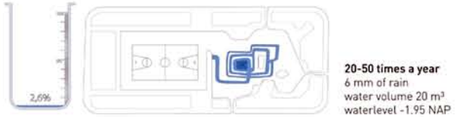
WATERSQUARES

The Elegant Way of Buffering Rainwater in Cities

New methods of dealing with increasing stormwater are currently being explored in Rotterdam where surplus surface water is stored in watersquares that are designed to flood temporarily.

regular rainfall
5 mm of rain
water volume 0 m³
waterlevel -2.10 NAP

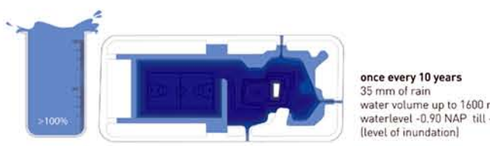


20-50 times a year
6 mm of rain
water volume 20 m³
waterlevel -1.95 NAP

10-30 times a year
7 mm of rain
water volume 75 m³
waterlevel -1.80 NAP

4-11 times a year
11 mm of rain
water volume 220 m³
waterlevel -1.65 NAP

once every 3 years
31 mm of rain
water volume 950 m³
waterlevel -1.05 NAP

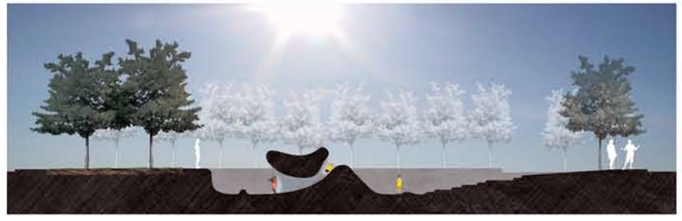


once every 10 years
35 mm of rain
water volume up to 1600 m³
waterlevel -0.90 NAP till -1.05 NAP
(level of inundation)

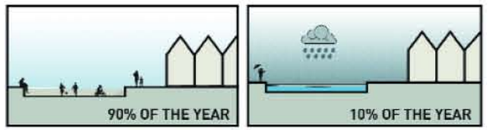
We are experiencing a change in our climate, and in the years to come heavy rainstorms will increase. This will become increasingly problematic since the city sewerage systems cannot cope with sudden amounts of water. Dense urban areas have too little infiltration space for heavy rainfalls, and the available space is either built up or intensively used and impermeable public domain. Parts of the city will flood time after time, causing nuisance and damage to public spaces and private properties. Many Dutch cities are particularly affected because they are situated below sea level; the water just cannot drain away. In cities such as Rotterdam this is a real and urgent issue.

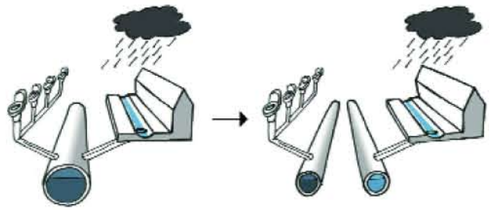
To solve this problem the city planners and engineers devised a water plan, which combines creating sufficient water storage within the city with improving the quality of public space. This so-called "Waterplan 2", has been official policy since October 2007. It implements a spatial strategy that relates the amount of space directly to the required amount of new water bodies that have to be built. In the outskirts of the city all new developments must be constructed with large water buffers. In the densely populated older neighbourhoods, as well as in the city centre, more compact solutions must be found. These range from large scale technical solutions to more aesthetic small scale interventions. At the moment, a voluminous subterranean basin for immediate sewage overflow is being constructed under the Rotterdam Museum Park. At the same time the city council has activated a subsidy plan that encourages individuals to create green roofs on their properties, in order to buffer stormwater before it reaches the ground. Here the buffering effect is limited, but the educational aspect is relevant. Finally, a solution has been found that buffers rainwater storage at street level: the watersquare.

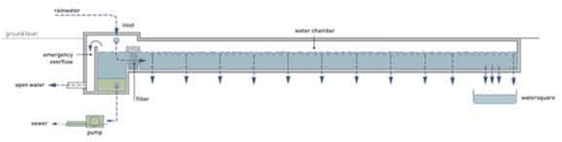
This solution, invented by De Urbanisten and Studio Marco Vermeulen, combines a technical engineering system with improvements to the quality of public squares. The idea of watersquare stems from our

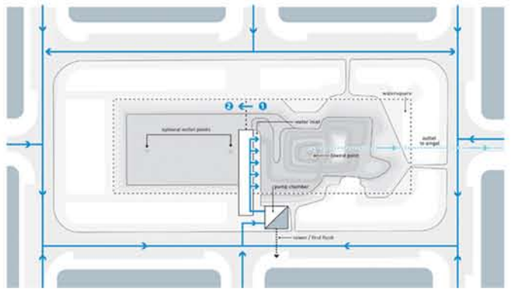


The capacity of the watersquare is related to the amount of rainfall. The diagrams on page 42 show different rainfall events. The image above illustrates the regular dry situation – a multifunctional public square and sports field for local residents.









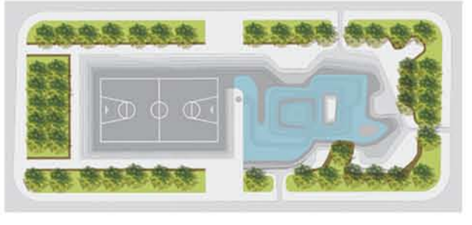
The watersquare requires a clean sewerage system of rainwater only, separate from black and grey water. The principle of water chambers and watersquares is described in the illustrations above.

desire, as spatial designers, to spend money for flood basins in a way that makes them spaces for people to enjoy. Most of these spaces can be effectively used as public open space. Only during heavy rainstorms is the space needed for temporary stormwater storage. Therefore, money spent on technical infrastructure can be turned into money spent on creating better spaces in the city. watersquares can be understood as a twofold strategy: firstly, it makes the money invested in water storage facilities visible and enjoyable and, secondly, it generates extra opportunities for creating environmental quality and identity in central urban spaces.

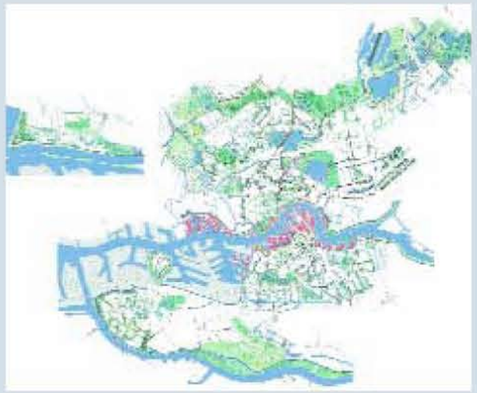
Several typologies have been developed that can be applied to different locations, depending on the scale of the environment, the usage of the place and the possibilities for rainwater storage capacity. The possible types vary from sunken squares, smart street profiles, to water balloons and dams that hold water on sloping surfaces. To explain how it works, we best focus on the typlogy of a square. A pilot watersquare has been designed to detect and solve possible problems, and to explore opportunities for improving the quality of public open spaces.

The design for a pilot watersquare is divided into two main parts: a sports field and a hilly playfield. The sports field is sunken into the ground by one metre and is surrounded by steps which can also function as a stand for people to sit and watch a game. The hilly playfield is sunken into the ground too and comprises numerous spaces set at different levels, to sit, play and linger. Both parts are enclosed within a green frame of grass and trees which borders the square. Most of the time, an estimated 90 percent of the year, the watersquare will be dry and used as a recreational space. Even with regular rainfall the square stays dry and rainwater seeps into the soil or is pumped into the sewerage system. This last option is the case in Rotterdam, since groundwater levels are too high to infiltrate rainwater into the soil.

Only when heavy rainfalls occur, the watersquare changes its appearance and function. The collected rainwater will flow visibly and audibly into the watersquare from an identifiable point in its middle. The design ensures that the square will flood gradually. Short cloudbursts will only fill parts of the hilly playfields in the watersquare. Here the rain will create streams, brooklets and small ponds, where children can play in and around the water. The rainwater will stay in the watersquare for a few hours until the city's water system is back to normal. During prolonged downpours the watersquare will gradually fill up, until eventually the sports fields are flooded and the square becomes a pure water storage basin. Then the possibilities for play are limited to daredevils who are not afraid of getting wet. Our pilot watersquare should hold a maximum of 1,000 cubic metres to cover heavy rainfalls in an entire neighbourhood.



Approximately 30 times a year medium rainfall event will let the volume of water climb to between 20 to 75 cubic metres. Then the water level in the basin rises to 30 centimetres – a perfect water playground.



WATERPLAN FOR THE CITY OF ROTTERDAM

The "Waterplan 2 Rotterdam" outlines how the municipality of Rotterdam and the water boards intend to deal with the city's water in the period ahead. In order to make the city waterproof, an integral approach is formulated. Three issues are considered crucial for this waterplan:

1. SAFETY. High water levels due to the rise in sea level will necessitate flooding defences to be reinforced. The city must continue to protect the city from water by making choices about the storm surge barrier and the required heights of the dykes. But also adaptive building in outer dyke areas is being studied.

2. QUANTITY OF WATER. Flooding caused by increasing rainfall will need at least 80 hectares of extra open water bodies such as lakes and canals to cope with the shortage requirements. Where there is space this will be implemented. Where there is limited space, the focus will be on alternative ways of retaining water, such as wadis, water gardens, green roofs and watersquares.

3. QUALITY OF WATER. Stringent demands are made on the quality of water to meet European requirements (European Framework Directive on Water). Rotterdam wants to be an attractive water city with clean, clear and plant-rich water. Existing open water areas will be improved by a mixture of measures. Another goal is separating waste water from the relatively clean rainwater by segregating the existing sewerage system in Rotterdam. A complete separation of the city sewage is not considered feasable, a suitable approach for each type of area is being sought.

The most important overall ambition of the waterplan is to make the city more attractive as a place to live, work and spend leisure time, in addition to solving the water problems. To achieve this the waterplan considers innovations such as watersquares, essential for the further development of the Rotterdam Water City 2030.
www.waterplan.rotterdam.nl

With the Waterplan 2 the city of Rotterdam outlines strategies of adaptation to prospective water development. Individual strategies for the different quarters are intended to secure and furthermore, promote the city.

Hygiene is an important issue. The watersquare is not a sewerage treatment facility. Rainwater is collected in a separate clean water system which takes it from public spaces and roofs to the watersquare. The collected rainwater is first collected in a so-called water chamber, where it is filtered before running into the square. The water will be held in the watersquare until it can be discharged into the nearest water body. The city's present sewerage system will no longer be burdened, thereby preventing contaminated sewage water from overflowing into moats and canals, which is the case at present. Consequently, watersquares are measures to improve the quality of the city's water bodies.

Rainwater will never stay in the square for long. Depending on the amount of stormwater, the worst case is 32 hours, which will statistically occur once every two years. This is not likely to be a health threat, even in summertime. Still water will leave some dirt and debris after the rain has passed though. It is important that the watersquare is cleaned after its use as a buffering space. For this reason, the design of the pilot is constructed with smooth slopes, avoiding tight corners. Also the choice of materials is important, concrete for example is suitable, but hard. We are currently examining a possible technique that makes figures and patterns appear in the concrete when it gets wet. The water chamber on the square will be connected to the water mains so that a high pressure hose can be used to clean it effectively. An additional advantage of this facility is that clean water puddles can be filled in summertime for children to play in when it is hot outside. Another possibility is to create an ice rink in winter when it is freezing. Such facilities are generally too expensive to implement in a regular outdoor space, but are now within reach because all of the engineering equipment is already included in the rainwater buffering function of the watersquare.

Another issue is the safety of the play space when it is filled with water. In conversations with the inhabitants of Rotterdam, it emerged that one of their major concerns is a lack of clarity about whether the watersquare is a safe place for small children to play. We are currently examining warning systems that also contribute to the aesthetic quality of public space. A system of colour coded lights indicates the depth of the water. Different coloured lamps, for example changing from yellow to orange to bright red, are integrated into the height differences of the watersquare. The higher the water level, the more red lights will appear. Additionally, simple bordering fences could prevent small children from entering the square when it is filled with water. What's more, the downpour itself will be a reminder that the watersquare is in use as a rainwater buffer.

A pilot scheme for a watersquare is currently being further examined, designed and developed for the city of Rotterdam. At the same time a survey on the best suitable pilot locations is executed in order to be able to start construction in 2011.

WATERSQUARES, ROTTERDAM
Client: City of Rotterdam, Rotterdam Climate Proof
Design: De Urbanisten

Once a year at the most heavy and long rainfalls submerge the sports field and water basin. The water level rises up to about one metre, so the square becomes an open water body for boating and playing.