Storm overflows

Wessex Water
YTL GROUP

This explanatory note sets out our position on storm overflows – why they exist, what impact they have, what can be done about them and how to go about it.

Wessex Water position on storm overflows

In an ideal world we wouldn't have storm overflows at all. They are a legacy from the past. We believe that storm overflows have no place in a 21st century network and we have embarked on a significant programme of long-term investment to eliminate the need for them. This will take time but work is already underway, focusing on overflows that discharge into the most sensitive areas first.

History of sewers in the UK

There are two types of sewer system in the UK. The older one, called a combined sewer system, carries all the foul water from homes and industry, as well as rainwater (run-off from roof gutters, patios, driveways and some highways) in one pipe. Rainwater and foul water combine to flow to the water recycling centre for treatment. Drains and sewers that carry both rainwater and foul water are called "combined".

The newer type, constructed since the 1960s, is a separated sewer system comprising one pipe for the foul water (from sinks, washing machines and toilets) and a separate pipe for all rainwater. The rainwater is discharged to a watercourse, the sea or, where it is permeable enough, to drain into the ground. The foul sewage flows to the water recycling centre for treatment.

Why do storm overflows exist?

During rainfall, the volume of liquid that a combined sewer needs to carry increases many times (eg, an average house roof area generates the same amount of flow in a 25mm/hr rainfall event as 90-130 houses where only foul water is connected).

Constructing pipes big enough to cope with all the rainfall, yet small enough to ensure sewage flows during dry weather (it needs a minimum velocity), proved uneconomic and unnecessary at the time.

The sensible and most cost-effective solution was to build sewers of a size that carried all dry weather foul flows and some of the wet weather flow. But this meant that, during heavy rainfall, the mix of rainwater and foul water could exceed the pipe capacity and put homes and businesses at risk of flooding due to flows backing up.

Storm overflows[1] were a pragmatic solution to this problem and designed to act as 'relief valves', allowing excess heavily diluted sewage to be released to rivers or the sea.

Nearly all towns and cities in the UK have combined sewerage systems, and consequently all have storm overflows to protect properties from flooding during heavy rainfall. There are around 15,000 storm overflows in England – 1,300 of them in Wessex Water's area.

1 "Storm Overflows" is the terminology used to encompass Combined Sewer Overflows (CSOs), settled storm tank overflows (SSOs) and overflows at pumping stations. Some campaigners and media incorrectly refer to CSOs when they mean Storm Overflows.

Legislation governing storm overflows

The way in which storm overflows are governed by law is covered by the Urban Wastewater Treatment Directive (UWWTD).

The European legislation recognises the inevitable need for storm overflows on combined sewer networks and requires Member States to ensure their operation is restricted to limit pollution.

More recently, the Environment Act 2021 has added new requirements for both Storm Overflows and environmental impact measurement.

Section 80 of the Environment Act 2021 placed an obligation on the Secretary of State to produce a Storm Overflow Discharge Reduction Plan. This was published in August 2022 and sets out stringent new targets on the operation of storm overflows by water companies.

Section 81 and 82 of the Act also placed new obligations on water companies to be more transparent with their reporting on the operation of storm overflows and a requirement to invest in river water quality monitoring equipment.

Monitoring their operation

Awareness of how many times and the duration for which storm overflows operate is only now being revealed after a multi-year programme to install monitors on them. Hitherto, the extent of their operation went largely un-noticed.

While this monitoring programme is still not complete, companies have committed to reach 100% coverage of Event Duration Monitors (EDM) by December 2023. The information is published each year. A summary of the industry performance in installing storm overflow event duration monitoring at the end of 2022 is set out below:

2022 EDM headlines	Anglian Water (AWS)	Dwr Cymru Welsh Water (DC/WW) (in England)	Northumbrian Water (NW)	Severn Trent Water (SvT)	South West Water (SWW)	Southern Water (SW)	Thames Water (TW)	United Utilities (UU)	Wessex Water (WSSX)	Yorkshire Water (YWS)	**Water company totals/average**
Total number of storm overflows listed in the annual return in 2022	1,552	126	1,564	2,466	1,342	978	777	2,254	1,300	2,221	**14,580**
Total number of storm overflows with EDM commissioned	1,058	126	1,542	2,457	1,333	963	480	2,004	1,182	2,178	**13,323**
% storm overflows listed with EDM commissioned	68.2%	100%	98.6%	99.6%	99.3%	98.5%	61.8%	88.9%	90.9%	98.1%	**91%**
Total number of storm overflows with spill data in 2022	1,054	120	1.463	2,438	1,323	939	472	1,971	1,182	2,118	**13,080**
Average number of spills per storm overflow with spill data in 2022	15.3	23.3	20.3	18.4	28.5	17.8	17.0	35.1	18.5	25.6	**23.0**
Average duration (hrs) per monitored spill event in 2022	5.6	3.4	3.6	5.6	7.7	8.8	9.3	6.1	5.9	4.3	**5.8**

The revelation of how often they operate has coincided with an increased appreciation and use of rivers by swimmers and other amenity users following the national lockdown due to the pandemic.

Various individuals and groups have been lobbying hard to stop storm overflows from operating and the government has responded to this pressure through the Environment Act 2021.

However the actual environmental impact resulting from intermittent storm overflow operation (especially when compared with continuous discharges from water recycling centres and agricultural run-off) has been somewhat overstated without reference to the available scientific data. This is discussed in further detail later.

As more policymakers and activists recognise the costs and disruption associated with addressing storm overflows (and the lower than portrayed environmental impact), so the ambition to eliminate them altogether has been revised to eliminating harm from them.

"Harm" can be categorised as environmental harm and/or public health harm. These are measured in different ways.

Annex I provides evidence of the level of environmental impact that storm overflows have based on current data.

Annex II discusses public health impacts of storm overflows.

What can be done to reduce storm overflow operation and/or their impact?

There are basically eight ways of stopping the problem get worse and reducing the future problem:

<table>
<tr><td rowspan="3">Stopping discharges increasing in the future</td><td>Preventing additional surface water from being added to combined sewers</td></tr>
<tr><td>Preventing additional subsoil or overland water ingress to combined sewers</td></tr>
<tr><td>Ensuring existing sewer capacity is maximised at any given time</td></tr>
<tr><td rowspan="4">Reducing current discharge levels</td><td>Removing existing connected surface water from combined sewers</td></tr>
<tr><td>Removing or limiting existing subsoil or overland water ingress into combined sewers</td></tr>
<tr><td>Providing additional capacity to the existing sewers</td></tr>
<tr><td>Providing additional hydraulic treatment capacity at water recycling centres</td></tr>
<tr><td>Reducing the impact of discharges</td><td>Providing adequate treatment to storm overflows to prevent harm</td></tr>
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The top five of these eight ways would benefit from changes to sewerage legislation to help enable the ambition to be fulfilled more cost effectively. Several of these issues are discussed in **Annex III**.

Solutions

Reducing discharges or impacts of discharges can be grouped into four main types of solution:

1 Separation of surface or groundwater to reduce discharges.
2 Attenuation of combined sewage to reduce discharges.
3 Increasing capacity of continuous treatment at water recycling centres.
4 Treatment of intermittent discharges to reduce impact.

The pros and cons and relative benefits of different solution approaches are discussed in **Annex IV**.

Wessex Water's 2020-25 investment plan

Wessex Water's current investment plan addresses storm overflows in the following way:

- Completion of our monitoring programme to cover 100% of all storm overflows by end of 2023.
- Increasing the treatment capacity at 14 WRCs (including our largest site at Avonmouth) to reduce storm overflow operation.
- Separation of rainwater upstream of two overflows to reduce the number of times they operate.
- Construction of 32 new storm tanks at Water Recycling Centres (WRCs) and at storm overflows on the sewerage network to reduce overflow operation.

Furthermore, over and above the level of investment we had planned to do, we are also accelerating the following investments:

- Additional environmental and public health monitoring at key locations.
- Developing AI tools to enable public health monitoring to become near real-time.
- Construction of nature-based treatment solutions at 28 rural storm overflows where groundwater infiltration is the primary cause of the overflow operation.

We have also drafted our investment plan for 2025-2030. This includes improvements to 148 storm overflows and is subject to regulatory approval from both the Environment Agency and Ofwat.

Summary

- Storm overflows used to be a pragmatic solution to the problem of combined sewerage systems, preventing property flooding in heavy rain without polluting the environment.
- Public acceptability of storm overflows has declined as operational data has been obtained and made available.
- Environmental impacts of overflow operation, as currently measured, are minor compared to other sources.
- The public's increase in recreational water use has raised concerns over public health impacts from overflow operation though little data on water quality (measured by faecal bacteria) exists to quantify where overflows are the main source compared to continuous discharges or agricultural run-off.
- Unless legislation is addressed to encourage the separation of surface water from pipes containing sewage, investment to reduce discharges is likely to involve substantial volumes of additional storage and unnecessary treatment – which will have a high carbon cost impact.
- Identified issues can either be resolved by reducing the frequency of spills by separation, attenuation, passing forward more to treatment, or reducing the impact through overflow treatment.

Annex I – What environmental impact do storm overflows have?

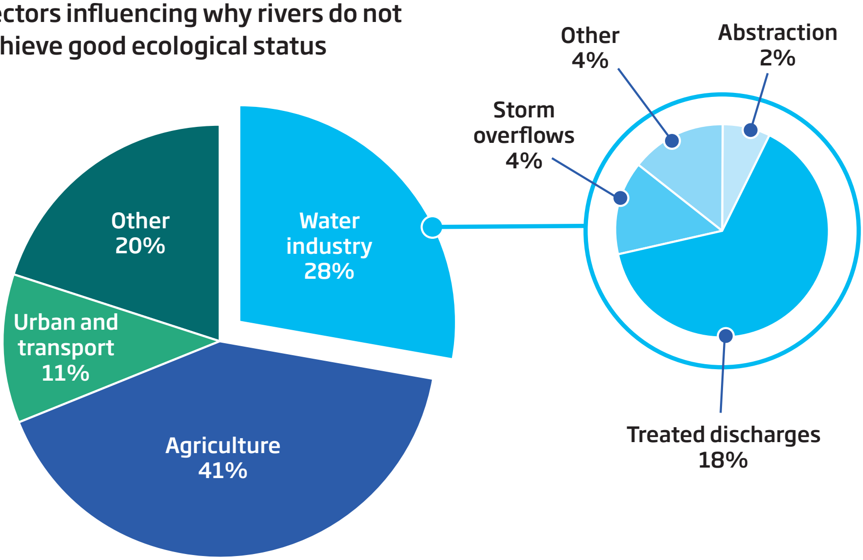
Storm overflows were designed to have a negligible environmental impact when operating in heavy rainfall. The main polluting load of the contents of a sewer should flow to the treatment centre, allowing very dilute sewage to overflow when capacity is exceeded.

Analysis of the reasons why waterbodies in the UK do not achieve good ecological status under the Water Framework Directive is publicly available data. The Water Framework Directive measures over 80 parameters – ranging from nutrients to pharmaceuticals.

Data from the limited number of waterbody monitoring points indicate that less than 4% of the reasons that rivers do not reach good ecological status are confirmed or probably as a result of storm overflow operation. In the Wessex Water region, storm overflows are assessed as contributing <0.9% of the reasons, affecting 1.5% of all waterbodies.

The two largest contributing sources are continuous discharges of treated sewage and agricultural impacts. The pollutants are nutrients – either phosphorus or nitrogen which are present in agricultural run-off and treated sewage. Nutrients are considered a pollutant as too much of it in a watercourse can lead to eutrophication – a situation where too much algae can inhibit healthy ecosystems.

Sectors influencing why rivers do not achieve good ecological status



Source data

Annex II – What public health impact do storm overflows have?

Answer: mostly unknown.

In 1976 the EU Bathing Water Directive introduced standards to limit the bacteriological loads at designated bathing water sites.

Companies invested millions improving treatment standards and adding ultra-violet disinfection to continuous discharges from water recycling centres. Nearby storm overflows also received additional investment to reduce spill numbers and improve bathing water quality.

When storm overflows operate, the dilute sewage contains high levels of faecal bacteria, but their operation does not mean a bathing water's quality is necessarily unfit for swimming; enteric bacteria generally do not survive long outside host organisms and are especially fragile when exposed to sunlight in seawater. Dispersion and dilution factors are also vital in determining the public health impact of sea water where overflow operation has occurred.

Sewerage companies provide near-real time information about when storm overflows (that might affect nearby bathing water quality) operate. Wessex Water uses a system called Coast and Rivers Watch and also supplies the data to the Surfers Against Sewage SaferSeas App. Wessex Water also provides this information for storm overflows near 14 amenity sites as well as all designated bathing waters.

However, these alerts do not provide public health water quality information.

Bacterial sources in bathing waters can be varied and not just of human origin. In addition to continuous discharges from water recycling centres and intermittent discharges from storm overflows, agricultural run-off and animals such as seagulls are also common sources of bacterial load.

The biggest issue for the public wanting to engage more with the water environment is a lack of near-real time public health water quality information so that risk-based decisions can be made. The Bathing Water Directive does not require such monitoring to make assessments of bathing water standards – only 20 samples during the bathing season 15 May – 30 September.

The difficulty arises because measuring faecal bacteria levels is a laboratory-based process involving growing colonies of bacteria overnight on petri dishes. Real-time information is currently unobtainable.

Wessex Water has developed an approach using AI to accurately predict this public health information using other more easily obtainable data such as flow, temperature, turbidity, conductivity, pH etc.

This app is now available (see QR code) for a popular swimming location near Bath and the approach is now being developed at other locations.

Find out more

Annex III – Areas where legislation could change to enable the aims to be achieved more cost effectively

1 Existing legislation still allows rainwater to be connected to sewers that carry foul sewage

Section 106 (right to communicate with public sewers) of the Water Industry Act currently only prohibits surface water being connected to foul sewers where there are separate foul and surface water sewers in existence. The Act does not recognise 'combined' sewers.

So, although separate pipes are laid to all new properties to drain surface water (eg, from roof areas), it is still possible for these to be connected to existing pipes containing foul water (ie, combined sewers) where there is no existing separate surface water sewer

Developers are encouraged to follow a sustainable drainage process where rainwater is discharged, starting with discharging to the ground, then to a surface waterbody, then to a highway drain or surface water sewer and finally to a combined sewer.

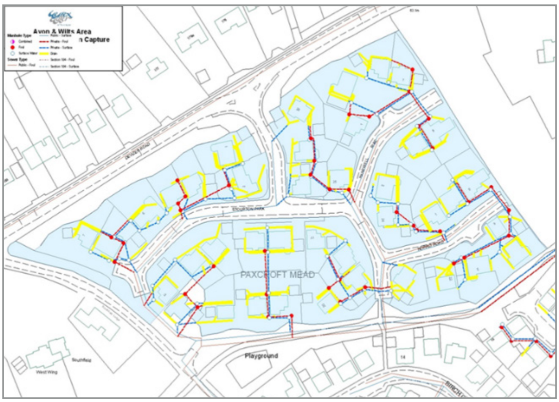
It is sometimes argued that discharging rainwater to the combined sewer system is the only affordable solution for their development. This passes the cost and problem further down the network, resulting in increases in overflow operation where overflows exist or a flooding risk where they don't.

What is needed? The government could amend Section 106 of the Water Industry Act to address the 'right' to connect surface water drainage to combined sewer systems because it continues to increase flows, causing more overflow operation.

While the government is progressing the implementation of Schedule 3 of the Flood and Water Management Act 2010, which will make sustainable drainage solutions mandatory for new development of more than 2 properties, the 'Right to Connect' (surplus rainwater to combined sewers) is not being rescinded.

2 Existing legislation does not provide appropriate powers to tackle groundwater infiltration

Under much of southern and eastern England are water bearing layers of rock such as chalk, where the levels of groundwater vary throughout the year. In wet winters, these levels can reach the ground and cause flooding. Even before it reaches this level, groundwater will be above the level of the underground pipes and can often flow into and flood drains, sewers and inspection chambers for weeks at a time.



Comparison of the length of privately-owned pipes (yellow) versus publicly owned (red and blue) on a typical development

Overflows, which can operate for these prolonged periods, will often protect properties from losing their ability to drain their wastewater.

Sewerage companies carry out extensive sewer relining work each year, but this can be totally ineffective because privately- owned pipes, whose length is greater than sewerage company owned pipes (demonstrated here), are neglected. A recent study has shown that about 70% of all underground pipes are in private ownership.

What is required? The Government could address this issue by providing sewerage companies with both the power to enforce private drain maintenance or to carry out the work and recover costs from the pipe owners.

This is already the case for water supply under Section 75 of the Water Industry Act which enables water companies to serve notice on consumers making them mend leaking water pipes.

3 Sewer capacity is frequently limited by wet wipes and other "unflushable" products

Wet wipes are the single biggest factor in restricting existing sewerage capacity. Partial and complete blockages are caused because they do not disintegrate quickly and are the main reason for premature overflow operation. In Wessex Water's area, we clear around 13,000 blockages a year and many thousands more occur in customers' own pipes.

Government and regulating bodies (such as the Advertising Standards Authority and Trading Standards) continue to allow manufacturers and retailers to advertise and sell products that claim to be 'flushable' but which sewerage companies refute.

What is required? The government must give legislative backing and full support to the organisations that deal with the problems caused by wet wipes (and other items labelled as 'flushable') rather than those who create them. Until such time this problem will continue to grow.

The government has recently announced a ban on plastic in wet wipes – which is good – but wet wipes that don't contain plastic and which still don't disperse immediately will still be allowed and will continue to be flushed. We will wait to see if the ban has any impact on blockage numbers.

4 Legislation does not sufficiently support disconnection of surface water from combined sewerage systems

Powers to disconnect

Sewerage companies have the power to disconnect rainwater pipes, but the surface water has to be reconnected to a public sewer (which removes the ability to construct property level soakaways) and has to be done by consent and at the cost of the company.

Rainwater should be allowed to infiltrate the ground as close to where it lands where the ground conditions allow it to do so.

The Right to Discharge

Sewerage companies do not have a Right to Discharge rainwater to canals or watercourses. Permission can only be obtained through negotiation with the owner which can involve significant costs making any such initiatives cost prohibitive.

The same constraint applies to developers when planning where the rainwater from new development is going to discharge. The result is that they often take the easier and cheaper route and use the current 'right to connect' to a combined sewer (see above) rather than paying the riparian owner and discharging to a watercourse.

Highways authorities are often responsible for assets that drain surface water. But as they have no duty to drain properties, surface water can often end up being connected to a system of pipes carrying foul water (ie, combined sewers), rather than surface water drainage pipes such as highway drains.

What is required? Government should review the opportunities that legislative change can have to encourage the separation of rainwater from pipes carrying sewage.

5 **Urban creep is not managed through the planning process**

The phrase 'urban creep' is used to describe the gradual increase in impermeable surface area. This can be as a result of paving over front gardens to make space for parking cars, or where house, conservatory or patio extensions are made.

Where rainwater is connected to the same pipes as foul water, this increases the volume of flow the pipe is required to carry when it rains and increases the number of times storm overflows operate.

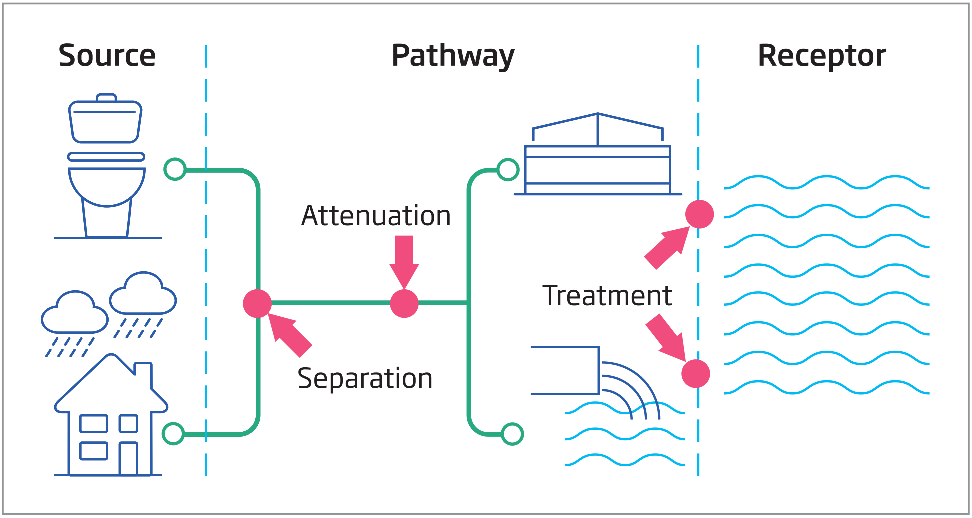
A 2009 UK Water Industry Research study using time-lapse aerial photography of more than half a million properties revealed that the increase in impermeable area amounted to between 0.4m^2 to 1.1m^2/property a year

Urban creep is not currently managed through the planning process. Theoretically, where hardstanding areas are increased by >5m^2, this should go through the planning process – but in reality it doesn't.

What is required? Local authorities need to be made aware of the impact of the rainwater's destination through a better supply of information and communication with the organisation (sewerage undertaker or highways authority). They must also be prepared to deny permission or impose conditions (eg, soakaways) or limiting run-off rates, on any application that could exacerbate storm overflow operation.

Annex IV – Solution options

There are four basic solution types: separation, attenuation and two types of treatment – treatment through the water recycling centre or treatment at the overflow.



Different solution approaches have different relative benefits:

Outcome	Solution approach	Relative benefits assessment				
		Water efficiency	Bio-diversity	Customer bills	Embodied carbon	Operational carbon
Reduction in discharges	**Separation** (property level)	✔	✔	✔	✔	✔
Reduction in discharges	**Separation** (community level)	✗	✔	✗	✔	✔
Reduction in discharges	**Attenuation**	✗	✗	✗	✗	✗
Reduction in discharges	Increased **WRC treatment** capacity	✗	✗	✗	✗	✗
Reduction in harm	**Overflow treatment**: nature-based solutions	✗	✔	✗	✔	✔
Reduction in harm	**Overflow treatment**: grey solutions (eg,UV)	✗	✗	✗	✗	✗

Separation of flow is a lower operating carbon solution compared to attenuation but more disruptive to construct, often with higher capital investment and riskier to deliver. Separation directs rainwater to where it should go (ie, straight back into the environment), rather than where it need not go (ie, to a water recycling works where large amounts of energy and chemicals are used to treat sewage before being returned to the environment). Separation can either be done at single property level, where there are many broader benefits to be gained, as illustrated above, or at a community level where the rainwater has already left the premises and been piped away in a surface water sewer before it subsequently connects to a foul sewer.

Attenuation of flows means rainwater is still processed through the water recycling centre, but it is held for longer within the network by storing it. The required volumes of underground storage capacity can be immense. Because most overflows are in older urban areas there is often no physical space to construct the required storage to eliminate them apart from tunnels - a good example of this is the Thames Tideway, a tunnel currently being constructed deep under the Thames. It is designed to reduce (not eliminate) storm spills from 34 overflows to operate about 5 times/year. The construction cost is nearly £5 billion.

In situations where overflows operate due to groundwater entering sewers, neither of the above solutions are practical or feasible as separation or attenuation would not have the desired effect. In this situation, all the underground assets need to be made watertight, including public and private manholes and pipes.

Additional treatment

The environmental impact of overflows is generally low, due to the heavily diluted nature of the flow. However, there are some occasions where prolonged discharges do have an environmental impact (eg, the growth of sewage related fungus).

Reducing biological loads is usually achieved through a biological process (such as used at water recycling centres) and requires space and often energy and chemicals to facilitate the growth of the bacteria required to break down the passing organic load. Since most overflows are in urban areas, there is generally insufficient space for biological treatment. In situations where there is an environmental impact, these have usually been addressed through reducing spill frequency rather than additional treatment.

There are notable exceptions where constructed wetlands or reedbeds have been used to treat storm overflows, but the space required and the intermittent nature of the flows (leading to the drying out of the reedbed) can easily reduce the feasibility of such solutions.

Where an overflow operation affects public health/bathing water status, the key requirement is to kill the bacteriological load. This is usually done through ultraviolet (UV) light – chemically killing bacteria using chlorine dosing is prohibited.

However, while using UV on continuous discharges is a common, but energy intensive, approach to meet bathing water standards, using UV treatment for intermittent storm overflows can be less effective (UV treatment relies on good transmissivity of the liquid being treated) and can be costly in terms of carbon emissions.