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WWF
DEALING WITH
THE DELUGE
Urban water management
in a changing climate

FOREWORD

Welcome to our first report on water management in our towns and cities. In this report we focus on the benefits of using innovative, sustainable urban drainage schemes to protect freshwater ecosystems, mitigate the effects of climate change and help to reduce the impact of flooding.

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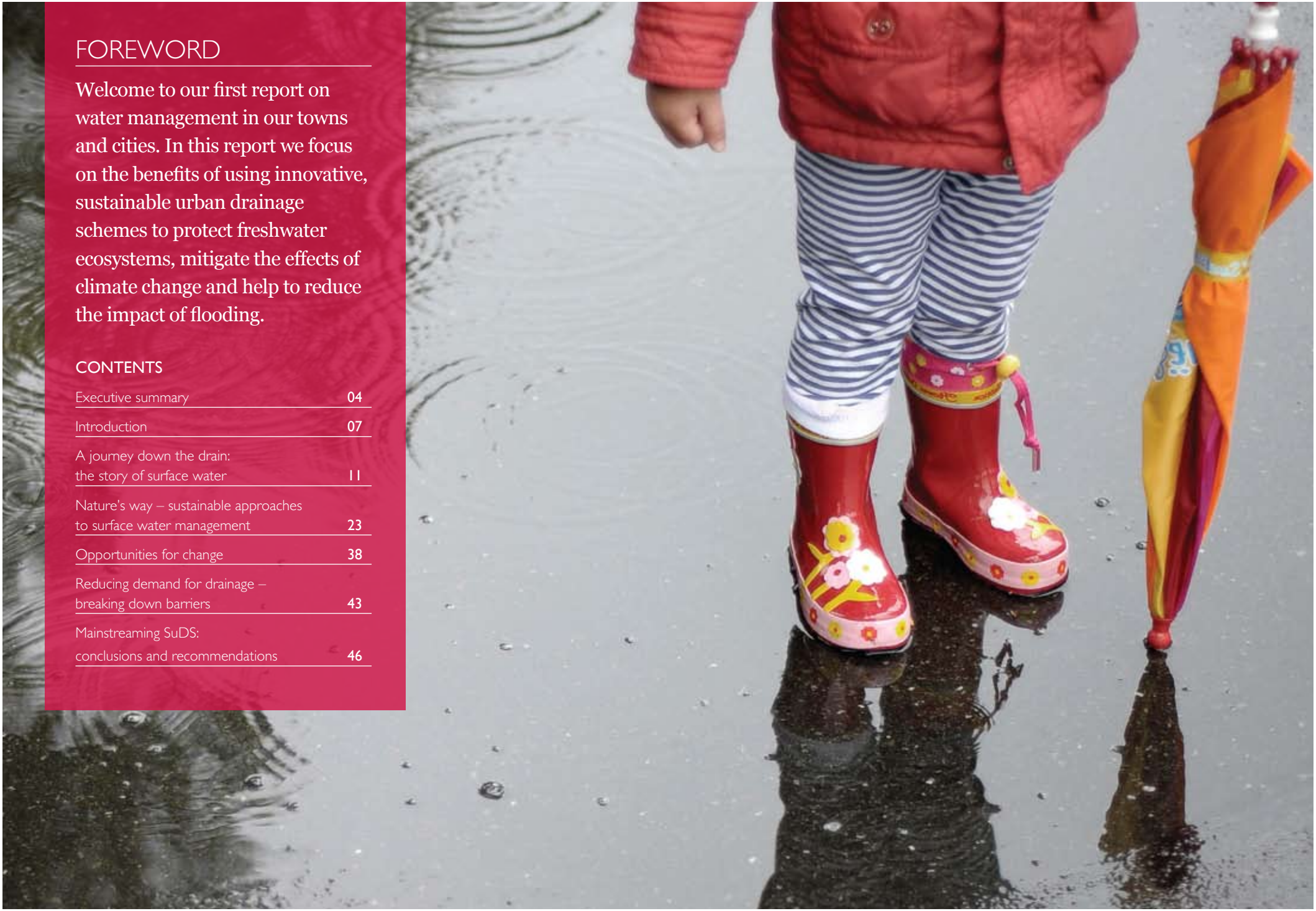


Adrian Brown
UK CEO, RSA

Sustainable drainage systems, or SuDS, use natural environmental processes to help slow, store and clean water. These processes are better for the environment and often cost less than traditional systems too. SuDS provide benefits for communities and nature, increasing our resilience to climate change in the longer term.

In this report, we'll highlight how restoring nature's capacity to deal with surface water can benefit wildlife and people. We're raising awareness of the many opportunities and advantages of using SuDS in towns and cities. Our particular focus is on retrofitting existing buildings and developments, as part of an integrated approach to modern water management. With pressure on Government spending, a holistic approach to water management may also help reduce cost.

The insurance industry plays an important role in protecting individuals and businesses from the consequences of natural disasters such as floods and helping communities to recover when disaster strikes.

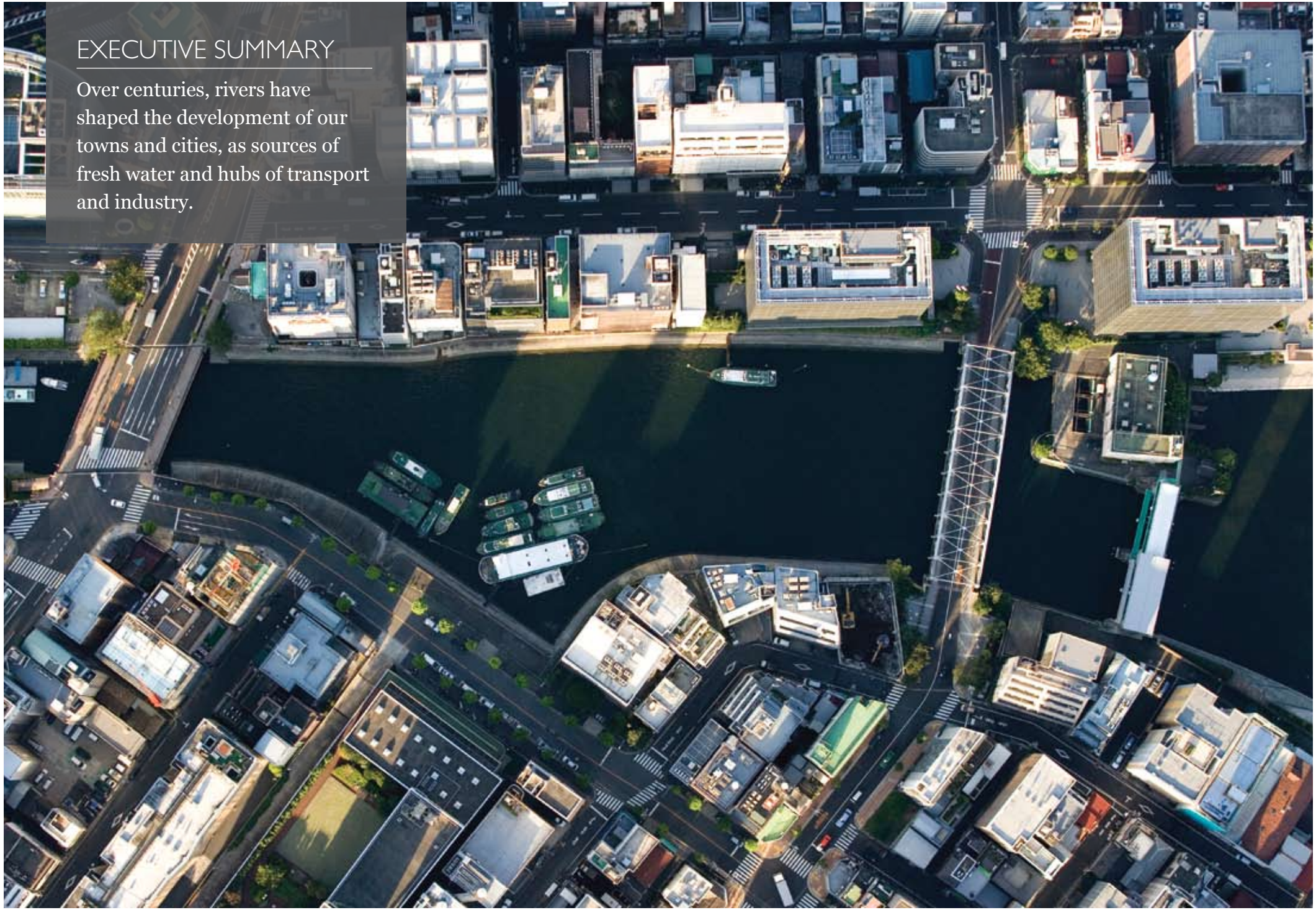
One in six homes in England are already at risk of flooding and the cost of protecting them is set to swell to £1bn a year by 2035, according to the Environment Agency in its recent National Assessment of flood risk. A big factor in preventing flooding is having the right drainage systems in place.

Through our own experience of dealing with flood victims, we're already supporting the local community to deliver a demonstration project at Mayesbrook Park in Dagenham, London. The project will restore the Mayes Brook, allowing the river to naturally meander across its floodplain – an example of sustainable drainage in action.

As a leading global insurance company, we believe that by supporting flood-proof measures and promoting practical steps that customers can take to minimise risk in preparing for extreme events, we can help manage these risks in a sustainable and responsible way.

Adrian Brown, UK CEO, RSA

I hope you find this report useful. For further information on our partnership with WWF please visit www.wwfrsapartners.com



EXECUTIVE SUMMARY

Over centuries, rivers have shaped the development of our towns and cities, as sources of fresh water and hubs of transport and industry.

Today, many of our great urban rivers provide a blue corridor in an otherwise grey landscape. They offer opportunities for relaxation, leisure and other activities which enhance well-being. In many places, they're also a haven for wildlife.

Over the last 30 years there has been considerable progress in tackling sewage and reducing industrial outfalls, to the benefit of our urban rivers. However, most remain under significant threat from the pollution that washes from our streets when it rains.

We have increasingly developed river valleys, urbanised our landscape and built on flood plains. We've squeezed rivers into straight, deep channels and hid them away in concrete culverts or manmade sewers. As a result, drainage systems in towns and cities are struggling to cope with heavy rains and water run-off, faced with a landscape that is increasingly impermeable.

Overwhelmed sewers often result in raw sewage being discharged into rivers and the sea, with disastrous effects on wildlife.
They can also cause surface water flooding, which creates millions of pounds of damage and immense emotional and financial stress. Currently, almost four million properties in England and Wales are at risk of surface water flooding.

Climate and land use change will have significant impacts on water, affecting patterns of rainfall, run-off and river flow with increasing uncertainty and variability. Increasingly, our towns and cities will need to cope with high volumes of surface water.

WWF is working with RSA to demonstrate how using natural processes through SuDS can best manage surface water.
SuDS can bring benefits to nature (by improving water quality and boosting biodiversity) and to people (by reducing flood risk and enhancing communities). There are huge opportunities for using SuDS in existing buildings and developments – in our gardens, schools and businesses and in roads, pavements and car parks.

In contrast to the traditional approach of managing surface water by piping it quickly away from vulnerable, valuable places protected by defences, SuDS technologies offer an alternative. They mimic natural processes by slowing flow, providing storage and encouraging water to soak into the ground and reduce the amount of water entering manmade sewage or drainage systems.

Examples include wetlands, ponds, green roofs, permeable paving and urban river restoration.

The existing evidence base shows that retrofitting SuDS can result in multiple benefits:

- improved water quality;
- reduced carbon emissions (because less water volume means less sewage treatment);
- reduced pluvial and sewer flood risk;
- aquifer recharge (relieving stress in water scarce areas);
- enhancement of urban spaces; and
- increased biodiversity.

There can also be financial benefits. SuDS can be cheaper to install and maintain than augmenting the existing sewer and drainage systems.

Adapting to climate change is such a huge challenge that it requires a 'twin track' approach, with SuDS working alongside more conventional solutions. While there has been considerable progress towards implementing SuDS in new developments (due to the Floods and Water Management Act 2010), retrofit is not commonplace in the UK, despite a number of proven examples from here and across the world.

Broadly speaking, this is not due to limitations with SuDS technology. WWF believes that the real barriers to wider SuDS implementation are social, cultural and political. SuDS are effectively a form of demand management (they can manage water 'at source' and reduce demand on built drainage and sewerage infrastructure).

Because they cannot be easily implemented within the current institutional, regulatory and legislative context, the familiar underground pipe and engineering solutions prevail.

The examples of SuDS retrofit from the UK and abroad show that successful projects involve multiple partners with strong leadership who engage the community. Public procurement and regulation (such as the recent amendment to planning regulations relating to paving front gardens) can also have a key role.

Significant barriers to SuDS retrofit include:

- lack of information on surface water risk and the benefits of SuDS;
- low awareness and expectations relating to SuDS amongst the general public and the professional community (such as planners and developers);
- shared risks and benefits that are difficult to capture in the current planning, cost-benefit and decision making approach;
- limited incentives for property owners, councils and water companies to install SuDS;
- lack of understanding about the need for a catchment approach and incentives; that encourage installing 'upstream' SuDS to protect 'downstream' properties;
- a regulatory framework and tradition of bias towards 'predict and provide' rather than demand management.

If SuDS are to be seen as an effective and viable part of water management in the UK we need an enabling legal and policy framework that requires and rewards sustainable surface water management, with strategies to facilitate partnership working, to encourage sharing information and defining roles and responsibilities. The framework must also enable the knowledge, skills, finances, partnerships and public engagement necessary to implement SuDS.

There remains significant scope to change the way we manage surface water, in order to create, through retrofit, a sustainable drainage network that can reduce the risk of flooding and reduce levels of pollution in our precious rivers and wetlands.

This approach requires everyone – Government, regulators, sewage and insurance companies, local authorities, and NGOs – to work together to:

- develop a policy and regulatory framework that encourages sustainable surface water management;
- lead by example and increase capacity and innovation within the sector; and
- improve awareness and understanding of surface water impacts and encourage take-up of SuDS.

Full implementation of the Floods and Water Management Act 2010, development of a number of Surface Water Management Plans and the Water and Natural Environment white papers offer significant opportunities to mainstream SuDS retrofit as part of a green infrastructure approach to urban design and modern water management.

There remains significant scope to change the way we manage surface water, in order to create, through retrofit, a sustainable drainage network

INTRODUCTION

Climate change is set to significantly impact how we experience water. It will affect patterns of rainfall, run-off and river flows and, above all, it will increase uncertainty and variability. Safeguarding our ecosystems, while securing reliable water supplies and managing increased amounts of surface water, represents some of the most urgent climate change adaptation challenges we face in the UK.

People and nature are already suffering as we struggle to cope with existing climate variability. Pollution associated with the run-off from heavy downpours threatens precious native biodiversity that needs clean water to survive.

One in six properties in England is at risk of flooding, with expected damage to property estimated to cost over £1bn a year[1]. At the same time, we're struggling to cope with periods of water stress (a third of our river catchments are at risk because we are taking out too much water[2]).

Managing surface water presents a significant challenge. Poorly managed surface water can impact people and nature. Surface water can cause flooding when heavy rainfall exceeds the capacity of local drainage and river systems; it can also cause sewer flooding when heavy rains overwhelm the capacity of the sewers.

Surface water flooding is difficult to predict and it is difficult to identify households at risk[3]. Despite this, the Environment Agency estimates that there are 3.8 million properties in England at risk from surface water flooding[4].

As well as the emotional and financial impacts of poor surface water management, there are also considerable environmental impacts. Over 800 water bodies (rivers, lakes or wetlands) in England and Wales are at risk from urban diffuse pollution[5] – pollutants washed into rivers and streams from roads, gardens or household sewer pipes incorrectly plumbed in to storm drains.

Each year there are thousands of instances where excess surface water inundates the sewer system, exceeding the capacity at sewage treatment plants and resulting in raw, untreated sewage being directly discharged into rivers or the sea (a Combined Sewer Overflow (CSO)). In 2008, in England alone there were over 14,000 consented CSOs[6] that during high flows can discharge untreated sewage, which can have adverse effects on the local ecology.

Climate change models suggest that future winter rainfall events will be larger and more intense, resulting in more frequent and higher volume flood events[7]. UK Water Industry Research (UKWIR) suggests that we could be facing a 180% increase in the amount of surface water we will need to manage.[8] The Environment Agency estimates that the cost of dealing with this using the current approach (i.e. increasing storage capacity) would be tens of billions of pounds[9].

WWF is working with RSA to demonstrate how the use of natural processes can help manage surface water better, bringing benefits to nature (by improving water quality and boosting biodiversity) and to people (by reducing flood risk and enhancing communities). This report focuses on the range of opportunities and advantages of using SuDS to better manage surface water in our towns and cities.

While there has been considerable progress towards better implementation of SuDS in new developments (e.g. the Floods and Water Management Act 2010) to fully maximise the benefits of SuDS we need to go much further by incorporating them into our urban landscape. This is why this report focuses on the opportunity for retrofitting SuDS in existing buildings and developments as part of an integrated approach to modern water management.

SUSTAINABLE WAYS TO MANAGE WATER

In the context of climate change, it is even more important to shift to sustainable water management that focuses on addressing demand and pollution at source, rather then expensive 'end of pipe' solutions.

The impacts of climate change, related to the quantity, quality and timing of water, will be complex and hard to predict, with uneven and sudden change. The inherent uncertainty in climate change models suggests that climate change adaptation strategies should be iterative and take a risk-based approach, using scenarios to consider sensitivity to climate change rather than using deterministic projections of impact.

Because of this uncertainty, We advocate achieving robust adaptation through three responses[10]:

Shaping strategies that can be implemented immediately for identified risks (including 'low regret' measures, such as water efficiency, that offer wins today, as well as under future climate scenarios;

Hedging strategies that enable responses to potential, but uncertain, future risks (e.g. developing organisational capacity and adaptive regulation, such as sustainable water allocation systems); and

Signposts to develop capacity to identify emerging change (e.g. targeted monitoring systems).

In 2006, WWF in partnership with other leading environmental organisations set out its blueprint for sustainable water management[11]. It outlined its vision for integrated water management – a world where we waste less water and price it fairly, make polluters pay and properly treat our waste water rather than washing it straight into rivers.

Now, more than ever, it is important to make this change. We need smarter water management that is resilient and responsive to natural variability and tackles the increasing demand on water management systems. We need to fully engage with the public to talk about water and the value it brings to our society.

Sustainable drainage systems are a key part of the 'blueprint' solution. Using SuDS, in place of, and alongside, traditional 'hard engineered' solutions, offers multiple benefits. This report presents a case for SuDS both in the UK and abroad.

SuDS can:

- prevent flooding;
- reduce pressure on sewer and drainage infrastructure and associated costs;
- cost less to implement than traditional hard engineering approaches;
- relieve water stress;
- reduce overheating in urban areas;
- reduce CO2 emissions;
- improve biodiversity;
- improve social spaces; and
- bring benefits for health and well-being.

Despite this multitude of benefits, SuDS are not widely implemented in the UK. There is huge opportunity to retrofit SuDS in our towns and cities – in parks and gardens, roads and driveways, pavements and car parks.

Because of their reliance on natural catchment processes, SuDS technologies can form a more sustainable approach to the management of surface water (compared to conventional underground pipe and storage-based solutions).

BLUEPRINT FOR WATER: 10 STEPS TO SUSTAINABLE WATER BY 2015

Waste less water
Reduce water consumption by at least 20% through more efficient use in homes, buildings and businesses.

Keep our rivers flowing and wetlands wet
Reform abstraction licensing to reduce pressure on rivers, lakes and wetlands today and increase flexibility to adapt to future climate change.

Price water fairly
Make household water bills reflect the amount of water people use and the value of water.

Make polluters pay
Ensure that those who damage the water environment bear the costs through more effective law enforcement and tougher penalties.

Stop pollutants contaminating our water
Introduce targeted regulations to reduce harmful pollutants in water.

Keep sewage out of homes and rivers and off beaches
Upgrade the sewage system to reduce discharge of sewage into urban environments and ecologically sensitive areas.

Support water-friendly farming
Help farmers to deliver healthy rivers, lakes, ponds and wetlands, and provide a range of other sustainable benefits to society.

Clean up drainage from roads and buildings
Create a modern urban drainage network that can mitigate surface water flooding and trap pollution.

Restore rivers from source to sea
Regenerate rivers, lakes and wetlands in partnership with local communities.

Retain water on floodplains and wetlands
Protect and restore large areas of wetland and floodplains to create vital wildlife habitats, improve water quality and quantity, reduce urban flooding and maintain carbon stores.

CHANGING POLICY AND PRACTICE

Government, regulators and the insurance industries are increasingly recognising that the traditional engineering approach, while removing a potential threat from one area, often simply passes large quantities of water forward so that it becomes someone else's problem downstream[12,13,14].

Uncontrolled and rapid urban run-off not only increases the risk of downstream flooding, but also has an adverse effect on river corridor habitat. The modern drainage engineer is therefore faced with challenges in maintaining the levels of flood protection demanded by society, while not causing damage to the natural environment or rapidly transmitting problems further down the catchment.

While there has been significant investment in reducing flood risk by building better flood defences, this approach could prove to be an overly expensive response in the face of future pressures of climate change and increasing urban development of our landscape[15]. The important challenge today is how to better manage surface water and reduce the preference for built infrastructure and defences. This can achieved by dealing more effectively with excess water at its source.

In recent years, partly in response to significant flooding events, the Government has passed new policy (*Future Water*) and legislation (the Floods and Water Management Act in 2010) setting out its approach to sustainable water management. The Flood and Water Management Act was a step forward in developing the right conditions for regulators, developers and private landowners to implement more sustainable forms of drainage and natural systems of managing water flows.

The Act clarified responsibilities for flood risk, gave local authorities powers to manage surface water and will require all new developments to comply with national standards to connect to the sewer system. However, more legislation is needed to champion SuDS retrofitting and resolve some of the policy barriers, such as uncertainty about the viability of the systems.

As part of providing evidence for the use of SuDS, CIRIA (the Construction Industry Research and Information Association) is preparing specific guidance on SuDS retrofit[16]. Their work, along with the case studies presented in this report, demonstrate that the technologies to mainstream sustainable approaches exist and are widely used elsewhere.

The barriers to SuDS implementation in the UK are largely related to cultural expectations and the difficulties recognising non-monetised and multi-sectoral benefits within the current policy framework. This report attempts to illustrate these problems and presents some recommendations for further changes in policy that could help mainstream SuDS in towns and cities across the country.

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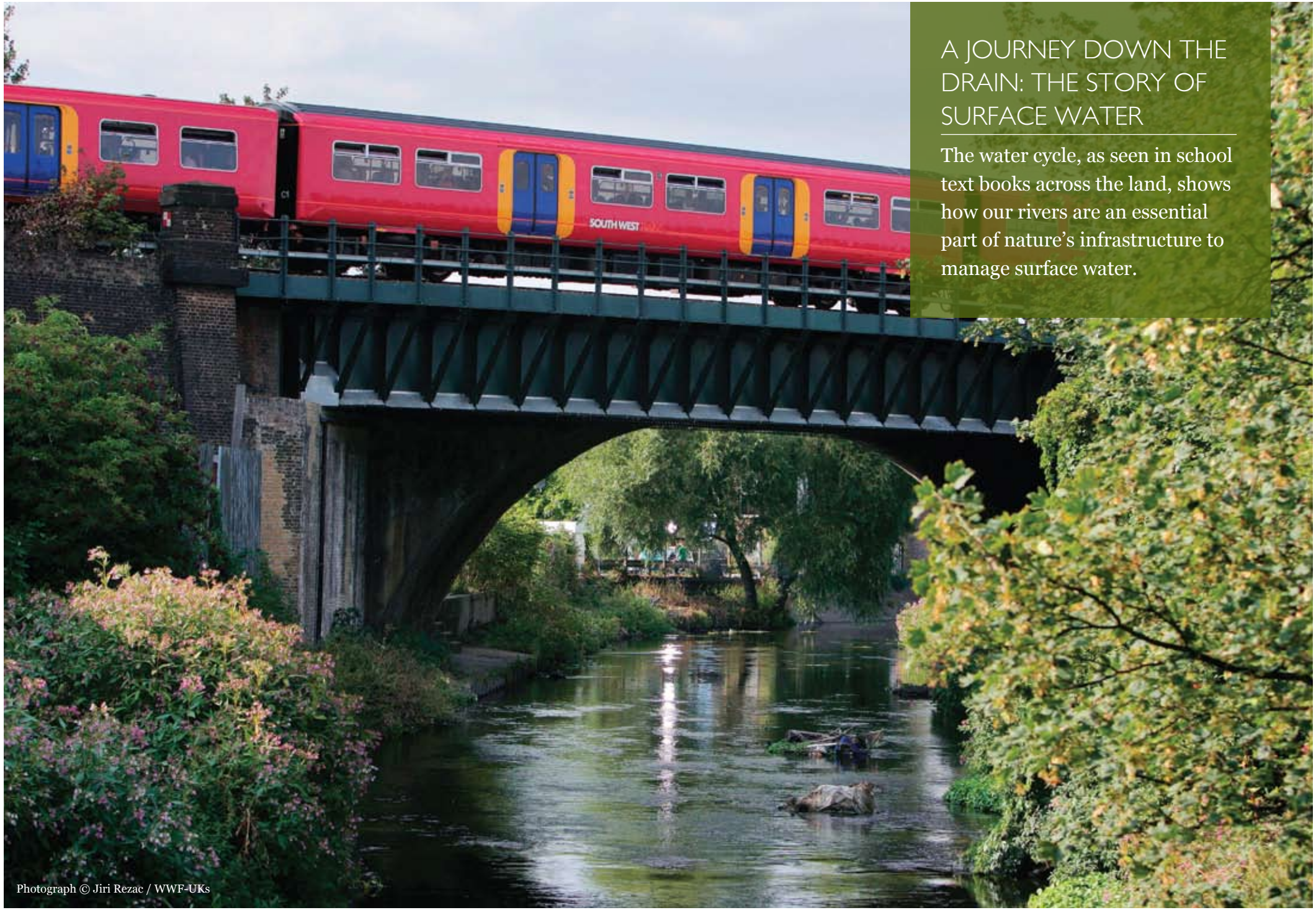
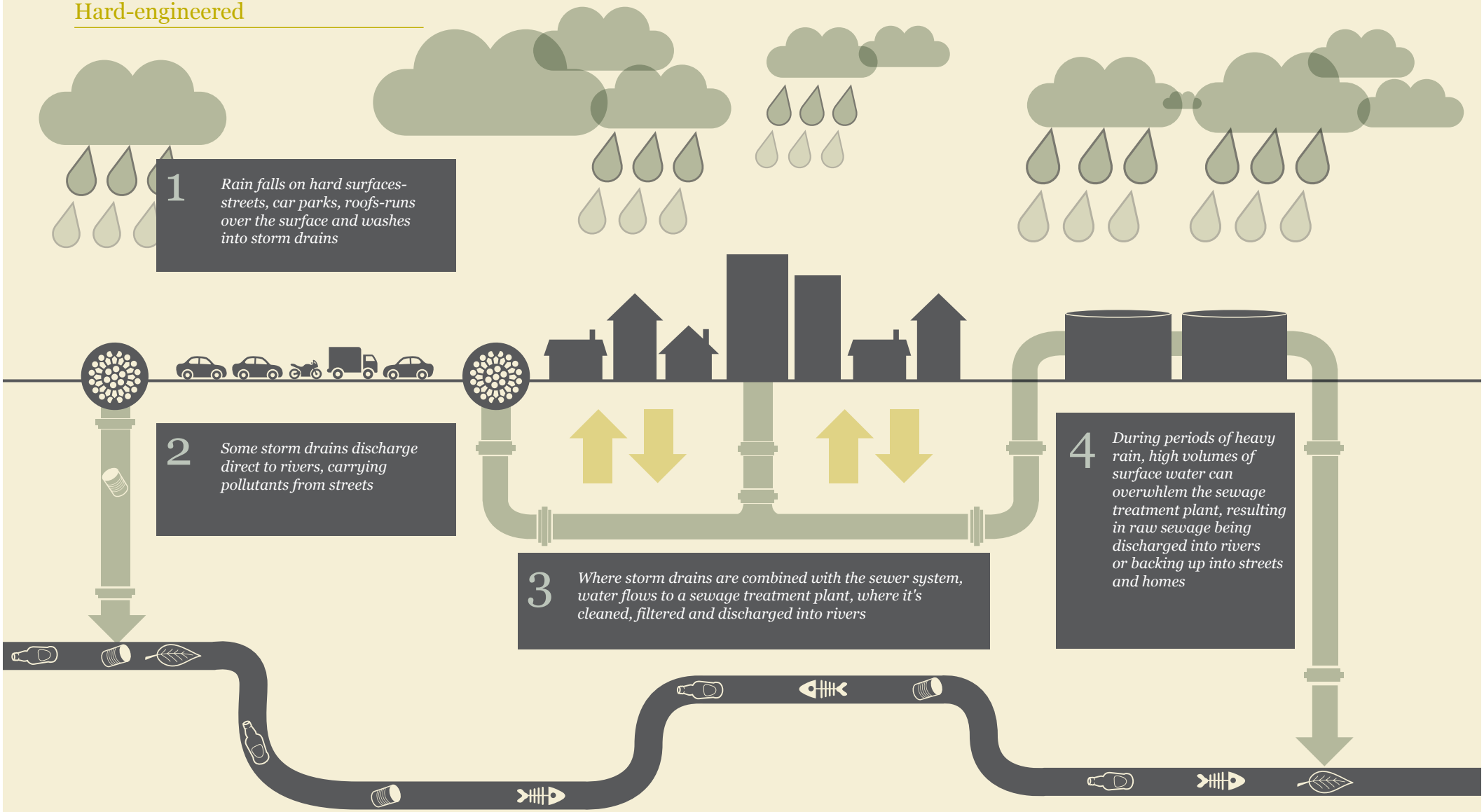


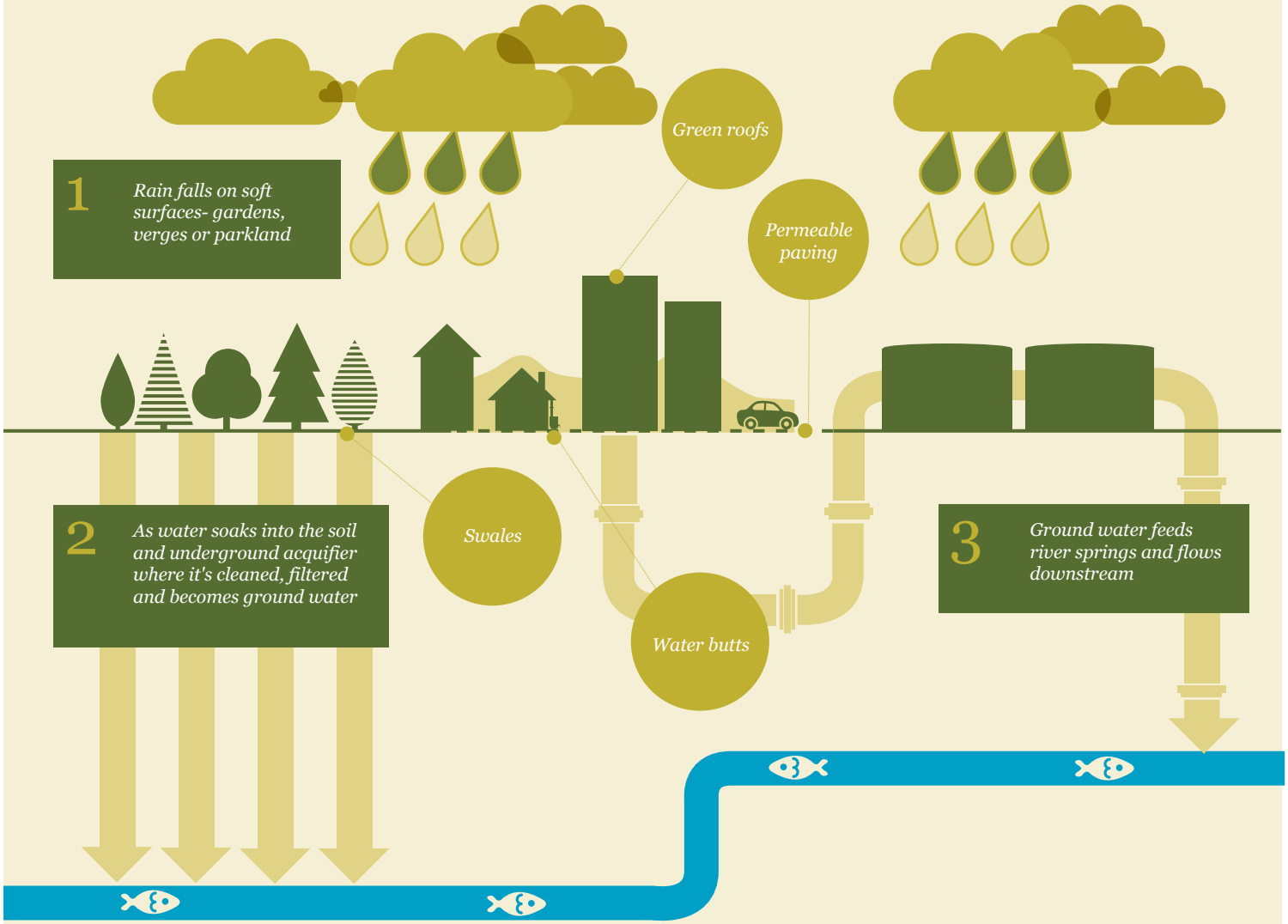
A JOURNEY DOWN THE DRAIN: THE STORY OF SURFACE WATER

The water cycle, as seen in school text books across the land, shows how our rivers are an essential part of nature's infrastructure to manage surface water.

SURFACE WATER CYCLE:
Hard-engineered



SURFACE WATER CYCLE:
Natural



The water cycle, as seen in school text book across the land, shows how our rivers are an essentinal part of nature's infrastructure to manage surface water. Rain water falls, floodplains and aquifers slow and store water and rivers and streams take water away from the land and out to sea. However, this picture of the water cycle misses one essential ingredient: people. It doesn't take into account our demands for using water, the consequences of ridding ourselves of water we don't want and moving rainwater away from our properties.

Over centuries we have tailored, adjusted and even side-stepped parts of the natural cycle in order to engineer solutions to our needs. As our population grew, we bought more and more water in to be managed, pumping water from rivers and underground aquifers into our towns for use in our homes and businesses. Once we've used it, we need to get rid of it – so it goes back in rivers or out to sea.

URBAN CREEP

As our towns and cities have grown, changes to the land have made natural storage systems useless or unavailable. Years of urban development, landscape change and home improvements which result in increased hard surfacing (patios, drives, extensions and conservatories) have drastically reduced the amount of natural space available to absorb water.

For example, between 3-5% of London's land area consists of front gardens and, in 2005, about two thirds were paved to allow for off-street parking. This directly affects the ability to absorb surface water and increases run-off[17]. To help reduce the effect of paving, amendments to the permitted development rights were introduced in 2008[18]. Householders now wishing to pave over their front garden with an impermeable surface must apply for planning permission; those using permeable surfaces (such as gravel) do not. The Pitt Review (which drew lessons for water management from the 2007 floods) also recommended extending this approach for back gardens and non-domestic developments[19]. Our hard urban surfaces are often designed to collect and rapidly discharge storm water and move it quickly away from valuable urban areas to natural water courses. Urbanisation of an area increases both the volume and speed of surface water run-off. It also results in poorer quality water, as it is degraded by contact with pollutants from numerous urban sources such as petrol spills and other debris on roads. When it is discharged into the natural environment, this 'diffuse urban pollution' can have devastating effects on the natural environment.

Floodplains are an important a part of a river as the channel. Yet they have also been increasingly lost through development, channelling and culverting. As we've paved over floodplains we've limited the effectiveness of natural soak-aways, such as chalk and sandstone, and put ourselves at high risk of flooding. Our growing population and demand for housing will result in continued pressure on land. This could result in even more developments being situated on floodplains[31].

As we've paved over the floodplain we've limited the effectiveness of natural soak-aways, such as chalk and sandstone, and put ourselves at high risk of flooding

TOXIC SURFACE WATER IN THE RIVER TAME

The city of Birmingham sits above the headwaters of the River Tame. The Tame is a tributary of the River Trent, which is one of the largest rivers in England and flows through a highly urban and industrialised landscape[20]. It's especially noted for its fishery and, following significant reductions in industrial pollution in the latter 20th century, salmon were reintroduced. The upper tributaries are now an important salmon spawning ground[21].

The Upper Tame and its tributary, the Rea, suffer from high amounts of urban diffuse pollution washed from the streets of Birmingham, industrial estates and from household sewers which are accidentally connected to the stormwater drainage system ('misconnections')[22]. This has resulted in poor water quality, which has an ongoing effect on river ecology. Local fishermen have reported a continual decline in catch records[23]. The River Basin Management Plan classifies the rivers as 'bad' and 'moderate' ecological status, with failures for fish and invertebrate populations due to urban pollution and run-off[24]. There have also been a number of significant incidences where whole fish populations have been killed[25]. For example, in June 2009 heavy rains washed high levels of pollutants – heavy metals, oil and litter – from the streets of Birmingham into the Tame. These pollutants, along with overflowing storm sewage, killed thousands of fish including barbel, chub, dace, roach, trout, bream and perch[26]. As a result, the Angling Trust and local angling clubs launched a campaign to stop this happening again.

Poor surface water management has also caused numerous large scale flooding events, including seven in the ten years to 2009. Pressure from the angling community, coupled with the need to improve water quality, reduce flood risk and improve social well-being (with the additional pressure of an extra 100,000 people by 2026) has driven Birmingham City Council, in partnership with the Environment Agency and others, to explore wider use of SuDS retrofit[27,28].

The council has won support and funding to develop a Surface Water Management Plan. There are plans to use river restoration to improve water quality, reduce flood risk and increase amenity value[29]. Other SuDS options proposed include using green roofs (particularly on large industrial buildings), buffer strips and swales to store and convey water to natural watercourses and down-pipe disconnections[30].

Public awareness campaigns are planned to reduce misconnections and increase understanding of how the drainage system impacts the natural environment (such as the 'Yellow Fish' campaign where drains are painted with yellow fish as a reminder). In addition, there are plans for better monitoring at the most polluting drainage outfalls in order to identify sources of pollution.

Photograph © Angling Trust

In June 2009 heavy rains washed high levels of pollutants from the streets of Birmingham into the Tame

SEWER SOLUTIONS

In the past, we've engineered solutions to manage our water. The traditional approach has been to remove all surface water run-off and wastewater flows from urban areas as quickly as possible via piped drainage systems.

Our underground network of sewers and pipes are perhaps one of the most important urban advances. Today, thousands of miles of manmade drainage systems protect our towns and cities from flooding and the transmission of waterborne diseases. These buried pipelines are hidden from view and the general public is largely unaware of their existence.

The rainwater that drains from hard surfaces such as roofs, car parks and driveways in most cases flows into drainage pipes that are managed and maintained by the sewerage companies. There are major costs associated with upkeep of the drainage system (approximately £600m per year). Without proper maintenance, surface water flooding can occur[32].

Up to the middle of the 20th century, most sewers were constructed as, or evolved to become, combined systems – carrying sewage and foul water from homes as well as rainwater from street drains and guttering. Since then, separate sewer systems have become the norm for new development. However, combined systems still dominate many of our urban drainage systems. The majority of towns and cities in the UK have a central core of combined sewers, with peripheral and more recently developed areas serviced by separate sewer and drainage systems.

In many cases, the local topography and distance from a suitable 'receiving water' dictates that the new, separate systems actually discharge into older, downstream combined sewers. Surface water may also enter separate sewers because of infiltration and illegal connections.

Even in the 21st century, combined sewer overflows – where large volumes of surface water exceed sewer capacity and cause raw sewage to be discharged directly to the natural environment – are still common. They are designed and licensed as 'safety valves' for the sewer system and help to prevent sewer flooding by allowing storm water to move quickly through the system. They survive because the volume of water in the sewer system during heavy rainfall would be prohibitively expensive to treat at the sewage treatment works. To do so would mean developing larger treatment works and sewers that are oversized in order to cope with volumes during infrequent heavy rainfall events. Upsizing sewers is an expensive business. In 2009, Ofwat approved a £1.2bn water company investment to build new sewer infrastructure and prevent 1,400 homes from sewer flooding[33].

The rationale behind the CSO approach is that the highly polluting raw sewage is significantly diluted by the surface water run-off. However, despite the considerable dilution, CSOs contain significant amounts of a wide variety of pollutants, including bacteria and viruses, oxygen demanding and toxic pollutants, as well as persistent materials such as heavy metals.

Although discharged over short periods of time and on a relatively infrequent basis, these pollutants can seriously compromise many beneficial uses of receiving waters such as fisheries, shellfisheries, bathing and recreational water use and the perceived amenity value of the waters. In extreme cases, CSO discharges can result in fish mortalities, shellfish unfit for human consumption, public health hazards and visual and odour problems.

SURFACE WATER FLOODING

Today, many people face the risk of flooding, but not everyone is aware of it.

Flood risk related to river and coastal flooding is the best understood. Currently, 2.4 million properties in England are at risk from river or tidal flooding. The Environment Agency's *What's in my back yard?* map highlights this flood risk.

Surface water flooding is far more prevalent than river and coastal flooding and far less understood. At present, 3.8 million properties are at risk in England. In 2004, the National Audit Office estimated that, on average, between 5,000 and 7,000 flooding incidents every year are the result of the drains being overwhelmed[34].

Surface water flooding can include:

Urban flooding

This is caused by a lack of drainage in an urban area. As there is little open soil that can absorb water in urban areas, nearly all rain is transported via manmade systems. Flooding occurs when the urban drainage or sewage systems do not have the capacity to drain away rain.

River flooding happens when rivers are inundated with surface water. Downstream areas may be affected as a result of heavy rain upstream, even if they don't experience much rainfall.

Sewer flooding

There are currently 5,000 properties at risk from sewer flooding[35], which is caused when sewers back up due to overloading by storm waters or blockage.

In recent years, excess surface water has caused major flooding. The floods in the summer of 2007 resulted in thousands of homes being damaged, many people being made homeless and an insurance bill running to billions of pounds. Scientists said that an intense period of rainfall like this was exceptional, likely to occur only once in 150 years[36].

New sewer systems are designed to cope with 1 in 30 year rainfall events[37]. Climate change may mean that extreme rainfall is increasingly likely. The pressure on the current capacity of urban drainage systems will be compounded by extra surface water run-off created by increased urbanisation and housing development. Our current systems won't withstand this pressure.

Photograph © Ernie Janes/rspb-images.com

The Flood and Water Management Act (2010) should unlock some of the barriers to SuDs, as long as the necessary funding is put in place

SURFACE WATER FLOODING IN SUMMER 2007

Flooding across the UK in June and July 2007 was a result of extreme and extended rainfall which led to a combination of river (fluvial) flooding and surface water (pluvial) flooding. Natural and artificial drainage systems failed to cope with the quantity of rainfall[38]. Flooding occurred in both urban and rural areas and the urban drainage system seemed unable to cope with the volume of surface run-off. While the rural landscape can typically absorb and store rainfall in summer when soils are dry and river and ground water levels are low, this time there was no spare capacity since May and June were unseasonably wet. Thirteen people lost their lives, while 48,000 homes and over 7,000 businesses were flooded[39].

In Hull, a month's rain in 24 hours led to high volumes of surface water and a 1 in 50 year rainfall event. Hull's relatively modern drainage system was inundated and the high volume of water caused it to back up and overflow. The topography of Hull meant that the water had no means to discharge, leading to major flooding[40]. The problem was compounded by poorly maintained surface drains (ditches) and pumping stations failing to push water to natural watercourses. Thirty thousand people were affected and ten thousand homes and businesses were flooded[41]. Hull City Council estimated repair costs at £200m[42].

The Hull floods provoked questions about what level of rainfall events to prepare for and defend against, particularly in the light of climate change. It highlighted the need to better understand surface water flooding risk and improve information about, and maintenance of, drainage networks[43].

Photograph © Corbis

Thirty thousand people were affected and ten thousand homes and businesses were flooded. Hull City Council estimated repair costs at £200m.

Floods can have devastating emotional effects, especially when they occur without warning. The stress associated with losing personal belongings, having to live in temporary accommodation while repairs are undertaken, worries over who pays the bill and the trauma of the clean-up and restoration can be considerable.

Losing personal belongings in floods has been found to have a greater impact on householders than the financial cost. The loss of sentimental items such as family photographs was one of the most upsetting consequences[44]. Diaries recording the experiences of flooding in Hull in 2007 illustrate this stress[45]:

"When I go home, the first thing I do if it has been raining is stop and check the level of the drain. The last thing I do before I leave is check the level of the drain... There is a lot of anxiety if the weather is going to be bad. As we move more into winter... the anxiety, I think, will rise and it's affecting people. I think the main one is sleep patterns .... a lot of us are waking up and we've dreamt it's been raining through the night because that's on our mind all the time."

FOOTING THE FLOODING BILL

The cost of preventing and dealing with the consequences of flooding is massive. In 2010, the Government budget for flood risk management and defence was around £800m per year[46].

The Environment Agency estimates that the annual cost of flooding, associated damage to property, infrastructure and loss of business, could rise from £2.5bn to £4bn by 2035 unless funding for flood defences is increased[47].

The insurance industry plays a significant role in responding to and recovering from flooding. It offers cover against flood events and, in the event of damage, provides funds and makes arrangements to replace or repair damaged property. The cost of repairing a house after a flood costs between £10,000 and £50,000, depending on the flood depth[48].

The 2007 floods, which hit Northern Ireland, Yorkshire, the Midlands, Gloucestershire, Worcestershire, Oxfordshire, Berkshire and South Wales, was one of the biggest challenges for the UK insurance industry. The industry dealt with 135,000 claims from householders and 35,000 from businesses with a total cost of £3bn[49]. The Cumbrian floods in 2009 led to property and motor insurance claims worth £200m[50].

Insurance companies set prices according to a number of risk factors, including flooding. Areas more at risk of flooding will generally face higher premiums (although properties at high or even extreme flood risk do not often pay a premium that reflects the true scale of the risk[51]).

As part of the underwriting process, RSA can establish whether a particular property is located in an area at risk of flooding using Geographical Risk Mapping (GRM) or Geographical Risk Assessment (GRA) tools. However, it is worth noting that at present, many insurance companies (along with the Environment Agency) have only limited information on surface water risk. GRM/GRA tools enable companies to assess the likelihood and probable severity of flooding incidents. These tools provide information on historical flood claims as well as hydrological, geographical (e.g. proximity to and height above waterways, and adequacy of known flood defences) and other external data[52]. New information technology, such as continuous digital mapping, allows insurers to continually improve their risk profile. While some companies now calculate properties risk profiles at a household or address level, few are able to calculate at postcode level like RSA. This means that some customers can face higher premiums even when, in reality their property is a low flood risk.

To protect householders at high risk of flood, the Government agreed a statement of principles with the Association of British Insurers[53] (ABI). The resulting regime defined by this statement requires that insurance companies will continue to provide cover to high risk households in return for continued Government action to reduce flood risk, invest in flood defence and avoid new developments in high risk areas. This regime of standard cover is virtually unique among European countries. But from July 2013, when the existing statement of principles expires, insurers will no longer have to guarantee affordable insurance cover as standard for households and businesses in high flood risk areas.

The UK insurance industry has made clear that the existing regime under the statement of principles cannot be extended. Insurers are working actively with Government to develop a viable and economic mechanism that will allow homeowners and businesses to be able to enjoy future reassurance and protection against flood risk. The insurance industry looks to Government to demonstrate a clear commitment to continuing and increasing planned public investment in flood defences over the long-term before any new regime to replace the statement of principles can come under consideration by insurers. RSA believe that such a commitment from Government is in the vital public interest, to protect citizens and communities from the social, environmental and economic trauma that follows flooding incidents.

The ABI recognises that *"climate change will affect every aspect of insurance"*[54]. It estimates that the increase in flood risk related to climate change could push up premiums and is likely to make some areas uninsurable[55]. By the 2040s, the cost of storm damage could double in an average year and more than triple in an extreme year[56].

The ABI's forecast modelling shows that a temperature rise of 2°c could push up the price of insurance premiums by 16%, a 4°c rise by 27% and 6°c by 47%[57]

BUILDING RESILIENCE

Surface water flooding is hard to predict and expensive to prevent. In the context of climate change, it is likely that we will experience surface water flooding more frequently. Instead of investing billions into over-sized sewers and drains to prepare for 1 in 150 year events across the country, we should work to flood-proof our buildings to make our towns and cities more resilient to sudden influxes of surface water.

There are a number of resilience measures that can reduce the impact of flooding in a property, including water resistant plaster, water-proof bricks, doors and windows, elevated electrical sockets and door guards. Making a property flood-proof can cost between £3,000 and £10,000 and the improvements could pay for themselves after a single flood[58] and could help to reduce insurance premiums. Where there is a history of flooding and there's potential to reduce the future risk of flood, insurers will normally work with a customer on a case by case basis to understand the risk and agree terms. This can result in a reduction of premiums if measures are sufficient to reduce the risk of flooding to an acceptable standard of a 1 in 75 return period.

Currently, there is low awareness and take up of these measures. The Environment Agency is working with the National Flood Forum to improve advice on the types and benefits of products available[59]. The ABI considers there to be significant opportunity for the insurance industry to encourage 'flood-proof' properties by[60]:

- raising awareness and offering guidance and advice;
- changing policy coverage, including adding new covers or excluding 'undesirable' risks;
- discounting premiums where flood-proof measures are used;
- applying additional terms and conditions requiring action by the policyholder; and
- engaging with suppliers to procure climate-friendly products and services, directly or on behalf of customers.

There is also an opportunity for the insurance industry to offer a 'resilient repair' when dealing with a flood claim. For example, following the 2005 flooding in Carlisle, some properties were subject to increased insurance premiums; householders had the chance to reduce excesses by installing flood-proof measures to minimise future flooding damage[61] Flood-proof repairs can be more expensive than standard repairs and insurance companies commonly require the customer to make up the difference.

Awareness of flood risk is an important part of reducing the impact of flooding. At the moment, much of the emphasis relates to flood warning. The Environment Agency's warning service – Floodline – is available to 61% of properties at risk from coastal and river flooding[62] but sign up is generally low[63].The Environment Agency and National Flood Forecasting Centre is developing Floodline to include properties at surface water flooding risk (lack of warning was one of the compounding influences on the Summer 2007 flood in Hull[64]).

There is also an opportunity for the insurance industry to offer a 'resilient repair' when dealing with a flood claim

CHANGING THE WAY WE MANAGE SURFACE WATER

Partly in response to significant flooding in recent years, the Government, regulators and the water and insurance industries have recognised the significant challenges of managing surface water. It's clear that those involved with flood risk management need to find better ways to work together to assess, avoid and manage flood risk and implement improved surface water management.

The floods of 2007 raised some serious concerns, and the resulting Pitt Review made many recommendations associated with better management of surface water and implementation of SuDS[65]. The Pitt Review recognised the need to determine and allocate the responsibilities for the maintenance of SuDS through effective stakeholder engagement. Surface Water Management Plans, which lay out the roles and responsibilities associated with surface water, could be a key way to achieve this.

As a result, Defra has published new guidance, and made funding available to support the development of Surface Water Management Plans. This is supported by new planning guidance documents, such as PPS25: Development and Flood Risk. CIRIA is also developing guidance for planners and other stakeholders involved in the specification, planning, design and implementation of sustainable drainage in developments[66].

The institutional and organisational arrangements in England for surface water management pose particular problems, despite the new legislation[67]. The Flood and Water Management Act 2010[68] takes forward several key recommendations of the Pitt Review and includes a number of provisions relating to management of flood risk and water quality, including clarifying responsibilities for all sources of flood risk. Some of these recommendations have already been implemented, such as the need to gain planning permission to establish new impermeable surfaces larger than five metres square.

In addition the Act requires:

- the establishment of new national SuDS standards, regulated by a SuDS Authorisation Board (SAB). This relates to new developments only and does not cover retrofitted SuDS;
- that organisations and developers design SuDS strategies and conform to the national standards in order to be able to connect to the public sewer system; and
- that local authorities have overall surface water management controls and are responsible for adoption and maintenance on SuDS assets in new developments that serve more than one property.

SCOTLAND'S LEADING SUSTAINABLE FLOOD MANAGEMENT

Sustainable flood management is not a new concept in Scotland. Since 2003, ministers have had a duty to promote sustainable flood management[69] and have used the four 'A's (awareness, avoidance, alleviation, assistance) to develop a National Flooding Framework[70].

This concept brings together the essential need for institutional partnership, raises the need for education, information and increasing awareness while advocating that property owners accept responsibility for protecting against floods.

A more sustainable approach to flood risk management was embedded in the Flood Risk Management (Scotland) Act 2009[71]. It emphasised the catchment approach and the role of natural flood risk management to address the causes as well as the consequences of flooding (*"moving away from reactive management of flooding towards a proactive and catchment focused approach."*[72]) The Act placed duties on minsters to provide guidance on flood risk management and set objectives and measures to ensure more natural approaches to managing flooding are considered.

Awareness

Improve awareness of the risks of flooding through the provision of better flood risk information and additional flood warning systems.

Avoidance

Strengthen the ability of planning authorities to prevent unsuitable further development where there is significant flood risk.

Alleviation

Invest to reduce flood risk for high risk properties.

Reduce the risk of sewer flooding by continuing to encourage the use of sustainable urban drainage systems and working with Scottish Water to ensure that such systems are properly maintained.

Manage flood risk by improving national guidance and administrative procedures for promoting new flood alleviation schemes.

Encourage joint working between local authorities, SEPA and Scottish Water to improve flood risk management and establish a national technical advisory committee.

Assistance

Help people who might be affected by flooding by encouraging them to take out insurance.

Give better support to those affected by flooding.

NATURE'S WAY – SUSTAINABLE APPROACHES TO SURFACE WATER MANAGEMENT

The traditional approach to surface water management is gradually being recognised as unsustainable. Instead of relying only on hard engineering solutions, incorporating more natural approaches can lead to a more sustainable approach.

Because nature can slow water flows and prevent the need for water to enter a built sewage or drainage system. It delivers other public benefits too, such as enhanced biodiversity and improved landscapes. Meandering rivers and wetlands are valuable for wildlife and have added value to society as they slow and store floodwater, provide recreation and tourism opportunities, improve water quality and can act as the focus for raising awareness of flooding issues in local communities.

SuDS slow and store water on and beneath the surface. This reduces the quantity of surface water run-off and improves its quality. There are many types of SuDS including constructed wetlands, ponds, grass filter strips and other porous surfaces. They take overflowing water from roads and drains, clean it and release it back into the natural water cycle.

The primary objectives of SuDS include:

- reducing demand on built infrastructure by minimising the amount of surface water entering sewer and drainage systems;
- reducing the flood risk from development within a river catchment;
- improving water quality by reducing diffuse pollution;
- improving recharge to groundwater; and
- achieving environmental enhancements, including improving wildlife habitats, amenity and landscape quality.

There are many types of SuDS including constructed wetlands, ponds, grass filter strips and other porous surfaces

SuDS are most effective when applied in a catchment-wide approach, particularly in urban catchments. For example, downstream flooding can be reduced by creating storage in the higher reaches of a catchment to attenuate peak flows. Better natural drainage upstream also helps to reduce the total run-off downstream.

To date, most SuDS implementation in the UK has been associated with new developments. However, SuDS can be retrofitted to existing developments to replace and/or augment the existing drainage system. There are many opportunities to address flooding, poor river quality and poor urban amenity through SuDS retrofit[73]. SuDS can be retrofitted in a variety of places and can be used in the urban environment to deal with excess surface water at source – at home, in schools, in businesses, in our parks and on our streets and car parks.

Examples of retrofitting SuDS include:

- re-paving car parks with permeable surfaces;
- installing green roofs on existing houses;
- diverting roof drainage from a drainage system into a garden soak-away; and
- conveying road run-off via roadside swales into a pond set in open space.

At a property level, SuDS retrofit does not depend on an 'authority', such as the local council or Environment Agency to implement it.

There are many situations where a householder can retrofit SuDS. For example, the Tokyo Metropolitan Government's SuDS retrofit activities, including an 'Experimental Sewer System' (an infiltration trench and storage system) and permeable pavements, were supported by efforts from residents. Householders constructed their own soak-aways at their own expense which contributed to a lower risk to their homes[74].

Photograph © Clynt Garnham Environmental / Alamy

SuDS can be retrofitted in a variety of places and can be used in the urban environment to deal with excess surface water at source – at home, in schools, in businesses, in our parks and on our streets and car parks

TYPES OF SuDS

Rivers, floodplains and natural waterways are all types of SuDS – they slow and store water and groundwater recharge. One form of SuDS relates to improving the natural processes in a river that has been heavily modified by man over time, such as opening up a floodplain, developing wetland and pond areas and encouraging the channel to meander.

The other forms of SuDS are technologies that mimic these natural processes and can be used in a wide range of places. SuDS have been shown to be effective in all soil types if designed, installed and maintained properly[75].The most appropriate type of SuDS depends on local conditions such as geology, geography, land use and the condition of the sewer and drainage system.


Photograph © Anthony Collins / Alamy


Photograph © CABE/Stephen McLaren

Permeable paving is a hard surface designed to allow water to percolate into ground water, preventing run-off. It can be used in place of traditional tarmac on roads, driveways, car parks and pavements. It also works as an effective filter medium for many forms of pollutant. Where disposing of water by infiltration is not possible, because of the height of the water table or risk of contamination, permeable paving installed in combination with an impermeable membrane can be used as a reservoir to regulate surface water flows off site.

Economic analysis shows that permeable paving costs less on a lifecycle basis than traditional surfaces, with reduced maintenance costs outweighing increased capital costs. While extra excavations are required to lay it, replacing worn out paving blocks is less costly than the digging required to renew worn out tarmac. It is estimated that nationwide application of permeable paving in place of 50% of current non-road hard surfaces (retrofitted at their 'end of life'), would provide savings of nearly £1.7bn. These benefits would stem from site owners and operators not having to pay drainage charges, and in cheaper maintenance costs[76].

Swales, ponds and infiltration basins are vegetated surface features that drain, filter and disperse surface water. A swale is a grassland depression that directs water to a dispersal or storage system. Swales are shallow and wide and are dry during normal conditions. During storms they provide temporary storage as well as dispersal. Infiltration basins are similar in construction but are designed to hold water and allow it to soak into the ground. They can provide economic and easy to maintain drainage for highways, car parks and other areas with extensive paving and reduce demand on drainage infrastructure at peak periods.

Soak-aways and infiltration trenches help disperse surface water run-off. Both are below-ground features filled with crushed rock, and rely upon the long-term permeability of surrounding soil for effective operation.


Photograph © Ecoscene / Ian Harwood


Photograph © David J. Green/ Alamy

Green roofs are vegetative layers over an impermeable roof membrane that attenuate the run-off and allow some water to evaporate. The vegetation can range from low grass to large shrubs. Larger plants need deeper soil (or more of the substance they're grown in) and so put extra weight on the roofs. They are more cost effective for larger roofs.

Retrofitting is likely to be most feasible in cases where there are existing flat roofs with some residual load bearing capacity. The type of vegetation used is likely to be grass in order to minimise the additional imposed load. Germany levies a tax on commercial buildings in several cities in proportion to the amount of sealed ground space occupied, with a reduction of 50% for buildings with green roofs. As a result, green roof area increased from 10,000,000 m^2 in 1995 to 190,000,000 m^2 in 2007[77]. Green roofs can also help to reduce the urban 'heat island' effect anticipated under climate change scenarios. Adding 10% of green cover would keep maximum surface temperatures in high density residential areas and town centres at or below the 1961–1990 base-line up until the 2080s.[78] Green roofs can also help insulate a property, saving energy and providing a habitat for birds and insects.

Rainwater harvesting and water butts store rain water for re-use. Water butts are the most traditional form of rainwater harvesting, providing water for garden irrigation. Traditional water butts have a high level overflow to maximise the storage of water for garden irrigation. However, new butts no longer provide attenuation when full. The design has been adapted to provide a mid-level throttled outlet in addition to the high level overflow. This will provide a more effective attenuation device. Such systems could be relatively easily retrofitted into most domestic properties with gardens.

More advanced rainwater harvesting systems store water for reuse in the building – usually for toilet flushing. This has the additional benefit of reducing demand for potable water. To achieve maximum reuse the tanks are larger and ideally should be stored underground to moderate temperatures and minimise the growth of pathogens. A filtration system and secondary pipe work must also be installed in the house to allow reuse. The water can also be used for garden irrigation.

Water butts provide economic benefits for homes with water meters, as they repay their cost via savings in the cost of water. The Environment Agency estimates that a national investment of £325m in water butts could deliver savings of nearly £1bn, providing they were regularly used through the summer months[79].

Benefits of retrofitting SuDS

Financial benefits can include reduced capital expenditure and lower ongoing maintenance when compared to traditional surface water management approaches. They will also save the money otherwise spent to repair flood damage.

Photograph © Benjamin Ealovega / WWF-UK

SuDS RETROFIT IN MATCHBOROUGH FIRST SCHOOL, WORCESTERSHIRE[83]

WWF's Slowing the Flow report found that working with nature to reduce surface water run-off from the upper parts of a catchment reduced the risk of flooding and the need for concrete defences downstream for roughly a tenth of the cost of extensive hard engineering[80]. Cost comparisons between conventional drainage systems and SuDS conducted for the Dunfermline Eastern Expansion showed that the capital costs of SuDS were half that of conventional drainage[81]. The annual average maintenance costs were 20-25% lower for SuDS, and the whole-life maintenance costs of SuDS within the catchment were half that of the conventional alternative.

A Scottish study piloted SuDS retrofit techniques in order to minimise the risk of combined sewer overflows, which were having an adverse effect on water quality of rivers and beaches[82]. It found that, although projected capital costs of SuDS and conventional options are similar, SuDS will be preferable in some circumstances, due to the lower long-term operational costs. When wider additional benefits (such as reduced flooding and enhanced habitats) were factored in, SuDS were the most attractive option.

Matchborough First School was originally designed with conventional drainage that flowed to a pumping station from where it was pumped against gradient to a sewer. However, it became apparent that one playground area could not be drained by gravity to the pumping station.

SuDS including swales, detention basins and a constructed wetland, followed the contours of the site and allowed the playground to drain downhill to the nearby stream. Swales collected overland flows from an adjacent site and the run-off from the car park and playground, providing source control. The main driveway was drained to an extended detention basin. These systems connected to a constructed wetland, which also took run-off directly from the roof and provided amenity as well as useful educational resource. The system was designed to cope with a 1 in 100 year return period storm event, and overland flow routes were provided for events exceeding this. The SuDS also provided a valuable amenity and teaching resource for the school.

The maintenance of the SuDS was marginal and included in an extension to the current school grounds landscape contract, with regular inspections undertaken by the school caretaker. SuDS removed the need for the pumping station and provided a total annual saving of £4000 from ongoing maintenance costs and the annual charge for the sewer connection (around £3200 per year). Any health and safety risks associated with the wetlands are managed by appropriate design and by educating children about the risks of playing around SuDS.

The lessons learned:

- Retrofitting SuDS to existing sites is feasible and can provide financial benefits.
- SuDS can effectively control overland and land drainage flows from adjacent sites.
- SuDS are cost-effective compared to conventional drains.
- Well-considered design provides valuable amenity and habitat for marginal cost.
- Water safety issues need not prevent the use of SuDS.

Photograph © Jiri Rezac/WWF-UK

Amenity benefits can include improved well-being, new social facilities and regeneration of a local area. Rivers, streams, parks and open spaces, greenery and natural wetland features make a great contribution to the character, diversity and sense of community and identity of urban areas.

SuDS IN MAYESBROOK PARK, DAGENHAM[85]

SuDS can make up an important part of the wider green infrastructure of an area. A well conceived SuDS scheme can improve and sustain property and land values (up to 20% in a Scottish study[84]) and help attract business and inward investment to regeneration areas.

Well-being benefits including improved health can stem from SuDS that open up accessibility to green space, providing an opportunity for exercise, sport, active recreation and physical and mental well-being. There are also opportunities for community involvement in developing and maintaining SuDS.

The Mayesbrook Park is a large, green recreation ground that's largely unloved and unused. It sits in a deprived area of Dagenham. Barking and Dagenham Council recognised the need to regenerate Mayesbrook Park as a strategic priority. The regeneration would: reduce problems of antisocial behaviour and give young people a positive role to play in the community; provide a clean, green and sustainable space; reduce health inequalities and improve awareness of climate change and lifestyle impacts on health.

The Mayes Brook is a small urban stream in East London and a tributary of the River Roding. The stream has been heavily modified throughout its course, and has been channelised and culverted in many sections. It currently runs around the edge of the park in an inaccessible manmade channel which largely consists of surface water run-off. There are two mature lakes formed by gravel extraction to the south of the park that are heavily silted and polluted.

The council's proposal is to restore the Mayes Brook River to a more natural form that establishes a good river-floodplain interaction. They want to improve access, build play and gym facilities, create a visitor centre and clean up two large lakes so they can be used for angling and boating.

The river restoration demonstration project will address issues of climate change adaptation, access to nature and habitat creation. As well as improved water quality, the main benefit of the scheme is to increase amenity value and public use of the park. The restoration has been designed with climate change in mind, with flood storage capacity provided to cope with potential future periods of heavy rainfall and flash flooding caused by high levels of surface water run-off.

The restoration scheme is designed to enhance habitat diversity by improving water quality. A series of wetland features aim to help slow, store and clean the water including 'on-line ponds' mimicking natural low points on the stream's floodplain, new wetland features along various sections of the old course of the channel and a mimicked meander cut-off.

The capital cost of the £2.9m project is spread between multiple stakeholders, including the Environment Agency, National England, the Mayor of London and RSA Insurance. Around 60% of the capital cost is covered by developer contributions under Section 106 of the Town and Country Planning Act (1990) for an adjacent site. Ongoing maintenance costs will be covered by the council. It has been estimated that the maintenance costs will be reduced because of less need to cut the grass (which, in places, will be allowed to grow freely[86]).

Environmental benefits include improved water quality and improved biodiversity through greener and more natural landscapes.

SuDS can help contribute to the maintenance, conservation and improvement of the local environment and provide and protect, recreate and rehabilitate landscapes and habitats damaged or lost by previous development or agricultural change. They can also help to maintain and enhance biodiversity while delivering Biodiversity Action Plan priorities.

SuDS IN THE BOURNE VALLEY[87]

The Bourne Stream flows through Poole and Bournemouth to the beach at Bournemouth Pier. The upper and middle catchments are designated as Sites of Special Scientific Interest due to their heathland flora and fauna and rich populations of dragon and damsel flies.

Other species that depend on the river include gray wagtails, water voles and all six British reptile species. However, around 60% of the stream length is culverted. The stream suffers from diffuse urban pollution and water flows are made up from a number of sources including outfall from a sewage treatment works and surface water run-off.

The problem was particularly severe when heavy rains fell after a dry period. This caused a 'first flush' of heavily polluted water to discharge causing bacterial contamination of the stream and the bathing beach. As well as impacting on the river's ecosystem, the 'first flush' events also affected water quality on the beach. The water failed to comply with the Bathing Water Directive Guideline standards in 10 out of the last 12 years, despite significant investment in reducing pollution sources. Regular and repeated flooding was also an issue for a small number of homes and highways due to the capacity of the surface water sewer.

The Bourne Stream offers an ideal opportunity to focus research on SuDS and a range of related issues. The Environment Agency has played a key role through its Research & Development programme with the aim of improving water quality in the stream and at the bathing beach at Bournemouth Pier.

The development of Alderney recreation ground in the project area included in-stream SuDS in the form of lagoons and wetlands. The lagoons were created immediately downstream of the main Ringwood Road and planted with reeds (Typha latifolia, commonly known as Reed Mace) in order to provide initial treatment to surface water run-off from the road.

During the work, an old and leaking foul sewer was discovered and rectified. Wetlands were created upstream of the lagoons to deal with 'first flush' water containing a high level of pollutants.

The wetlands were designed to pool and store the water before flowing down to the lagoons for further treatment. Opening up the river (from a culvert beneath the recreation ground) and developing storage in a naturalised floodplain helped to reduce flood risk from 1 in 2 years to 1 in 20.

The Bourne Stream SuDS have been successful at improving water quality, reducing flood risk and demonstrating the environmental benefits of SuDS techniques to the local community. They have diverted the need for expensive (and non-sustainable) solutions such as a longer outfall pipe. In addition they are now the subject of detailed studies and monitoring to assess their effect on both water quality and wildlife habitat.

SuDS can make a positive difference to the way we manage floods. Benefits include reducing the demand on built drainage and sewage infrastructure and using natural habitats, green open spaces and watercourses to attenuate flows and reduce the ‘flashiness’ of responses to rainfall events.

Photograph © City of Malmö, malmo.se/sustainablecity

MALMÖ, SWEDEN[89]

Augustenborg, an inner-city suburb in Malmö, suffered from repeated flooding in basements and garages as a result of heavy rains exceeding the capacity of the combined sewer system.

To reduce flood risk, surface water drains were disconnected from the combined sewer and a new open storm water system was developed. The system has been in operation since 2001 and has reduced flood risk. Surface water is managed through a series of green roofs, swales, channels, ponds, detention basins and small wetlands, to reduce total run-off and attenuate storm peak flows.

MEANWOOD ESTATE, LEEDS

The Meanwood estate in Leeds is served by a combined sewer system. During extreme storm events, run-off results in overwhelmed sewers, causing flooding. Much of the housing is semi-detached and is typical of many areas in the UK's older cities. It includes grass verges that were judged suitable for the retrofitting of swales.

A study proposed a SuDS retrofit as the solution, incorporating infiltration-based schemes as much of the area overlies sandstone. Nearly half (46%) of the roofed area and 31% of the paved area could benefit from infiltration-based SuDS and be disconnected from the sewer system in order to reduce the risk of flooding. In order to eliminate the flooding problem, the SuDS proposal could be combined with a reduced level of conventional sewer rehabilitation. Costs for a range of conventional and SuDS hybrid options suggested that the hybrid options were between 12-23% cheaper than the cheapest conventional solution[88].

In urban areas across America, green infrastructure (such as SuDS) has become prevalent[90].

Several major metropolitan areas, including Portland, Seattle, Philadelphia, Kansas City, New York, Washington and Louisville use (or plan to use) green infrastructure to address the impacts of combined sewer overflows (and, in places, contribute to neighbourhood rejuvenation, job and habitat creation and reduce urban 'heat island' effects[91]). For example, in the City of Aurora, the aging surface water infrastructure system was struggling to cope with the growing population, resulting in frequent combined sewer overflows, which polluted local rivers and enhanced flood risk. Through the use of green infrastructure, the city was able to avoid building a new wastewater treatment plant, significantly reducing costs, while reducing average run-off by 10% and pollutant loads by 20%[92].

Photograph © Environmental Services, Portland Oregan, USA

PORTLAND, OREGON – SuDS RETROFITTING ON A CITY SCALE[93]

On average, Portland receives just under a metre of rain every year, resulting in billions of litres of surface water run-off. To combat the effect of urban diffuse pollution on local rivers and streams, Portland has developed SuDS to reduce the impact of surface water.

Green roofs are a key part of the Portland SuDS programme. In 1999, a green roof was installed as a demonstration project on the newly constructed Hamilton West apartment building. It is also a monitoring facility, which measures water capture, water quality and compares the success of planting methods, soil type, depth, and vegetation selection. During dry months, the roof retains nearly all of the rain water. This is the key period as summer rains after dry spells create the most damaging pollutant spikes in water systems.

During wetter months, the roof manages much higher volumes of water than the conventional roof. It eventually becomes saturated, but even when it does not retain all of the water, it slows and filters the flow. The Hamilton West roof cost $15 per square foot, reducing run off from 8,400 square foot of roof area. The green roof has double the life span of a conventional roof and, over the course of a year, manages about 768,000 gallons of rain water. As a result, a green roof was installed at the regional Government building when the conventional roof was due to be replaced in 2005. It provided additional sewer capacity (from reduced run-off) of 25,000 gallons per year.

Portland also uses permeable paving to allow surface water to be absorbed, filtered, and cleaned before recharging groundwater. The Westmoreland Pervious Pavers demonstration was constructed in 2004, when existing conventional pavements needed to be replaced. Rainwater falls on the permeable surface and infiltrates through small core holes and interstitial spaces, before collecting in the base rock beneath, and infiltrating soil and groundwater. In periods of intense run-off (storms greater than a 25-year event), water exceeds the capacity of the permeable paving and flows into the existing sewer. Street trees were also planted to mitigate surface water run-off. The pavements were considered successful in alleviating some of the pressures on the combined sewer system, although there were some maintenance issues.

Landscaped stormwater planters were constructed in 2005 in pedestrian and parking areas to capture and infiltrate approximately 8,000 square feet of street run-off. They show how SuDS can provide direct environmental benefits and be aesthetically integrated into the urban streetscape. Street run-off is disconnected from the conventional drainage system and instead flows downhill along the existing curb until it reaches the first of four stormwater planters. Once inside the planter, the water is allowed to collect until it reaches a depth of six inches. The landscape system within each planter allows the water to infiltrate the soil at a rate of four inches per hour.

If a rain event is intense enough, water will exit through the planter's second curb cut, flow back out into the street and eventually enter the next downstream stormwater planter. Depending on how intense a particular storm is, run-off will continue from planter to planter until all of the stormwater planters are at capacity. Once exceeding capacity, the water exits the last stormwater planter and enters the storm sewer. With the new stormwater facilities now in place, nearly all of the street's annual run-off, estimated at 180,000 gallons, is managed by its landscape system. The main challenge for retrofitting stormwater planters was finding enough space for pedestrians, on-street parking, street trees, landscaping, street lighting, signage, and stormwater planters within an eight-foot wide space.

In conventional arrangements, downspouts (drainpipes) channel water from a property roof into the drainage system. Portland has encouraged drainpipe disconnection, encouraging households to allow roof water to collect in a water butt or drain into planters, lawns and gardens and soak naturally into the ground. Portland promotes the initiative with the motto 'every downspout counts' and estimate that each disconnected downspout can redirect thousands of gallons of surface water every year.

Photograph © CABE/Stephen McLaren

OPPORTUNITIES FOR CHANGE

Increased used of SuDS is one part of a wider shift towards sustainable water management. Reducing waste, enhancing natural drainage, tackling pollution at source and increasing understanding of the link between people and rivers are part of smarter water management that is responsive and ecologically sensitive.

The 2007 floods, the Pitt Review and recent Government guidance has emphasised the importance of improving management of surface water in order to reduce localised flooding and improve water quality. Improved surface water management in cities can only be fulfilled by retrofitting SuDS in urbanised parts of the UK.

Existing surface water infrastructure is substantial and will continue to be utilised for the foreseeable future, but will require innovative and alternative supplementary measures if future challenges are to be met affordably.

There are specific opportunities for SuDS retrofitting in the UK, including[94]:

- at the 'end of life' of existing systems or of existing paved areas;
- during building refurbishment;
- during drainage improvements for large areas such as trading estates or where there are unsatisfactory CSOs or misconnections; and
- giving incentives to property owners to carry out the work.

The best time to retrofit roads is during road reconstruction, resurfacing, large scale drainage improvement works or as part of increased residential expansion[95]. There is a need to ensure that surface water management is part of city planning so that redevelopments and improvements, as well as new developments, take account of drainage needs and potential impacts.

There are many other opportunities associated with existing drainage systems in responding to problems and changes in related external drivers. With new regulations, climate change, urbanisation and other effects, expecting existing drainage systems to continue to deliver required service levels is no longer an option. Performance will continue to deteriorate over time without planned interventions. Compliance with the environmental legislation such as the EU Water Framework Directive will also drive improvements.

ROLE OF PUBLIC ENGAGEMENT

It is vital that education and publicity campaigns feature highly. Information about the impacts of water use along with advice about using and disposing of water wisely need to be developed in order to support sustained efforts to achieve a change in behaviour towards a more sustainable valuing of water.

There is also a key role for public-facing organisations, including local authorities and water companies, to provide information and advice. The first step is to provide information. There are some good examples of general SuDS information: Bristol City Council includes general SuDS information and local case studies on its website[96]; the Scottish Environment Protection Agency has a SuDS guide for planners and designers[97] and CIRIA has a wealth of information for professionals[98]. But there is little for the general public (including householders and businesses), on raising awareness and providing information on how they can change their behaviour.

The Walker Review recommended that Government[99]:

"...should promote a national education strategy working with stakeholders to influence public behaviour on water use, and building on the Act on CO2 water saving campaign. Regional and local community-based campaigns on water efficiency should be developed using the key national messages and brand, but targeting local issues. Local councils, the private sector and other local stakeholders should be closely involved."

It is important that the education strategy looks at water in the round, considering waste water as well as water efficiency. The campaigns could open a public dialogue about the financial and environmental benefits of sustainable approaches and spark a debate about how we manage water, particularly in the face of climate change.

ROLE OF PUBLIC PROCUREMENT

The Government and all public organisations should lead by example and only procure the designs and products that reinforce a sustainable approach to water management, in terms of both reducing flooding risk and by promoting greater conservation of water.

Currently, the limited examples of SuDS retrofit in public sector buildings in the UK are driven by individuals and understanding of local benefits. However, there is real scope for public buildings to embrace and exemplify best practice, and thereby encouraging others to adopt sustainable practices. The green roof on the Portland regional Government building is a good example of the public sector leading the way, and in doing so, building the evidence base, business case and awareness of SuDS.

There is wide scope for Government offices, town halls, schools and hospitals across the country to retrofit SuDS. Increasing awareness among public sector planners, landscape designers and procurement officers about the opportunities and benefits of sustainable water management is a key first step, along with development of procurement policy to ensure that SuDS are considered and selected in the process. Government needs to provide and communicate clear guidance for Government procurement policy to ensure that where possible, sustainable water management purchases and approaches are made. This would help to stimulate the suppliers, bring down prices and mainstream water efficient and sustainable water management products and designs.

ROLE OF LOCAL AUTHORITIES

In the absence of legislative and regulatory drivers or other incentives, a common critical success factor in the case studies is the presence of local Government action and leadership.

People and organisations who have the drive and determination to overcome barriers, and who are able to identify and create opportunities are key to successful implementation of innovative surface water management schemes. There are important examples of local authorities who have been working towards developing policies for more sustainable surface water management and do an excellent job in promoting SuDS to developers and householders.

Islington Council promotes SuDS on all new developments and emphasises that SuDS techniques can also be incorporated into existing buildings and even individual homes. It provides detailed guidance on SuDS techniques relevant for Islington in a SuDS Good Practice Guide[100]. For Islington Council the promotion of SuDS:

"...will bring a range of benefits. SuDS manage run-off from development in an integrated way to reduce the quantity of water entering drains and therefore to reduce surface water flood risk – an important consideration in a dense urban area like Islington, particularly given the increase in heavy rainfall likely as a result of climate change. SuDS also improve the quality of run-off from development, bringing clean water back into use in our urban environment to create attractive places for people and wildlife[101]".

Cambridge City Council has a policy to adopt SuDS that are located within public open space. This adoption strategy is particularly significant in given that uncertainties relating to adoption and maintenance of SuDS presenting a key barrier to their implementation. To support this strategy, the council has also produced the Cambridge Sustainable Drainage Design and Adoption Guide to embed these elements in the development of plans and designs by architects and designers. The guide:

"provides developers with all the information needed to meet [the council's] adoption standards... this guide should ultimately ensure that we treat water as a friend and not an enemy[102]."

There is real scope for public buildings to embrace and exemplify best practice, and thereby encouraging others to adopt sustainable practices

In Bristol, the council regards SuDS development as a critical component of its overall programme on environmental sustainability[103]. One example is the Marissal Road Flood Alleviation Scheme. Working in partnership with Wessex Water the council developed a scheme to alleviate a flooding issue and provide an amenity to benefit the local community.

The scheme is designed as a multi-functional public park area, which is also a wildlife habitat. The surrounding area suffered from excessive run-off from rainstorms after the development of the Windmill Lane Estate in the 1980s. The surface water sewer leading away from Windmill Lane became overloaded during times of heavy rainfall. Due to the presence of a high pressure gas main, the adoption of a traditional engineering approach of upsizing the sewer in Windmill Lane could not easily be done. As a result, during storm events the road gullies became inundated. Three properties on were affected by flooding internally and several more properties suffered external flooding. The new SUDS attenuation pond which receives the surface water run-off now protects these houses.

ROLE OF REGULATION

A good example of the role regulation can play to encourage sustainable drainage is the recent change to the planning system relating to paving of front gardens[104].

Under new legislation, residents installing impermeable paving have to apply for planning permission, while those using permeable surfaces do not. This is also an opportunity for planners to engage with householders about using SuDS.

Regulation can also play a significant role in encouraging use of SuDS retrofit. For example, each state in the USA is required to review and revise its storm water permit system every five years. In 2009, Illinois took advantage of this opportunity to add several provisions to its permit requiring or encouraging the use of green infrastructure[105].The new requirements for developers and municipalities focus on better training of employees in green infrastructure strategies and techniques, while addressing storm water run-off from urban surfaces (like roads, car parks and pavements and existing developed property).

KEY TO SUCCESS:

Community engagement, local leadership and partnership

These case studies demonstrate the advantages of working in partnership with other stakeholders from an early stage to fully realise the benefits of SuDS. Strong partnerships need:

- Clarity of the roles and responsibilities. SuDS schemes can have multiple interests and owners each with different expectations and requirements. Unless addressed, this can result in complex adoption and maintenance issues.
- Effective leadership. This is the key to incorporating SuDS into a wider, local approach to improve urban environments, rather than specifically focusing on SuDS schemes for flood relief or river clean up[106].

Community engagement should take place throughout the development process with residents, schools and businesses encouraged to contribute to supporting SuDS solutions (this can prompt local ownership opportunities). Engagement with individual householders, landowners and the community can help to identify solutions and encourage local responsibility for taking and supporting action. Local community action requires strong leadership. Evidence from the case studies shows that the local or municipal Government often acts as a champion, providing impetus as the project develops, securing funding and engaging the community.

With an active community programme in place, opportunities will arise to work with individual members of the local community and encourage them to take appropriate measures to minimise the residual risk to their own properties without causing problems to others. For example, some residents could install a small bund at the top of any upward sloping drive to direct water away from their properties, undertake downpipe redirection and disconnection, or expand rain water collection systems and install permeable paving on driveways.

Businesses and local institutions might also be encouraged to install permeable paving and rainwater collection systems on their premises. This would save them money from drainage charges, and in the context of the concerted action of others, support surface water management objectives in the community.

The absence of legislation or enabling regulation is the primary reason there are relatively few examples of SuDS retrofit in the UK. Legislation in England and Wales, including the Flood and Water Management Act, does not address the issue of retrofitting SuDS measures.

The Act does provide an opportunity to resolve clarification of responsibilities within the water sector and provides a mechanism – the development of Surface Water Management Plans – by which different stakeholders can work more closely to achieve the most effective and efficient objectives. This could have the effect of encouraging the retrofit process.

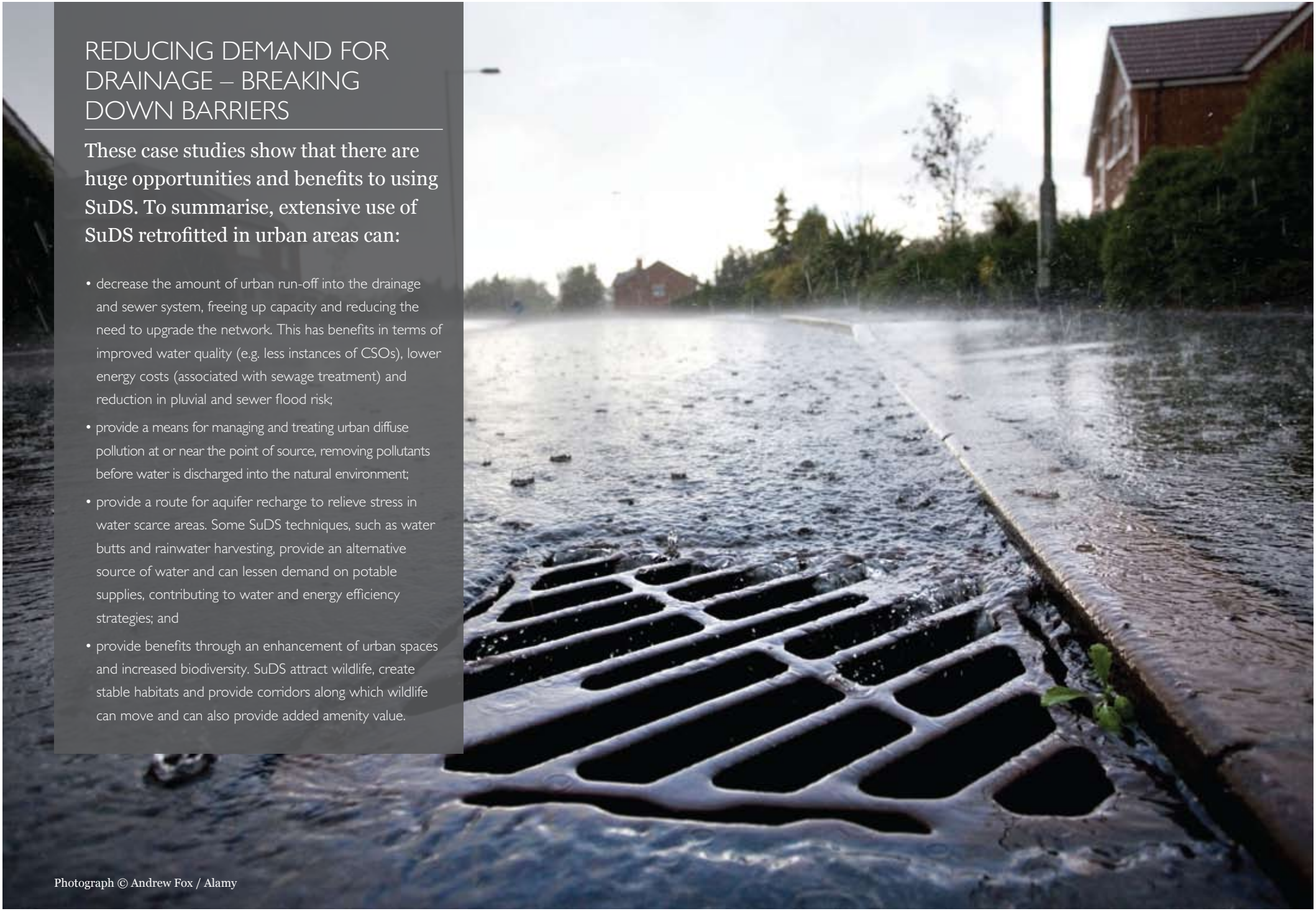

Photograph © Jiri Rezac / WWF UK

Community engagement should take place throughout the development process with residents, schools and businesses encouraged to contribute to supporting SuDS solutions

REDUCING DEMAND FOR DRAINAGE – BREAKING DOWN BARRIERS

These case studies show that there are huge opportunities and benefits to using SuDS. To summarise, extensive use of SuDS retrofitted in urban areas can:

- decrease the amount of urban run-off into the drainage and sewer system, freeing up capacity and reducing the need to upgrade the network. This has benefits in terms of improved water quality (e.g. less instances of CSOs), lower energy costs (associated with sewage treatment) and reduction in pluvial and sewer flood risk;
- provide a means for managing and treating urban diffuse pollution at or near the point of source, removing pollutants before water is discharged into the natural environment;
- provide a route for aquifer recharge to relieve stress in water scarce areas. Some SuDS techniques, such as water butts and rainwater harvesting, provide an alternative source of water and can lessen demand on potable supplies, contributing to water and energy efficiency strategies; and
- provide benefits through an enhancement of urban spaces and increased biodiversity. SuDS attract wildlife, create stable habitats and provide corridors along which wildlife can move and can also provide added amenity value.



Despite this, SuDS retrofitting is not commonplace in the UK. The case studies clearly show SuDS successfully delivering benefits in urban areas in the UK and abroad and CIRIA's forthcoming SuDS retrofit evidence base will highlight a wide range of examples of SuDS retrofit implementation.

WWF believes that the real barriers to wider SuDS implementation are cultural, political and related to the current policy and regulatory framework. We have identified five major barriers to SuDS implementation.

LACK OF INFORMATION

SuDS can help reduce risk of surface water flooding but it is notoriously hard to predict. Environment Agency and insurance industry flood risk maps still have significant gaps when it comes to surface water (although this is recognised and progress is being made). Many stakeholders hold different sorts of information and can be reluctant (due to commercial and licensing arrangements) to share it[107]. Some information, such as current condition and maintenance records of smaller surface drains does not always exist, or can be out of date[108]. New Surface Water Management Plans will be a key instrument in gaining a better understanding of current surface water risks.

AWARENESS AND EXPECTATIONS

The public is understandably fearful of flooding. The fear of being overwhelmed by surface water inspires large flood defences designed to get surface water away as quickly as possible. Even in flood risk areas, the public is still largely unaware of flood risk, with low uptake of the Environment Agency's Floodline warnings and even lower uptake of household flood prevention measures. Encouraging householders to make homes more resilient will require efforts to help people understand why and how to install flood-proof measures. Improved awareness of surface water impacts and SuDS alternatives is needed at all levels.

People working throughout the supply chain – procurement professionals, designers, architects, planners, contractors, white goods suppliers, insurance underwriters and plumbers all have a potential role to play to improve awareness and understanding. They can also address misconceptions and encourage uptake of SuDS. Interactions between customers and suppliers are invaluable in promoting SuDS, changing expectations and establishing sustainable social norms.

SHARED RISKS AND BENEFITS

Poor surface water management presents a shared risk between businesses, Government, households and the rest of civil society. The risks are time and place specific and are best understood at a river catchment scale[109].

Correspondingly, SuDS should be a catchment solution: some of the best places for installation may be upstream (where there may be little direct benefit) in order to reap significant benefits downstream. A home or business that installs SuDS may not directly benefit – it may not even be at risk of flooding. But the installation will benefit others who are situated in an 'at risk' part of the drainage area. The SuDS approach requires multiple individual actions (where there may be little direct incentive) to deliver collective community benefits. Additional incentives, provided through regulation and policy, are needed to ensure that there is sufficient participation in 'upstream' or low risk areas and to minimise the 'free rider' effect – where people benefit, but do not contribute.

A key barrier to SuDS implementation relates to the difficulties capturing shared benefits in cost benefit analysis and decision making. This relates to the difficulties quantifying shared, multiple, non-monetary, longer term or externalised benefits. For example, Defra's Integrated Urban Drainage Pilot showed that[110]:

"there are complex institutional and funding arrangements which divide responsibilities between water companies, the Environment Agency, planning departments in local Government, housing developers, householders and internal drainage boards. As a consequence urban drainage solutions have not always been as cost effective, sustainable and robust than might have been possible had a more integrated approach been adopted."

LACK OF INCENTIVES

Many of the decisions on retrofitting SuDS are the responsibility of property owners. This includes private domestic and commercial properties, and public properties such as schools, leisure centres and the associated hard surfaced areas and roads. For instance, the responsibility for retrofitting permeable paving sits with the owners of large car parks such as supermarkets and local authorities.

Local authorities and other Government bodies are owners of buildings and land areas in a variety of roles, as highway authorities, as planning authorities and as significant property managers in their own right. Property developers, property owners, managers and all their engineering and architect advisors have a key responsibility to deliver. So incentives for change will need to be firmly directed at changing the behaviour of property owners. For example, in the recent review of charging for water services in England and Wales (the Walker Review), the increasing importance of surface water drainage in the future is emphasised[111]:

"Household customers should, over time, be incentivised to reduce the amount of surface water drainage going from their property into public (sewerage company) sewers. This aim can be achieved cost-effectively, in a way that supports the 'polluter pays' principle, if this service, too, is paid for by those customers."

There are currently few incentives for households, businesses or organisations to install SuDS.

We propose incentives such as:

- surface area-based charging, which offers financial incentives to customers to reduce their surface water drainage. Ofwat considers area-based charging as the fairest way to pay, as it most closely reflects the costs of surface water drainage[112]. It may be more tenable for non-household premises which have much greater area variation (e.g. from small retail premises to huge factory or warehouse complexes) than for households. The Floods and Water Management Act allows water and sewerage undertakers to operate concessionary water drainage charges for community groups[113];
- more significant discounts on water bills on proof that there is no connection to the public sewer;
- lower insurance premiums for all properties that install SuDS (not just those in high risk areas); and
- subsidised products and installation included in other forms of household retrofit (such as for water efficiency and energy).

DEMAND MANAGEMENT VS 'PREDICT AND PROVIDE'

SuDS are a form of demand management, which reduce demand on the sewage and drainage infrastructure. Currently, water companies are effectively rewarded for increases in capital expenditure (such as building new sewers), while they can be penalised if demand management expenditure (generally classified as operational expenditure) is too high. In addition, the 'predict and provide' model has been in operation for 100 years and remains the predominant skill set and comfort zone. Defra's Integrated Urban Drainage Pilot showed that:

"mindsets are still linked to providing solutions that route surface water away through improved sewerage or via water courses... (and) did not generally consider how run-off could be managed on the surface, retained in highways and routed safely to storage areas in green space [114]."

Building hard engineered solutions such as bigger sewers and flood defences tend to inspire confidence because, although expensive, there is high certainty that they can deliver. Under current regulatory arrangements there is also little scope to innovate and trial new approaches.

Incentives for change will need to be firmly directed at changing the behaviour of property owners

MAINSTREAMING SUDS: CONCLUSIONS AND RECOMMENDATIONS

Reducing the risks through sustainable surface water management requires stakeholders to work together.

KEY TO THIS IS:

- an enabling legal and policy framework that requires and rewards sustainable practices;
- clear strategy to co-ordinate stakeholders, encourage the sharing of information and set outs roles and responsibilities; and
- capacity to deliver, in terms of knowledge, skills, finance, partnerships and public engagement.

The 2010 Floods and Management Act and new Surface Water Management Plans are key opportunities to address this agenda. While significant progress has been made, it's essential that the enabling legislation and guidance documents proposed in the Act are published and sufficient long-term funding is made available to enable implementation.

There remains significant scope to change the way we manage surface water and create, through retrofit, a sustainable drainage network that can reduce the risk of flooding and reduce levels of pollution in our precious rivers and wetlands.

WWF and RSA call for urgent action to meet the three challenges set out on the next page.

1. Development by relevant authority of a policy and regulatory framework that encourages sustainable surface water management

Government should:

- remove the automatic right to drain surface water to a public sewer by fully implementing the Flood and Water Management Act 2010;
- ensure that National Standards for SuDS integrate and promote their potential wildlife and amenity benefits;
- identify long-term funding streams so local authorities can adopt and maintain SuDS;
- introduce measures to strengthen planning policy to safeguard floodplains and riparian land as part of its commitment to protect wildlife and promote wildlife corridors;
- amend building regulations and planning guidance to favour the use of SuDS in all building developments (new build and refurbishment);
- give local authorities powers (and incentives) to require that new and existing properties (when making changes such as building extensions or car parks) have a neutral impact on surface water run-off; and
- amend planning and climate change policy to promote SuDS retrofit as an appropriate way of encouraging adaptation to climate change – particularly in areas which currently suffer from surface water flooding or are likely to in the future.

Ofwat should:

- introduce regulatory incentives for demand management in order to address the bias towards capital expenditure in the price review process;
- introduce economic incentives for meeting environmental quality objectives through SuDS solutions to sewer overloading;
- require water companies to provide information on SuDS and drainage disconnection as part of their duty to provide drainage services; and
- review the sewerage companies' charging mechanism for surface water drainage to incentivise the control of surface water at source (including domestic customers).

The Environment Agency should:

- place enforceable conditions on all combined sewer overflow permits and ensure those most likely to cause damage are monitored and permits enforced.

2. Leadership by example and increase capacity and innovation within the sector

- Public sector organisations should prepare a SuDS Retrofit Action Plan for their premises and embed SuDS in designs for their new buildings, upgrades and refurbishments as a part of their green procurement policy.
- Local authorities, the Highways Agency and sewerage companies should launch a major programme installing and retrofitting SuDS in built-up areas where surface run-off and sewer overflow is causing pollution and flooding.
- Government should work with professional associations, academia and other organisations to reinforce best practice in SuDS retrofit (e.g. though professional accreditation schemes) and support development of both the skills and evidence base.
- Ofwat should allow opportunities and develop incentives for sewerage companies to innovate and invest in sustainable approaches to managing drainage and mitigate the bias towards capital solutions.
- Insurance and sewerage companies should work with the Environment Agency, local authorities and other partners to share information and improve the understanding of surface water flood risk.
- Insurance companies should encourage 'resilient repairs' to flood-proof homes when settling claims by providing information, advice and incentives.

3. Improvements in awareness and understanding of surface water impacts and greater encouragement for take-up of SuDS

Local authorities should:

- promote the use of SuDS to the professional community (including designers, architects and developers) as part of the planning process;
- promote the benefits and opportunities for using and retrofitting SuDS to local residents and businesses and provide advice and information to make it easy for people to install SuDS and reduce sources of domestic water pollution; and
- take a proactive role in convening stakeholders and championing SuDS as part of responsibilities relating to surface water management (including staff training).

Sewerage companies should:

- consider SuDS retrofit as part of a contribution to achieving sewage flooding service levels, reducing combined sewer overflows and, where appropriate, contributing to a positive supply-demand balance;
- provide customers with clear, easy to understand information about the opportunities for disconnecting surface water drainage. This should include information about financial benefits and guidance on using SuDS as an alternative; and
- charge commercial customers for surface water drainage on the basis of drainage area and provide guidance about opportunities to replace hard surfaces with SuDS.

Government should:

- promote the use of permeable paving to large businesses, including property rental and retailing sectors, as a key part of their corporate social responsibility agenda; and
- support delivery of a national communications campaign relating to the value of water, the impact of water use and need for water efficiency, including messages relating to wastewater and SuDS.

The Environment Agency should:

- include properties at risk from surface water flooding in its Floodline service; and
- include SuDS retrofit as part of a catchment approach to sustainable flood risk management.

Insurance companies should:

- promote risk awareness for customers living in flood prone areas of the danger to their property;
- promote flood-proof measures and steps customers can take to minimise risk in preparing for extreme events;
- promote SuDS-related products, such as water butts, to all customers as part of a catchment wide approach to flood risk management;
- deliver 'resilient repairs' to flood-proof homes when settling claims;
- work with stakeholders on new developments relating to where and how properties are built and measures which can be taken to reduce flood risk; and
- develop incentives to reward customers who make sustainable choices (such as installing flood-proof measures).

Manufacturers should:

- introduce colour coding for foul and surface water pipes on all domestic and industrial water appliances to avoid misconnections.

Authorship and acknowledgements

WWF and RSA are partnering for progress in a changing world. Tackling climate change is an increasingly urgent challenge. It is more important than ever that businesses and NGOs work together to drive smart solutions.

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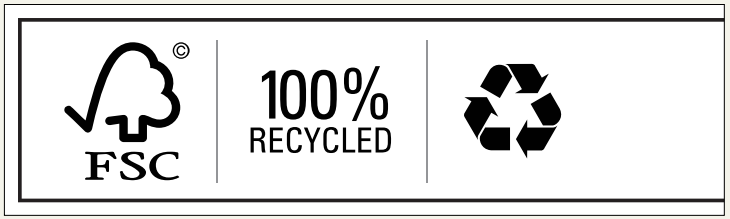

Why we are here

To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony and nature.

RSA

With an almost 300 year heritage, RSA Group is one of the world's leading global insurers. Focusing on general insurance, it has the capability to write business in over 130 countries, with major operations in the UK, Scandinavia, Canada, Ireland, Central & Eastern Europe, Asia, the Middle East and Latin America.