

Water Sensitive Urban Design in the UK –
Ideas for built environment practitioners

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This document provides an overview that sets out the drivers, benefits and vision for Water Sensitive Urban Design (WSUD) in the UK and is based on findings from a collaborative project that included extensive consultation and a literature review to understand the role of WSUD in the UK. There is a more detailed scoping study available from www.ciria.org (CIRIA publication C724). The project outputs have been developed by AECOM and Arup under contract to CIRIA with support from a project steering group and funding from those organisations listed and on the back cover.

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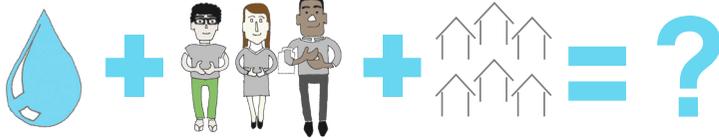
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WATER, PEOPLE AND PLACES



Our cities, towns and villages all have a long and intimate relationship with water and were historically located around a water source, watercourse or coastline as the focus point for life and trade. In modern times, not only do we depend on clean water supply for our daily needs, but we also depend on water to grow our food and produce resources, to transport our goods and waste, beautify our urban areas and provide fun and recreation. Water is often central to the identity of a place. Yet the relationship between the places we live and the water resources we depend on is often not prioritised in the design and evolution of those places. Water shortages, flooding and watercourse pollution are all signs of stress where developed areas have a troubled interaction with the natural water cycle and where, conversely, water has become a risk or a nuisance rather than an asset or an opportunity.

WATER DEFINES OUR PLACES



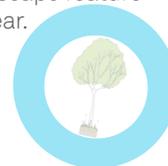
VITALITY: The support and sustenance for a growing population.

IDENTITY: The river, pond, lake or coastline that has become central to the identity of our cities and towns.

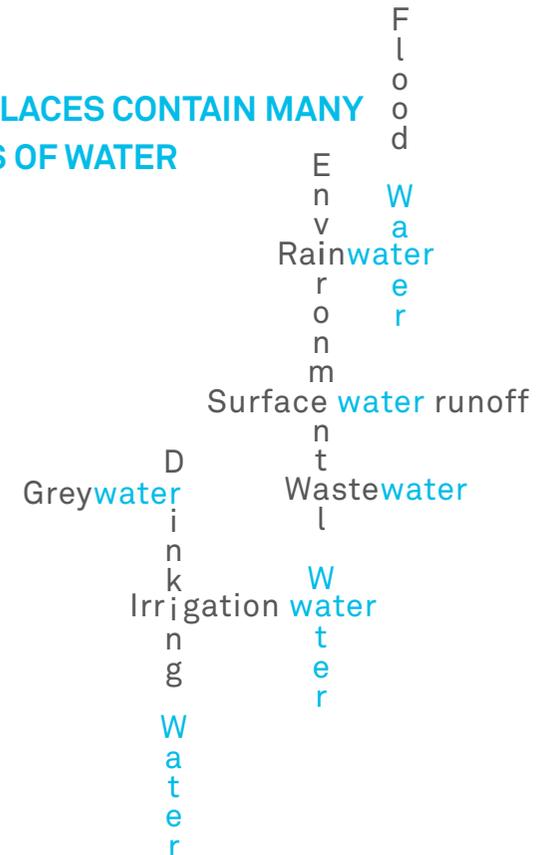
ACTIVITY: A provider of recreation and well-being for all.

HEALTH: The supporter of essential ecosystems and food supplies.

LANDSCAPE: A desirable landscape feature that communities love to be near.

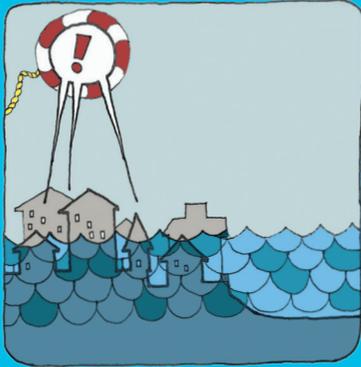


OUR PLACES CONTAIN MANY TYPES OF WATER



WHY CHANGE?

FLOODING



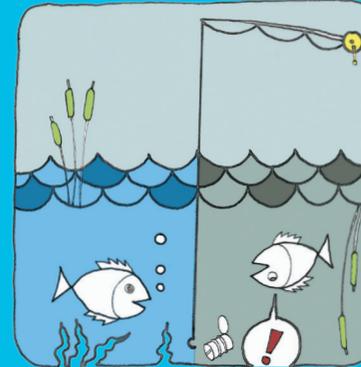
Flooding in parts of the UK in 2007 killed 13 people and cost the economy £3,200,000,000. This will increase if left unchecked.

WATER SHORTAGES



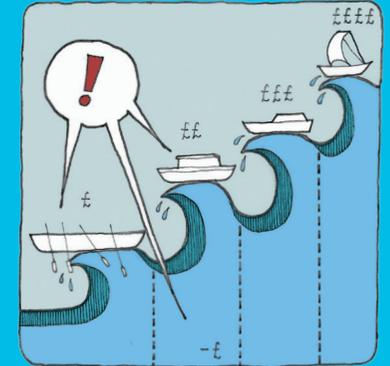
20 million customers in the UK experienced hose pipe bans in 2012 to limit stress on water resources.

WATERCOURSE HEALTH



27% of water bodies in England do not meet water quality standards. Significant investment is being made to improve the quality of the UK's water courses to meet European standards.

AFFORDABILITY OF WATER



We need to keep water bills affordable while recognising the increasing strain on water resources.

RE-CONNECT PEOPLE WITH WATER



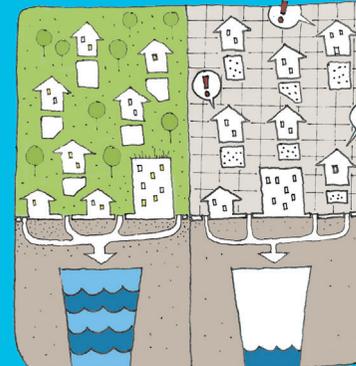
Urban places and spaces have become detached from water as infrastructure has been hidden underground.

ENCOURAGE CROSS-DISCIPLINARY WORKING



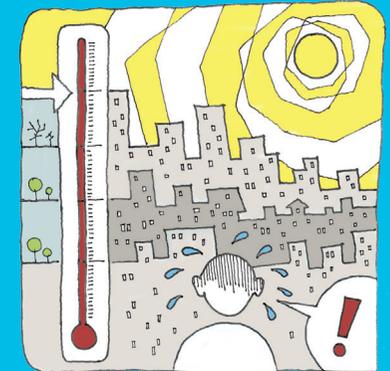
Practitioners involved in water management and in designing places are often not working closely enough.

SUPPORT GROWTH



The population continues to grow and demand new water infrastructure. Already water-stressed south east England will grow by 23% by 2035.

SUPPORT LIVEABLE URBAN PLACES



London loses 2.5 Hyde Parks of green space per year as gardens are paved over. Climate change will heighten heat stress in paved urban areas.

INTRODUCING WATER SENSITIVE URBAN DESIGN

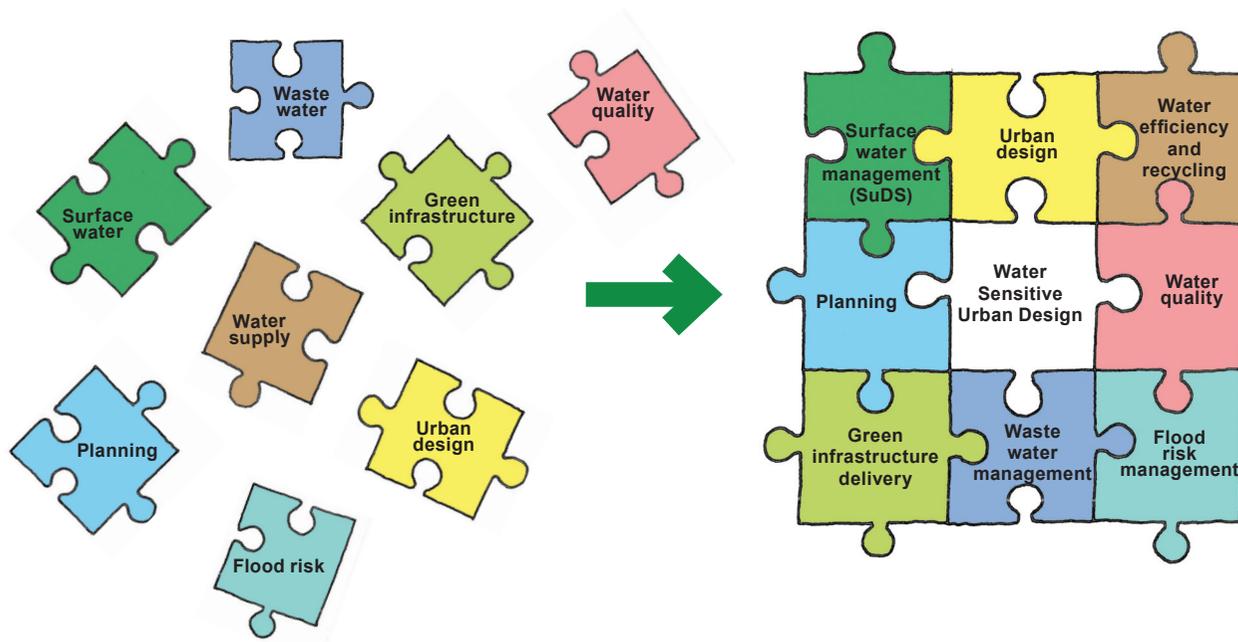


Water Sensitive Urban Design is the process of integrating water cycle management with the built environment through planning and urban design.

Two principles are essential to its application:

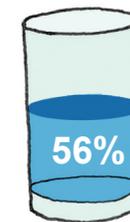
- 1 All elements of the water cycle and their interconnections are considered concurrently to achieve an outcome that sustains a healthy natural environment while meeting human needs. This includes managing:
 - a Water demand and supply
 - b Wastewater and pollution
 - c Rainfall and runoff
 - d Watercourses and water resources
 - e Flooding and water pathways
- 2 Consideration of the water cycle is made from the outset, and throughout the design and planning process. Accordingly, water management solutions seek to meet the expectations and aspirations for design of successful places, such as:
 - a Celebrating local character, environment and community
 - b Optimising the cost-benefit of infrastructure and built form
 - c Improving quality of life for communities
 - d Providing resource security and resilience in the future.

Water Sensitive Urban Design is the process. Water sensitive places are the outcome.

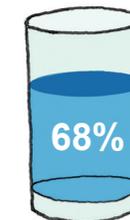


WSUD can be applied at all scales...

When consulting with built environment professionals about water sensitive urban design:



56% of the survey respondents believe Water Sensitive Urban Design to be rarely practised in the UK and only 1% think it is commonly practiced.



68% of survey respondents had heard of Water Sensitive Urban Design.



83% of survey respondents believe that water management is considered too late in the planning and design process for developments.

WHAT COULD A WATER SENSITIVE HOUSE LOOK LIKE?

URBAN FORM:

Semi-detached home
Front and back garden

WATER CONTEXT:

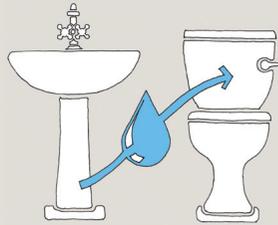
Downstream flooding
Desire for high water quality in local harbour
Water security concerns
Water metering in place
Moderate soil permeability

COMMUNITY CONTEXT:

Cary and Tim own the house
Cary enjoys gardening
Both looking to save money
Both are environmentally conscious
Home on edge of city bordering ecological area

WATER REUSE

One simple solution could be using grey water from the sink for flushing the toilet - saving money and reducing wastewater leaving the house.



RAIN GARDEN

Cary disconnected her back downpipe to help reduce runoff from the property and reduce neighbourhood flooding. It now drains to a rain garden, which soaks up rain so Cary's plants thrive without her watering them.

GREEN ROOF

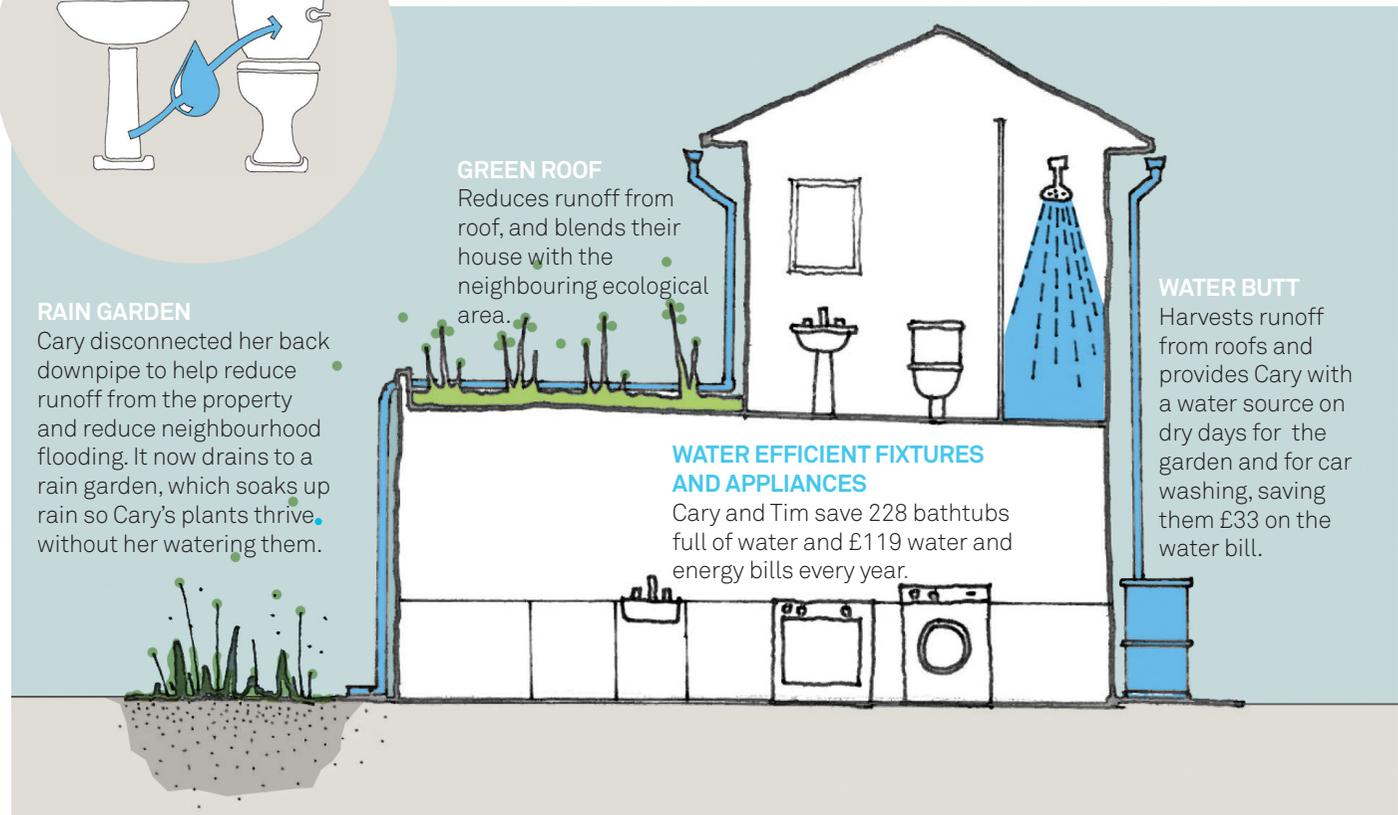
Reduces runoff from roof, and blends their house with the neighbouring ecological area.

WATER EFFICIENT FIXTURES AND APPLIANCES

Cary and Tim save 228 bathtubs full of water and £119 water and energy bills every year.

WATER BUTT

Harvests runoff from roofs and provides Cary with a water source on dry days for the garden and for car washing, saving them £33 on the water bill.



WHAT COULD A WATER SENSITIVE BLOCK OF FLATS LOOK LIKE?

URBAN FORM:

High-rise flat
Public spaces are dull and unused

WATER CONTEXT:

Next to river with variable level
High water stress area
Combined sewer system at capacity

COMMUNITY CONTEXT:

Amy and Jeremy rent a flat for themselves and their two children
Tight budgets
Communally managed flats
No good recreation space for adults or children

GREEN ROOF

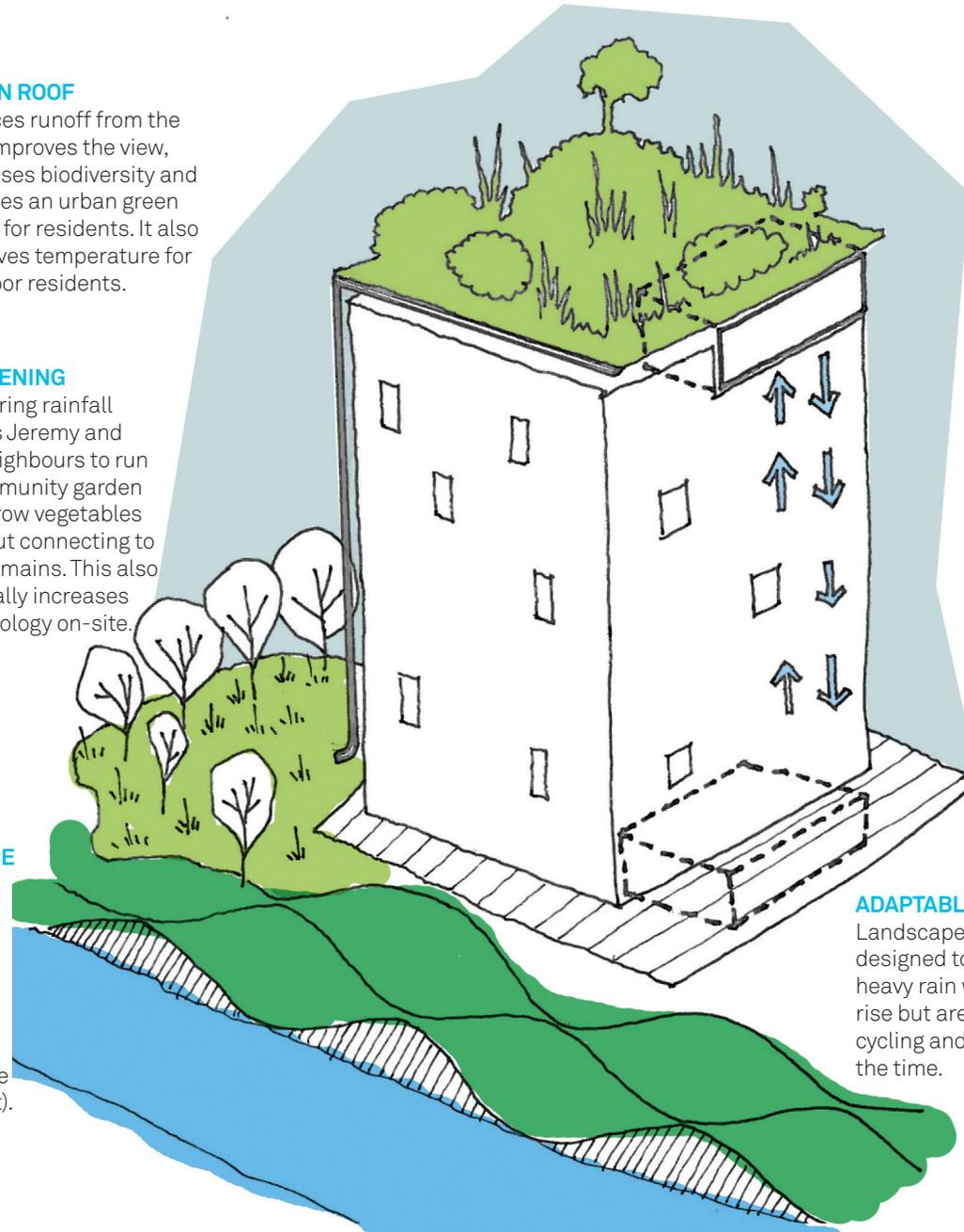
Reduces runoff from the roof, improves the view, increases biodiversity and provides an urban green space for residents. It also improves temperature for top floor residents.

GARDENING

Capturing rainfall allows Jeremy and his neighbours to run a community garden and grow vegetables without connecting to water mains. This also naturally increases the ecology on-site.

QUIET GREEN SPACE

Converting paved area to green space provides a pleasant space for residents, reduces runoff and reduces the urban heat island effect (where materials like concrete retain heat).



GREYWATER RECYCLING

Greywater from flats is recycled reducing water bills and the amount sent to sewers and treated. The building manager runs a communal system.

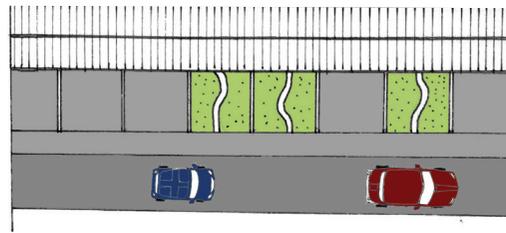
GROUND FLOOR RESILIENCE

The ground floor should be designed or retrofitted to be flood resilient and with an appropriate low-risk use to mitigate any damage that might occur if flooding does happen.

ADAPTABLE SPACE

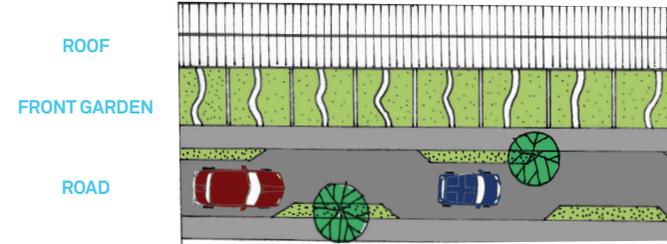
Landscaped areas that are designed to be floodable during heavy rain when water levels rise but are great for walking, cycling and playing the rest of the time.

WHAT COULD A WATER SENSITIVE EXISTING NEIGHBOURHOOD LOOK LIKE?



BEFORE: IMPERMEABLE ROADWAY AND PAVED FRONT GARDENS

Gradual increase of impermeable area as front gardens have been paved over has increased surface water runoff and pressure on existing sewer infrastructure.



AFTER: RETROFIT PERMEABLE SURFACES AND SUSTAINABLE DRAINAGE SYSTEMS (SUDS)

Returning permeability and introducing additional runoff treatment and storage reduces pollution and downstream flooding as well as improving urban ecology, amenity and property value.

URBAN FORM:

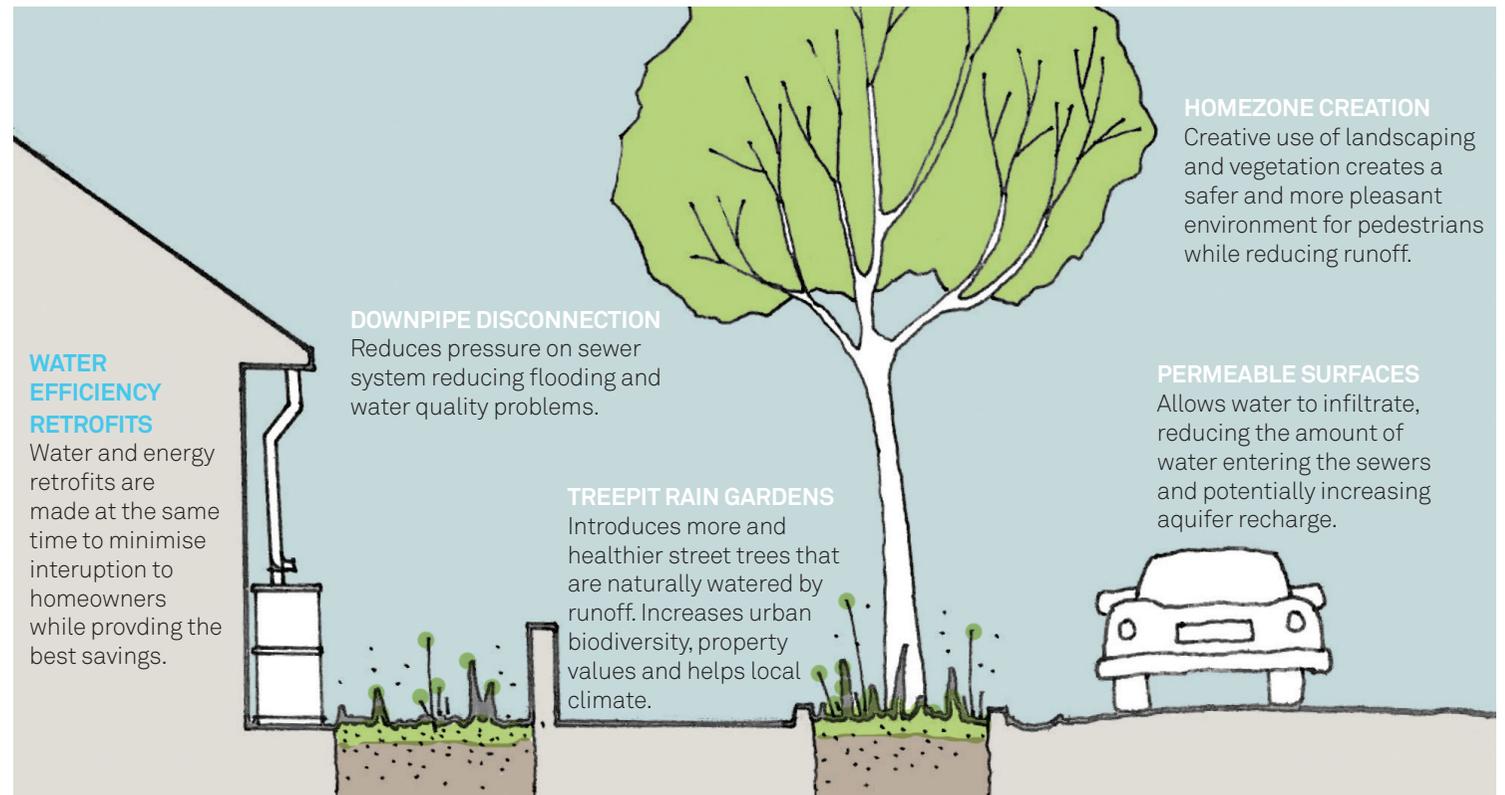
Existing medium density neighbourhood
Terraced and semi-detached properties

WATER CONTEXT:

Surface water flooding
Strained existing infrastructure

COMMUNITY CONTEXT:

Family area
Strong architectural character
Need for street safety and pedestrian priority



WATER EFFICIENCY RETROFITS

Water and energy retrofits are made at the same time to minimise interruption to homeowners while providing the best savings.

DOWNPIPE DISCONNECTION

Reduces pressure on sewer system reducing flooding and water quality problems.

TREEPIT RAIN GARDENS

Introduces more and healthier street trees that are naturally watered by runoff. Increases urban biodiversity, property values and helps local climate.

HOMEZONE CREATION

Creative use of landscaping and vegetation creates a safer and more pleasant environment for pedestrians while reducing runoff.

PERMEABLE SURFACES

Allows water to infiltrate, reducing the amount of water entering the sewers and potentially increasing aquifer recharge.

WHAT COULD A WATER SENSITIVE COMMERCIAL AREA LOOK LIKE?

URBAN FORM:

Supermarket adjoined by a carpark and carwashing facility

WATER CONTEXT:

Surface water flooding
High concentrated demand for low quality water in carwash facility

COMMUNITY CONTEXT:

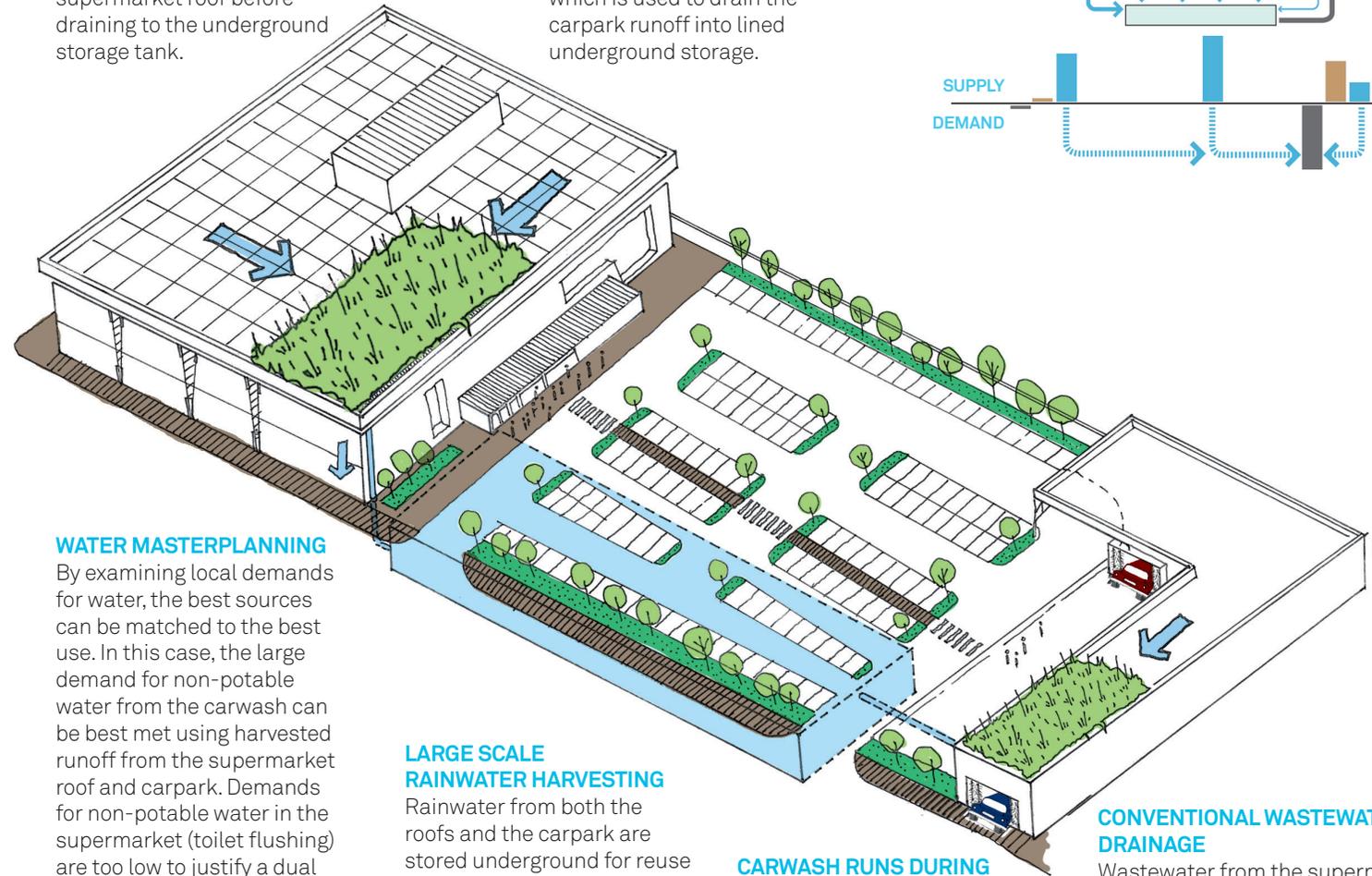
The supermarket owners would like to maximise car parking space while creating an attractive environment
Carwash owners looking to reduce water costs

BLUE-GREEN ROOF

Water is initially stored and treated on a section of the supermarket roof before draining to the underground storage tank.

SPACE EFFICIENT SUDS

Integrating permeable paving and treepit rain gardens, which is used to drain the carpark runoff into lined underground storage.



WATER MASTERPLANNING

By examining local demands for water, the best sources can be matched to the best use. In this case, the large demand for non-potable water from the carwash can be best met using harvested runoff from the supermarket roof and carpark. Demands for non-potable water in the supermarket (toilet flushing) are too low to justify a dual supply.

LARGE SCALE RAINWATER HARVESTING

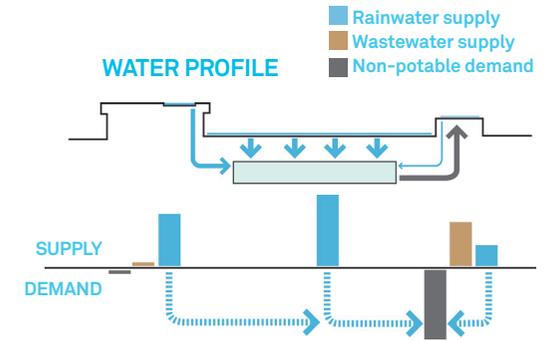
Rainwater from both the roofs and the carpark are stored underground for reuse by the neighbouring carwash. Runoff from the site is greatly reduced.

CARWASH RUNS DURING HOSEPIPE BANS

A local non-potable source of water from harvested rainwater runoff means that the carwash can operate during a hose pipe ban.

CONVENTIONAL WASTEWATER DRAINAGE

Wastewater from the supermarket and carwash are transferred to the local wastewater treatment plant. An on-site system could have been used to recycle wastewater from the carwash for reuse, but rainwater harvesting provided a lower cost and lower carbon solution.



WHAT COULD A WATER SENSITIVE NEW DEVELOPMENT LOOK LIKE?

URBAN FORM:

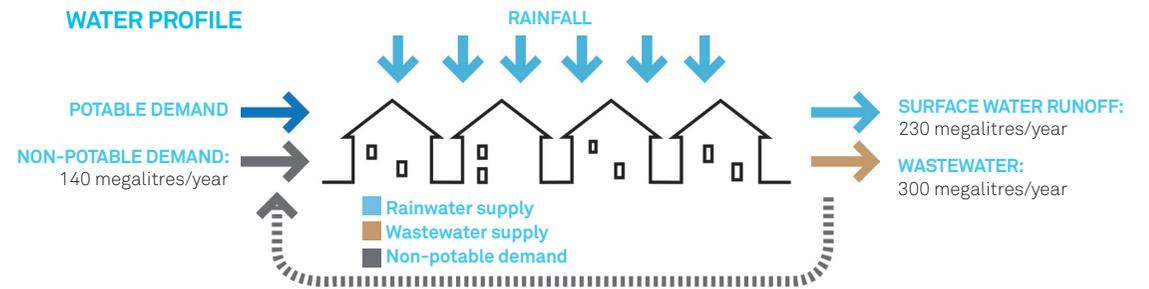
New mixed use urban extension
3500 new homes
Code for Sustainable Homes level 5 target

WATER CONTEXT:

Driest area of the UK
Water infrastructure needs to be extended and upgraded
Downstream flooding issues

COMMUNITY CONTEXT:

Sustainable living desired
Mix between rural and urban living



FLOOD AVOIDANCE

Location of new development should be outside areas of flood risk.

WATER CYCLE STUDY

Completed at masterplanning stage to inform layout and design. Holistic strategy formulated to manage water supply, wastewater and drainage to meet Code for Sustainable Homes targets.

HIGH STANDARD HOMES

Water efficient fixtures to maximise water efficiency.

BLUE-GREEN CORRIDORS

Creates channels for surface runoff to collect, be treated and flow overland through the development. Creates multi-functional green grid to raise value of homes and provide recreation and pedestrian movement corridors.

WETLANDS

Provides a natural environment for water capture and filtration and potential recharge of aquifers.

WATER HARVESTING AND STORAGE

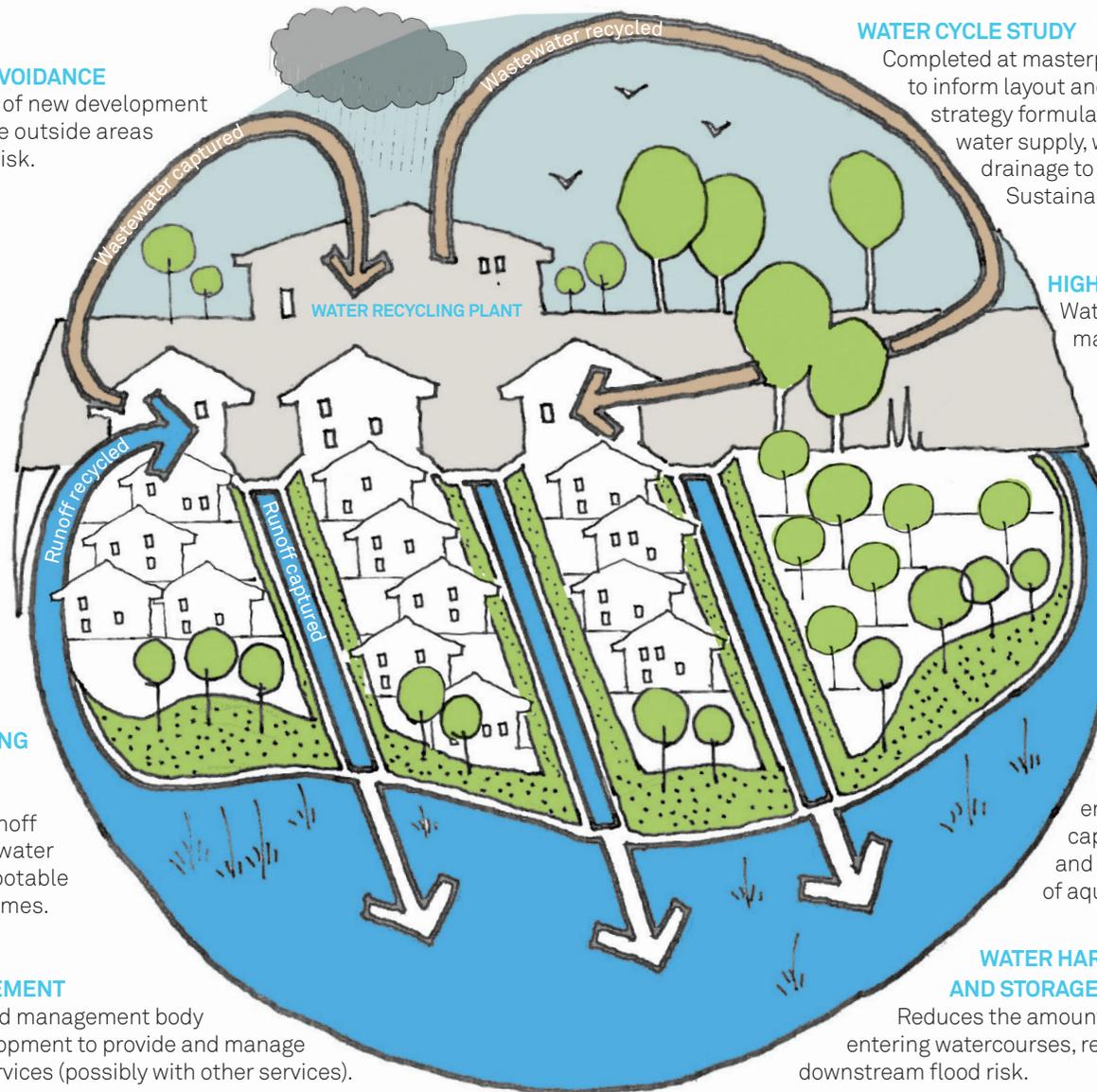
Reduces the amount of water entering watercourses, reducing downstream flood risk.

ON-SITE WATER RECYCLING PLANT

To treat either runoff or wastewater for non-potable use in homes.

LOCAL MANAGEMENT

Dedicated management body for development to provide and manage water services (possibly with other services).



WHAT COULD A WATER SENSITIVE CITY LOOK LIKE?

URBAN FORM:

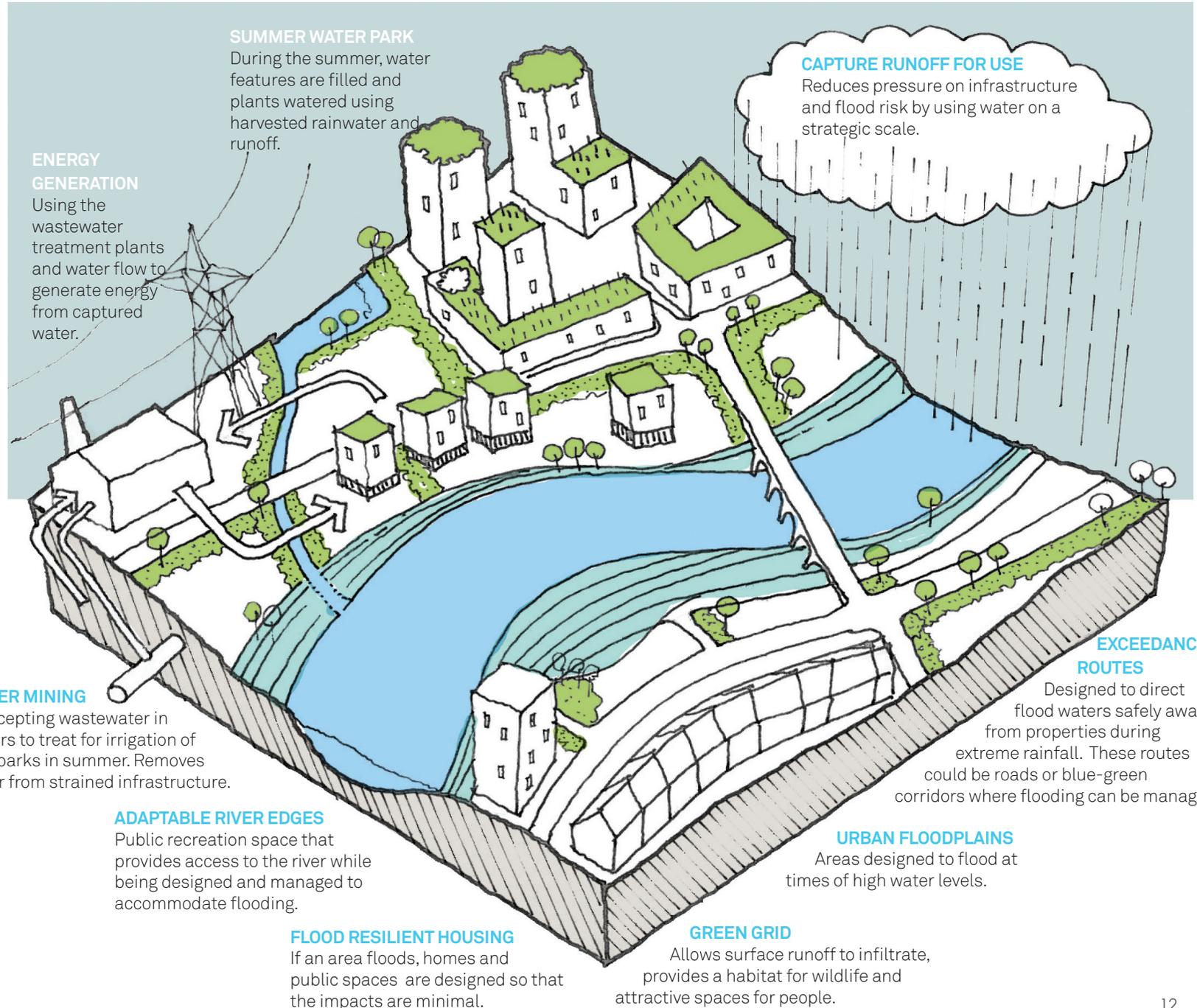
Large urban area centred on river corridor
City centre dominated by paved areas
Significant growth targets

WATER CONTEXT:

Lack of capacity in sewer system
Serious flood risk
High rainfall and low water stress

COMMUNITY CONTEXT:

Pockets of deprivation
Neighbourhood parks and recreation space needed



ENERGY GENERATION
Using the wastewater treatment plants and water flow to generate energy from captured water.

SUMMER WATER PARK
During the summer, water features are filled and plants watered using harvested rainwater and runoff.

CAPTURE RUNOFF FOR USE
Reduces pressure on infrastructure and flood risk by using water on a strategic scale.

SEWER MINING
Intercepting wastewater in sewers to treat for irrigation of new parks in summer. Removes water from strained infrastructure.

ADAPTABLE RIVER EDGES
Public recreation space that provides access to the river while being designed and managed to accommodate flooding.

FLOOD RESILIENT HOUSING
If an area floods, homes and public spaces are designed so that the impacts are minimal.

GREEN GRID
Allows surface runoff to infiltrate, provides a habitat for wildlife and attractive spaces for people.

EXCEEDANCE ROUTES
Designed to direct flood waters safely away from properties during extreme rainfall. These routes could be roads or blue-green corridors where flooding can be managed.

URBAN FLOODPLAINS
Areas designed to flood at times of high water levels.

WHY WE WANT WATER SENSITIVE URBAN DESIGN

Quotes from people working and living in our communities



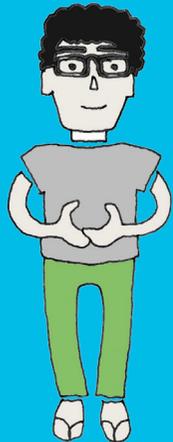
SPATIAL PLANNER:

'This should be an essential component of delivering sustainable development. Yes, it will help meet runoff targets and water efficiency targets, but it will also support great place-making and add value for communities.'



WATER COMPANY:

'Holistic consideration of water in the urban catchment can deliver significant benefits over traditional approaches to water management. By taking a holistic view of water in the urban environment we can find integrated solutions that look for synergies over individual solutions.'



ARCHITECT/URBAN DESIGNER:

'Water isn't given the priority and attention it should have in design of the built environment. Water is being designed out when really we should be designing it in. A good design will carefully craft in good water management practices with occasional moments of flamboyance to celebrate water. Water needs to be a core consideration thrown into the mix with all the other aspects that make great places.'



LOCAL AUTHORITY:

'We don't want to stifle growth in the future so we need to be smarter about how we plan and design development to grow while maintaining our natural resources.'



HOUSE BUILDER:

'Cross-disciplinary working is essential the more you can do upfront, the easier it is to take it forward. If things are brought into the process too late there can be serious implications so developers want to know what is needed up front. We are used to a changing planning context, so our approach has to be flexible.'



ECOLOGIST:

‘WSUD is a very practical opportunity to develop locally appropriate responses for water management that also deliver green infrastructure and habitat. It seems we all want the same result, and we can deliver great solutions by bringing initiatives and skills together.’



ACADEMIC:

‘Even though there is the desire to integrate better, market forces can work against that. Silos can be reinforced in academia - they aren’t just in industry. All professions involved in the built environment need to be educated in a little bit of everyone else’s work and also in pressing issues like water. We need to think about the structure of an ideal team, what everyone does, and ensure education matches those teams.’



LOCAL RESIDENT:

‘It would be great to have more street trees and water for my garden, while at the same time saving on energy bills. If this can be done in a way that is also water efficient and beneficial to the environment, it would make me feel good about the place I live.’



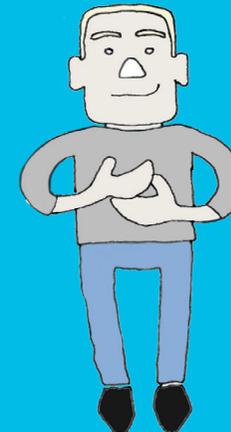
HOUSING ASSOCIATION:

‘Water sensitive urban design could create much more interesting and engaging places for local people. We often work with very small budgets for gardens and food growing projects, and often struggle to get a water source to a site, so using new ways of capturing water is great and financially beneficial. People love the idea of creating a peaceful and natural landscape in urban areas where kids can splash through water areas. Huge amounts can be done if you use a little bit of imagination.’



LANDSCAPE ARCHITECT:

‘It’s impossible to separate WSUD from wider sustainability opportunities. Solutions need to be community specific and environment specific – design has to be central. The good news for designers is that they are already part of that process. You need designers who are used to working with sites and understanding sites to implement WSUD.’

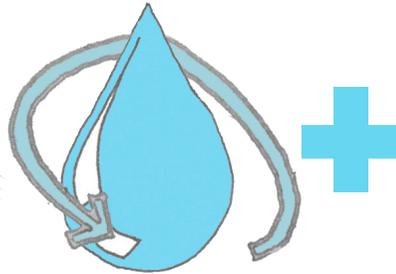


WATER ENGINEER:

‘We typically manage water in different stakeholder boxes and I don’t think we are joined up. For example we aren’t joining the dots on flood risk management with water resource management, we could be holding onto more of our flood water for reuse rather than rushing it out to sea.’

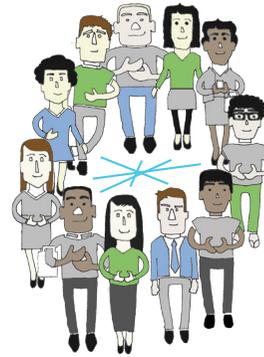
WHAT NEXT?

Water Sensitive Urban Design is an opportunity to create beautiful, successful and resilient places. It is undeniable that the relationship between water and our urban areas needs to be given a higher priority to provide integrated solutions to flood risk management, sustainable water use and supply and the improvement of water quality in our treasured watercourses. This priority needs to be applied in an integrated way by the people and partners that plan and design the built environment. In doing so, we can bring together the skills and creativity of practitioners who plan and design the places we live in to bring much wider benefits to communities.



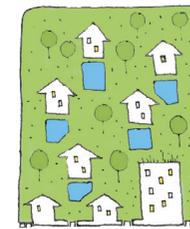
CONNECT the water cycle

Seek the best solution for all aspects of the water cycle by thinking about water supply, wastewater, surface water runoff and flood management.



COLLABORATE with other disciplines

Seek out others built environment practitioners who can bring new perspectives and expertise.



CREATE great solutions for great places

Plan and design the built environment to respond to urban form, community needs and water issues.

**water
sensitive
urban
design**

Who we are

Established in 1960, CIRIA is a highly regarded, industry-responsive, not for profit research and information association, which encompasses the construction and built environment industries.

CIRIA operates across a range of market sectors and disciplines, providing a platform for collaborative projects and dissemination by enhancing industry performance, and sharing knowledge and innovation across the built environment.

As an authoritative provider of good practice guidance, solutions and information, CIRIA operates as a knowledge-base for disseminating and delivering a comprehensive range of business improvement services and research products for public and private sector organisations, as well as academia.



How to get involved

- **Core membership**

Allows your employees to assist with the development of and access to good practice guidance, formal networks, facilitation, conferences, workshops and training.

- **Associate membership**

Allows your employees to access CIRIA's services. Members are able to access exclusive content via the CIRIA website.

- **The CIRIA Network**

A member-based community where clients and professionals meet, develop and share knowledge about specific topics relevant to construction and the built environment.

- **CIRIA Books Club**

Members can buy most CIRIA publications at half price and can attend a range of CIRIA conferences at reduced rates.

- **Project funding**

Project funders influence the direction of the research and gain early access to the results.

- **LACL (Local Authority Contaminated Land Network)**

LACL helps local authorities address responsibilities under Part IIA of the Environmental Protection Act 1990.

- **EMSAGG (European Marine Sand and Gravel Group)**

CIRIA provides secretariat support to EMSAGG, including management of the Group's conferences, workshops and website and producing its newsletter.

- **BRMF (Brownfield Risk Management Forum)**

Promoting sustainable and good practice in brownfield projects in the UK.

CIRIA manage or actively participate in several topic-specific learning and business networks and clubs:

Where we are

Discover how your organisation can benefit from CIRIA's authoritative and practical guidance – contact us by:

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MWH

National Grid UK Ltd

Network Rail

Northumbrian Water Limited

Rail Safety and Standards Board

Royal HaskoningDHV Ltd

RSK Group Ltd

RWE Npower plc

Scottish Water

Sellafield Ltd

Sir Robert McAlpine Ltd

SLR Consulting Ltd

Tarmac

Temple Group Ltd

Thames Water Utilities Ltd

United Utilities Plc

University College London

University of Reading

University of Sheffield

University of Southampton

WYG Group (Nottingham Office)

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