looks and tastes.

Source: https://www.constructionproducts.org.uk/media/87904/water_efficiency_report.pdf

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Water Sources

Mains water, supplied by a water company:

- Mains water accounts for the biggest proportion of water use overall, with alternative sources used as backup to guarantee security of supply.

Directly abstracted water from either a river or groundwater source:

- The abstraction of water directly from freshwater surface or groundwater sources requires a licence from the relevant environmental regulator (Environment Agencies). Many companies have an abstraction license, especially those in the heavy industries such as aggregates, concrete and bricks.

Source: https://www.meathchronicle.ie/2020/05/22/disruption-to-navan-water-supply-as-main-bursts-on-proudstown-road/

Source: https://www.constructionproducts.org.uk/media/87904/water_efficiency_report.pdf

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Water Sources

Harvested rainwater, collected on site, perhaps in tanks from roof runoff, in lagoons from site run-off, or from dewatering activities on site:

- Rainwater harvesting is becoming more common across the sector though tends not to be relied upon to supply significant proportions of water. This may be due to lack of constant supply, since seasonal variations in rainfall mean there is usually a reliance on mains water to 'top up' the available rainwater supply, or because of the treatment required to achieve the required water quality for wider use. Less commonly used sources of harvested water include quarry water and site lagoons which can be developed on a site by site basis.

Recycled water – where water from one process is later used in another process:

- The use of recycled water is widespread amongst construction product manufacturers; half of all respondents to a 2013 industry survey already recycle water. Whilst mains water is still the primary water source for respondents, almost a quarter indicated that recycled water is the main source of process water.

Source: https://www.constructionproducts.org.uk/media/87904/water_efficiency_report.pdf

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Water and the Circular Economy - Closing the Loop

It is vital that we not only reduce our consumption of water but that we increase the amount of reuse of this water. Closing the loop is a term used when describing the act of keeping a material in use for longer, in this case it means that once water enters a building or site it is reused as much as possible before it must be sent off site.

Source and Further Reading: https://www.chardonlabs.com/resources/importance-of-a-closed-loop-water-system-water-treatment/

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Water and Sustainable Use in Construction

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Sustainable Water Technologies

- Installing rainwater harvesting systems for dust suppression, vehicle cleaning, ponds, or underground tanks;
- Reusing water from groundwater or surface water drainage to dampen roads in hot weather;
- Using innovative technology, e.g. percussion taps, twin flush/low water toilets;
- Introducing recirculating systems for cleaning tools and greywater, and use for flushing toilets or irrigating plants;
- Designing ground surfaces to slope away from structures and towards garden areas and recharge zones;
- Retaining as much vegetation as possible during construction to reduce water evaporation.

Source: https://www.igbc.ie/water-conservation-guide/

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Water Management in the Built Environment

Four broad groups of construction products facilitate better water management in the built environment, they are:

- Products that help reduce water use in buildings
- Products that enable building occupiers and infrastructure managers to recycle or use alternative sources of water
- Product systems that channel or soak up rainwater (runoff)
- Products that help other product manufacturers reduce water use in their processes

Source: https://www.constructionproducts.org.uk/media/87904/water_efficiency_report.pdf

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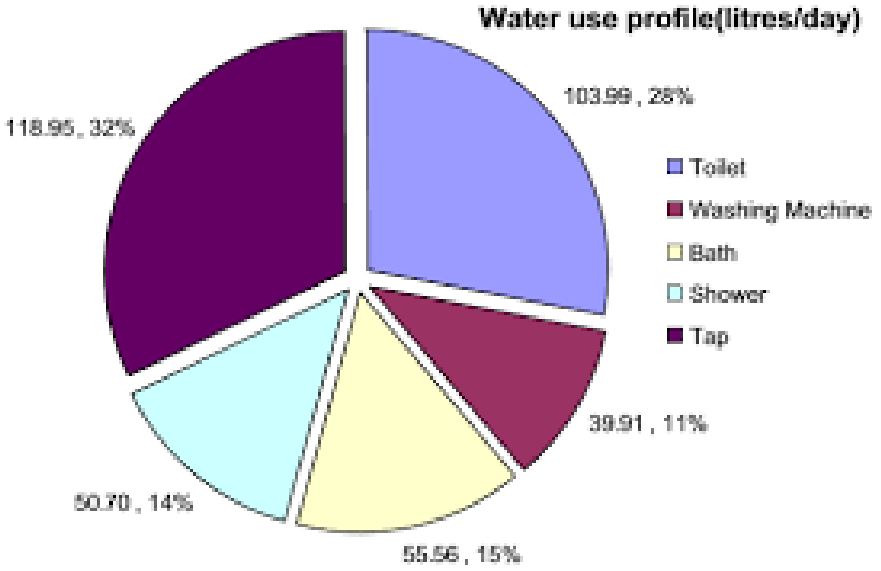
Water in Buildings

Products that help reduce water use in buildings.

A great many households are now engaging in water savings behaviour and this is assisted by innovation and new developments in the products industry



Source: Irish https://www.water.ie/about/research-and-innovation/CRU-Report-Promoting-Sustainable-Household-Water-Consumption-27th-Sept-2019-Final-Website.pdf

Source: https://www.constructionproducts.org.uk/media/87904/water_efficiency_report.pdf

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Examples

Efficient taps

Efficient baths and showers

Efficient toilets

Source: https://prestigefaucets.com/products/bathroom-faucet-water-saving-taps-chrome-touchless-hot-and-cold-mixer-tap-fully-automatic-faucet-infrared-sensor-faucet-8021

Source: https://www.constructionproducts.org.uk/media/87904/water_efficiency_report.pdf

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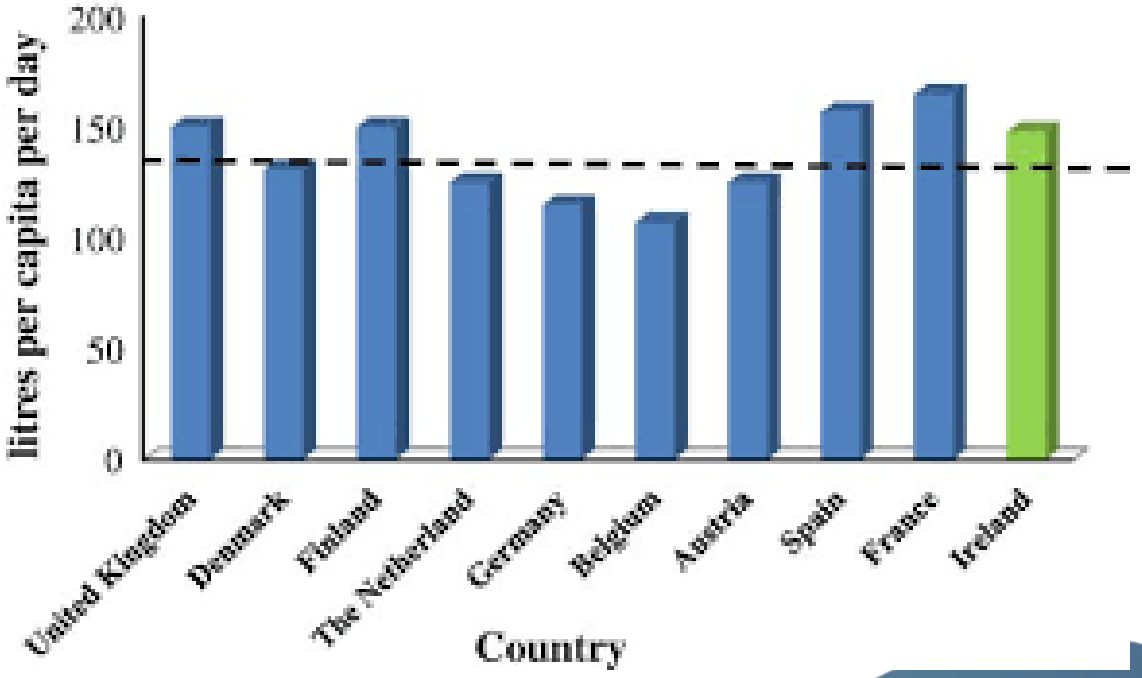
Water Infrastructure in Buildings

Products that enable building occupiers and infrastructure managers to recycle water or use alternative sources.

Much of the water used in buildings or rainwater that is not captured is lost when it can be easily utilised in many ways on a building.



Source: https://arrow.tudublin.ie/cgi/viewcontent.cgi?article=1021&context=engschmecart

Source: https://www.constructionproducts.org.uk/media/87904/water_efficiency_report.pdf

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Examples

Greywater recycling systems

- In the domestic context, greywater systems collect the water from sources such as baths, showers and hand basins and reuse the collected water for toilet flushing, washing machines, and external use.

Rainwater harvesting goods

- For domestic purposes rainwater harvesting systems are applicable to both domestic and commercial properties, with the collected water primarily used for toilet flushing, garden irrigation and, less frequently, washing machines.

Source: https://www.harvst.co.uk/harvesting-rainwater-and-how-to-go-about-doing-it/

Source: https://www.constructionproducts.org.uk/media/87904/water_efficiency_report.pdf

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SuDS

Product systems that channel or soak up rainwater (runoff).

Source: https://www.farminguk.com/news/reed-bed-creates-sustainable-source-of-water-for-vegetable-produce_46184.html

Source: https://www.constructionproducts.org.uk/media/87904/water_efficiency_report.pdf

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SuDS

Sustainable Drainage Systems (SuDS) is the term used to describe an approach to managing rainwater falling on roofs and other surfaces that harnesses or mimics natural environmental processes.

The key objectives are to manage the flow rate and volume of surface runoff to reduce the risk of flooding and water pollution.

To achieve this, elements of the built environment that receive and handle rainwater are designed so that initial flows can be attenuated, runoff water channelled or stored and surface water transported at a controlled rate. SuDS also reduce pressure on the sewerage network and can offer scope for biodiversity and local amenity

Source: https://www.constructionproducts.org.uk/media/87904/water_efficiency_report.pdf

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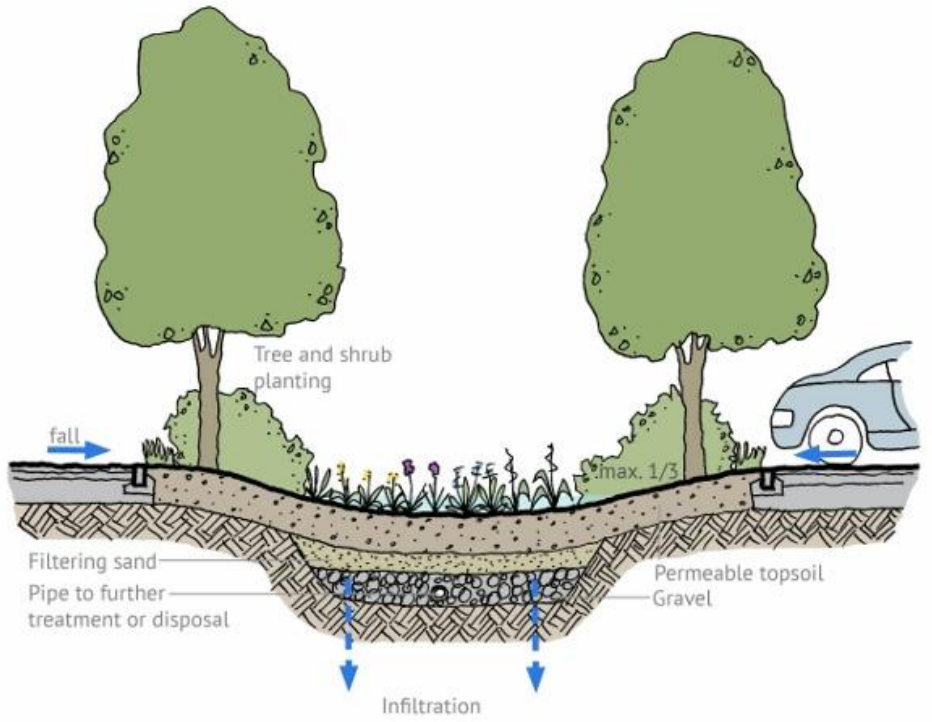
SuDS

Susdrain lists five key principles underpinning SuDS which enable the design and planning process to mimic natural drainage.

- Storing rainwater and releasing it slowly (attenuation)
- Allowing water to soak into the ground (infiltration)
- Slowly transporting (conveying) water on the surface
- Filtering out pollutants
- Allowing sediments to settle out by controlling the flow of the water



Source: https://www.susdrain.org/delivering-suds/using-suds/suds-components/filtration/filtration.html

Source: https://www.constructionproducts.org.uk/media/87904/water_efficiency_report.pdf

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Water Reduction in Production

Products that enable other manufacturers and construction contractors to reduce water use in their processes.

These tend to be of a chemical nature and either alter a manufacturing process so that less water is required or else may be coatings that prevent the leakage of water.

Source: https://theconstructor.org/practical-guide/construction-water-qualityspecification/6012/

Source: https://www.constructionproducts.org.uk/media/87904/water_efficiency_report.pdf

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Water Treatment Technologies

Disinfection

- Water disinfection means the removal, deactivation or killing of pathogenic microorganisms.

Purification

- Water purification means the process of removing undesirable chemicals, biological contaminants, suspended solids, and gases from water.

Clarification

- Clarification is an essential step in a water or wastewater treatment process to remove suspended solids through gravity settling, providing a clarified liquid effluent.

Source: https://vareoblu.com/water-treatment/

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Water Treatment Technologies

De-ionization

- A deionized water system is an arrangement of DI tanks and other components that are used to produce high purity water.

Reverse Osmosis

- Reverse osmosis is a water purification process that uses a semi-permeable membrane (synthetic lining) to filter out unwanted molecules and large particles such as contaminants and sediments like chlorine, salt, and dirt from drinking water. In addition to removing contaminants and sediments, reverse osmosis can also remove microorganisms – which you certainly do not want to drink.

Source: https://vareoblu.com/water-treatment/

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Water Treatment Technologies

Filtration

- Water filtration is the process of removing or reducing the concentration of particulate matter, including suspended particles, parasites, bacteria, algae, viruses, and fungi, as well as other undesirable chemical and biological contaminants from contaminated water to produce safe and clean water for a specific purpose, such as drinking, medical, and pharmaceutical applications.

Degassing

- By degassing the water, unwanted oxygen or carbonic acid is removed.

Screening

- A necessary part of all municipal and industrial wastewater treatment plants, wastewater screening retains solids found in the wastewater.

Source: https://vareoblu.com/water-treatment/

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Measuring Water and Assessing Environmental Impacts

Measuring water quantities is one thing, but understanding and measuring the environmental impact of water consumption is a much more complex process and a variety of different terms have come to be used for the measurement of water consumption associated with a product, building or project.

These terms have tended to become intertwined and somewhat confused. The most common terms encountered are

- water footprinting
- water calculator
- embodied water.

Also, as is inevitable in a rapidly developing topic, these terms often mean different things to different groups of people and are sometimes used interchangeably. However, accepted definitions of key terms are beginning to emerge.

Source: https://www.constructionproducts.org.uk/media/87904/water_efficiency_report.pdf

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Embodied Water of Construction Products

The construction industry first developed the concept of embodied energy to distinguish the energy associated with construction materials

- energy used in their extraction, manufacture, transport, installation, maintenance and disposal

from the energy associated with operating buildings known as “operational energy”. As climate change became a concern, industry moved to the measurement of embodied carbon and operational carbon and as interest has grown in water, the term “embodied water” has come to be used in relation to the water associated with construction materials.

Source: https://www.constructionproducts.org.uk/media/87904/water_efficiency_report.pdf

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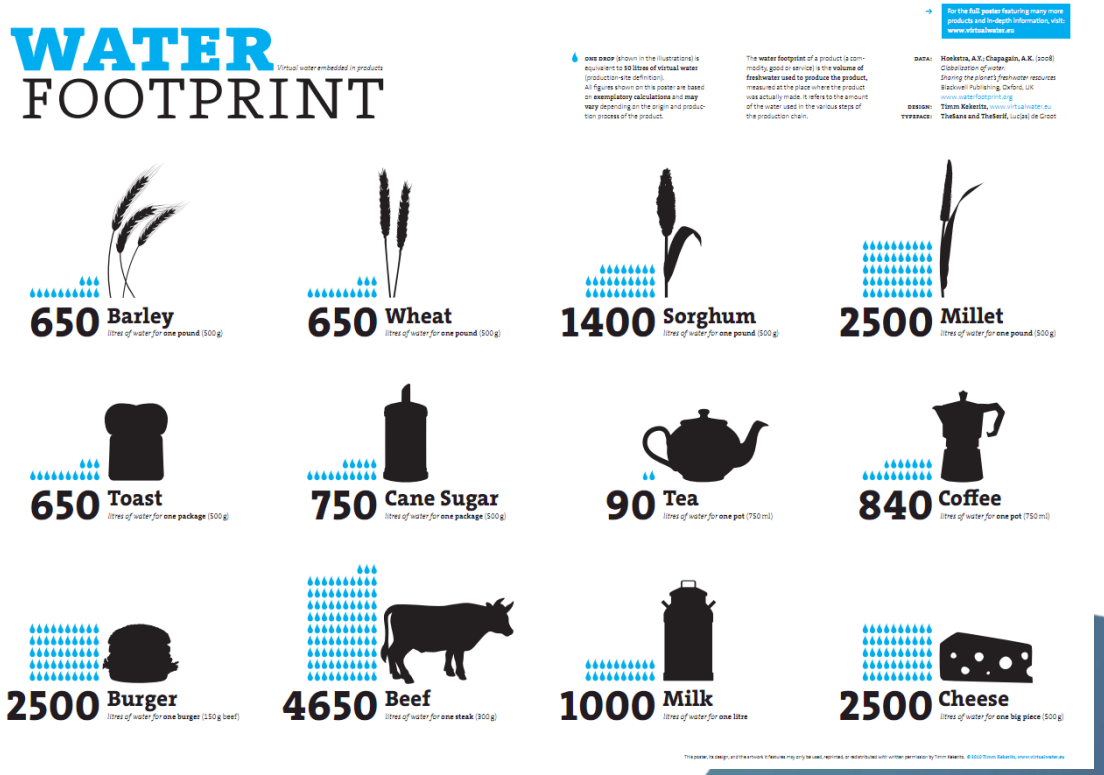
Water footprinting

This relates to all products, for instance food crops such as vegetables grown in Africa and flown to European supermarkets or textile production for the global clothing industry.

Water footprinting is the study of the water associated with organisations as well as products and has developed in two distinct phases.



Source: https://undisciplinedenvironments.org/2016/01/28/what-does-virtual-water-conceal/

Source: https://www.constructionproducts.org.uk/media/87904/water_efficiency_report.pdf

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Case Study - Culemborg

In Culemborg, a district with around 250 homes and small businesses has been realised with an extraordinary degree of integration.

Besides retaining rainwater and treating greywater at decentralised locations, the plan incorporated an ecologically designed outdoor space, use of sustainable materials and low energy consumption.

The energy consumption levels per home are exceptionally low. The houses are fitted with solar collectors and are heated using a district heating system that extracts heat from the groundwater.

Source: https://www.urbangreenbluegrids.com/projects/eva-lanxmeer-results/

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Water in Culemborg

The design of the water system is an important foundation for the urban planning design of the residential district and the associated business locations. The district was designed around a water extraction site.

- The flow of clean water (rainwater runoff from roofs) is led off to the water extraction site
- where it is captured in retention pools and rinse water (see below for more specifics) is added.
- The flow of dirty water (street water, greywater and blackwater) is led away from the vulnerable water extraction area.

Source: https://www.constructionproducts.org.uk/media/87904/water_efficiency_report.pdf

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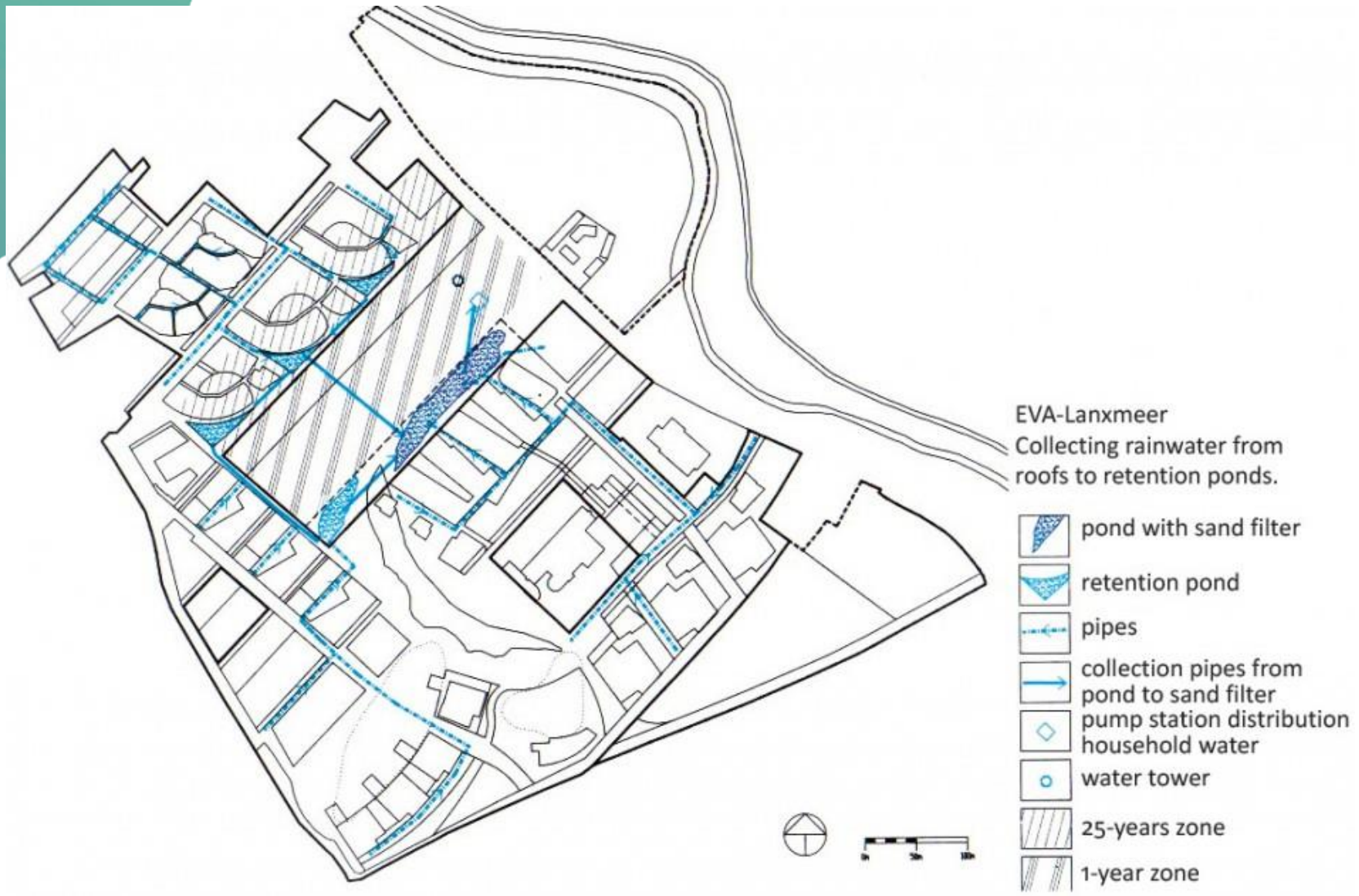

Collecting rainwater from roofs te retention ponds © Copijn Utrecht

Source: https://www.constructionproducts.org.uk/media/87904/water_efficiency_report.pdf

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Water in Culemborg

PRECIPITATION FROM ROOFS

- Clean precipitation running off from roofs is captured in four retention pools, via a closed system of pipes

STREET WATER

- Street water is treated as it runs along wide gutters and parking spaces with scoria semi-paving.

GREYWATER

- The greywater (wastewater from dishwashers, showers and kitchens) is treated in helophyte filters at three locations along the periphery of the area covered by the plan.

Source: https://www.constructionproducts.org.uk/media/87904/water_efficiency_report.pdf

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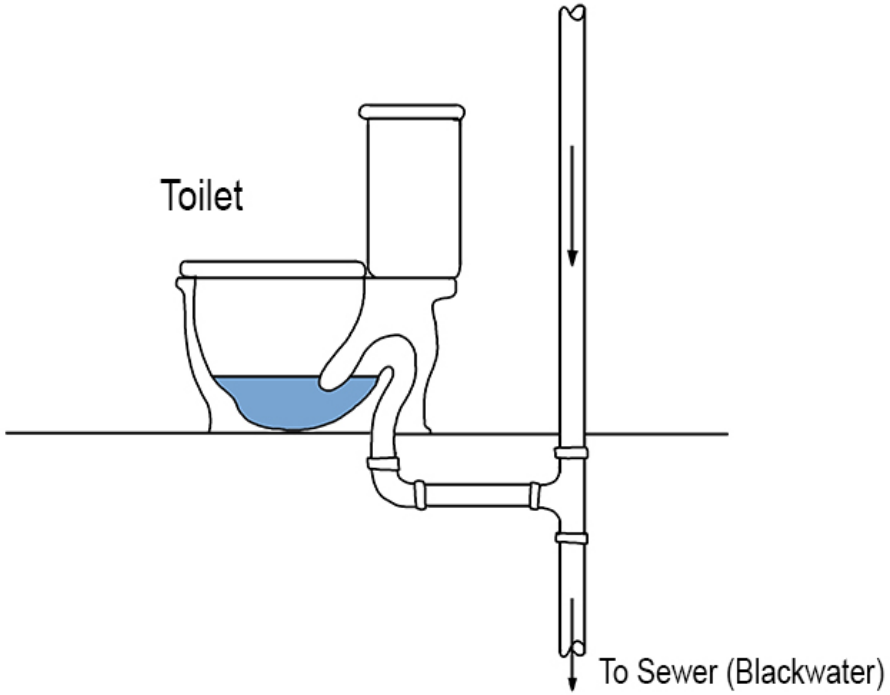
Water in Culemborg

BLACKWATER

- A separate sewer system has been realised for blackwater, which comes from toilets. The plan is to build a biogas plant to process the blackwater, together with green and garden waste and pruned branches and use it to produce energy.



*Source:*https://mammothmemory.net/geography/geography-vocabulary/water/blackwater.html

Source: https://www.constructionproducts.org.uk/media/87904/water_efficiency_report.pdf

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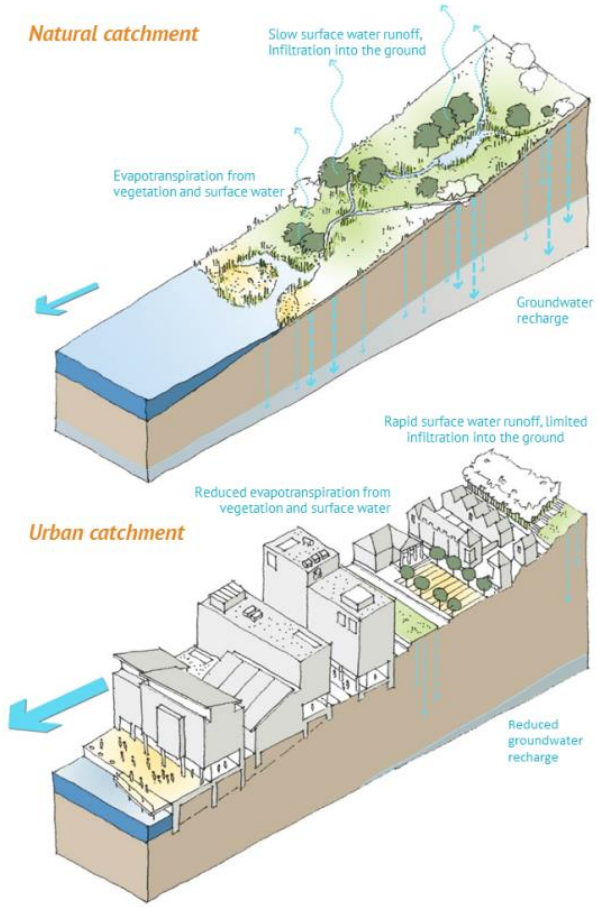
Sustainable Drainage Systems (SuDS)

Approaches to manage surface water that take account of

- water quantity (flooding)
- water quality (pollution)
- biodiversity (wildlife and plants)
- amenity

are collectively referred to as Sustainable Drainage Systems (SuDS).



Source: https://www.susdrain.org/delivering-suds/using-suds/background/sustainable-drainage.html

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Sustainable Drainage Systems (SuDS)

SuDS mimic nature and typically manage rainfall close to where it falls. SuDS can be designed to

- transport (convey) surface water
- slow runoff down (attenuate) before it enters watercourses
- they provide areas to store water in natural contours and can be used to allow water to soak (infiltrate) into the ground or evaporated from surface water
- lost or transpired from vegetation (known as evapotranspiration).

Source: https://www.susdrain.org/delivering-suds/using-suds/background/sustainable-drainage.html

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Why are SuDS Sustainable

- Manage runoff volumes and flow rates from hard surfaces, reducing the impact of urbanisation on flooding
- Provide opportunities for using runoff where it falls
- Protect or enhance water quality (reducing pollution from runoff)
- Protect natural flow regimes in watercourses
- Are sympathetic to the environment and the needs of the local community
- Provide an attractive habitat for wildlife in urban watercourses
- Provide opportunities for evapotranspiration from vegetation and surface water
- Encourage natural groundwater/aquifer recharge (where appropriate)
- Create better places to live, work and play.

Source: https://www.susdrain.org/delivering-suds/using-suds/background/sustainable-drainage.html

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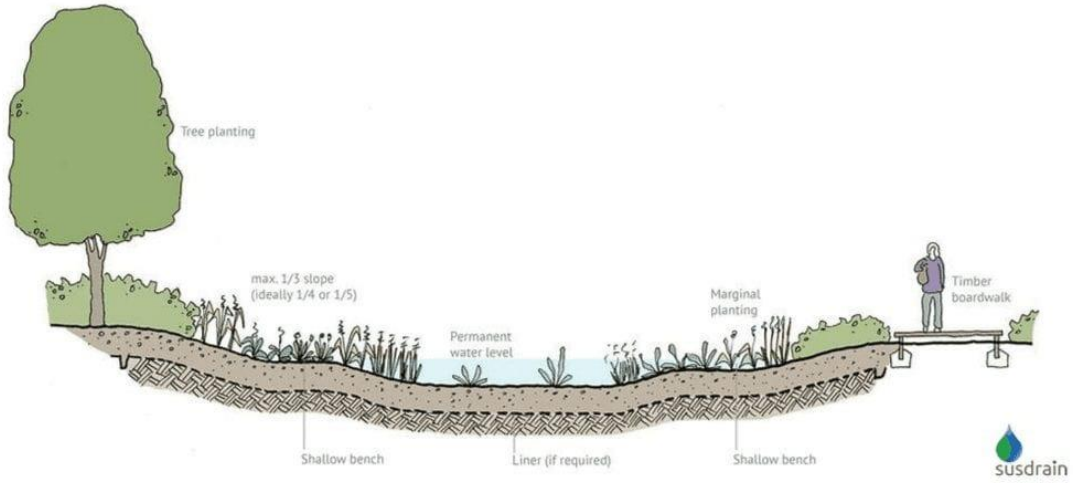
SuDS - Reed Beds

Reed beds can be used for a wide range of wastewater treatment ranging from domestic use to the treatment of farm waste and even the treatment of heavy industrial contaminants.

One of the advantages of sustainable urban drainage systems is that they are visually more attractive than other forms of wastewater treatment and this is certainly the case with reed beds.



Source: https://www.thelkgroup.com/the-suds-balancing-act/

Source: http://www.energysavingwarehouse.co.uk/learning-portal/sustainable-urban-drainage-systems-and-reed-beds/

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SuDS - Reed Beds

- Low operational costs
- No operational noise
- No electricity needed
- Do not produce sludge
- Enhance the natural environment
- Provide habitats for invertebrate such as dragonflies

Source: https://www.planningresource.co.uk/article/1311898/government-proposes-planning-changes-deliver-urban-drainage-push

Source: http://www.energysavingwarehouse.co.uk/learning-portal/sustainable-urban-drainage-systems-and-reed-beds/

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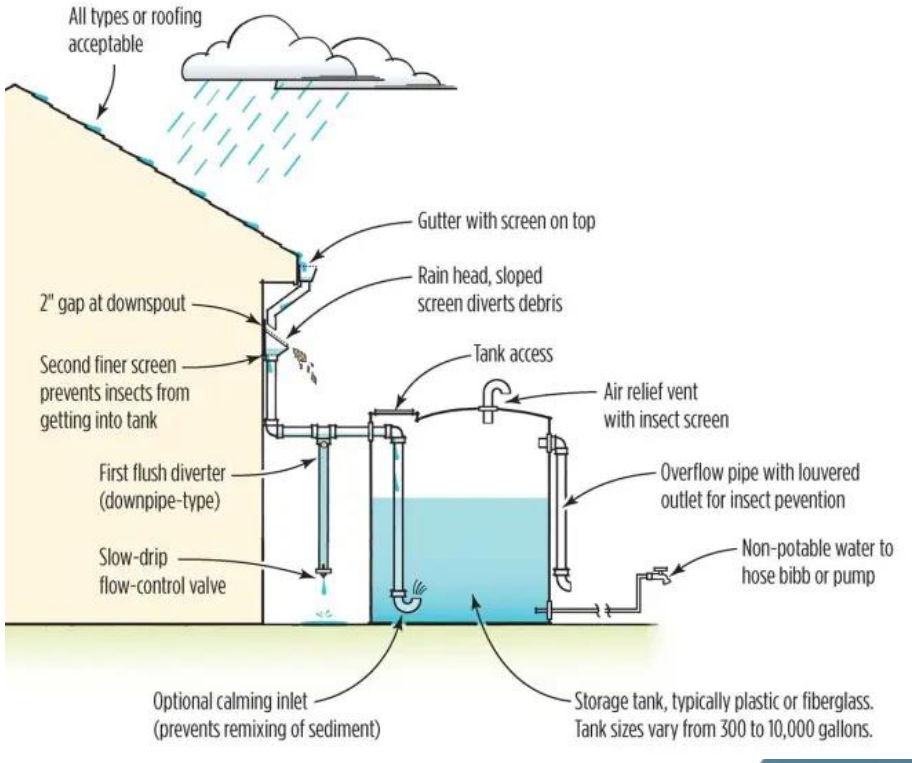
Rainwater Harvesting

The Main Components of a RWH System are:

- A catchment area such as a roof.
- Collection system such as gutters.
- A downpipe from the gutters.
- A diverter to collect water from the down-pipe.
- A water storage container such as a butt or tank.



Source: https://homesteadandchill.com/rainwater-collection-systems-101/

Source: https://www.sustainablehomes.ie/energy-insulation/rainwater-harvesting/

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Rainwater Uses

- Washing clothes - You will need to put an additional storage tank in the attic area of your home and a pump located near the ground tank.
- Cleaning your car - rainwater is free from chemicals such as chlorine and fluoride which have a tendency to leave water marks on surfaces.
- Watering your garden - plants love chemical-free rainwater.

Source: https://www.jdpipes.co.uk/knowledge/rainwater-harvesting/what-type-of-rainwater-harvesting-tank-do-i-need.html

Source: https://www.sustainablehomes.ie/energy-insulation/rainwater-harvesting/

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Water Management Plan

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Water Management Plan

A successful water management program starts with a comprehensive strategic plan. The process for developing a strategic plan is generally the same for an individual facility or an agency.

The plan provides information about current water uses and charts a course for

- water efficiency improvements
- conservation activities
- water-reduction goals.

A strategic plan establishes the priorities and helps a site or agency allocate funding for water-efficiency projects that provides the biggest impact.

Source: https://www.energy.gov/eere/femp/developing-water-management-plan

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Water Management Plan Scope

- Actions during construction.
- Appliances and plumbing to be installed.
- Water reuse potential.
- Landscaping and rainwater utilisation.
- Include water conservation and water quality in all of your project tenders and contractual documents.
- Specify water efficient fittings and appliances. These should reduce drinking water use inside the home to under 80 litres per person per day. Use the Water Efficiency Calculator from European Unified Water label to calculate water use per person.

Source: https://www.water.ie/conservation/business/business-conservation-tips/construction/

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Water Management Plan Scope

- Stay up to date with the latest design and appliances to help water conservation.
- Agree on a budget and procure funding. Check Enterprise Ireland programmes GreenPlus and Green Start for funding and grants.
- If you are designing a greenfield site, use natural drainage swales instead of costly concrete pipes.
- Install drainage systems that allow the polluted 'first flush' to be diverted into trade waste. The clean water that follows it can flow into tanks, pond systems or drainage swales.

Source: https://www.water.ie/conservation/business/business-conservation-tips/construction/

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Application for Multi-functional Green Roofs Facades and Interior Elements

Presentation

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Case Study - VanDusen Botanical Garden Visitor Centre

- Client: Vancouver Board of Parks and Recreation
- Size: 19,483 square feet
- Completion Date: 2011
- Sustainability: LEED Platinum, Living Building Challenge Petal Certified

Source: https://perkinswill.com/project/vandusen-botanical-garden-visitor-centre/

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Concept

“How would a flower (orchid) do it?”. A flower is rooted in its own place by harvesting all its own energy and water, by adapting to the climate and site, by operating pollution-free, and by promoting health and well-being.

Source: https://www.architectmagazine.com/design/buildings/vandusen-botanical-garden-visitor-centre_o

Source: https://www.archdaily.com/956788/vandusen-botanical-garden-visitor-centre-perkins-and-will

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Sustainability

Designed to exceed LEED Platinum standards, the LEED® Canada-NC 1.0 Platinum Certified the VanDusen Botanical Garden Visitor Centre uses renewable sources found on-site to meet net-zero energy annually.

The primary building material is wood which stores carbon dioxide for the life of the building.

Photovoltaics on the roof create electricity for the Centre, and hot water is provided by a biomass boiler fed by dry wood waste reclaimed from the surrounding area.

100% of water use comes from captured precipitation or reused water – rainwater is filtered and used for the Centre's greywater requirements and 100% of blackwater is treated by the on-site bioreactor, the first of its kind in Vancouver, and discharged to a new percolation field in the garden.

Source: http://www.greenroofs.com/projects/vandusen-botanical-garden-visitor-centre/

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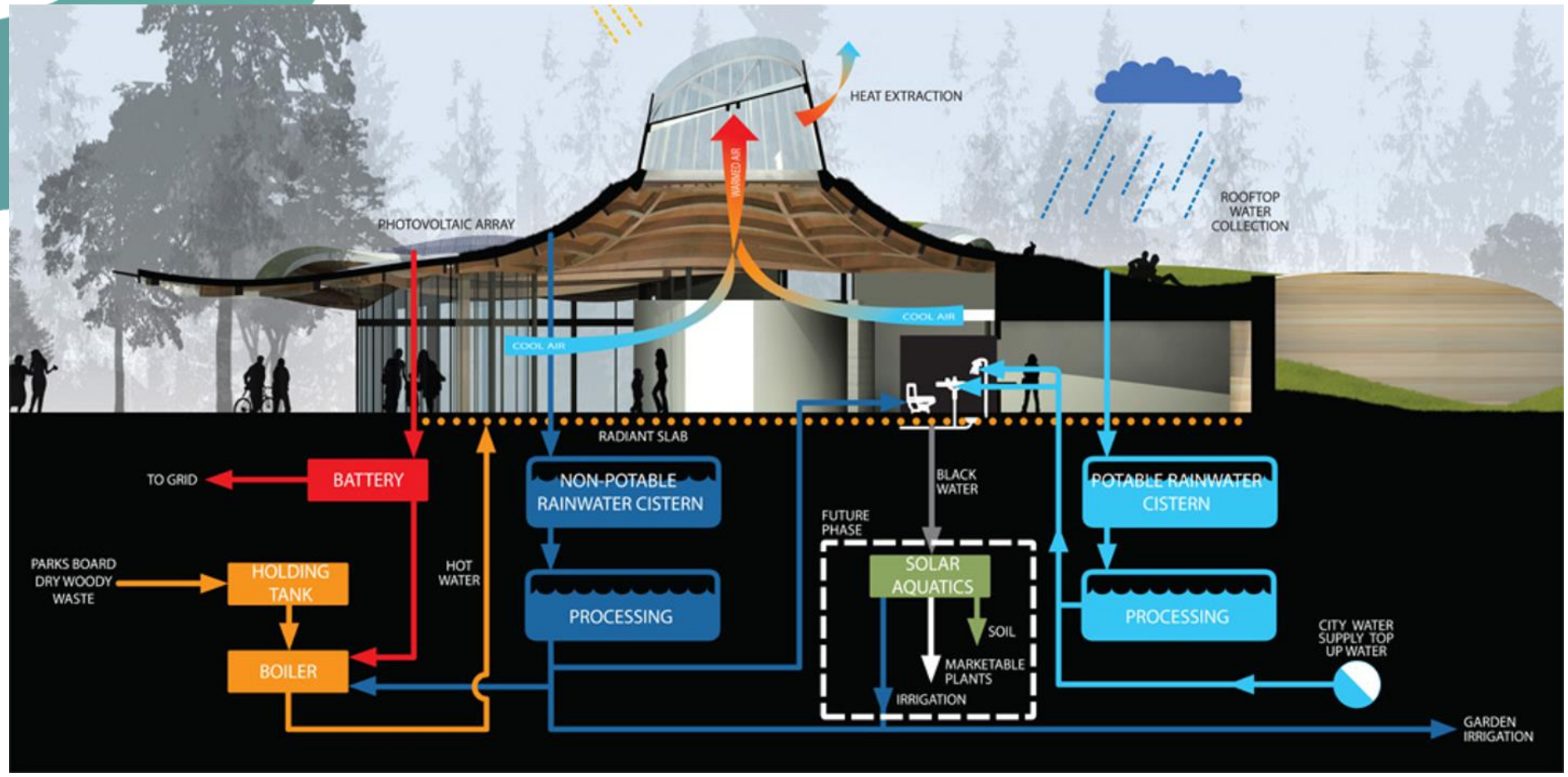

Source: http://www.greenroofs.com/projects/vandusen-botanical-garden-visitor-centre/

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The Green Roof

With slopes ranging from 2 degrees to 50 degrees, this project used three different green roof systems. On the low sloped land bridge roof the “ZinCo Perennial Garden” with the Floradrain FD40 and 20 cm of growing medium was installed.

The sloped petals green roofs were constructed with the “ZinCo Sloping Meadow” system including the Floraset FS75 and 20 cm of growing medium. And the oculus roof with a slope of more than 45 degrees was installed with the “ZinCo Steep Sloping Meadow” system including the Georaster elements and 12 cm of growing medium.

The entire green roof was hydroseeded with local grasses and planted with bulbs native to the area.

Source: http://www.greenroofs.com/projects/vandusen-botanical-garden-visitor-centre/

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Learn More About this Project

https://perkinswill.com/project/vandusen-botanical-garden-visitor-centre/

http://www.greenroofs.com/projects/vandusen-botanical-garden-visitor-centre/

https://www.architectmagazine.com/design/buildings/vandusen-botanical-garden-visitor-centre_o

https://www.archdaily.com/956788/vandusen-botanical-garden-visitor-centre-perkins-and-will

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QUIZ/ASSIGNMENT/ACTIVITY

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EXTRA READING/STUDY

Activity

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EXTRA READING/STUDY

For Further Case Studies and Training Material Please Follow the Link Below

https://docs.google.com/spreadsheets/d/1DTte4Ph8pQ4lKzYGFt2_S-d1Z_Rmd9-i/edit?usp=sharing&ouid=112148808974461842163&rtpof=true&sd=true

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Colophon

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Partners

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