



**Innovative Urban Watersystem**



# Colofon

**PROJECT TITLE** Hanging Water Tank

**STATUS** Final version

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**PRODUCT DESIGN** Green Art International

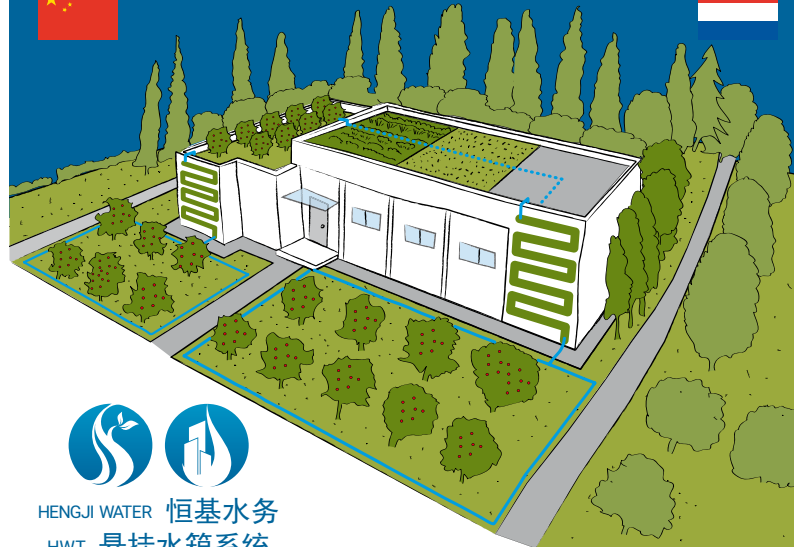
**VISUALIZATION** ZNdesign, Eerbeek NL

**LAYOUT** AMGdesign, Deventer NL

## 中荷大连HWT海绵建筑研究示范项目

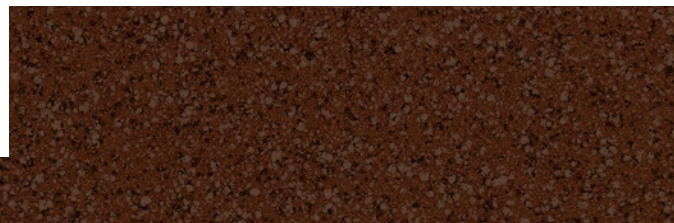
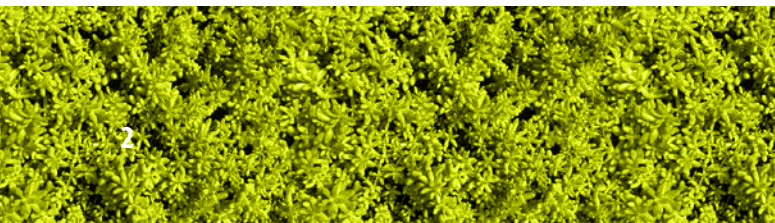
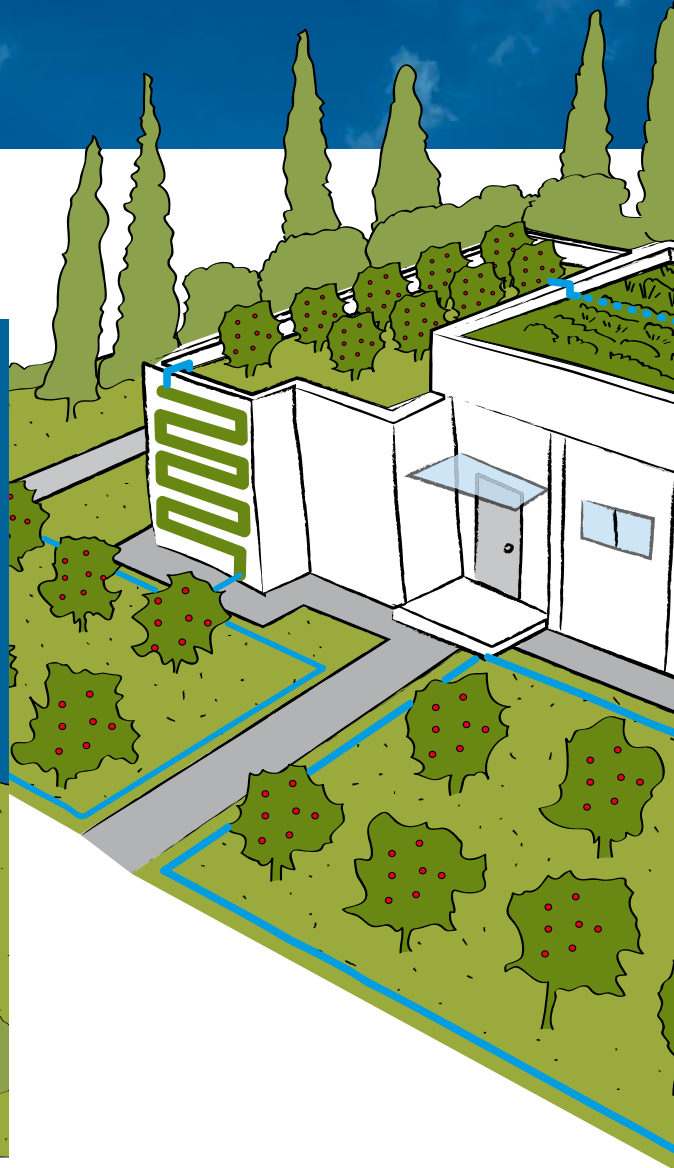
The Demonstration Project of Sino-Dutch Dalian Sponge Building Research

本项目的研究旨在通过HWT建筑物屋顶和墙壁的“海绵”设施留存并再利用雨水，提高建筑物的保水能力，恢复城市的水资源平衡，减少洪涝灾害，补充地下水，防止海水倒灌，减轻污水处理的负担，节约并再利用宝贵的淡水资源，保证城市水资源的良性循环。HWT海绵建筑技术还可有效改善城市空气质量，降低建筑物的温度，减少城市“热岛效应”和噪音，增加生物多样性，改善城市空中景观。“生态、环保、绿色、节能、低碳”的HWT海绵建筑技术愿为中国“海绵城市”的发展贡献力量，让城市生活更美好！



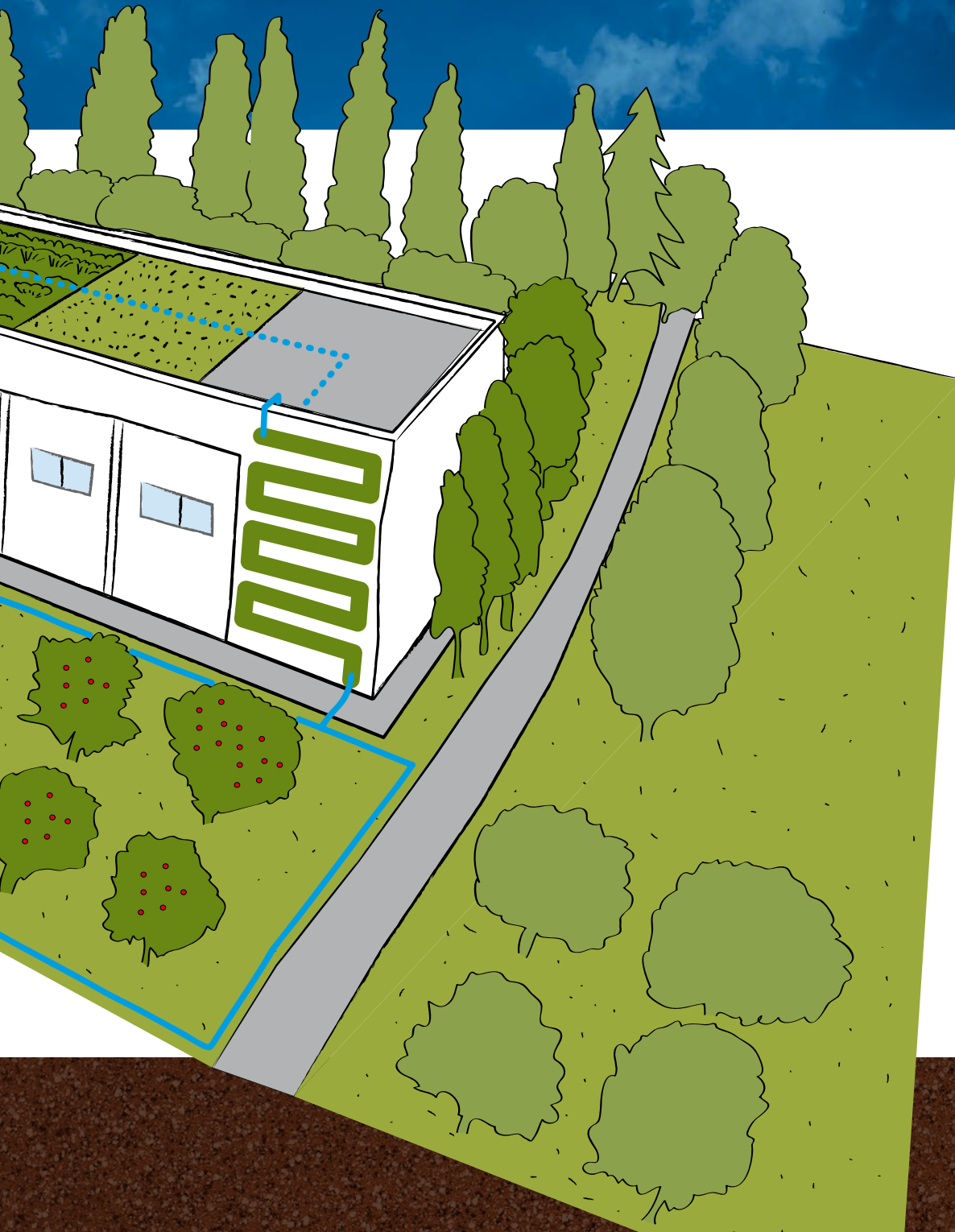
HENGJI WATER 恒基水务  
HWT 悬挂水箱系统

Purpose of the project is to retain and reuse the rain water through HWT sponge facilities on the roof & wall of building. It should raise the capacity of building water retention, restore balance of water resources, reduce flood disaster, prevent pouring backward from salt water, reduce the burden of sewage treatment, save and reuse the precious sweet water resources, guarantee the positive circling of city water resources. HWT sponge building technology could also improve the city air quality effectively, reduce temperature of the building, City Hot Island Effect and noises, increase the diversity of biology, improve landscape of the city. "Ecological, Environmental, Green, Energy saving and Low carbon" - The HWT Sponge Building Technology would like to make contribution to the development of Sponge City of China, Better City, Better Life!



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# Introduction: the city as a living system

Cities are not only manmade constructions of concrete and asphalt, they are also the natural habitat of men. As large urbanization ambitions come together with meteorological, environmental and health challenges and shortages in the water supply, it is essential to be engaged on cities that provide a safe and healthy place to live in. Regarding the city a living system provides the strategic view to urbanism that can help resolve major city challenges.

Whether there is a surplus, with heavy showers, or not enough, with droughts. Whether it comes in the wrong places, with floodings, or it doesn't have the right quality, with salinization of the ground water: water management in a defensive way is in the best case expensive and sometimes even dangerous when regarded only engineer's business in a manipulatable world and a mainly paved dense urban area.





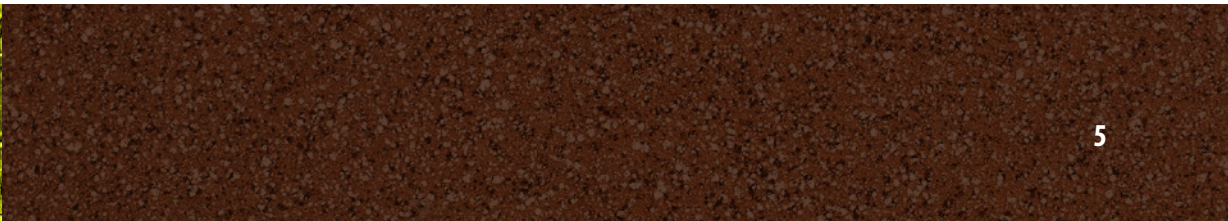
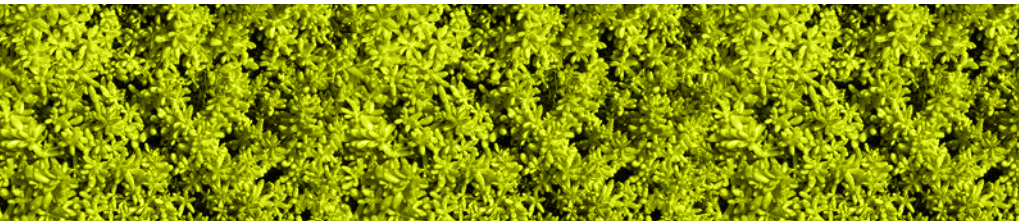


## Introduction: the city as a living system

What do living organisms do to survive? First, as moving is not an option in case of a city, adaption to the situation is the thing to do. Second, use what is provided, in example the existing natural surroundings and the sweet water that comes down for free.

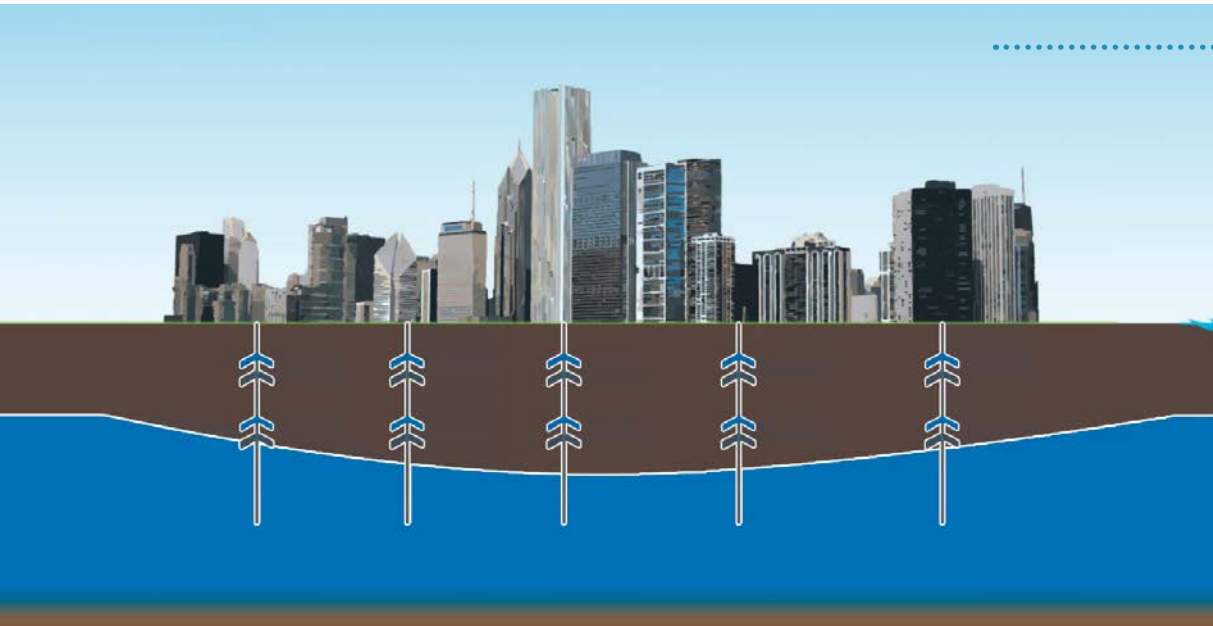
Regarding the city a living system makes you wonder why a scarce resource such as potable water is excreted without use. That is what we use to do when it comes to the engineering of the city water system. We drain it as soon as possible, regarding it a potential threat. And in doing so, the water in fact becomes an enemy instead of a necessity of life.

This document explains how the entire urban water system can be improved by using these innovations. Then the products and applications of the Hanging Water Tank are illustrated and its advantages for city, building and people are listed.

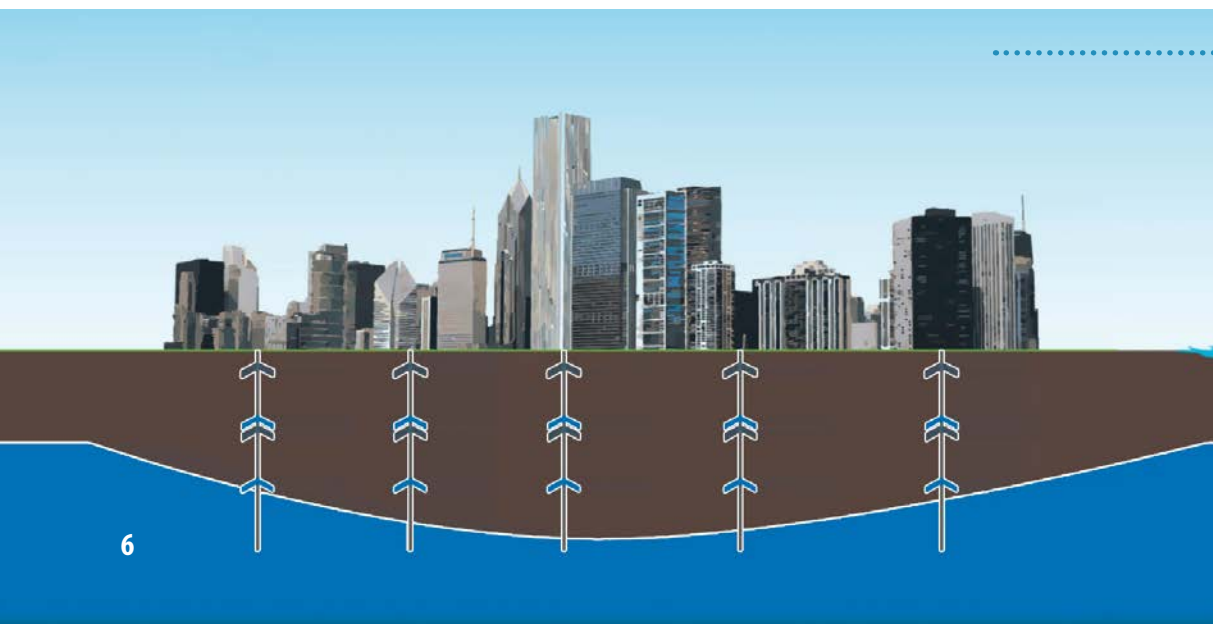




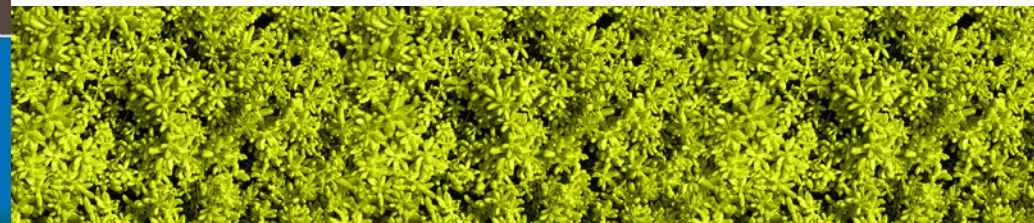
# Ground water management: challenge...



What usually happens in a densely urbanized situation? Sweet ground water is tapped to be used as drinking water. In a natural situation rain water would restore the ground water level, but in case of densely urbanized land, infiltration of surface water is nearly impossible. Rain water from roofs and paved surfaces is drained out of the city. This prevents the rain water from seeping into the soil, restoring the ground water level.

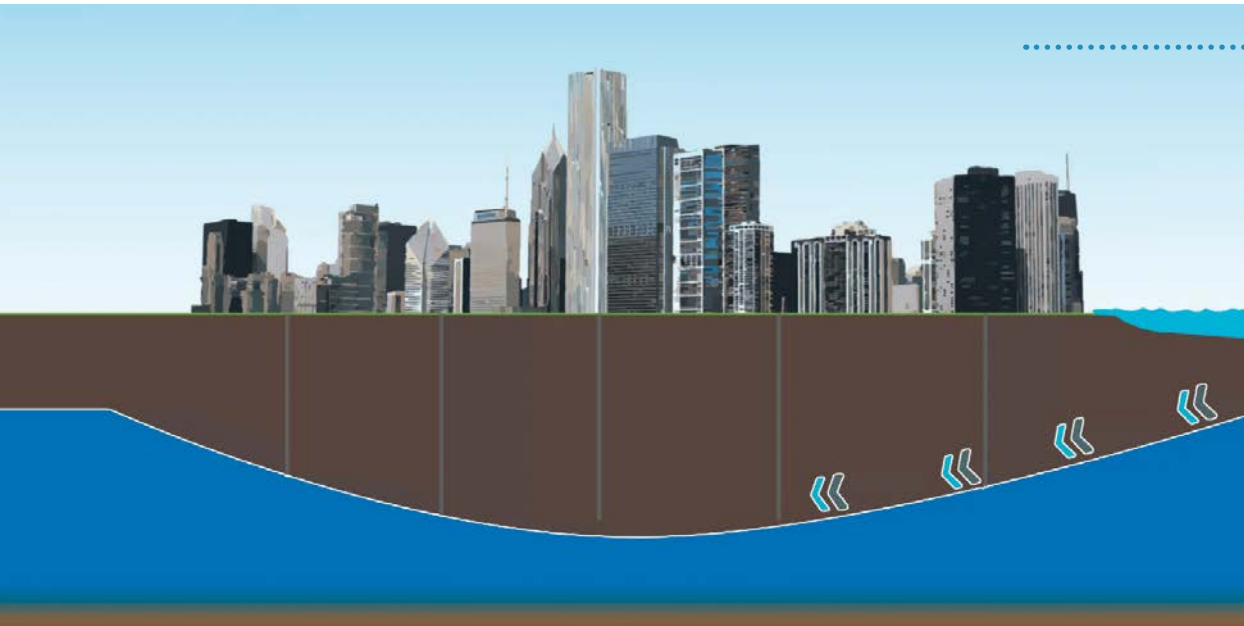


In dry periods this process even strengthens because the ground water is also used as a source to irrigate the vegetation. As the tapping causes descending of the ground water level, city vegetation will decline because the roots cannot reach the water by themselves anymore. So additional irrigation is needed to keep the city's green spaces alive. This irrigation is supplied with tapped ground water, which increases the sinking of the ground water level.



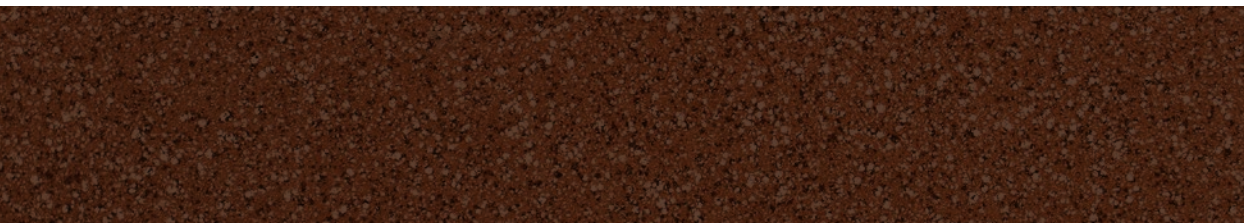


# Ground water management: challenge...



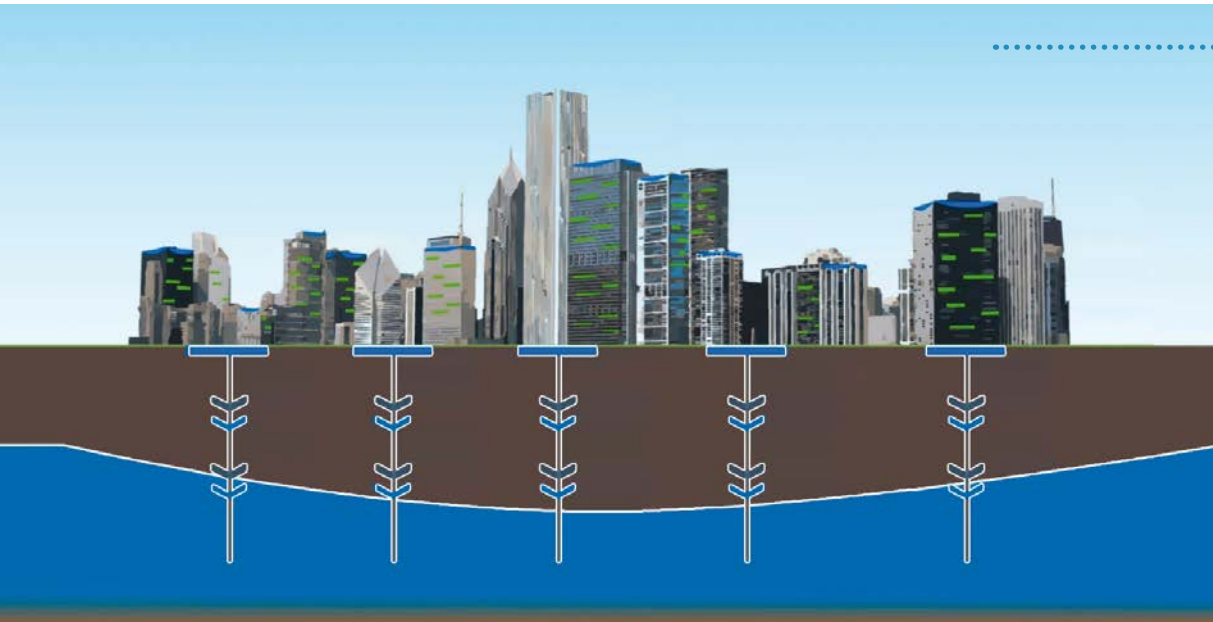
If the city is located near the coast, the ground water moreover tends to salinize. Sea water flows into the soil, to fill up the underpressure caused by the pumped out sweet water. This process causes pollution of the ground water, which makes it useless for irrigation purposes. Expensive desalinization measures are needed to make the water drinkable. The growing of any vegetation is only possible with irrigation water brought in from elsewhere.

**How can we prevent this major city problem, that damages the self-sufficiency of the city water system and as a result threatens the independency of the city?**

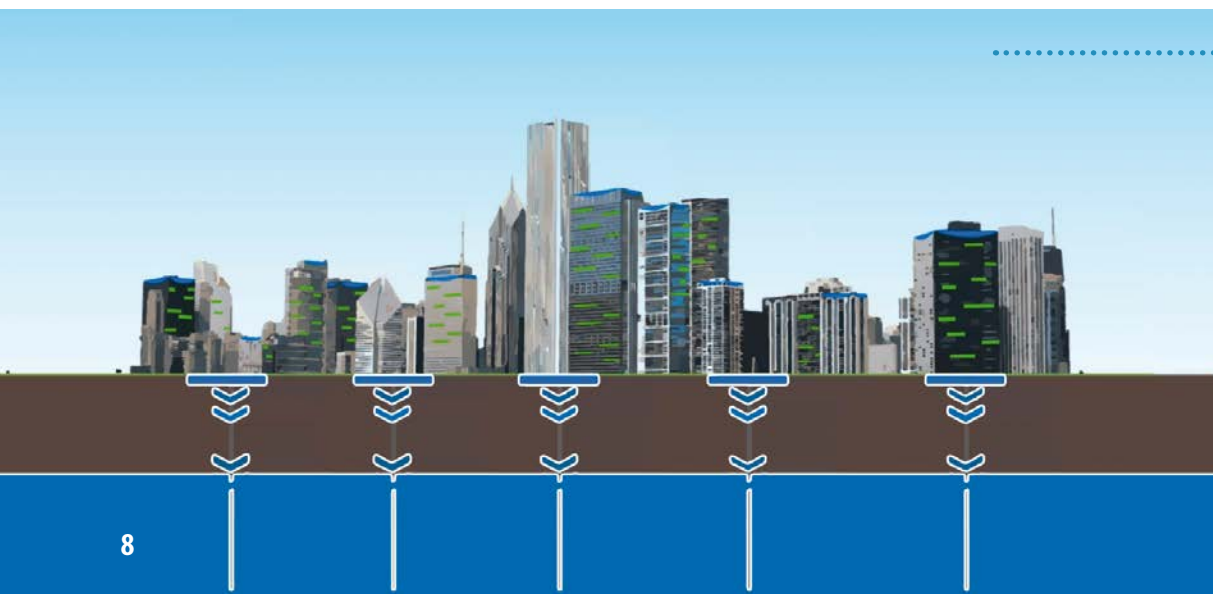




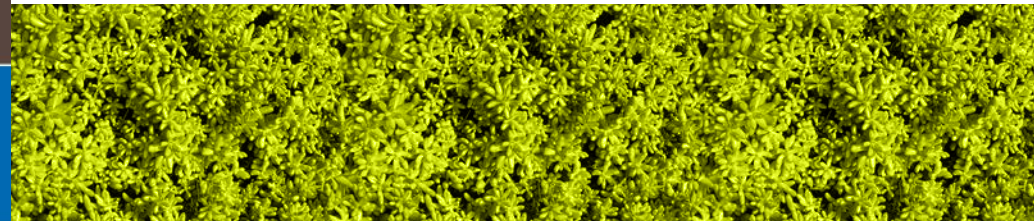
# Ground water management: ...and solution



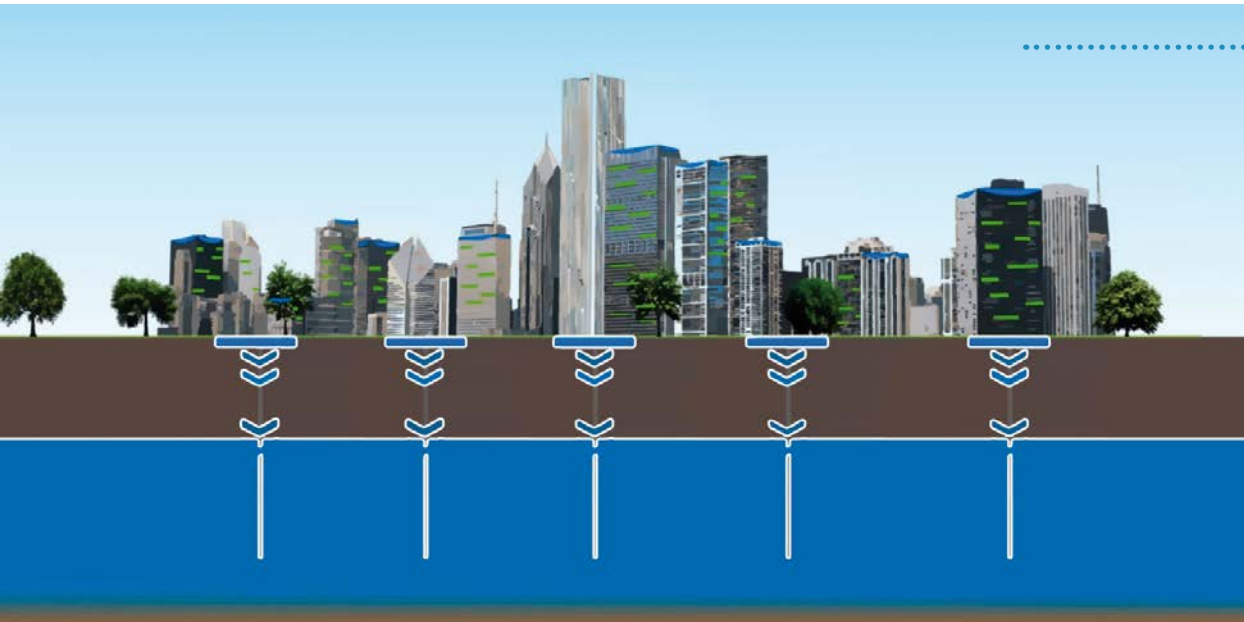
If the buildings in the city are equipped with the Hanging Water Tank and Skin Roofing, rain water is collected in the urban system itself. The water is stored upon the roofs and in green building facades and can be released whenever it is wanted. This opens up new possibilities for the people to use rain water where usually ground water was applied. This makes the tapping of ground water superfluous.



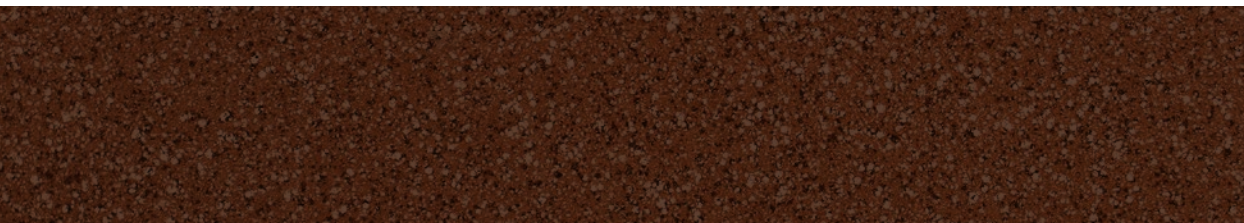
On top of that, modest measures at street level provide the possibility of rain water infiltration. Controlled infiltration of the rain water in the city soil comes close to the natural situation of the unused land. Now the ground water can be replenished. Continuing recuperation of the water can even restore the natural ground water level.



# Ground water management: ...and solution



In the ideal situation a new state of equilibrium is obtained. Rain water is collected and used in the city and its soil. The ground water level has returned to its natural state. And the city vegetation can reach the ground water and can grow and bloom without added irrigation measures. The urban system has become part of and even contributes to a new natural situation.





# Explanation of the Hanging Water Tank

This innovative urban rainwater system contains the following structural elements, all explained in the following paragraph.

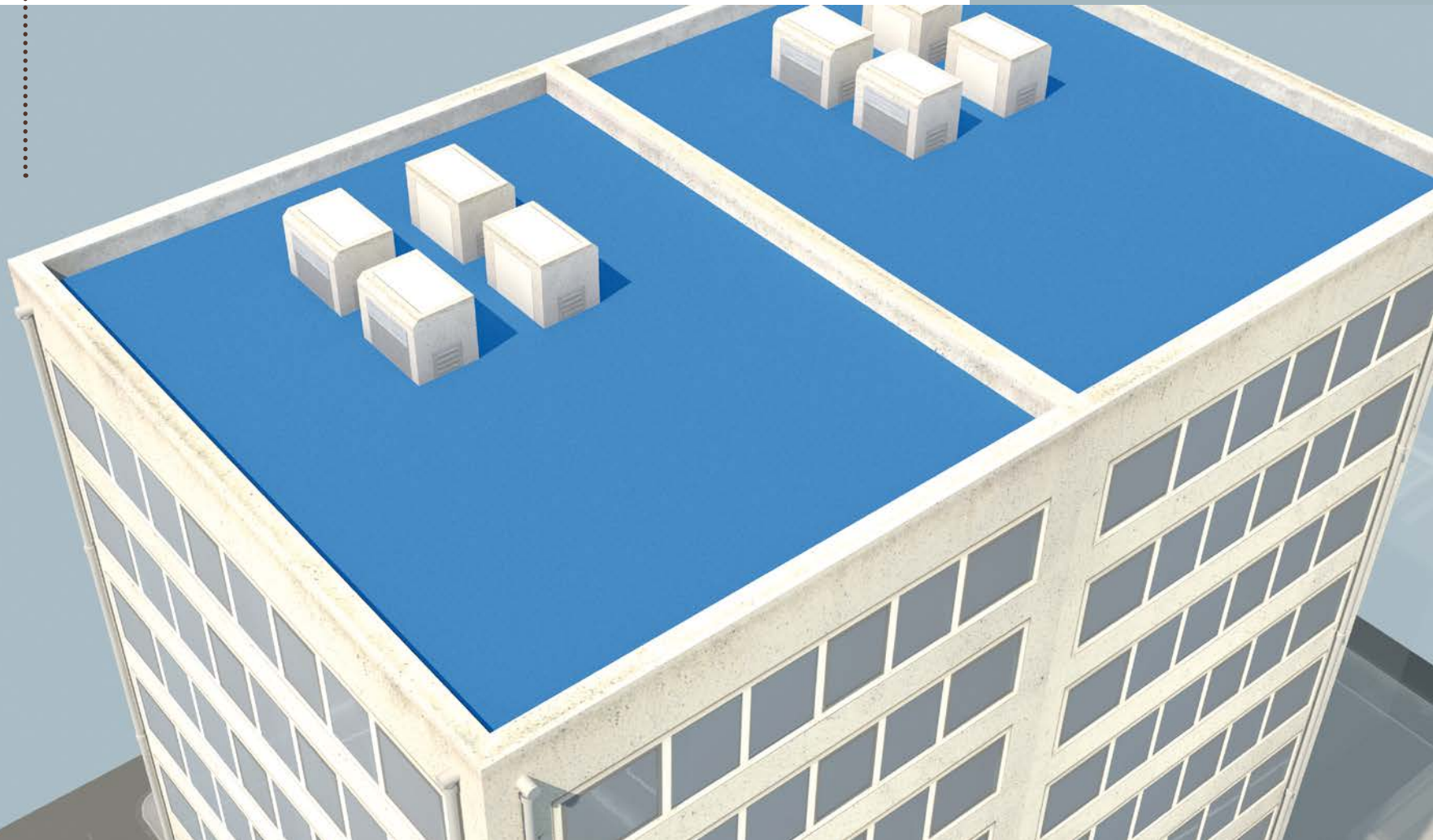
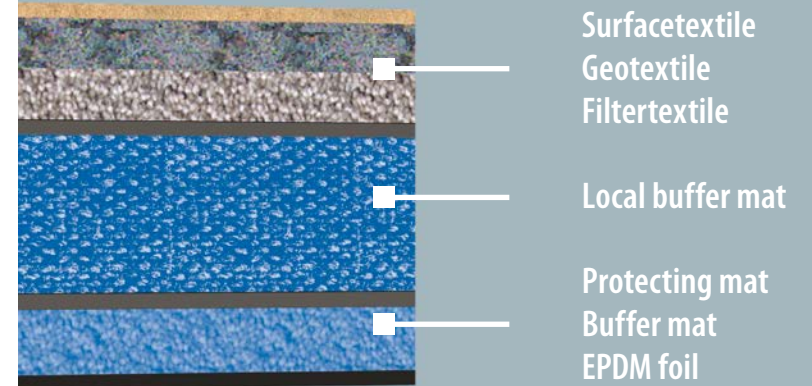
1. HWT Skinroof
2. HWT Roof Gutter
3. HWT Greenroof
4. HWT Hanging Water Tank
5. HWT Storage Tank
6. HWT Drainy Rain-pipe
7. HWT U-Block Wall
8. HWT Infiltration Unit
9. HWT Kerbstone
10. Wadi's





# 1. Skinroof

To store the rainwater right where it falls HWT Skinroofing, a patented roofing, covers the upper roof surface. In specially designed buffer mats up to 5 cm water can be stored. This corresponds to a buffer capacity of 50 liters per square meter. The water builds an isolation barrier for the inner temperature of the building. Especially in a tropical climate this decreases the use of air conditioners.

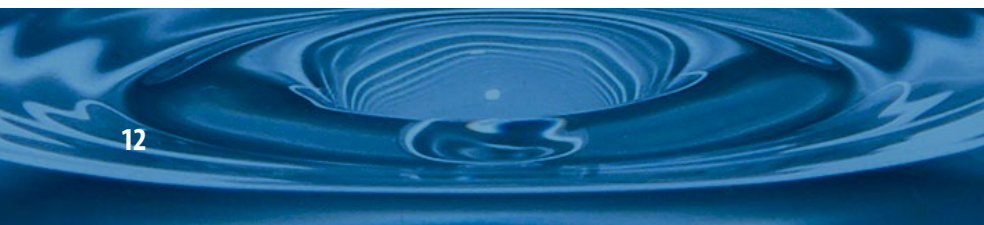
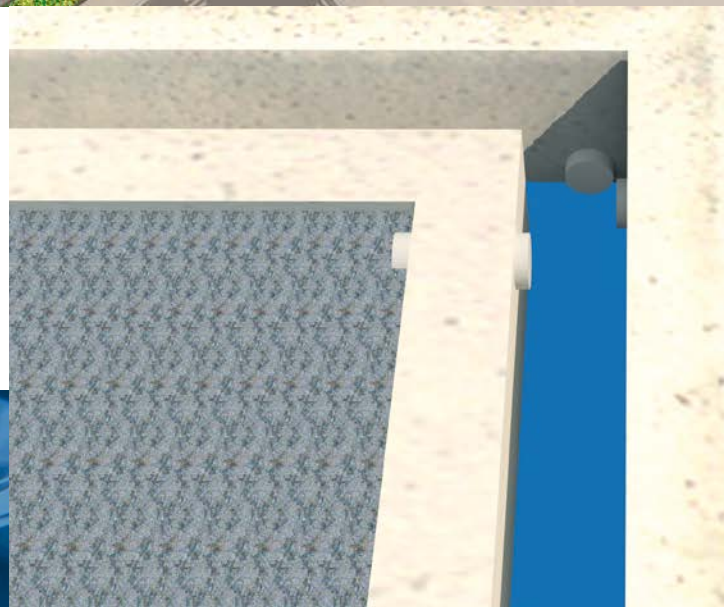






## 2. Roof Gutter

The HWT Roof Gutter keeps the water in place and, in case of heavy showers, prevents an overflow of the roof. A floaters detects the water level and opens the valves to the HWT Drains Rain-pipes if necessary.

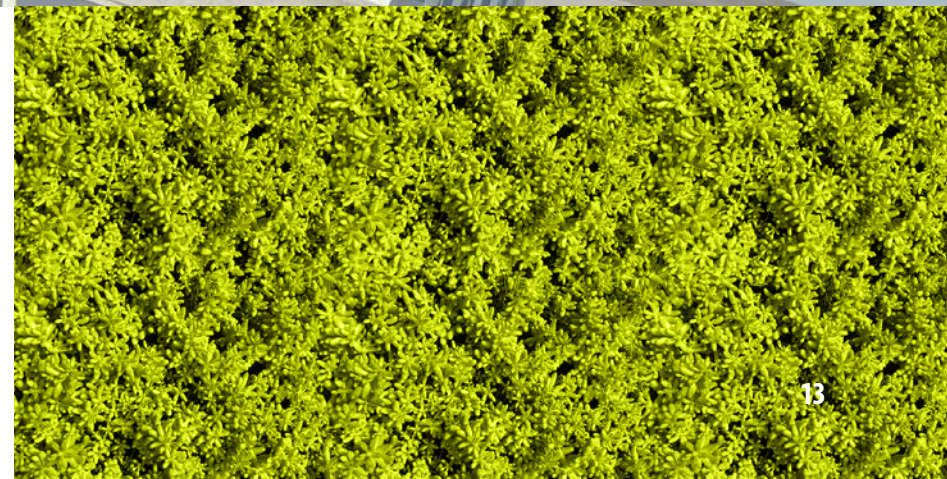






### 3. Greenroof

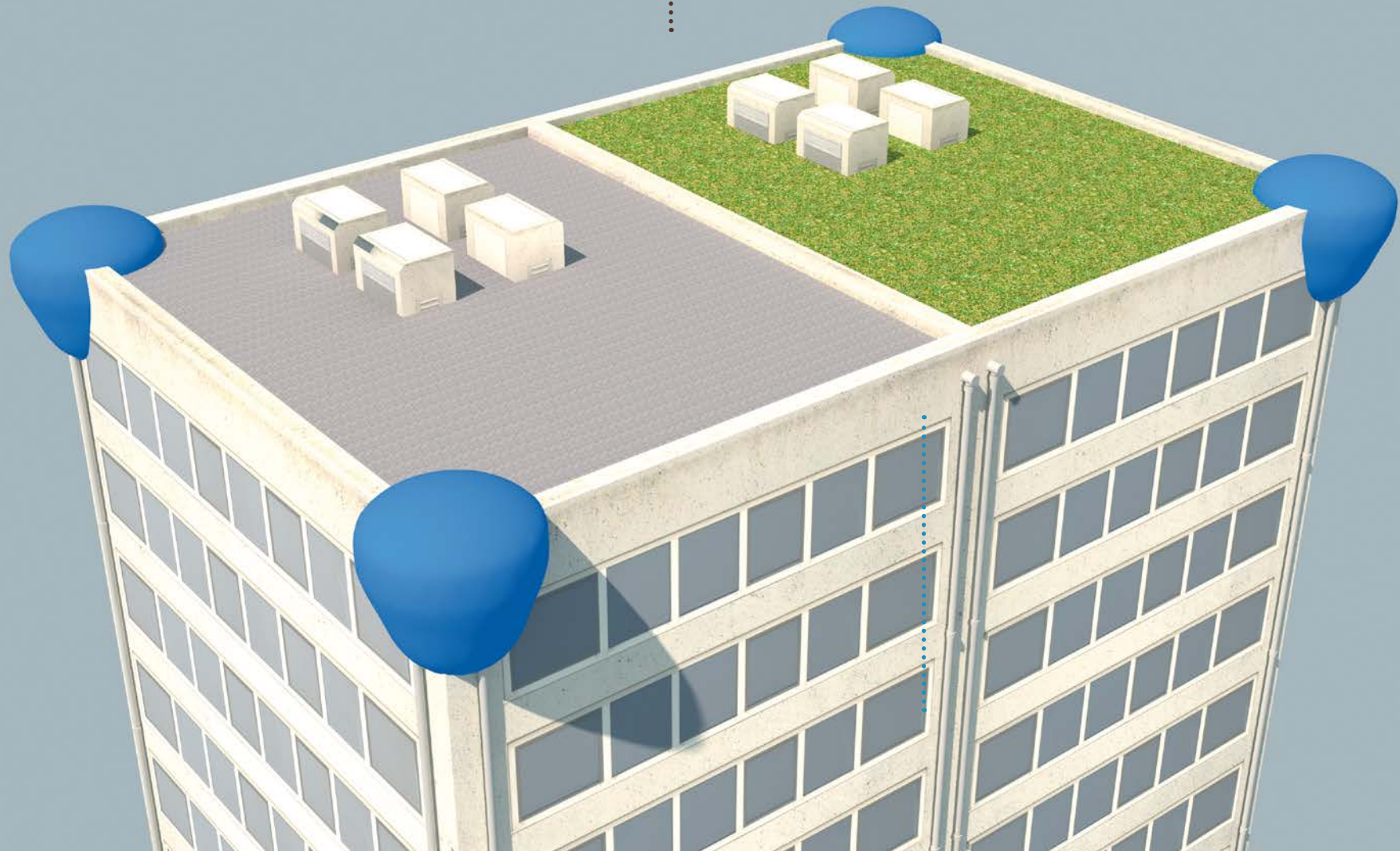
In high-dense urban areas a green roofing is an attractive alternative. Although the capacity of the water storage is little less, HWT Greenroof has multiple advantages. It provides the surroundings with a better view, combined with other functions and added ecological value. The purifying power of the vegetation contributes to a cleaner air.



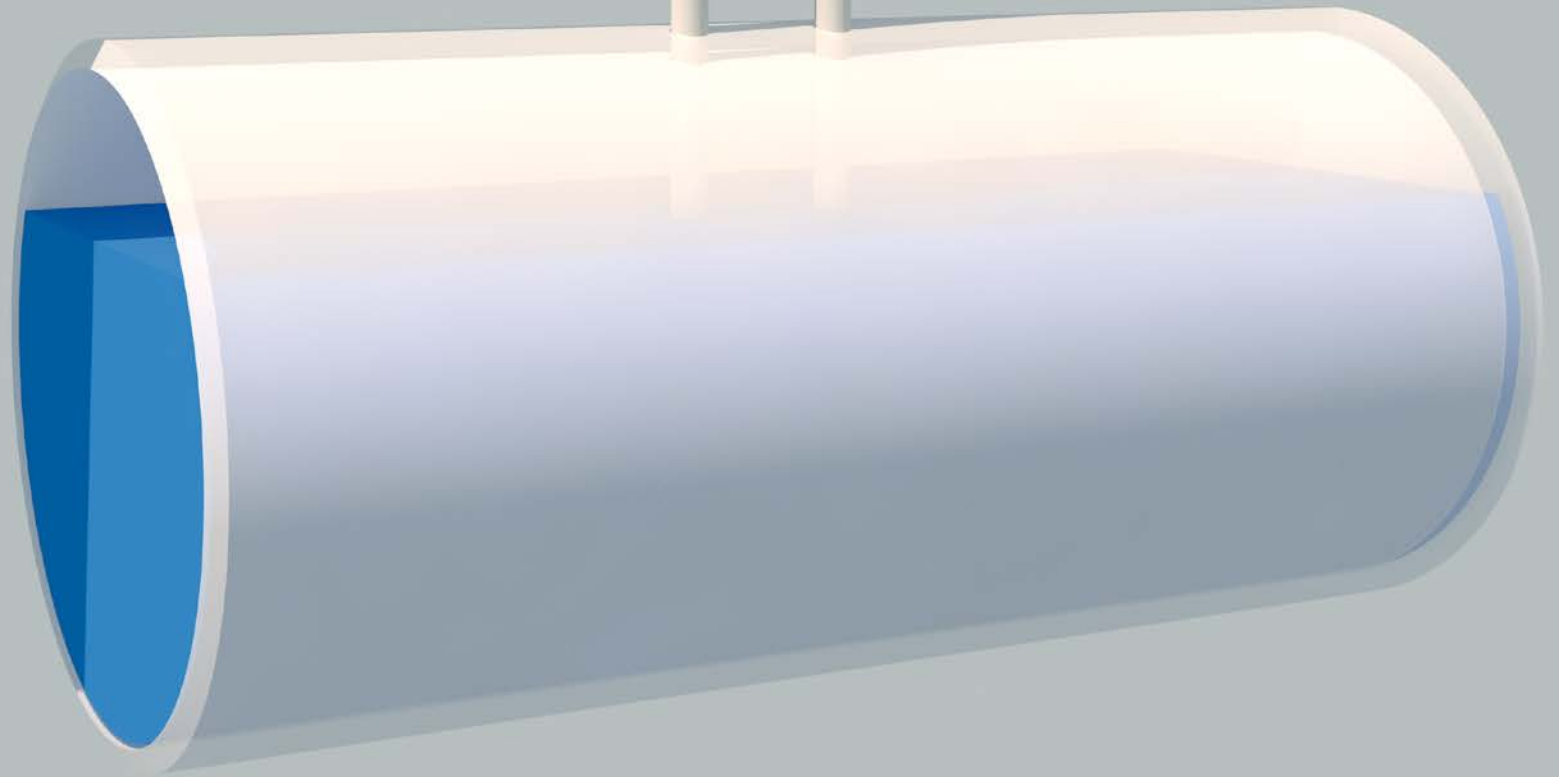


## 4. Hanging Water Tank

An even bigger storage capacity is provided with the Hanging Water Tank. Heavy showers don't lead to water trouble, they just fill up the tank. This keeps the water under pressure where it fell: up above, available whenever it is needed.







## 5. Storage Tank

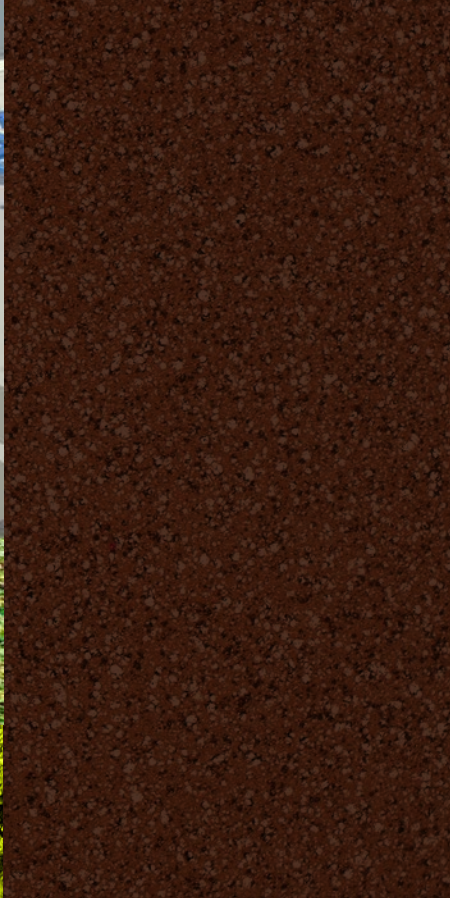
Of course not all the rain falls on roofs. To collect rain water from the streets complementary storage capacity can be found underground in the HWT Storage Tank. There it can be kept until it is needed.





## 6. Drainy Rain-pipe

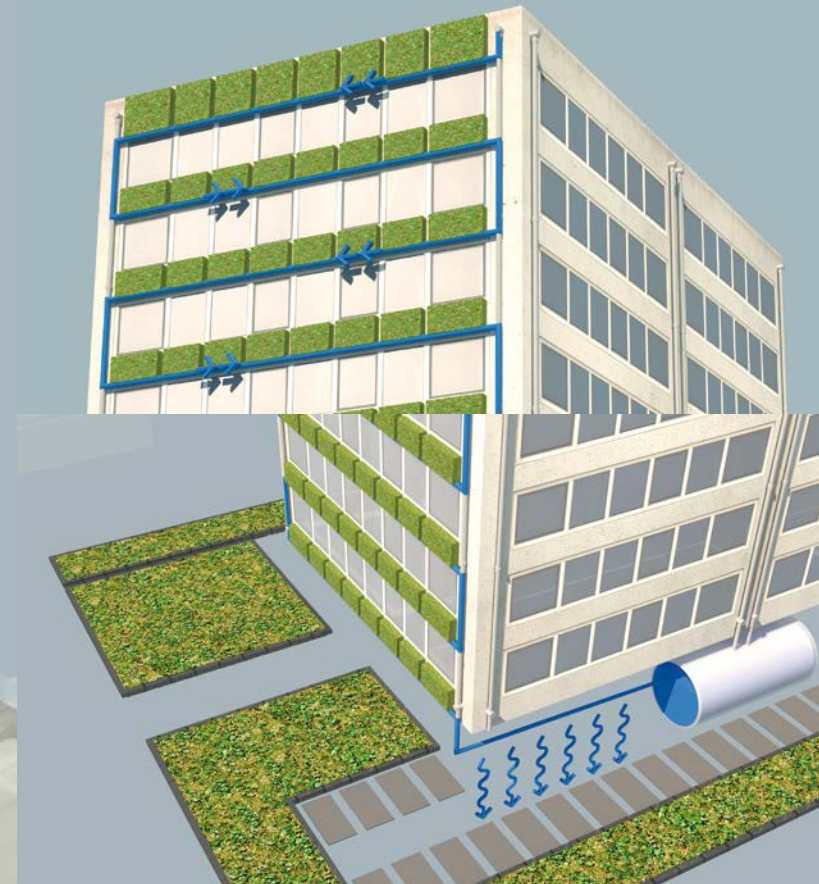
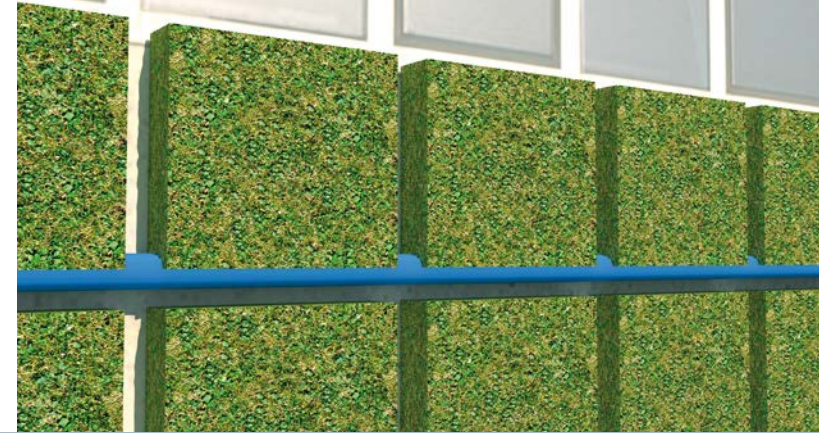
The water flows down to the ground through a smart rain-pipe, with the down side closed by a valve seal. This keeps the water within the pipe, using the pipes as storage capacity, and opens up when the water pressure gets too high. Thus the HWT Drainy Rain-pipe with cut-off, increases the storage capacity of the building and gives control about the timing and dose of the outflowing water.



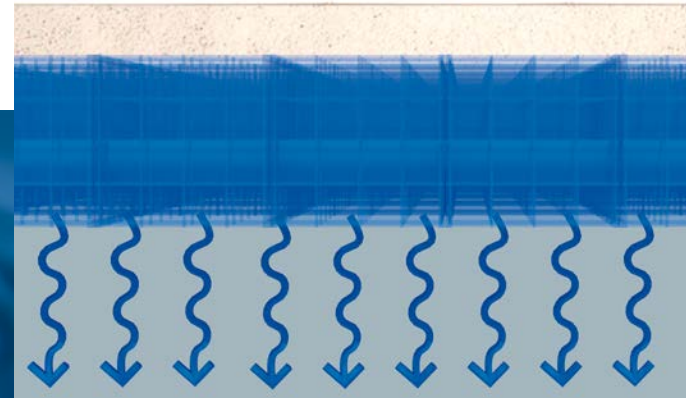
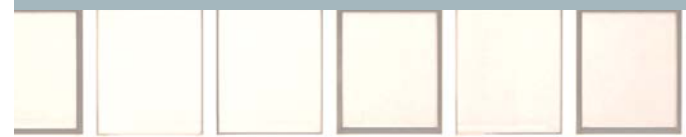
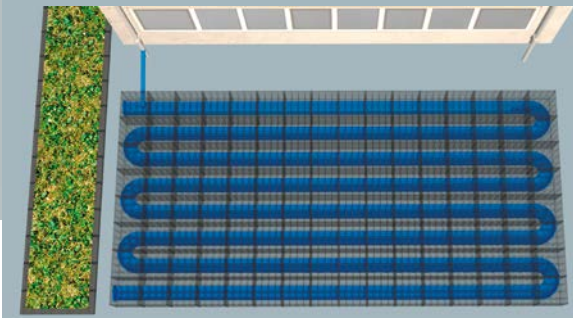
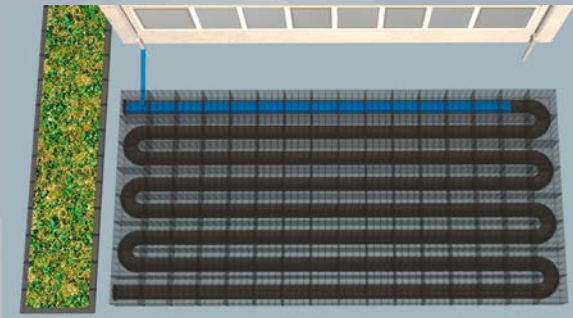
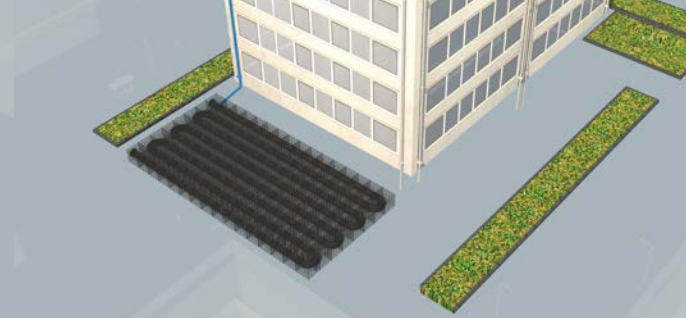
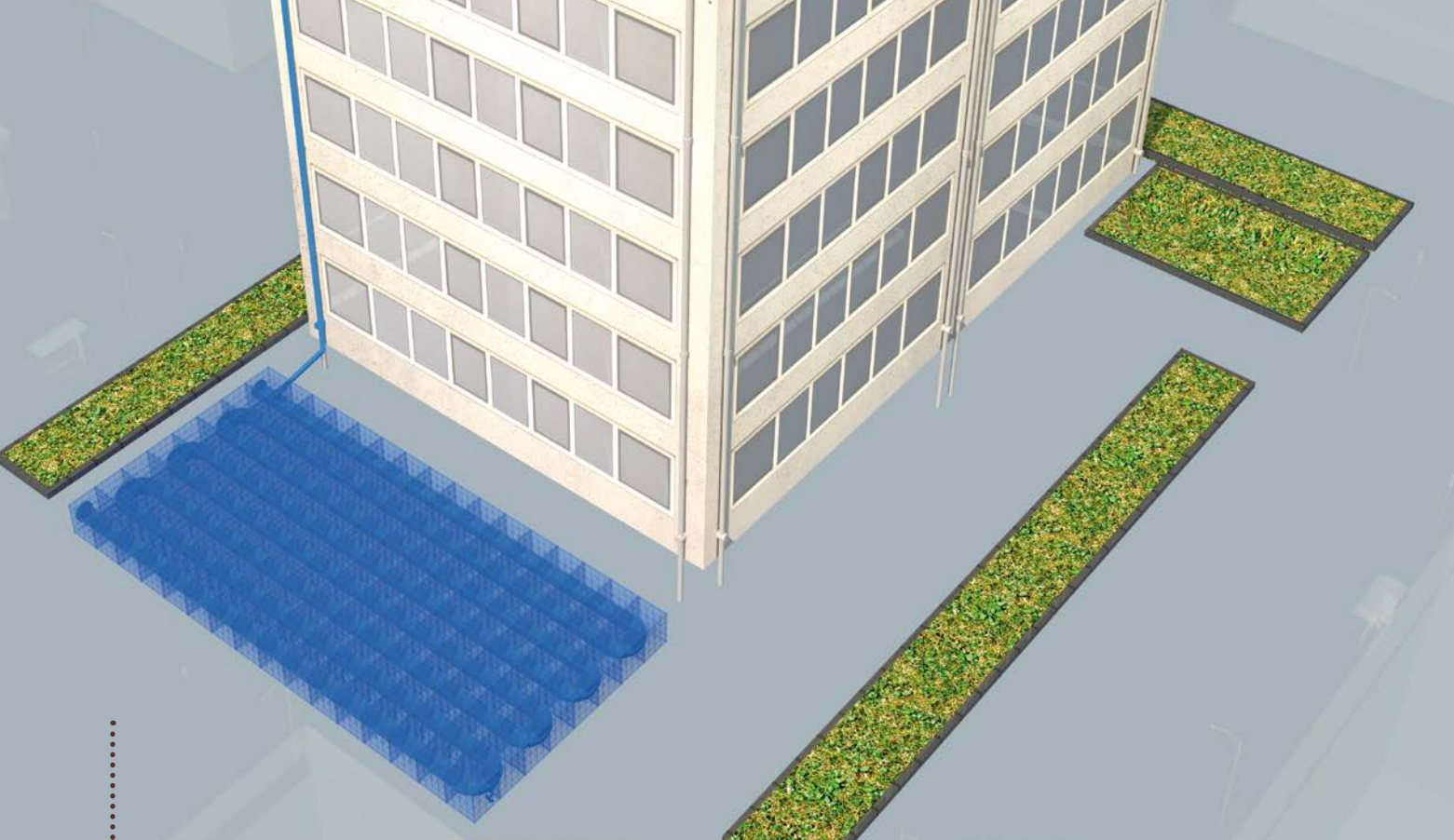


## 7. U-Block Wall

With HWT U-Block Wall elements the roof water system can be combined with a grown over facade. The water is conducted slowly through the blocks, providing storage capacity and irrigating the facade. As the elements are made of capillary material, the facade has a constant humidity, also in perpetual drought.







## 8. Infiltration Unit

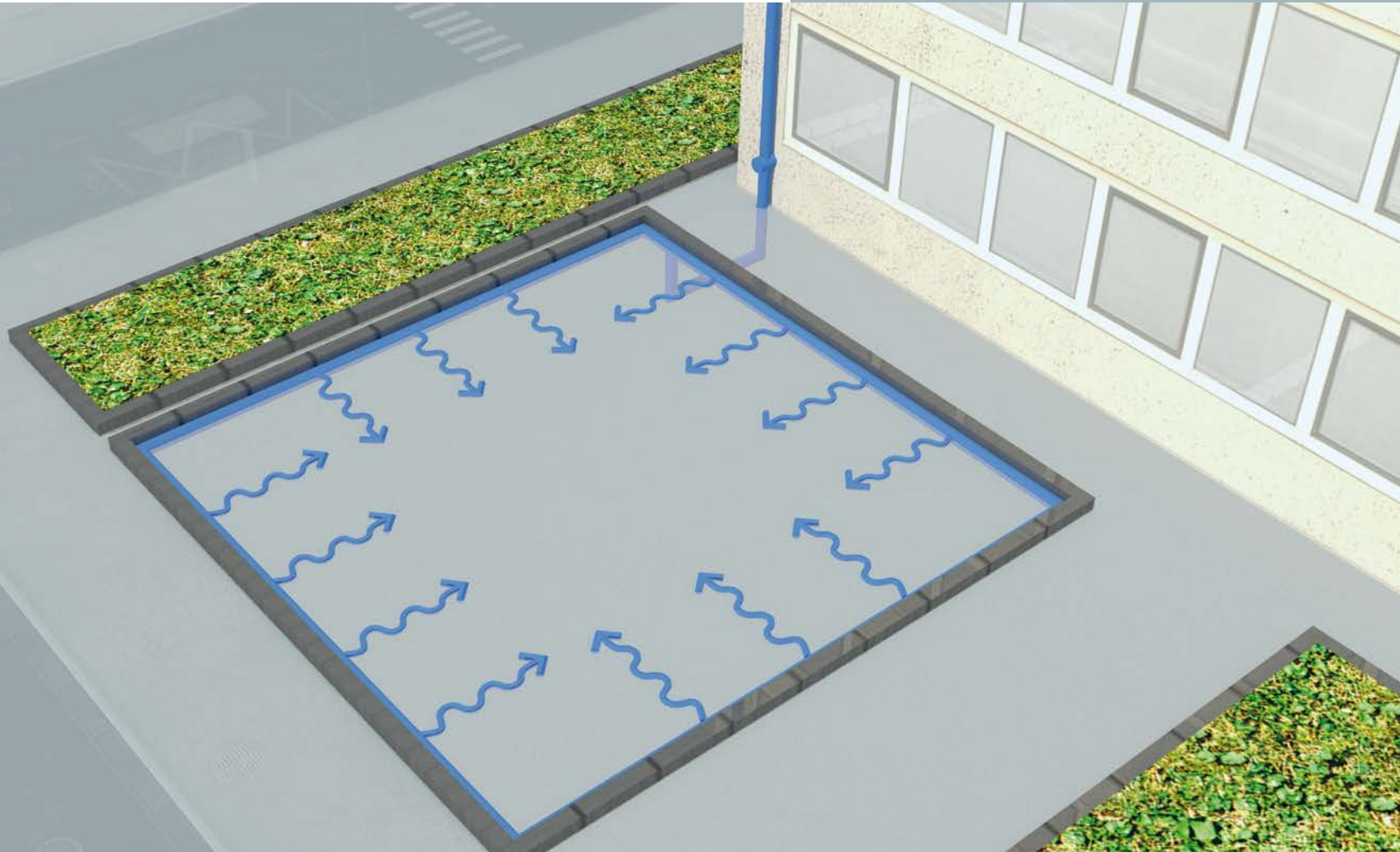
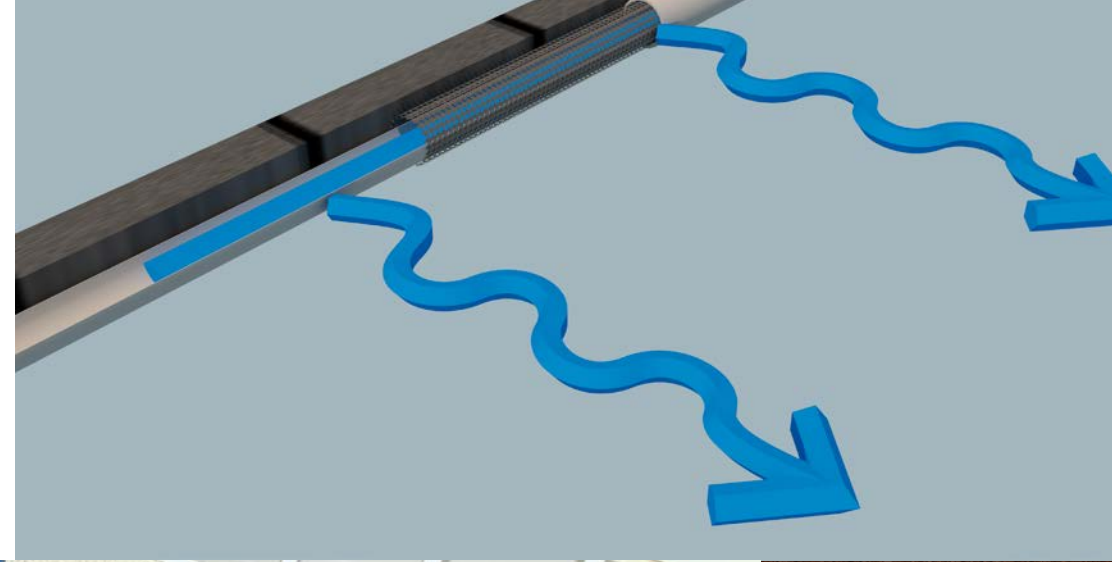
Once down at ground-level there are several possibilities to store and infiltrate the water. In a densely urbanized area the HWT Infiltration Unit saves space. The elements collect the water and infiltrate it slowly in the soil. The storage unit can be installed under a parking lot or playground of any size.



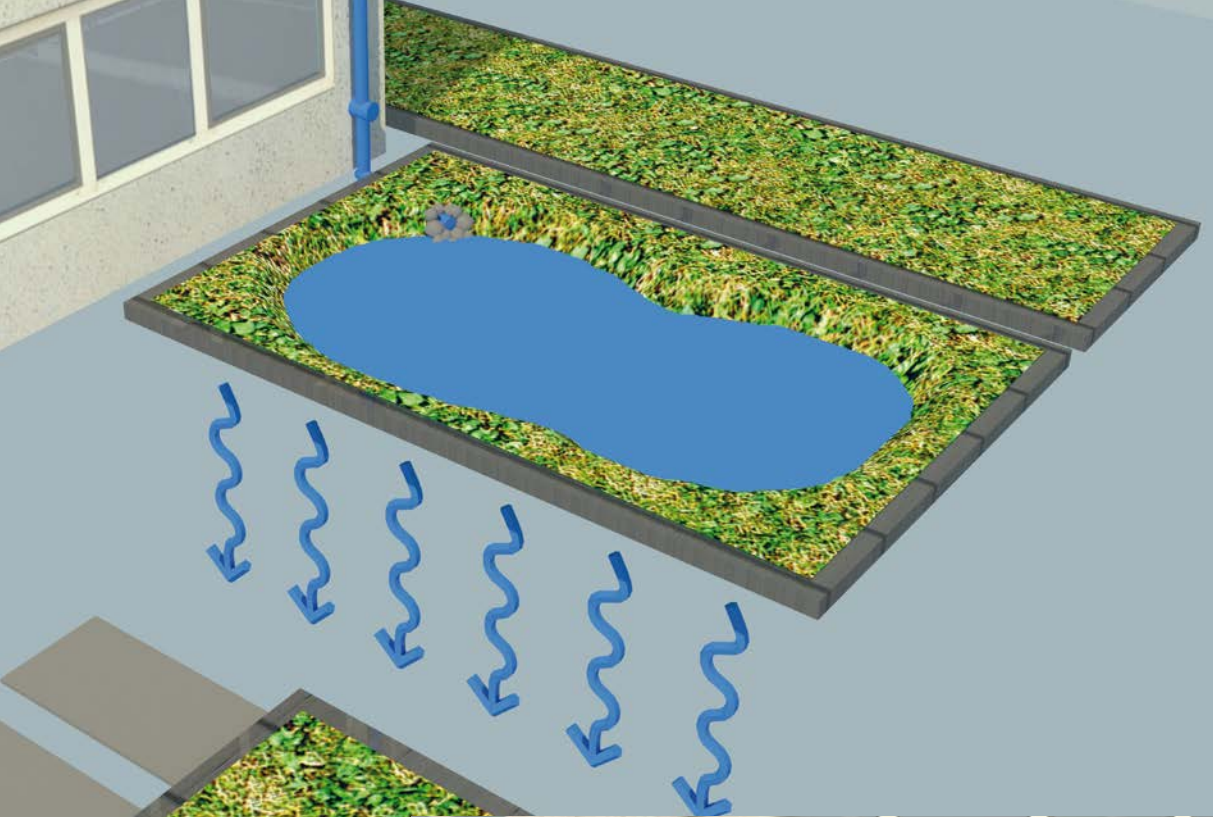


## 9. Kerbstone

Due to the pressure in the HWT Drains Rain-pipes, HWT Kerbstones conduct the water to a green area with a ground level higher than its surroundings. There the water is flown out to irrigate a surface that would suffer drought otherwise.







## 10. Wadi's

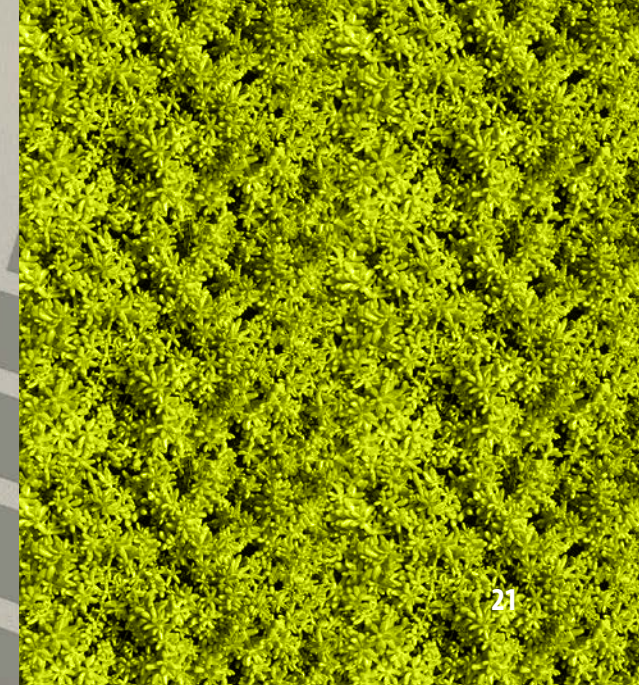
When there is enough space at ground-level, water collected in wadi's contributes to a green atmosphere and quality in urban space. From the wadi's it can seep into the soil in a natural way.





# Applications of the available water

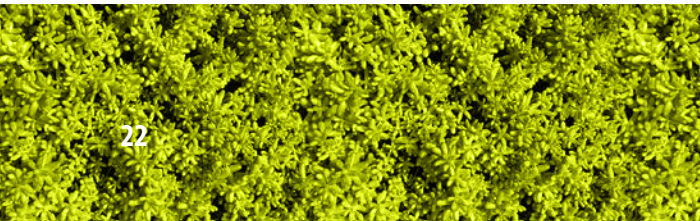
Upon the roofs of the city the rain water is stored under pressure. Influenced by gravitational force it can be conducted anywhere the people of the city can use it. This will save a lot of precious drinking water. A few examples of the endless possible applications are: car wash, sprinkling of vegetation zones, cooling water in industrial processes, a city square fountain and flushing of streets.



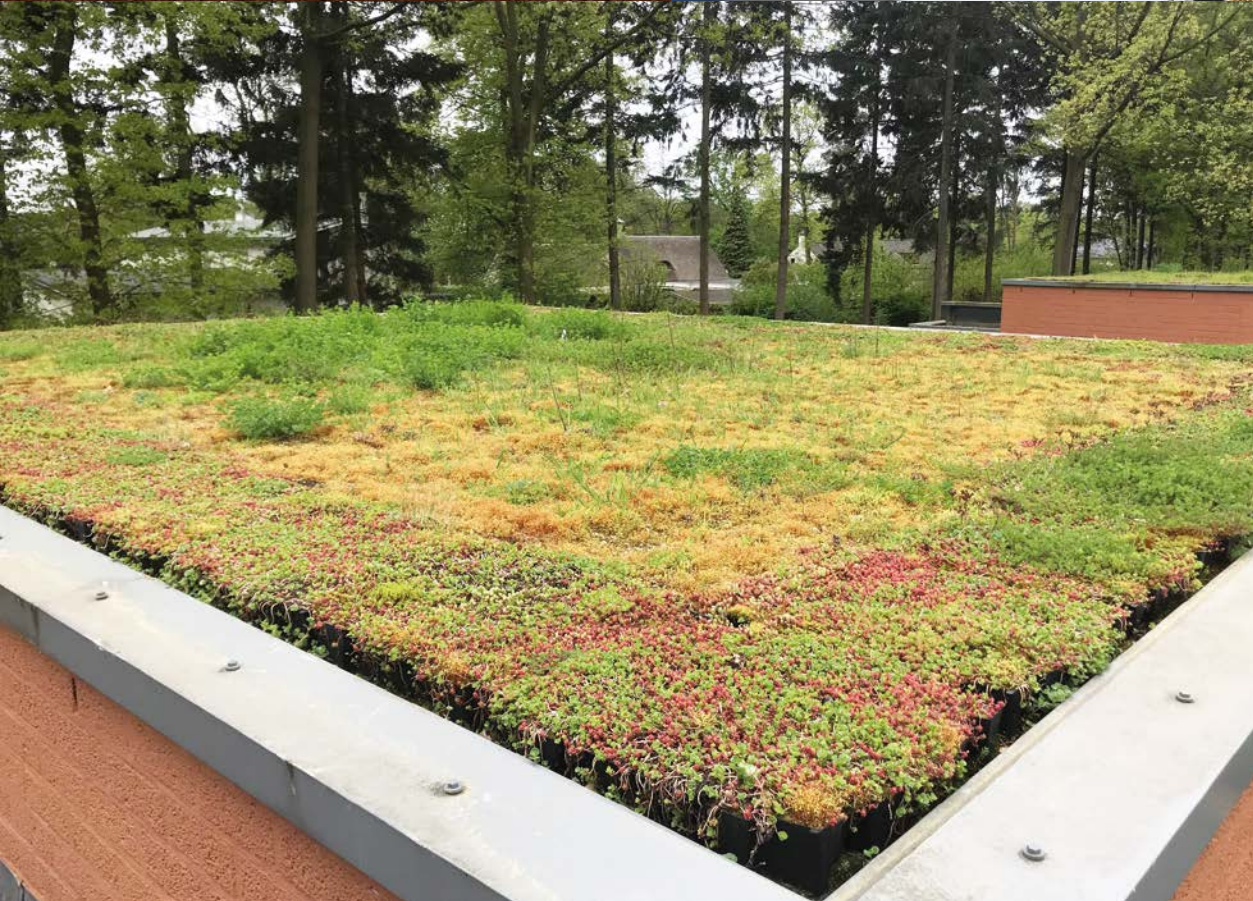


# Sponge building Mutsaers foundation Venlo

In 2016 and 2017 the Hanging Water Tank system was applied upon several roofs of the Mutsaers foundation in Venlo. Here the roofs are covered with Bees & Butterflies vegetation mix, to attract insects. The roofs do not only collect rain water. They contribute to the local biodiversity and a beautiful scenery as well.









# Sponge building Plinthos Sweikhuizen

Hanging Water Tank was also applied in the location of Mutsaers foundation, Plinthos in Sweikhuizen. At this location a choice was made for a green roof system with "Sedum Boxes". This is an uncomplicated system in which all parts of foil, substrate and plant mix are incorporated in a basket and fixed on the roof in a windproof way.

The boxes are hooked together and can quickly be mounted on the roof. The system is easily replaceable and interchangeable and has plenty of good combination options with, for example, solar panels. Soon the construction of the green façade will start, which will further complete the system.









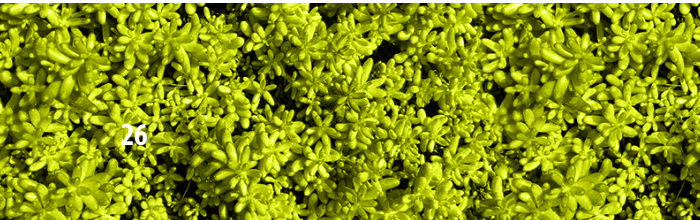
# Sponge building Dalian China

The first pilot of Hanging Water Tank in Liaoning, China was realized in Dalian, with subsidy from the Dutch government.

Hengji Water was the cooperating company that provided a roof for the innovative urban water system. This water treatment company is highly ranked in sustainability and wanted to be the first to have Hanging Water Tank on the roof.

The project started at the beginning of 2017. In April most of the construction works were done by Green Art International. All materials were supplied by local companies.

The rooftop was equipped with three samples of SkinRoofing. The first was just the plain roof with gravel, the second was covered with sedum plants and the third was overgrown with urban agriculture.







In this pilot project the following parts of the HWT-system were applied: SkinRoofing, in three different sections mentioned before, HWT-drainy rain pipe, and a green wall, supplied by Sempergreen. The eventually overflowing water irrigates the surrounding garden with orchards and viticulture. The whole system is equipped with measuring instruments, which can be supervised in the Netherlands via Wifi. The project opened at the first of June 2017 with a festive seminar.





# Advantages of the Hanging Water Tank



## City

- ▶ Less flooding damage, such as washed away roads and flooded cellars
- ▶ Less public space needed for surface water to retain rain water, the space is free for other public functions or allotment
- ▶ Higher economic values in the city, like productivity, health, real estate values, due to the examples mentioned

## Building

- ▶ Improved quality and sustainability of roofing
- ▶ Lower energy bills by decreasing use of airco and heater
- ▶ Lower bills for drinking water by increased efficient use of drinking water
- ▶ Higher economic values of real estate due to examples mentioned before

## People

- ▶ Better image of companies and governments by application of HWT



## Building

- ▶ Less use of airconditioning, due to the cooling effect of using water on the roof and the facade
- ▶ Less heating necessary due to extra isolation by water on the roof

## City

- ▶ Reduced use of drinking water for irrigation
- ▶ Less use of sewage system by rainwater
- ▶ Decrease of unnecessary water transport to and from sewage treatment plants

## Building

- ▶ Less use of drinking water by using water of roofs, which is stored under pressure. Intended use: industrial processes, cleaning and maintenance of terrains





# Advantages of the Hanging Water Tank



## City

- › Increased resistance of the urban system against flooding during heavy showers
- › Higher safety level underground, for example in tunnels

## Building

- › Increased fire safety by omnipresence of water



## City

- › Increased control of ground water level
- › Prevention of dehydration and improvement of retention capacity in soil due to control of rainwater drainage
- › Improved waterlevel control in rivers: rainwater can be used to raise the waterlevel and increase passing of ships



## City

- › Prevent loss of ecological values by overflow of polluted sewage water to surface water
- › Improve ground water quality, decrease pollution and salinization
- › City vegetation can grow the natural way, without additional irrigation
- › Increase biodiversity by improving the quality of vegetational areas

## Building

- › Intensive Green Roof provides a building with additional ecological value: the roof garden is a functional space



## City

- › Better air quality due to more vegetation in public space
- › Decrease of urban heat island effect

## Building

- › Better indoor environment.

## People

- › Less indoor outdoor temperature shocks by combination of decrease of urban heat island effect and reduction of airco use
- › Decrease of stress during heavy showers



# Advantages of the Hanging Water Tank



## People

- ▶ Visible water system has educational values
- ▶ Improved ambiance higher social security level by increase of public involvement in urban space
- ▶ Contributing to a sustainable way of living for the future of the world gives a good feeling



## City

- ▶ Increased amenity due to expanding natural areas in the city

## Building

- ▶ Intensive Green Roof and U-block facade offer extra spacial quality for the building: a roof garden is a new living area, the green facade increases the amenity of the building

## People

- ▶ Comfortable surroundings due to increased amount of vegetation in the neighbourhood



# In coöperation with

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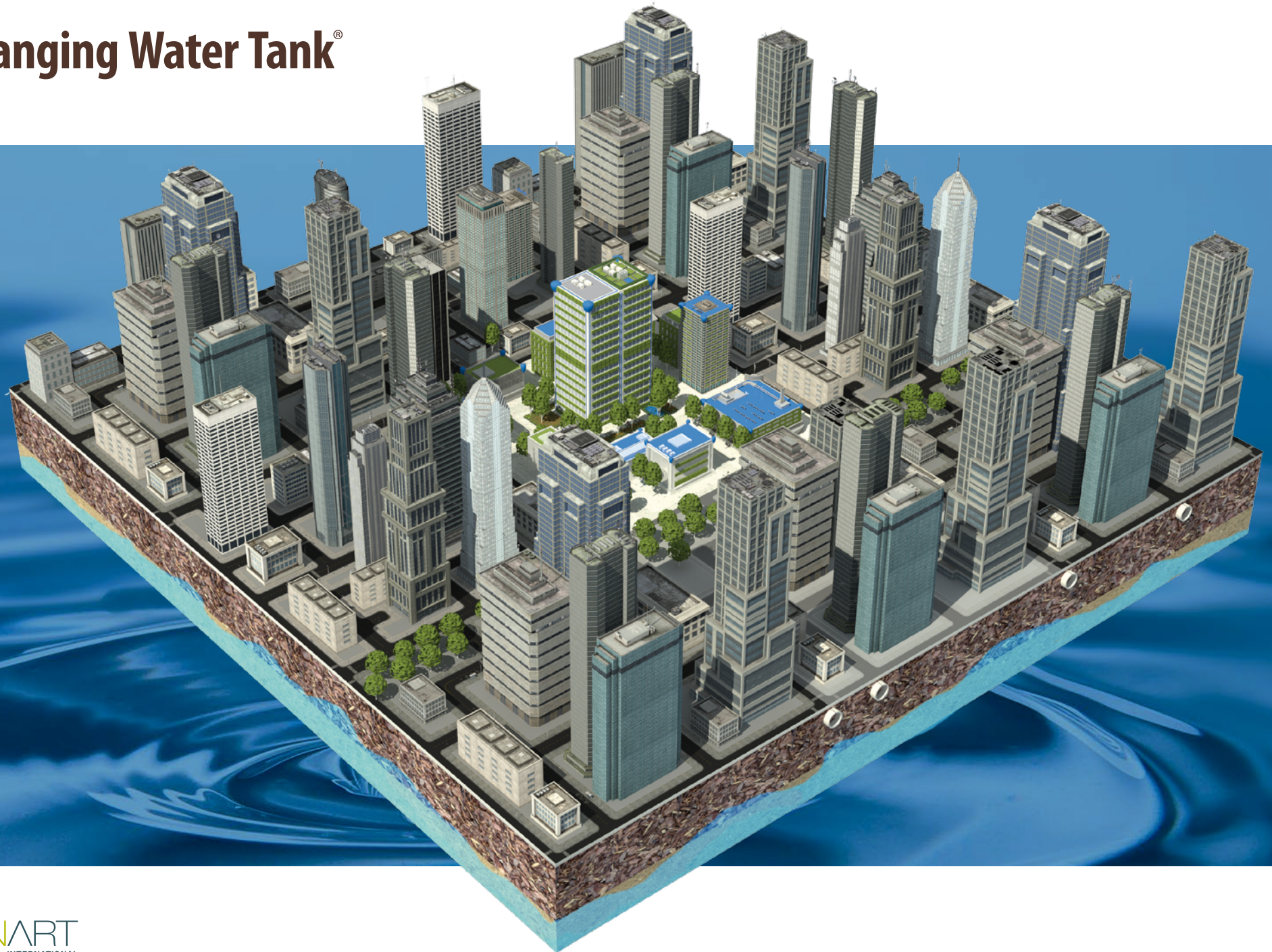
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