Interreg
2 Seas Mers Zeeën
Water Resilient Cities
European Regional Development Fund

# Greening the Grey

## A guide to retrofitting sustainable drainage systems into urban areas

# Climate change and extreme weather

**European cities continue to experience a steady increase in the intensity and frequency of floods, largely due to high urban densities and the resultant sealed surfaces such as buildings, car parks, paving and roads that prevent infiltration of water into the soil. In the last decade, flooding has produced high economic losses across Europe and storm water management has become a serious urban challenge.**

Consequently, we need to protect areas against the effects of extreme weather, especially:

- **Drought.**
- **Floods.**

Urban areas are risk zones due to:

- **The high percentage of impermeable land leading to large volumes of surface water flow in short time periods during heavy rain storms.**
- **The low percentage of land area covered in vegetation which would help to absorb and slow down the flow.**
- **Significantly increased temperatures in urban areas compared to rural areas due to human infrastructure and activities.**

**Climate change projections show that heavy rainfall, flooding and drought will become more frequent.**

To adapt to the effects of future climate change, cities need to change the design of urban areas and their management of surface water runoff, otherwise flooding, pollution and erosion problems will worsen. Sustainable drainage systems (SuDS) can play an important role in enabling adaptation to climate change.

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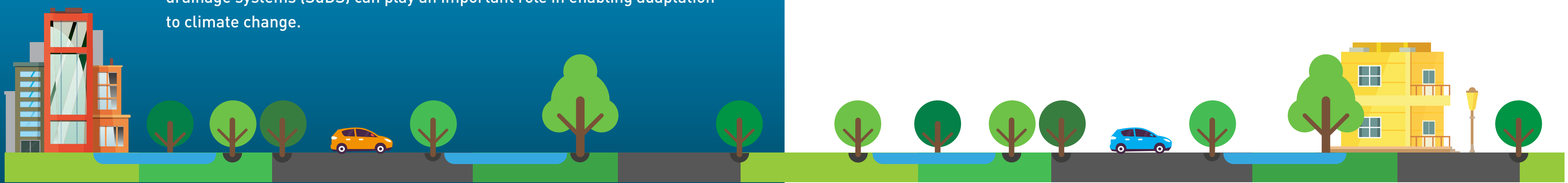
**Natural environments buffer water, providing short-term storage and slowing its release. They need to be part of the solution to counter the extreme weather events of the future.**



# SuDS - What are they?

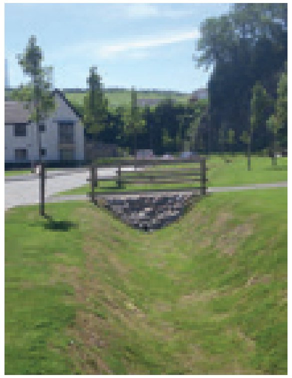
**Sustainable drainage systems are 'green' engineering techniques and design solutions that mimic natural processes of rain water drainage.**

SuDS are designed to maximise the opportunities and benefits that can be secured from surface water management.

**SuDS techniques can be divided into three groups.**

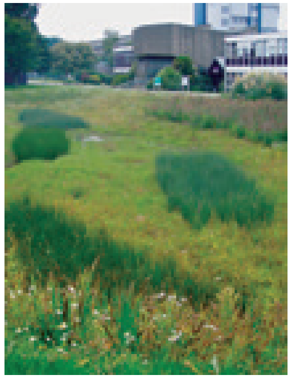
### Source control

Manage runoff where the rain falls **e.g.:** green roofs, permeable paving, bioretention and infiltration trenches.



### Site control

Provide in-situ rain water management **e.g.:** retention basins, ponds, swales and ditches.



### Catchment control

Manage runoff from several sites or a large site **e.g.:** ponds and wetlands.

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Flooding in Plymouth

## KEY PRINCIPLES OF SuDS

**SuDS are based on the three following principles:**

1

### Infiltration

Reduce the amount of water entering drains by increasing the ability of water to soak into the soil.

2

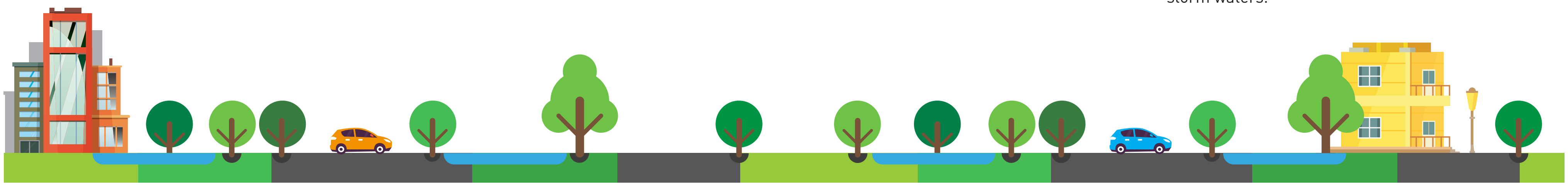
### Buffer capacity

Slow the flow of water away from a site so that it does not overwhelm drains and cause flooding, by providing temporary storage and slow release of storm waters.

3

### Keeping water on the surface

Keeping water on the surface where possible to reduce the need for underground drainage infrastructure, which is expensive.



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# SuDS Components Factsheet

## TREE PITS

Tree pits are commonly used to protect tree roots and avoid soil compaction in urban settings. They also store water and their storm water retention capacity is designed into some SuDS. Trees additionally capture water and atmospheric contaminants in their canopy, helping to reduce the rate of storm water runoff and reduce water pollution.

## SWALES

Channels formed as a shallow depression in a large landscaped area such as a park, or a highway verge. Typically planted with grass, shrubs, or trees. Swales provide temporary water storage and conveyance via a large surface for infiltration of storm water into the soil.

## CHANNELS AND RILLS

Compact channels collect water, slowing the flow and capturing silt and contaminants. Planting improves their efficacy and their amenity benefits.

## FILTER TRENCHES AND STRIPS

Filtration and bioretention areas are designed to remove contaminants and sediments from storm water. This is especially useful for draining highway, parking and industrial spaces. Chemicals are removed by bacteria, plants and soils as the storm water is stored and percolates away.

## RAIN GARDENS

Rain gardens collect, filter and store rainfall close to its source. They typically serve a single roof, or small paved area, or section of highway. They are ornamentally planted and include some water storage capacity. They can be easily and successfully integrated into public realm and highway improvement schemes.

## PERMEABLE PAVEMENT

This allows water to infiltrate directly into the soil, or to a storage chamber under the surface. Permeable pavements can be constructed from traditional block paving laid with small gaps between the blocks, or from a porous material.

## WETLANDS

Wetlands are designed to retain water for long periods, to allow time for sediments to settle out of the water column and for contaminant removal through adsorption onto plant surfaces. They are planted with natural aquatic vegetation and are valuable wildlife habitats.

## GREEN ROOFS

Green roofs act like sponges to absorb rain where it falls and release it slowly into the drainage systems. Planting provides a biodiversity benefit and improves evaporation of rainwater and its subsequent cooling effect.

# The case for SuDS

**Planning and designing for SuDS requires a change of approach, but there are many benefits in doing so.**

## DRAINAGE BENEFITS

**Conventional drainage systems manage water volume in a manner of "out of sight and out of mind" in order to avoid urban flooding in city areas.**

**In the design of conventional drainage systems there is limited concern for water quality issues and even less for its amenity and recreational values.**

### SuDS

- Allow for natural drainage patterns.
- Limit the amount of runoff reaching drains and free up capacity in sewers by:
  - providing areas to store water,
  - slowing the flow of water before it enters a watercourse,
  - allowing water to infiltrate into the soil,
  - allowing transpiration from vegetation and evaporation from surface water.
- Reduce an area's risk of flooding.
- Deliver a wide range of social, economic and ecologic benefits.

### OTHER IMPORTANT BENEFITS OF URBAN WATER MANAGEMENT

- Improved runoff quality.
- Improved visual amenity.
- Improved recreational value.
- Improved ecological protection.
- Multiple water uses.

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### FOUR MAIN OBJECTIVES FOR SuDS SCHEMES

**Technical**
The prevention of damage caused by heavy rainfall or droughts, by holding and treating urban surface water run-off.

**Social**
The provision of additional amenity benefits.

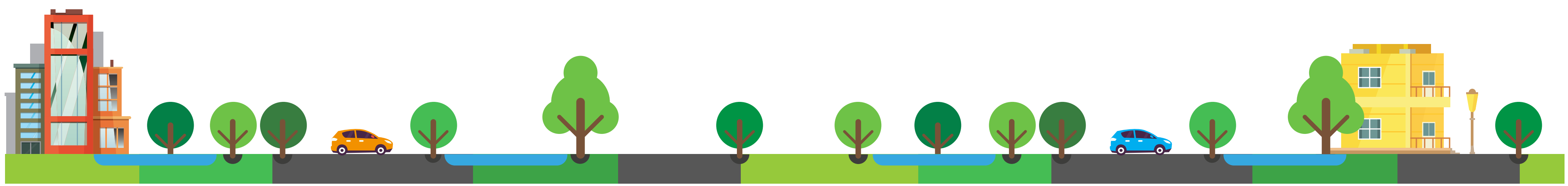
**Ecological**
The provision of additional nature conservation benefits.

**Economical**
The decrease of long term water management costs.

## SuDS MISCONCEPTIONS

**Various arguments have been put forward in favour of traditional drainage and against the use of SuDS, but there is now ample evidence to refute these:**

- **SuDS are not expensive.** A well-designed SuDS is not any more expensive than traditional drainage and it typically offers better value for money, because it provides additional benefits such as amenity.
- **SuDS do not need more space.** Good SuDS design favours many smaller interventions, such as green roofs, rain gardens and permeable paving which serve other functions as well as flood control, so avoiding large centralised water basins.
- **SuDS do not attract mosquitoes.** Most SuDS are intended to hold water for only short periods, being designed for the water to infiltrate into the soil, or drain away slowly. Mosquitos require standing water to breed.
- **SuDS do not pollute soils.** SuDS can be designed to filter run-off from road surfaces and so improve water quality.
- **SuDS are possible even when the soil is made of clay.** Infiltration may not be possible in some soil conditions, but there are many other options for SuDS design that achieve positive benefits for flood management.
- **SuDS look good even with simple management.** This is a question of management and ownership, issues which a good SuDS design addresses at the outset.



# How to retrofit SuDs

## THE RETROFIT CHALLENGE

**Retrofitting SuDS in cities can be a real challenge as public areas are often very busy and limited in space. Moreover, spaces that seem to be available at first sight can hide problems due to underground services such as sewer pipes, cables and other utilities, or historical remains.**

Retrofitting SuDS will be different at every site. A site-specific evaluation is therefore necessary as the basis for SuDS design. When retrofitting SuDS, compared to conventional drainage, it is far more important to look at the potential for additional benefits so that the investment delivers maximum value for money and to resolve potential conflicts over the use of urban spaces.



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SuDS in Rik Wouterstuin, Mechelen

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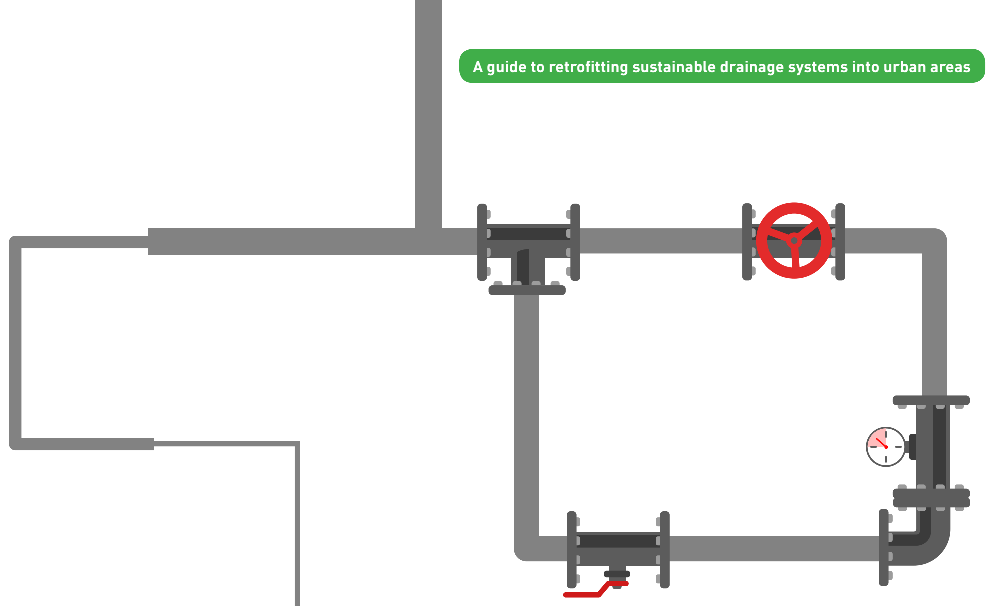
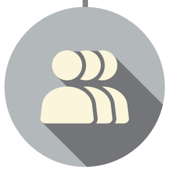
# Design Principles



## RETROFITTING SuDS IN URBAN AREAS CARRIES UNIQUE CHALLENGES

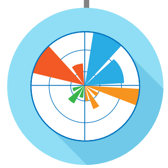
### CREATING VARIETY AND CONNECTIONS

SuDS provide wide scope for creative design, to improve the quality of public space as well as reducing flood risk. That creativity can extend to their connectivity, enabling managed water flow and storage throughout the city, and supporting ecological, mobility and visual connectivity at the same time.



### DESIGN WITH PEOPLE IN MIND

Considering the needs of the people who live in and use the urban setting in which the SuDS are to be located is essential. Local people are able to provide a broad perspective which should be used to inform the design, taking into account engineering design constraints.



### MAXIMISING THE PURPOSE

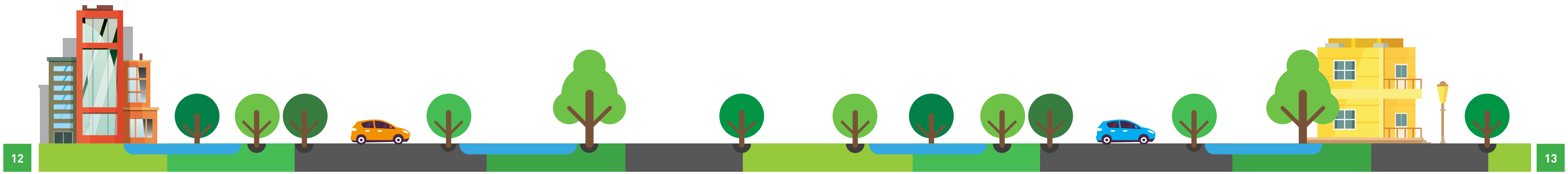
When designing SuDS, a holistic, multi-functional design perspective is necessary, to avoid conflicts and to maximise additional benefits and value for money. This is a site-specific activity involving analysis, consultation and integrated planning.

### FLEXIBILITY TO ADAPT TO CHANGES

Creative place-making is important. People's needs, the climate and the environment are constantly changing. SuDS have to be designed in such a way that they can respond to these changes by gradual adaptation. Consideration should be given to possible future needs, especially those concerning climate change.

### RETROFITTING IN HISTORIC CITIES

Retrofitting SuDS in historic cities is constrained by requirements to protect the historic character. It is therefore important to take historic features, building materials and design style into account, and to investigate how permeability, buffering and surface conveyance of storm water can be increased within these constraints.



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## Case Study

# King Albert-I Park, Bruges

## PROBLEM

The King Albert-I Park is the main water inlet to the Bruges canals. These canals enable the evacuation of large volumes of storm water and are a vital part of the city's drainage infrastructure. The canals are subjected to flooding, drought and poor water quality. The water is very shallow and has a low oxygen value.

## SOLUTION

The City of Bruges invested in a SuDS which tackles the water quality by enlarging the storm water storage capacity and increasing the oxygen content of the water at the inlet to the canal system. A part of the King Albert-I Park, where the water enters the Reien, was retrofitted to enhance the historic context of the area.

**The SuDS design included the following measures:**

- Deepening a part of the Kapucijnenrei canal.
- Installing a fountain for aerating the water and introducing extra oxygen.
- Creating extra buffer capacity of 400m$^3$ water.

The pumps of the fountain create a flow of 150m$^3$ per hour and introduce a huge quantity of oxygen into the water. Consequently, the water coming from the Ghent Canal that enters Bruges via the Kapucijnenrei receives extra oxygen and an increased flow.

## BENEFITS

As well as the additional buffering capacity and the increased oxygen levels, there are two further benefits that arise from the investment. Firstly, the design of the retrofitted King Albert-I Park aims to enable people to get closer to the water, by incorporating steps and a platform at water level. This is part of a wider access strategy for the city's canals. This new level of access, combined with good quality fresh and clean water flowing through the Bruges canals, creates an attractive new aspect to the city.

Secondly, King Albert-I Park is also the main entrance gateway to the city for walkers and cyclists, connecting the railway station with the city center. The Kapucijnenrei was barely visible and made no contribution to the attractiveness of this gateway. Now it is a distinct and very visible feature.

Beginning work

Mid work

Completed work

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## Case Study

# Inner-Dijle, Mechelen

## PROBLEM

The historic course of the River Dijle is a canalised branch of the river running through the city centre (the Inner-Dijle), connected to the tidal water course which runs around the city. It has a constant regulated water level and the potential to store storm water and reduce flooding in the city. Many of the historic canals in the city are now covered, reducing their storm water storage potential, so extra capacity is needed.

## SOLUTION

Regeneration of the Inner-Dijle for storm water storage. A culvert under a paved parking area was reopened, and the 'Melaan' brook between Zakstraat and Muntstraat opened up. Enabling access to the canal creates opportunities for improving the natural and the living environment in the city centre.

Also, the sewer outlet containing grey water from the adjacent university college building used to discharge into the Inner-Dijle. Together with the reopening of the culvert, the sewer system has been updated and is now disconnected from the river.

Prior to work commencing

Mid work

## BENEFITS

**The benefits of this project are:**

- Transforming an unattractive paved parking area into an attractive and instantly popular public space with open water, grass and marshland river banks.
- Infiltration capacity was increased by replacing the paved surface with permeable river banks.
- Disconnection of grey water from the river improved water quality.
- A new jetty encourages the use of the river for tourist boats and kayaking.
- The creation of a new green/blue corridor to connect the city park with a nature reserve, so removing a barrier to wildlife movements.

Work was also undertaken to increase the ability the Inner-Dijle to store excess storm water. This necessitated renovation of the canal walls which were in a bad state due to poor water management and a lack of investment in infrastructure in recent decades. These walls are privately owned and so a sensitive stakeholder engagement exercise was organised by the City of Mechelen to inform owners of their duties. The City provided support for renovating canal walls and separating sewer systems, in the form of advice and by facilitating the joint commissioning of contractors to reduce costs. The renovation of the canal walls has enhanced the quality of the city environment due to separation of grey water, and the Riverwalk experience is now far more attractive.

Completed work

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## Case Study

# Mechelen tree pit

## PROBLEM

In common with many older cities with beautiful historic centres, Mechelen has some narrow streets with ageing drainage infrastructure. Hallestraat is a typical example of this. The narrow confines of this shared-space street limits design choice for drainage engineers seeking to alleviate the pressure of storm water surges on drainage systems which were designed for a different era. Paved space, vehicular access and traffic management mean traditional rain gardens and swales are not feasible.

Below-ground services and utilities added a further dimension to the challenge, as is typical for such locations, so the solution needs to both protect these and provide for the tree root system.

## SOLUTION

Working closely with GreenBlue Urban, the City of Mechelen installed a special SuDS tree pit system which has been developed for tree planting in urban locations. The system allows a tree to be planted with minimum surface paving loss, but maximising the below-ground storage and water buffering potential from the tree pit zone.

The solution allowed for the diversion of a traditional gully drain directly into the root zone of the tree. This allows water to disperse across the total tree pit area and then percolate down into the soil.

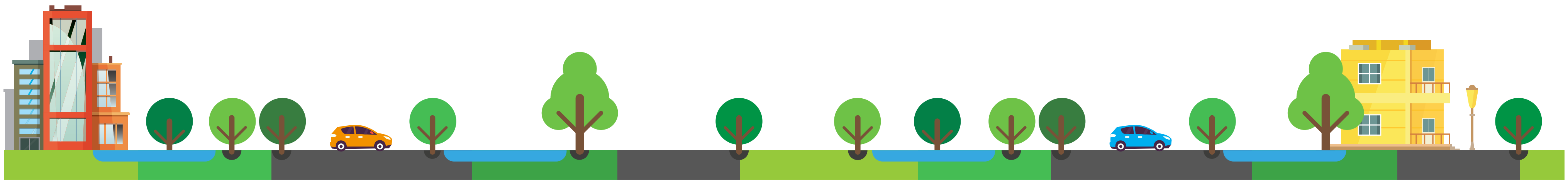
Tree pit design

## BENEFITS

The benefits to Mechelen from using this strategy are multiple: 3,520 litres of storm water can be accommodated within the tree pit design, so reducing significantly the pressure on drains in storm events. In addition, the water is cleaned through biofiltration before it eventually reaches the exit drain. Once established the tree will give additional benefits through canopy interception of rainwater, urban cooling through shade and evapotranspiration, air pollution removal and carbon sequestration, as well as its aesthetic appeal.

Mid work

Completed work



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## Case Study

# Molenwater Park, Middelburg

## PROBLEM

Molenwater Park is a 2 hectare public park, which is located in an area that was a part of the city's canals in the 17th Century. A review of flood risk in the city indicated that the area is vulnerable to flooding together with the houses located in the direct vicinity of the park.

## SOLUTION

The park has been adapted to act as a strategic SuDS. An intensive and interactive process with stakeholder engagement has been used to identify citizens' needs and aspirations, and to co-produce the design.

The SuDS consists of two elements, each providing extra short-term rainwater buffering capacity: (i) a series of swales, and (ii) a permanent water body that has capacity to provide extra storage for storm water.

The swales provide temporary buffer capacity during heavy rain within low ground level zones. The water then evaporates or infiltrates into the ground. The water that enters these swales comes from roofs and streets in the immediate vicinity of the park that have been disconnected from the sewage system. In this way the sewer system is not overwhelmed during heavy rains.

This SuDS creates an extra 2,000m$^3$ of buffer capacity, with additional benefits for the attractiveness and amenity of the park.

## BENEFITS

Areas have been created to store storm water when required, but at other times these form part of an attractive garden and public open space for the citizens to enjoy. By involving users and other stakeholders of the park in the design process, mutual trust and understanding of the SuDS design was created leading to widespread acceptance of this change to a highly valued public space.

Before work

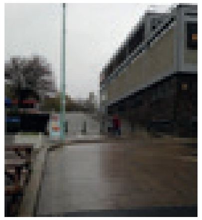
During work

Completed work

# Case Study
# Market Way, Plymouth

## PROBLEM

This poplar route into the city centre from the Western Approach bus stops was previously very steep and unattractive due to the high amount of grey infrastructure. It provided a challenge for the elderly and those with physical impairments to safely negotiate the ramp to access the shops and services in the West End of the city. At the same time, the lack of surface water drainage or infiltration in this part of the city created localised flooding.



Before work

## SOLUTION

This scheme changed the environmental characteristics of the site from a totally hard surfaced space to one which provides 40% soft landscape where rain water infiltration can occur. Treepits were also installed in the adjacent street to provide more buffering capacity for the neighbourhood.

## BENEFITS

The improvements have seen the steep gradient remodeled to provide a series of gentle ramps and steps fitted with supportive handrails together with a central level seating area and raised terrace to support commercial uses on the ground floor of a redeveloped building which was the catalyst for the scheme. This together with new paving, street lighting, trees, shrubs and ground cover planting has created an attractive, safe and high quality public landscape.

Proposed design





Completed work

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## Case Study

# Millbay Boulevard, Plymouth

## PROBLEM

This part of the city is low lying and was originally a tidal marsh. Thus, it was always subject to tidal influence and flood water inundation, which remains a problem today. The drainage of the city centre is mostly achieved by combined sewers, which lack sufficient capacity to drain all the storm water. Surface water drains become 'tidelocked' at high tide, being unable to discharge to the sea. This combination leads to combined sewer water being discharged untreated into the sea at times of high rainfall and pollution of the harbour and beaches. The land is part of the city centre's 'critical drainage area' where special measures are needed to develop separate storm water and foul sewer systems.

## SOLUTION

The development of this SuDs scheme will provide buffering of storm water flows locally, improving the city's resilience to flooding particularly at times of both high rainfall and high tides. Developing the new boulevard will help to increase the value of land in this area and improve property values and rents, so helping with the neighbourhood's regeneration.

## BENEFITS

The infrastructure in this area has been a longstanding challenge for the city of Plymouth. The project is ground breaking in many ways:

- It demolishes structures to create new public space.
- It doubles the width of a narrow street to form a green public realm.
- It connects the city centre to the waterfront by providing a new attractive walking and cycling link.
- It provides generous pavements for people to stroll down and a welcoming new public square.
- It delivers an extensive sustainable drainage system in the form of rain gardens planted with an avenue of trees which will be irrigated by the surface water.
- It protects the surrounding community from flooding by the buffering capacity provided within tanks below the rain gardens.

Before work

Proposed design

## Case Study

# Foch Square, Wimereux

## PROBLEM

Wimereux is a coastal city that attracts many tourists during the summer season, causing congestion of the local roads and parking places. Furthermore, the sewer system captures sand from the beach causing it to clog. During periods of heavy rain, these clogged sewers are unable to handle the volume of storm water, leading to local flooding in the city centre. Debris on the streets is then flushed into the sea, polluting the sea and beaches.

Foch Avenue and Square were in a very poor condition, with damaged surfaces and having poor visual quality.  Renovation was required to make the environment more welcoming and more useable for visitors, whilst also solving the flooding problems.

## SOLUTION

The solution was to make the parking area of Foch Square water resilient. It is located in a low-lying part of the city, so it will buffer not only rainwater falling there, but also rainwater from nearby areas. By catching, filtering and draining this water, the sea water quality will be improved.

The new Square is surfaced with permeable paving, and the whole Avenue has been redesigned with cycle tracks and swales, offering more sustainable draining solutions within the city centre. Under the parking area there is an innovative underground basin where water can be stored and filtered. Inside the basin, 1.90 meter-high arches enable people to maintain the basin and keep it clear of sand.

Before work started



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## BENEFITS

Other than solving flood episodes and water quality problems, the project has created a high quality urban environment with plantings, new and sustainable urban furniture, plus new walking and cycling infrastructure. This approach reduces the vulnerability of people to road accidents thanks to more space allocated to a cycle path. More parking spaces in the redesigned Avenue and Square reduces parking on pavements, saving on the cost of repairing damaged walkways.

Proposed design

During construction

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# Experience gained from working on SuDs

## EXPERTISE

- Mixed teams of planners, engineers and urban designers are essential to deliver sustainable adaptation solutions.
- Access to expertise can be achieved through public private partnerships, but such approaches need careful preparation and management especially in schemes with mixed objectives.
- Working with suppliers of SuDs solutions to adapt designs to meet site specific needs can deliver effective solutions.
- Nature based solutions can add quality to the public realm.

## PLANNING & STRATEGY

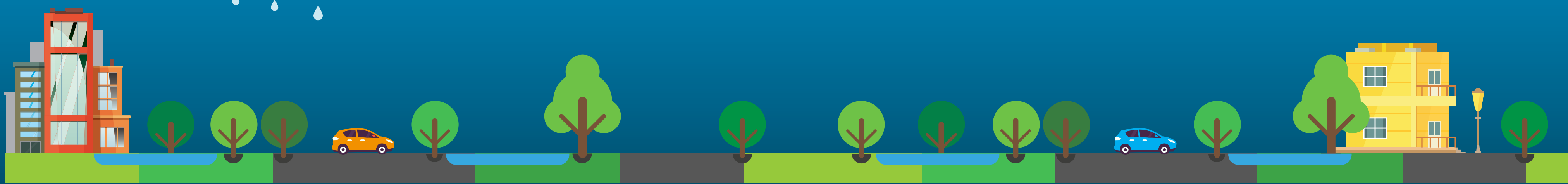
- A strategic planning approach is necessary to connect drainage and permanent water bodies, to integrate SuDs within the urban fabric, and to support urban development priorities.
- Watery landscapes such as in Flanders and Zeeland create complex water management challenges which demand a holistic and strategic response.
- The urban historic environment can yield surprises, adding cost and complexity.
- Effective strategic working between private and public sector can lead to better solutions in difficult locations.

## ADDED BENEFITS

- Well-designed SuDs schemes can bring benefits beyond flood risk reduction, such as for biodiversity, amenity, mobility and the economy. These benefits should be sought from the beginning of the design process.

## INVOLVING THE PUBLIC

- Urban public space serves many different stakeholders with differing needs and perspectives. The planning of SuDs needs sensitivity and strong political leadership.
- Given the sensitivities and complexities of public space involving multiple users and uses, and complex ownerships, planning for retrofitting SuDs should involve the public and stakeholders throughout the planning process.
- The use of a holistic approach, taking into account history, the surroundings, the people and circumstances is important. Also, an open attitude, inclusion and listening enables greater engagement.



# Multiple benefits from SuDS

**Considering what SuDS can deliver in addition to reducing flooding can help to build support for the scheme with political leaders and local stakeholders:**

- Improved public realm has a wide range of social, ecological and economic benefits.
- Integrating SuDS into construction and urban design schemes can reduce the maintenance costs of sewage systems and avoid the need to increase their capacity in response to climate change and urbanisation.
- Multifunctional schemes, designed with additional benefits integrated from the start deliver better value for money.

## WHAT BENEFITS CAN RETROFITTED SuDS DELIVER?

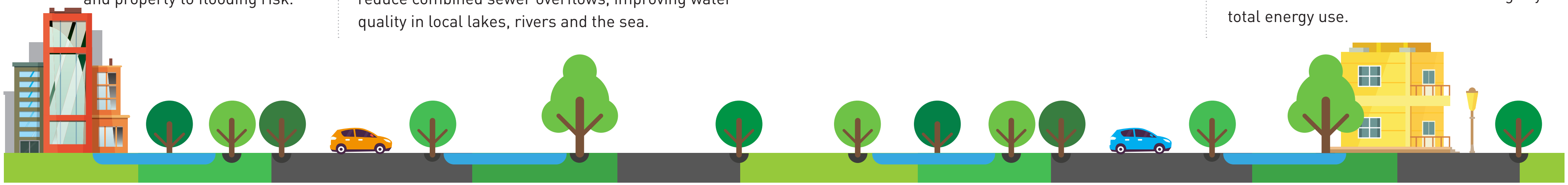
**TECHNICAL: The prevention of damage caused by heavy rainfall or drought**

### Water quantity

Sustainable drainage systems are part of flood risk management, which aim to prevent flooding and prevent the exposure of people and property to flooding risk.

### Water quality

SuDS reduce the amount of sediments and contaminants in run-off water by sediment settlement or biological breakdown of pollutants. They also reduce the amount of water which enters sewers and therefore reduce combined sewer overflows, improving water quality in local lakes, rivers and the sea.







**SOCIAL: The provision of additional amenity benefits**

### High quality living space for improved well being

Surface water management systems can be designed to help create relaxing, pleasurable, usable, useful and fun environments for local communities to enjoy.

### Participation of stakeholders

The participation of stakeholders in the design of SuDS creates a commitment and a feeling of ownership of the solution. It enhances the understanding between stakeholder groups, reducing potential conflicts and promoting effective cooperation.

### Leisure activity

The open spaces created by urban SuDS can provide more space in which people can spend time. They can also enhance the education opportunities for children regarding the environment and wildlife.

### Sustainable mobility

Surface water management components can often be integrated with road space, traffic management schemes and sustainable transport corridors to manage day-to-day drainage and storm overflows, whilst aesthetically enhancing the urban environment.

**ECOLOGICAL: The provision of additional nature conservation benefits**

### Biotope area factor (BAF)

Landscape features that support diverse habitats and associated ecosystems provide a healthy and stimulating environment that can add significant value to urban living. The BAF expresses the ratio of the ecologically effective surface area to the total land area. A higher BAF increases urban resilience to flooding and climate change.

### Biodiversity

With good design, SuDS can provide shelter, food and foraging, and breeding opportunities for a variety of wildlife including plants, amphibians, invertebrates, birds, bats and other mammals.

### Provision of cooling in urban areas

Green and blue spaces provide cooling via the return of moisture to the air through evaporation and evapotranspiration from vegetation and water features, which can help to reduce temperature increases in urban areas and thus reduce the urban heat island effect.

**ECONOMICAL: The decrease of water management costs in the long term**

The volume of water which needs treating at sewage treatment works is reduced through using SuDS. This is due to reduced volumes of surface water runoff entering sewers and drains. Therefore, there is less water that needs pumping and treating through the system. This also reduces treatment costs and reduces the sewage system's total energy use.

# The Quick Scan Tool for SuDS

The Water Resilient Cities project partners have developed a 'quick scan' tool as an aid to designing integrated SuDS schemes. The tool is designed to help project designers to think about the range of additional benefits that could be incorporated and help them to optimise the design. A full guide is available on the Water Resilient Cities website: **www.waterresilientcities.eu**

The aim of the tool is to evaluate the different benefits of a SuDS and to visualise them in a user-friendly format that helps to compare different SuDS options at the same location and identify which one is the most beneficial.

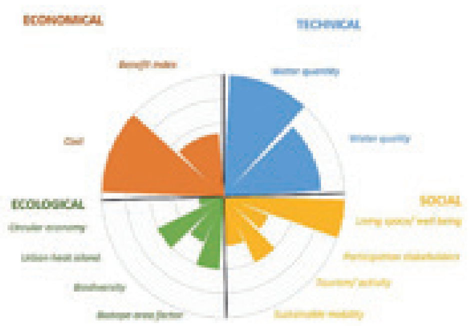
The quick scan tool is divided into four main parts, corresponding to the main objectives of SuDS: technical, social, ecological and economic.

Each category has a number of key performance indicators (KPIs), chosen to reflect the challenges of retrofitting SuDS. In the example below the length of each segment illustrates the value of each KPI resulting from the SuDS solution. By comparing the KPIs of the existing situation, or a different design, a clear view can be gained of the benefits of a SuDS solution.

**The KPIs are based on the benefits of SuDS as described on pages 30-31, with for example:**

- The water quantity KPI reflecting the increase in buffering capacity and the reduction in the impermeable area of land.
- The benefit index KPI reflecting the total cost of the solution in relation to the benefits it provides.

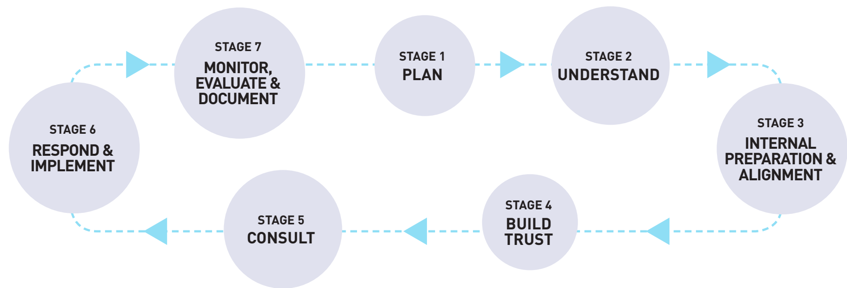
SuDS design 1




SuDS design 2

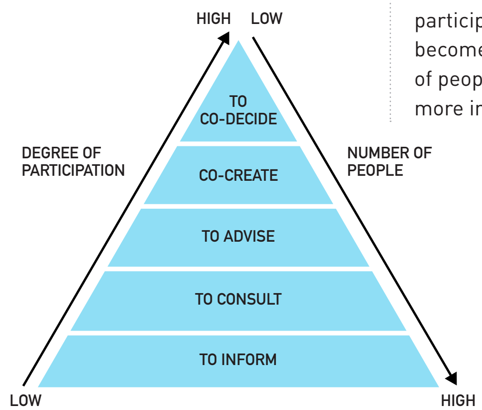



# Stages of a stakeholder engagement process




**The implementation of SuDS should take into account:**

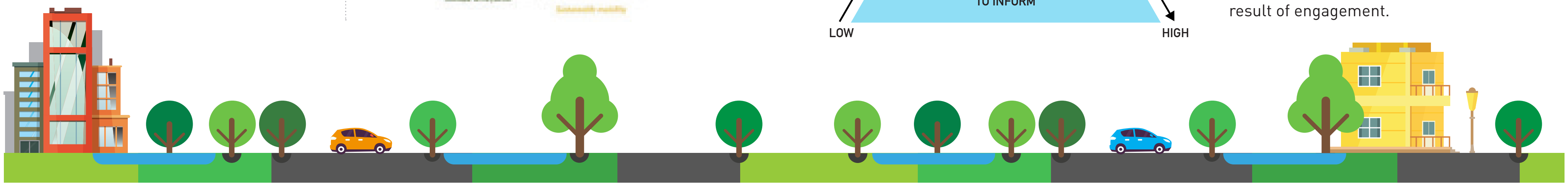
- The local circumstances.
- The specific situation.
- The stakeholders.




Public spaces are used by many stakeholders, amongst whom there will be many different opinions and perspectives. This creates potential for disagreement and conflict, which introduces political, design and financial risks into a project. The level of resources needed for good quality engagement should not be underestimated, but done well it is time and money well spent, delivering better quality schemes, with less time and money spent resolving stakeholder conflicts.

There are different levels of participation as shown in the participation Lubberding pyramid. The degree of participation becomes higher as one ascends the pyramid, and the number of people involved decreases (mostly due to the practicalities of more intense involvement).

The key issue is to explore the relationships between the involved stakeholders, the way trust and loyalty are built in these relationshipships, and how this translates into an overall stakeholder strategy in which communication, opinions and proposals flow in both directions and where the organisation is willing to change its behaviour as a result of engagement.



# Strategic planning

**Strategic planning for SuDS is necessary because in most cases SuDS will need to drain somewhere – they are rarely self-contained systems. That means they must each link to other SuDS and ultimately be connected to the city drainage system.**

In cities, space is at a premium. Strategic assessments will provide information on what additional needs could be fulfilled by any one SuDS scheme, and ensure that, where relevant, these benefits are complementary (for example, in the creation of a wildlife corridor through the design of a series of SuDS).



A guide to retrofitting sustainable drainage systems into urban areas

## ACTION PLANNING GUIDE

Flood risk management and city planning are legal responsibilities for most city authorities. The Water Resilient Cities project partners have tested an action plan approach which brings together urban development and flood management needs and opportunities, and identifies key sites for SuDS action over a 5-10 year period.

Combining flood risk management and city development priorities in action plans at municipal level can be used to stimulate action on SuDS. Combining these objectives will result in better designed and more effective SuDS, and economic savings over the long term.

Our simple three-step procedure builds on standard flood risk and climate change assessment processes that municipalities are required to undertake:

### 1: PRIORITISE ▶

- Identify surface water flood risk zones in the city.
- Prioritise zones for action using criteria; risk of harm (economic, social, environmental); needs for environmental improvement (green, blue, grey); existence of opportunities to retrofit SuDS.

### 2: PLAN ▶

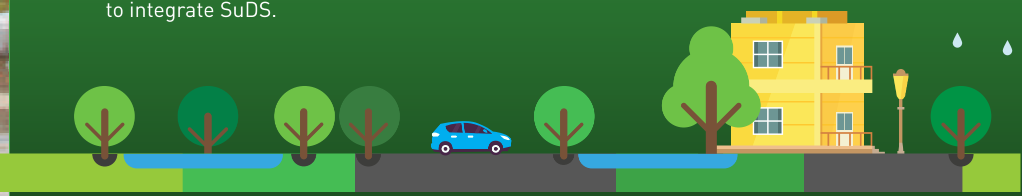
- Identify specific retrofit opportunities, through analysis of options for surface water flood risk mitigation.
- Consider the added benefits from these options as part of the options appraisal process.
- Consider detailed design options, incorporating innovative design or products and aiming to maximise added benefits.

### 3: DELIVER

- Programmatic timetable showing sites to be delivered within 5 years.
- Mechanism for delivery (e.g. in connection with specific redevelopment projects, or through public flood risk management programmes).

**Action plans for retrofitting SuDS, should achieve the following:**

- Presentation of conclusions of city, neighbourhood and site level diagnostics regarding flooding risk, future climate change effects, and existing drainage capacity and infrastructure. Much of this is already necessary under existing flood risk management responsibilities.
- Identify locations in the city which present opportunities for improving storm water drainage through SuDS. This may be related to existing green infrastructure, or planned redevelopments of city buildings or neighbourhoods.
- Assess and prioritise opportunities to integrate SuDS with green spaces.
- Assess and prioritise opportunities to make new green-blue networks that can be integrated with SuDS.
- Identify and assess site-specific drainage options and potential additional benefits for priority sites. Priority sites are those that need early action, or those which are likely to undergo some form of redevelopment in the near future, presenting an opportunity to integrate SuDS.



Interreg
2 Seas Mers Zeeën
Water Resilient Cities
European Regional Development Fund

**Water Resilient Cities** is a partnership of municipalities, water authorities, knowledge centres and SMEs, led by Plymouth City Council. It was established to develop solutions to the increasingly urgent and costly problem of storm water flooding in urban areas. As a partnership we could collectively see the potential of sustainable drainage in urban areas, but knew from experience that there are many challenges to retrofitting them in areas that are already developed.

The Interreg 2 Seas programme gave us the opportunity to create a joint work programme to develop and test solutions. This non-technical guide is both a product of and an introduction to those experiences, gained through pilot investments and related activities in cities in Belgium, France, Netherlands and the UK. It is accompanied by additional web-based resources.

**Dutch:** www.waterresilientcities.nl
**English:** www.waterresilientcities.eu
**French:** www.waterresilientcities.fr

**WE HOPE THAT YOU FIND IT A VALUABLE RESOURCE IN OUR CONTINUAL EFFORTS TO ADAPT TO THE EFFECTS OF CLIMATE CHANGE.**

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