BlueCircles

BlueCircles depicts the urban transition towards a decentralised grid of circular water systems, focusing on the creation of greener, cooler, and water resilient cities.

A publication by Field Factors, Delft University of Technology, Aquafin NV, and the Technical University of Madrid.

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If we tell you that fresh water is the most precious resource on earth, would you agree?
Healthy urban water systems are fundamental for our lives. We need them to secure food and drinking water production, clean air, social and economic welfare, even for our health and happiness. But because of climate change and rapid population growth, cities are challenged to keep the water infrastructure uptime.

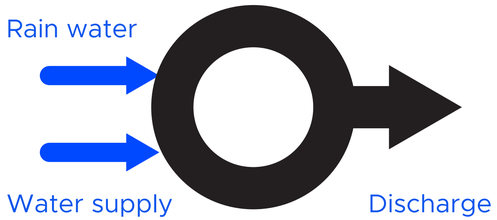
By 2100 the entire urban water infrastructure could be transformed into grids of decentralised circular water systems. In the future, the urban water demand will be supplied by local water sources including stormwater, surface water, grey water and wastewater, gradually upgrading the current discharge and supply networks.

Find out more

1

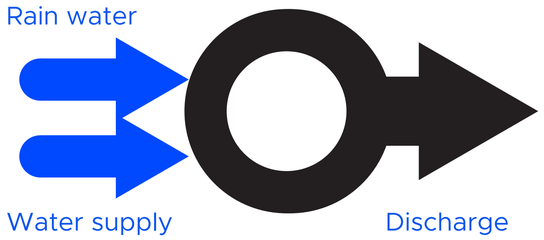
Vision

2020

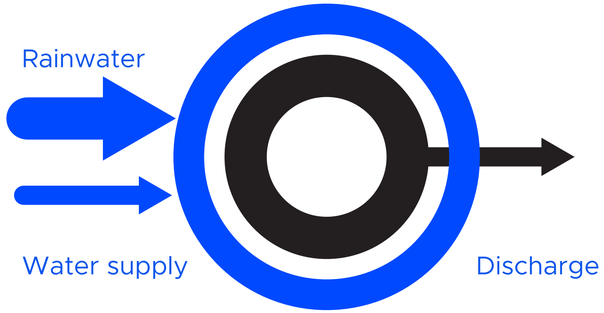


Current standard

2050



business as usual

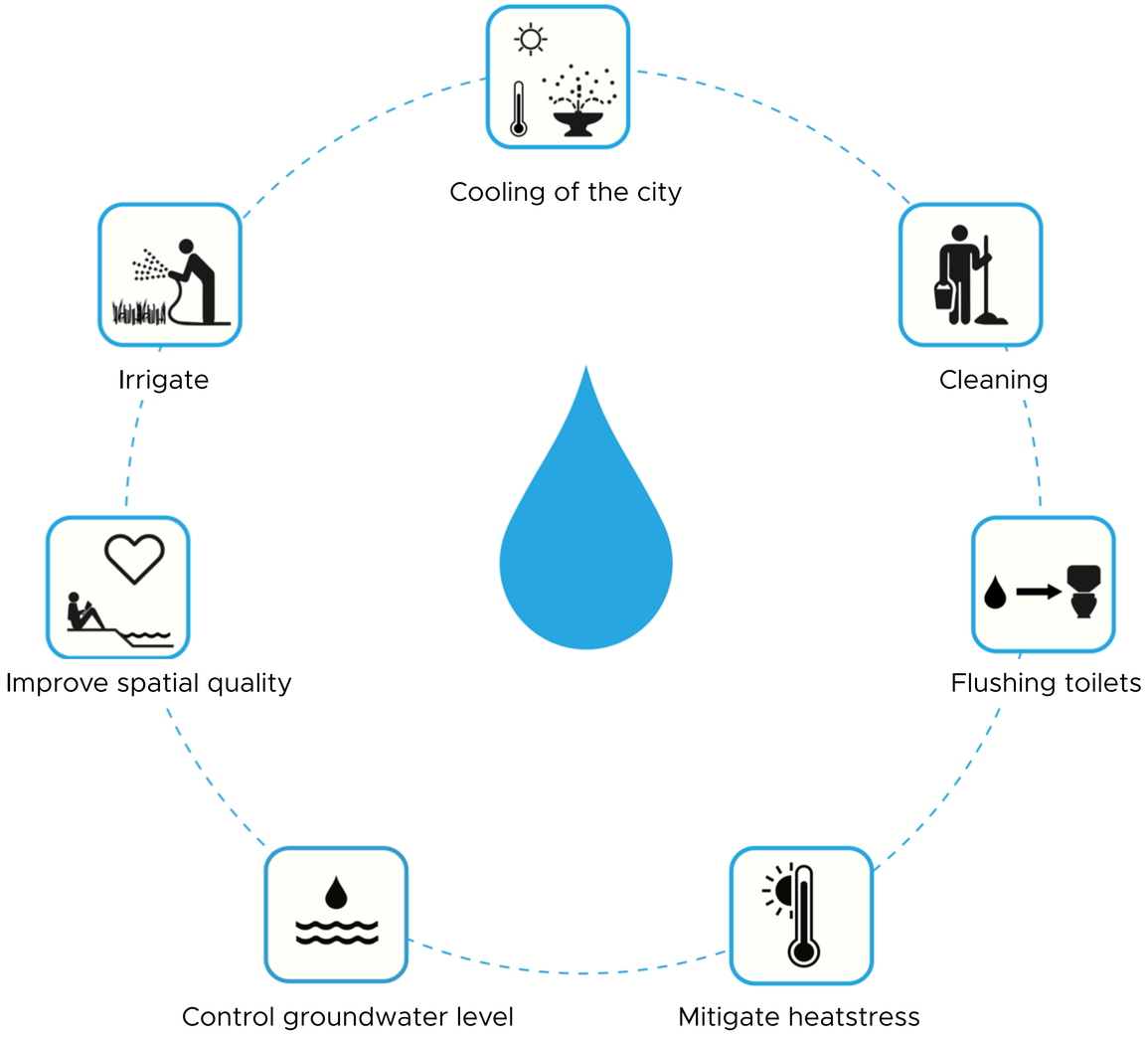


with BlueCircles

From linear to circular urban water systems

The growing urban population, together with more intense rainfall and longer droughts, impose major challenges to the existing urban infrastructure and the liveability of our cities. More people living in the city means a higher demand for freshwater, more paved area to be discharged and more wastewater is generated. Enlarging the current centralised urban drainage and supply networks as remedy is expensive and labour intensive.

BlueCircles offers a flexible and decentralised model to effectively and gradually upgrade the traditional urban networks for water supply and discharge. The growing paved surface is used as catchment area to collect rainwater run-off. Collected water is treated and stored locally, through small scale water systems, reducing discharge to the municipal network. The stored water is used to meet the local water demand. These small scale circular water systems can be implemented as addition to the existing infrastructure, in urban retrofitting or development projects, enabling the urban transition to greener, cooler and water resilient cities.

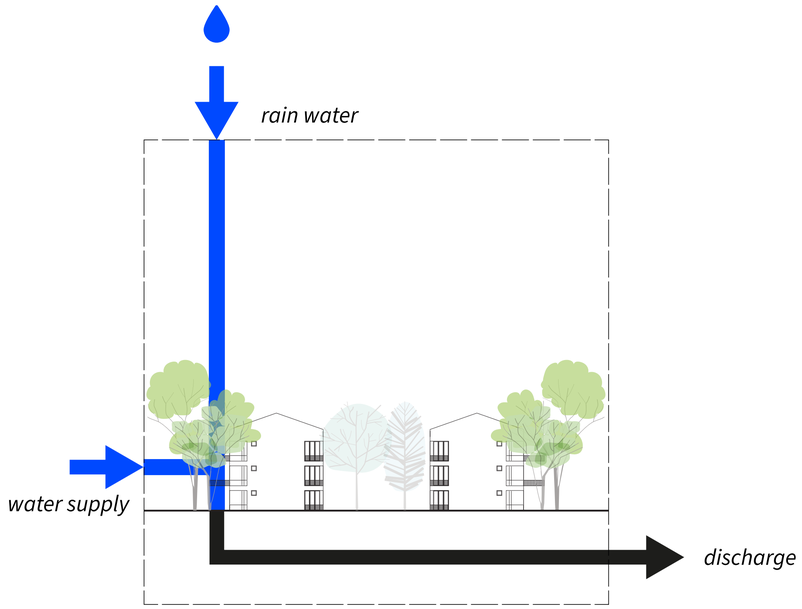


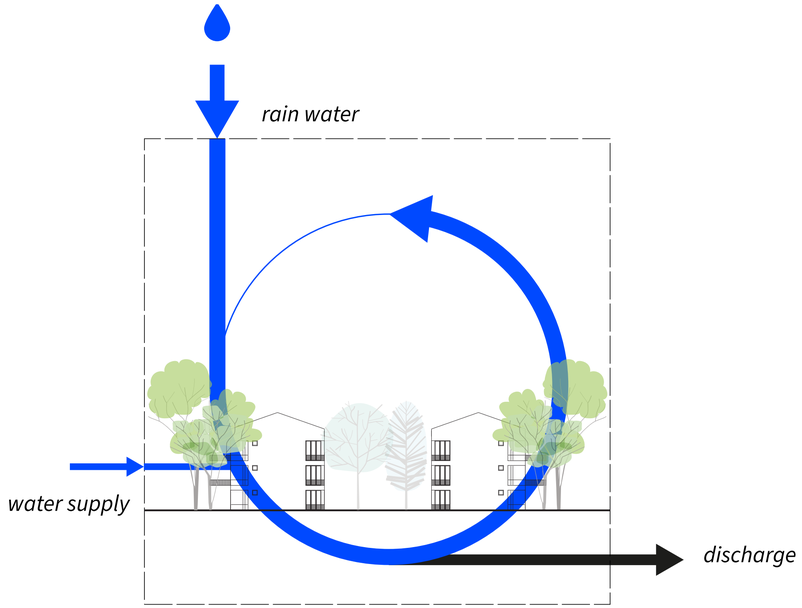
Local water sources for different applications

1. Stormwater is collected where it falls, within project boundaries, reducing discharge to the municipal sewer.
2. Water is supplied from local sources, close to the end-users, avoiding large transport and distribution networks, and enabling customised water supply.
3. Water is treated through autonomous nature-based systems, adapted to the available water volume and necessary quality.
4. Urban infrastructure is flexible for expansion to manage and minimise the impact of extreme fluctuations in water availability.
5. Water is visible in the public space, enhancing liveability.

BlueCircles as key opportunity to:

- Gradually upgrade ageing water infrastructure
- Ensure a safe, healthy and pleasant living environment
- Adapt to climate change and rapid urbanisation
- Reduce drinking water footprint





Bluecircles offer an opportunity to keep stormwater in the neighbourhood, creating a local source for water supply and reducing discharge to the treatment plant.

2

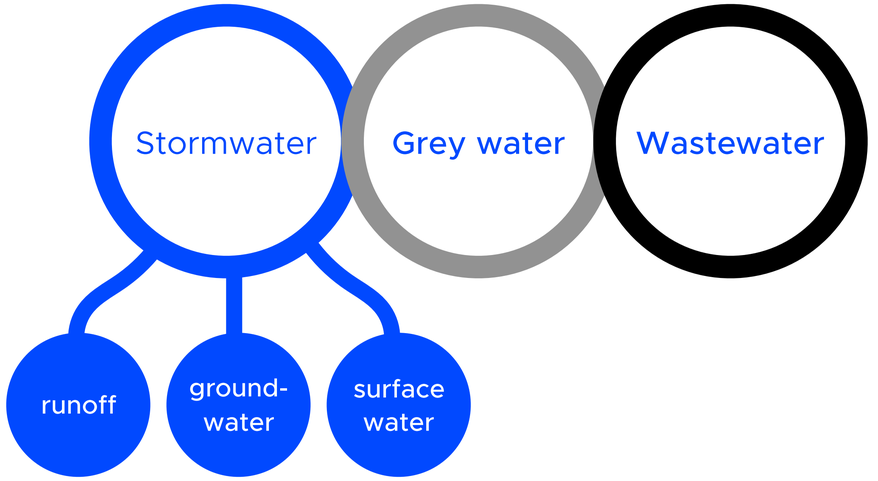
Autonomous water systems

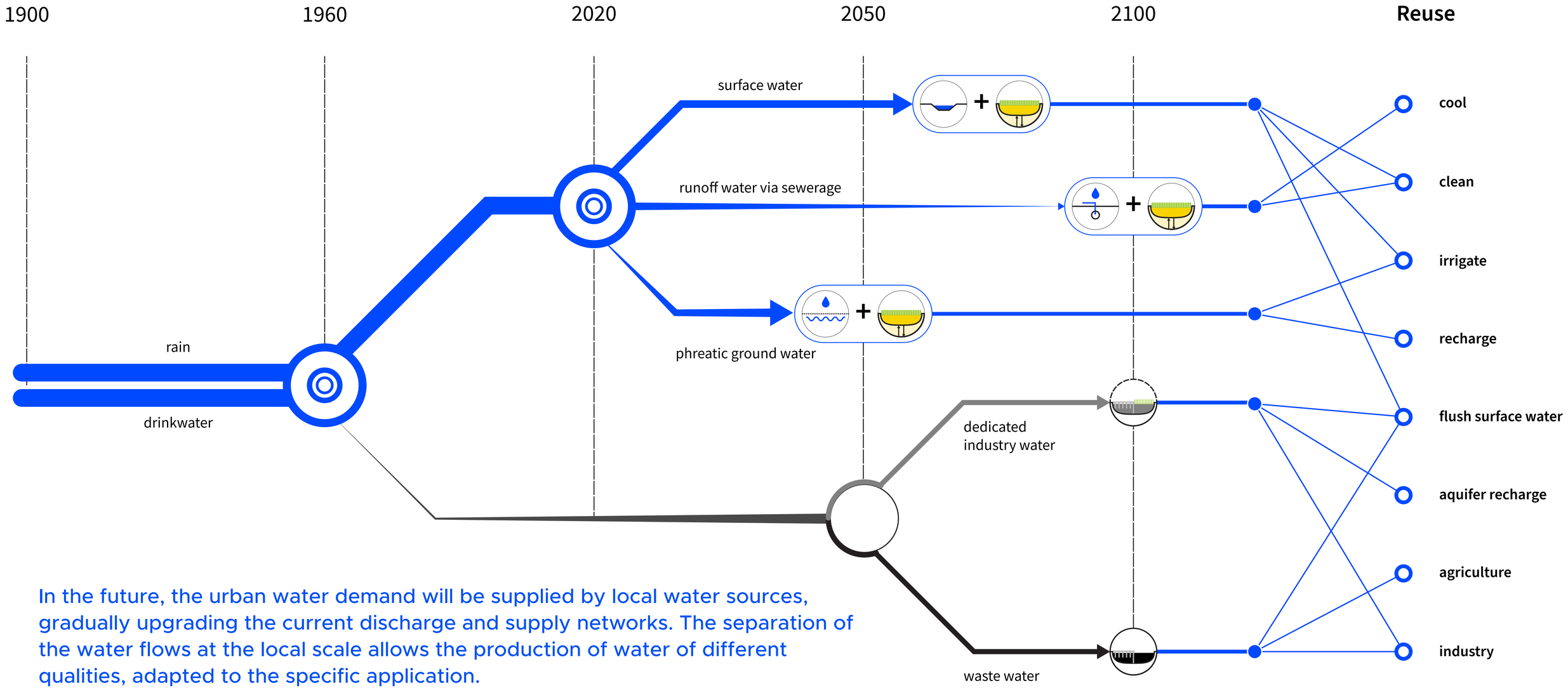
Separated water flows at the source to enable reuse

Since the 19th century, centralised water supply and drainage systems have become inherent to urban development: every building conglomeration is accompanied by kilometers of piping network for collecting, distributing and supplying water from the natural source to, the most dominant, final discharge at the treatment plant. Water supply and drainage are generally provided and managed independently from each other, through disconnected infrastructure. Decisions on how water is supplied are made by the management authority, generally without consultation with the users on the receiving end.

This centralised model has led to an one-fit-all approach in which stormwater is discharged through the sewer; traditionally through a combined sewer with wastewater. In most serviced areas in western Europe, high quality potable water is provided through the tap, which is mainly produced from groundwater and surface water. The supplied water is used for all urban applications regardless the required quality.

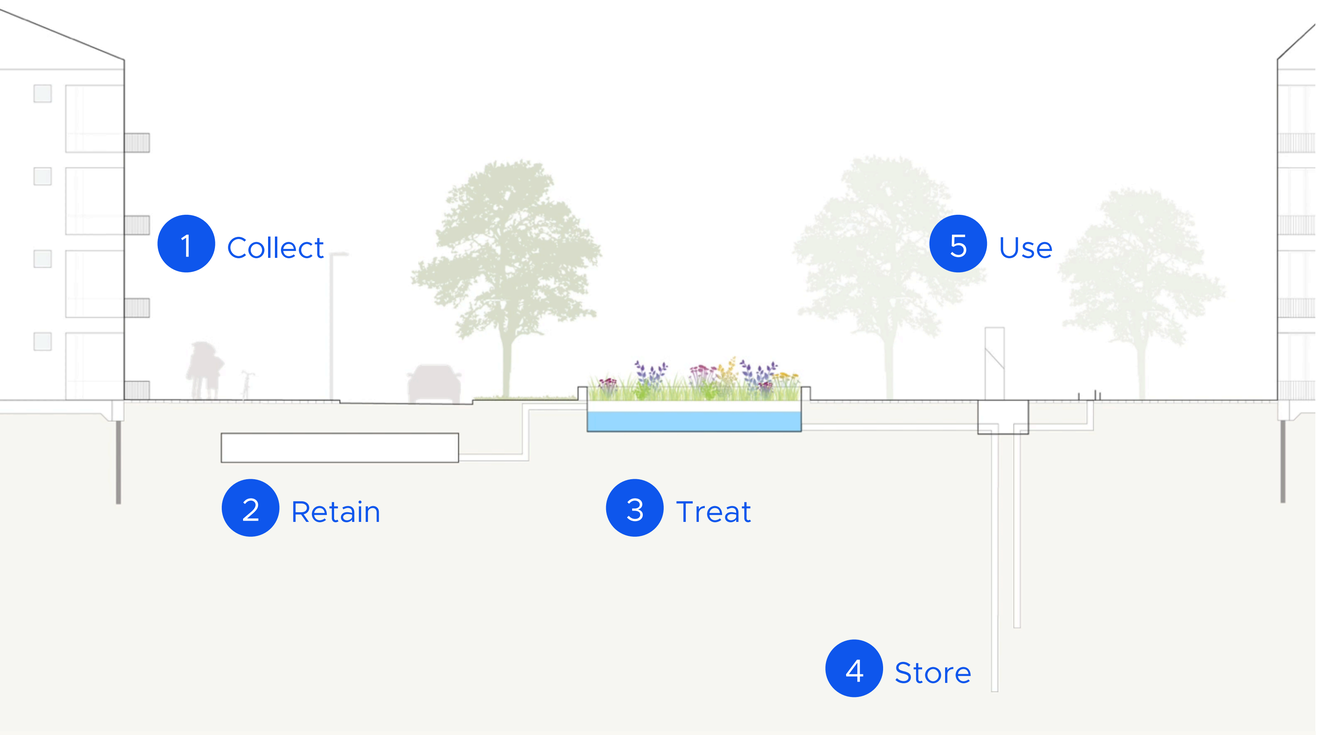
With BlueCircles, there is more emphasis on the integration of water management with urban development. The separation of water flows - stormwater, greywater and wastewater- occurs at the local scale, allowing the production from local water sources, and of water of different qualities, customised for the specific application.





In the future, the urban water demand will be supplied by local water sources, gradually upgrading the current discharge and supply networks. The separation of the water flows at the local scale allows the production of water of different qualities, adapted to the specific application.

The most important condition for local water reuse is that the water can be purified into clean water that meets all requirements for the specific application. Suitable sources for local water production must also meet other requirements, including affordability, adaptability to the local environment and feasibility of storage and extraction.

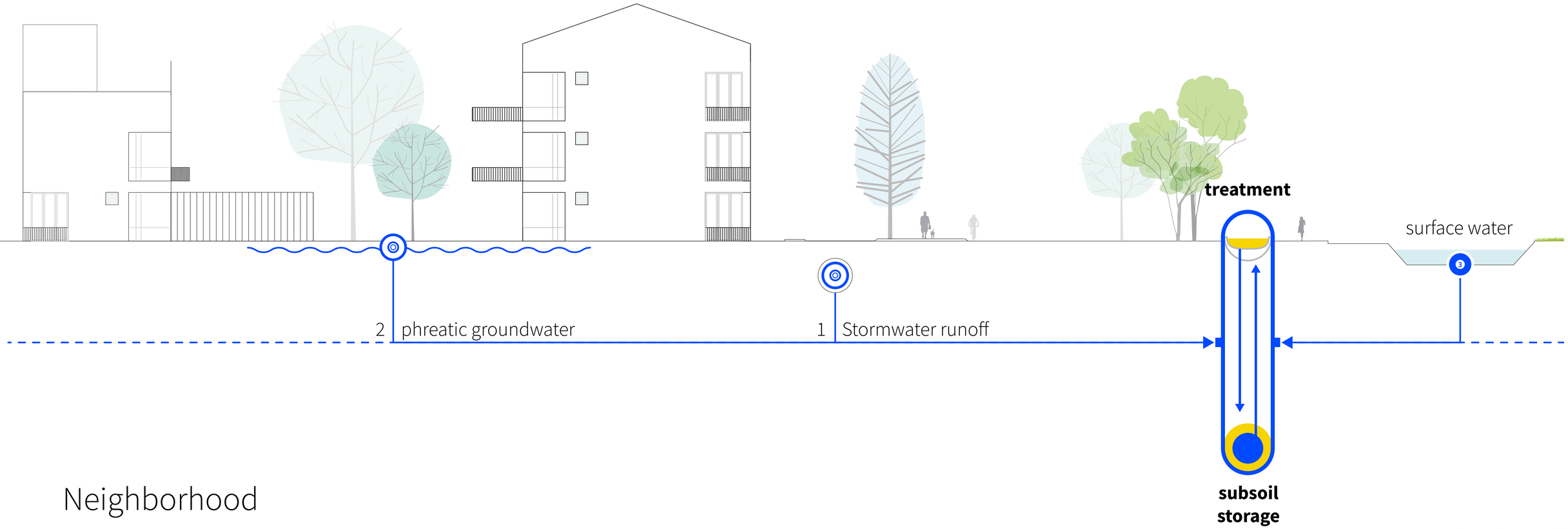


Autonomous and self-regulated water systems

Emerging technologies for local water treatment and reuse offer promising opportunities to enable a flexible and decentralised urban water system.

Bluebloqs is a nature-based system that combines bio-filtration and deep infiltration techniques for stormwater collection, treatment, storage and reuse in urban areas: a compact bio-filtration system is designed as a green feature, and the purified water is stored in the subsurface, from where it can be retrieved for different urban applications, e.g. irrigation, industrial processes or combating urban heat.

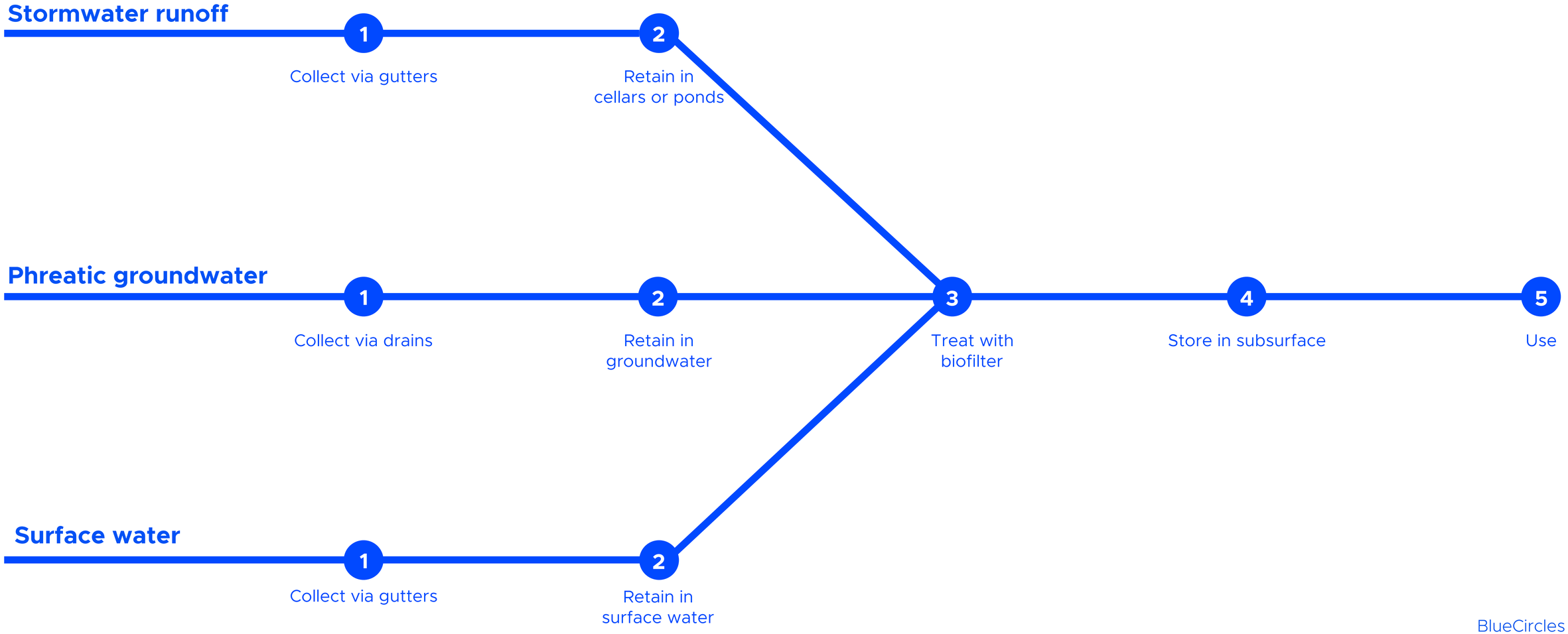
For local water production, BlueCircles focuses on three water sources in the urban landscape: stormwater runoff, phreatic groundwater and surface water. Collected water is purified through natural treatment systems and stored in the subsoil for supply within a distance of 500m.

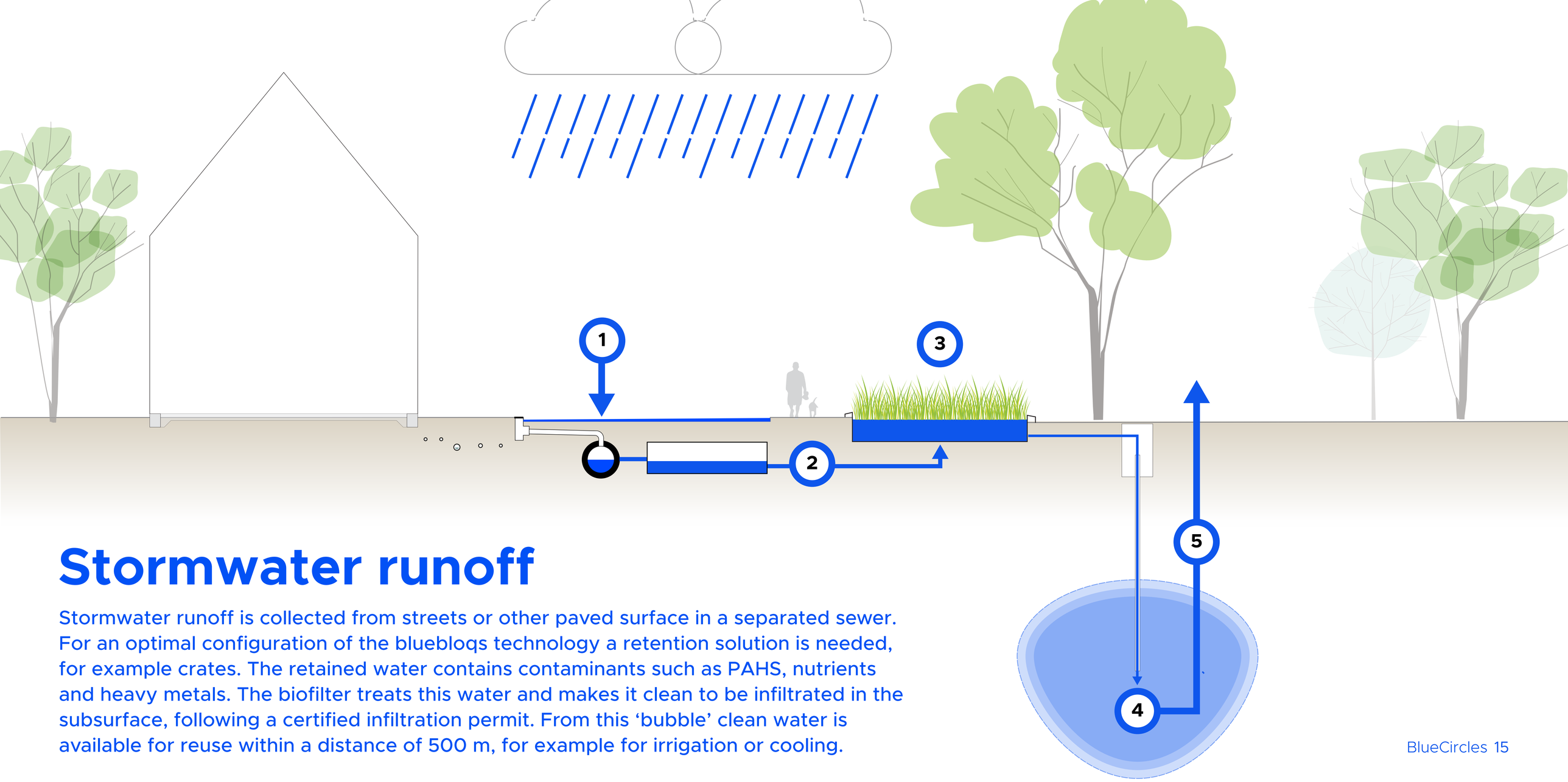


Neighborhood

500 m

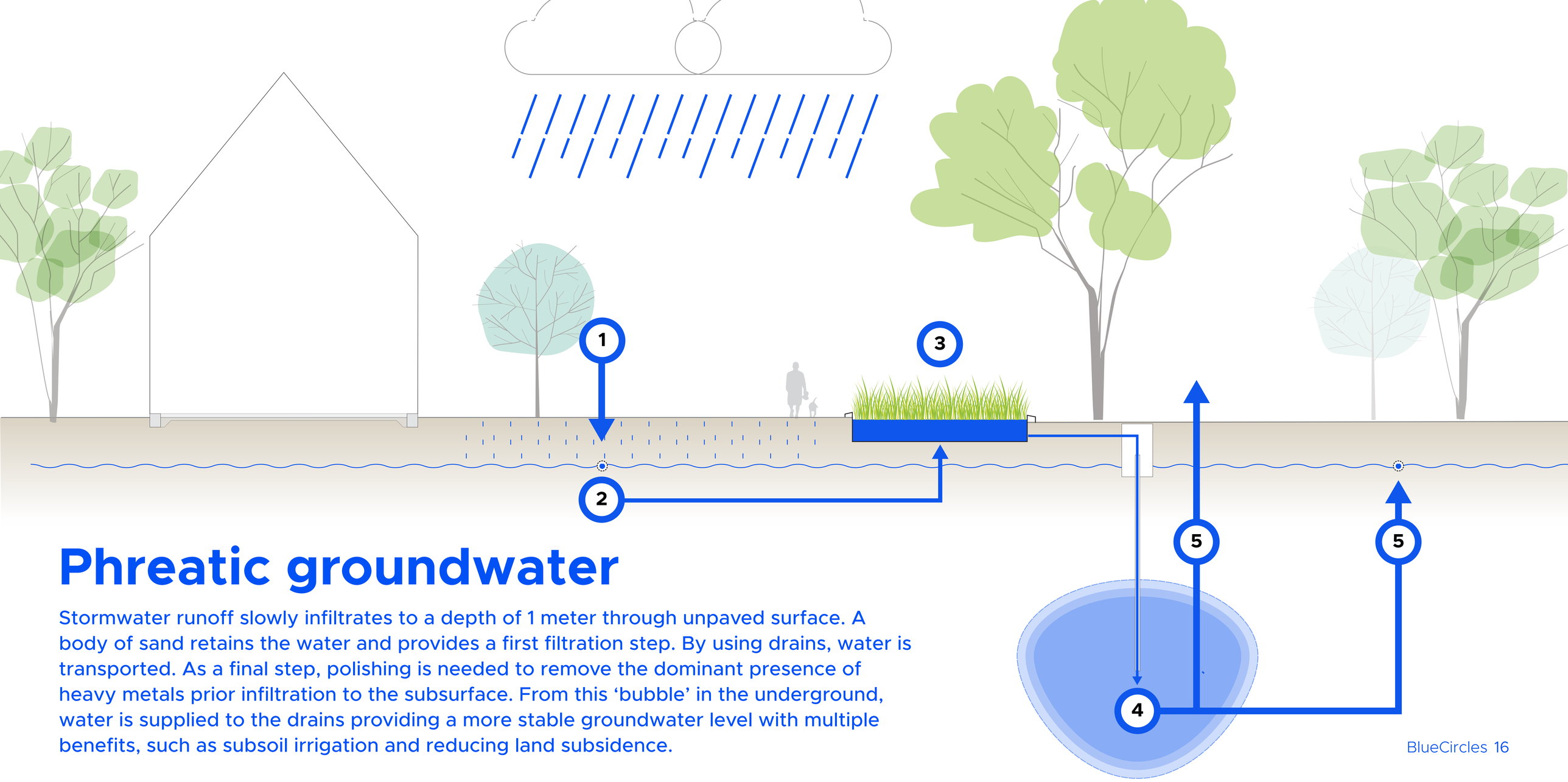
Depending on the water source, different technical solutions can be implemented to obtain the required volumes and quality, and to meet the specific project requirements.





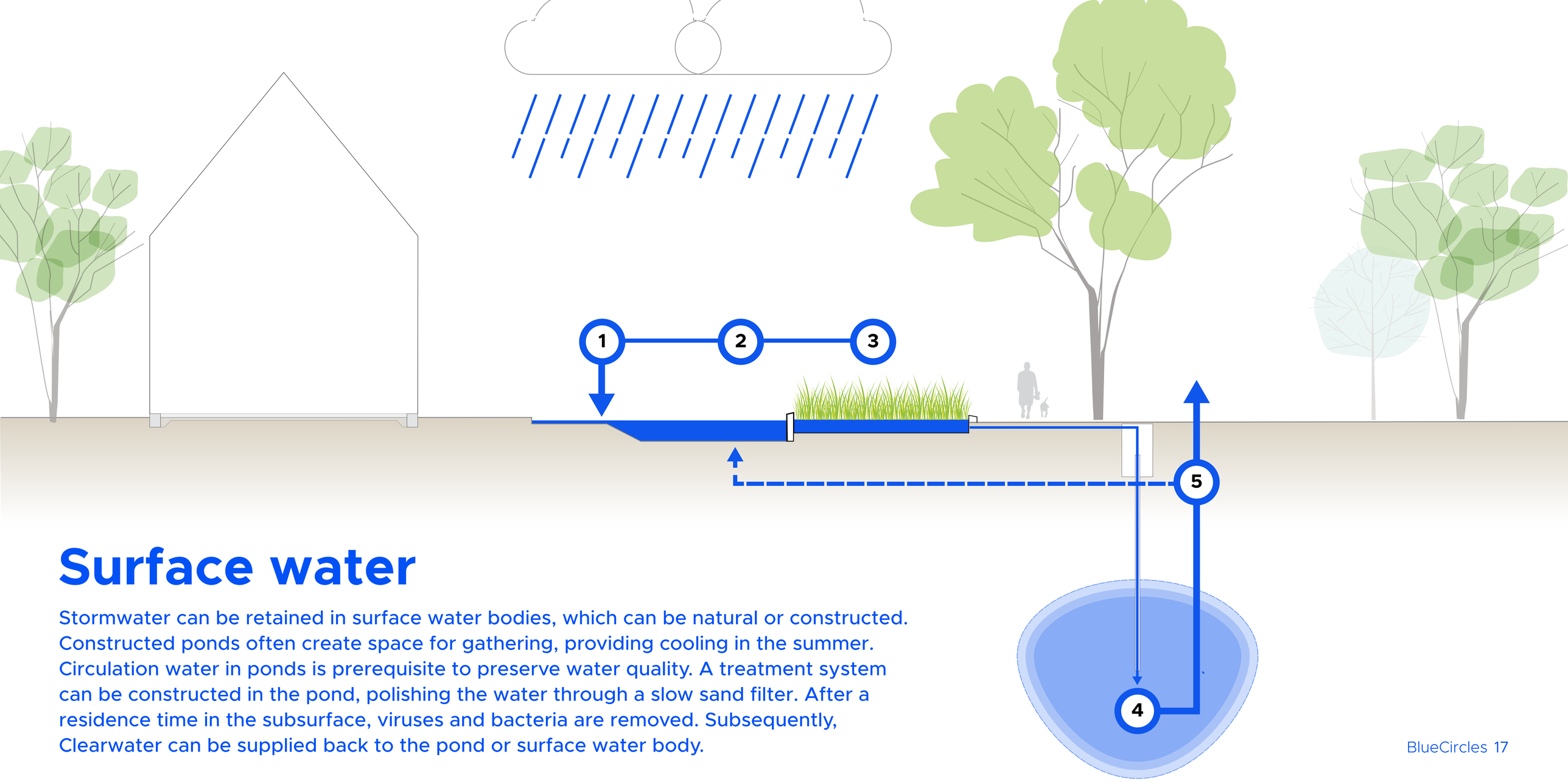
Stormwater runoff

Stormwater runoff is collected from streets or other paved surface in a separated sewer. For an optimal configuration of the bluebloqs technology a retention solution is needed, for example crates. The retained water contains contaminants such as PAHS, nutrients and heavy metals. The biofilter treats this water and makes it clean to be infiltrated in the subsurface, following a certified infiltration permit. From this ‘bubble’ clean water is available for reuse within a distance of 500 m, for example for irrigation or cooling.



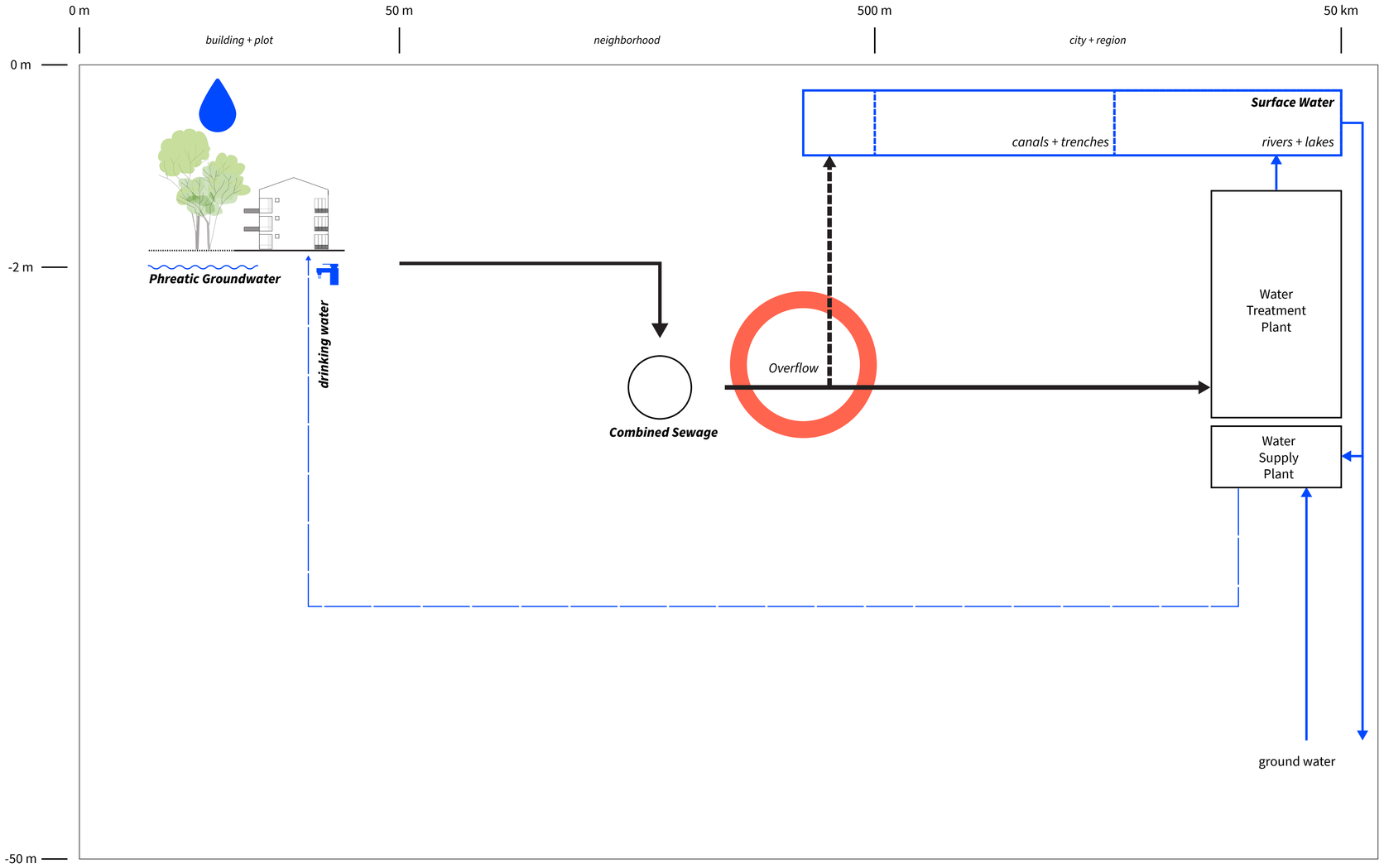
Phreatic groundwater

Stormwater runoff slowly infiltrates to a depth of 1 meter through unpaved surface. A body of sand retains the water and provides a first filtration step. By using drains, water is transported. As a final step, polishing is needed to remove the dominant presence of heavy metals prior infiltration to the subsurface. From this ‘bubble’ in the underground, water is supplied to the drains providing a more stable groundwater level with multiple benefits, such as subsoil irrigation and reducing land subsidence.



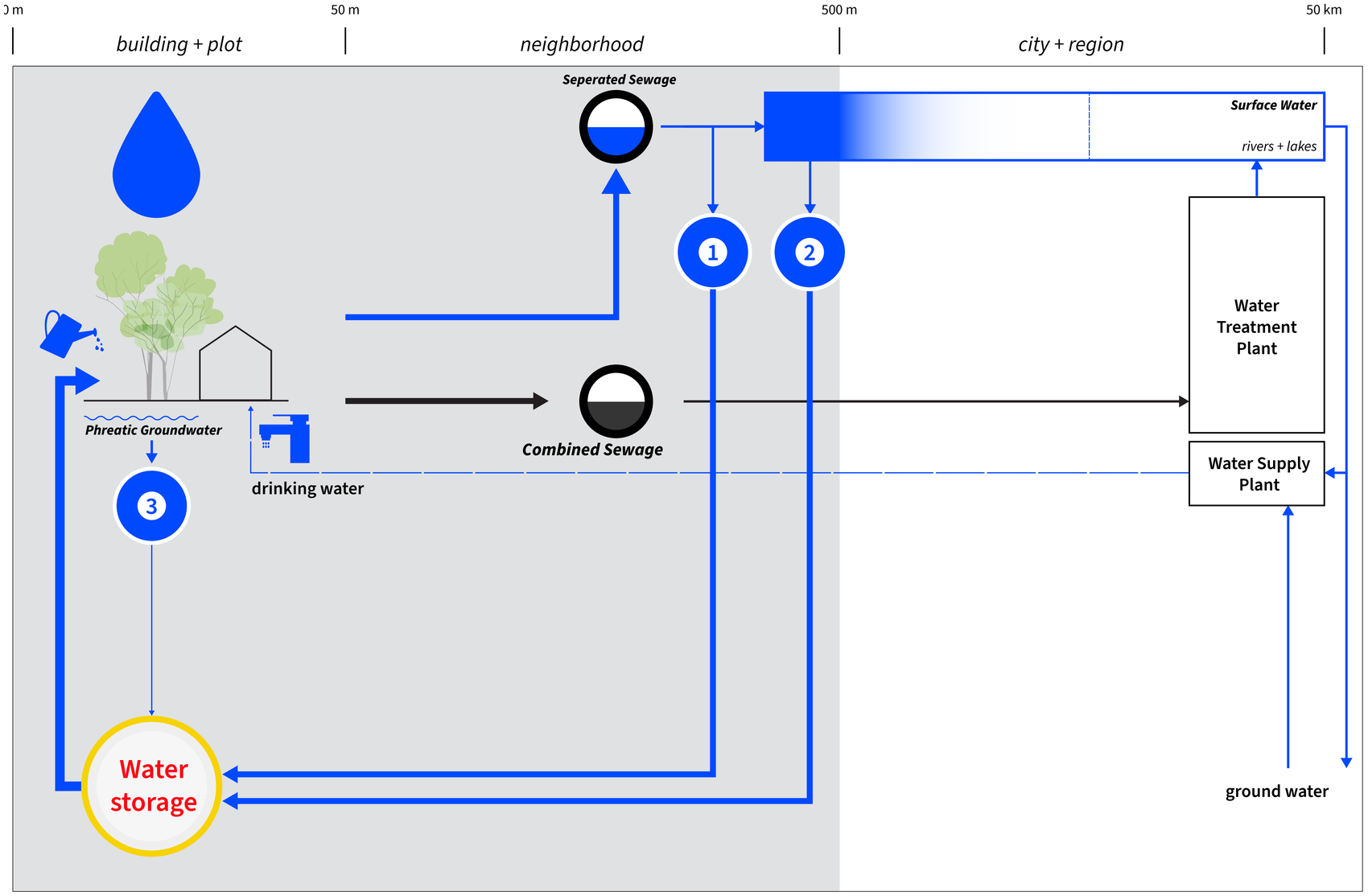
Surface water

Stormwater can be retained in surface water bodies, which can be natural or constructed. Constructed ponds often create space for gathering, providing cooling in the summer. Circulation water in ponds is prerequisite to preserve water quality. A treatment system can be constructed in the pond, polishing the water through a slow sand filter. After a residence time in the subsurface, viruses and bacteria are removed. Subsequently, Clearwater can be supplied back to the pond or surface water body.



From a linear and difficult to adapt urban water cycle...

In the traditional practice, when a development project takes place, a large part of the supply and discharge networks needs to be adjusted or replaced. A cost-effective alternative is to create a discharge and supply point within the project area, aimed at solving local effects while avoiding the need for long distance of long distance intervention and linking direct with the users.



To a shorter and resilient water cycle.

The shift to autonomous and self- regulated water networks that operate at a building, community or cluster level independent of the wider grid, requires a change in legislation and building regulations to enable smaller- scale applications in water collection, storage, treatment and distribution.

3

Greener, cooler, water resilient cities

	Social	Economic	Environment
			
Aesthetic betterment of the direct context.	+++	+++	+
Increased health and better air quality, blue-green spaces help keep cities cool, act as natural filters and noise absorbers, improve micro-climates.	+++	+	+++
Increased value of real estate.	+	+	
Increased biodiversity.			++
Provide opportunities for outdoor recreation and residing.	++		
Risk reduction of pluvial flooding and urban heat islands.	++		
Ability for children to play outdoors.	+++		
Allowing a participatory care for urban neighbourhoods.		+	
Less cost and optimal use of treatment plant.		+	+
Flexibility (no bottle necks) in future urban retrofitting projects on changing needs.		++	
Lower sunk cost in water infrastructure.		++	

Urban transition to greener, cooler districts

BlueCircles envisions a decentralised grid of circular blue-green water systems integrated in the urban landscape, replacing the current urban infrastructure for water supply and drainage in new developments or retrofitting projects. The impact on the local context include aesthetic betterment and increase of public health by adding green and cooling. Wider impact at system level includes flexibility of the urban infrastructure and optimisation of water resources.

The transition towards greener, cooler and water resilient cities starts at the local level with water at the core of new developments, such as buildings, sewer replacement or public space. These paved areas which often become inhabitable during hot summer days, offer the opportunity for small scale interventions that integrate green and water, creating green spots in the city, the so called urban pockets. This blue-green network is flexible, resilient and adaptive to future population growth and uncertain climate events.

Gradually replacing the current network

The first decentralised water systems are interventions aimed at solving local effects and links direct with users. However, the system is open and suitable for expansion.

2020

2030

Existing network

Bluebloqs Grid

Scaling up the grid of decentralised systems

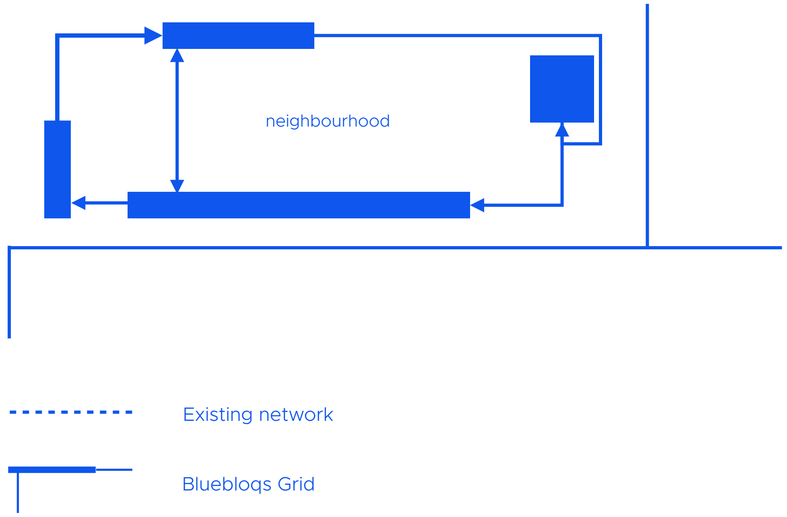
Subsequently, when another new developed takes place, another system can be added to the grid. Eventually, many autonomous systems can be added to the urban infrastructure replacing the current network, becoming a robust blue-green grid.

New developments (buildings, sewer replacement, public space design, management change) are linked to the system with their own operational networks and thus form urban mini-grids that are more robust in terms of security of water supply and discharge capacity.

Creating a robust, flexible grid network

All systems can be connected to each other creating clusters, so that less pressure is put on the individual systems, but more on the grid as a system. The grid is therefore stronger than the weakest link, because one system can rely on the other. The total influence becomes so great that the whole of individual systems, providers and users must be organised differently.

2050



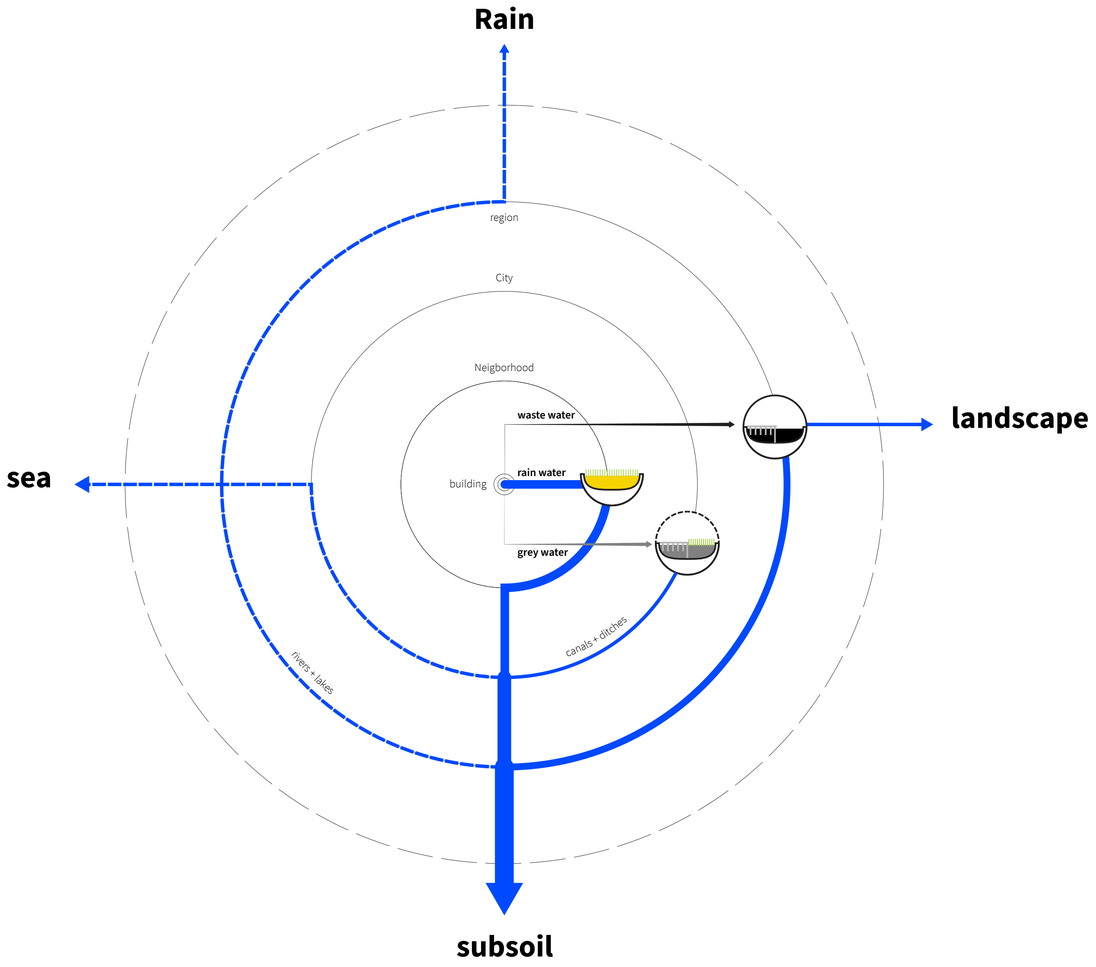
Rotterdam, NL

As initiative of the citizens, the Municipality of Rotterdam, the water authority Delfland, water utility Evides, Bluebloqs has been implemented in a full-scale pilot application in Spangen, Rotterdam. In this application, stormwater run-off is locally collected, treated, stored and reused for the irrigation of the pitches of the Sparta Stadium, saving 15.000 m3 of drinking water per year, preventing pluvial flooding and creating a liveable environment for the inhabitants. A second system is planned to be implemented in the redevelopment of Hart van Zuid.

2018
UWB Sparta

2020
Hart van
Zuid

Blueblogs Water Treatment at Sparta Stadium, Rotterdam



Creating shorter water cycles at the building and neighbourhood scales allows for a more efficient management of water resources. Key success factors for implementation include:

- **Collaboration in-between utilities, users and management authorities.**
- **Changes in legislation and building regulations to enable smaller- scale applications in water collection, storage, treatment and distribution.**
- **Knowledge exchange across urban planners, architects, engineers, contractors and operators to integrate small scale treatment and storage systems in urban development projects.**

BlueCirles is a vision developed by Field Factors, Delft University of Technology, Aquafin NV, and the Technical University of Madrid as part of the EIT Climate KIC Demonstrator project Bluebloqs Circular Water Systems.

Contact person: Karina Peña
kp@fieldfactors.com

www.circularwatersystems.eu

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