

Session 4: Future Visions for Urban Drainage - Paper 11

CSOs – The Past, The Present and The Future.

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Summary

There are over 15,000 permitted CSOs in England. The majority (89%) spill to inland waters (rivers and lakes), 10% to coastal and estuarine waters and 1% to ground.

This paper looks back at the environmental improvements secured to CSOs over the past 25 years, presenting the scale of achievement, both in terms of the number and complexity of schemes, and the environmental outcomes. Innovation is highlighted, including that which WaPUG / UDG have been at the centre of; developing, promoting and embedding in our industry.

Whereas the past has focused on fixing historic problems, through capital schemes enabled by environmental drivers, we now as an industry look towards the future. Protecting previous investment from future pressures, whilst addressing new environmental and public requirements, will require; strategic planning, external communication and mechanisms to trigger proactive measures.

This paper sets out aspects of the Environment Agency's contributions to the future planning and regulation of Combined Sewer Overflows (CSOs). It describes three key pieces of work; Event Duration Monitoring⁽¹⁾, the Drainage Strategy Framework⁽²⁾ and Spill Frequency Permitting⁽³⁾ that the Agency expects to contribute to a wider industry strategy for CSOs.

The Past

Scale of the issue

The industry was privatised in 1989. Water UK⁽⁴⁾ say; *“The UK water companies were privatised in 1989 and took over responsibility for a public water and wastewater industry that had suffered decades of under investment and struggled to deliver good service and meet quality standards”*.

Between 1989 and 2020, approximately half (~8,000) of all permitted storm overflows will have been improved by Water and Sewerage Companies (WaSCs) in England and Wales to meet environmental needs through the National Environment Programme (NEP). Much of this investment was reactive to cure a sewerage system that did not meet current needs.

Objectives

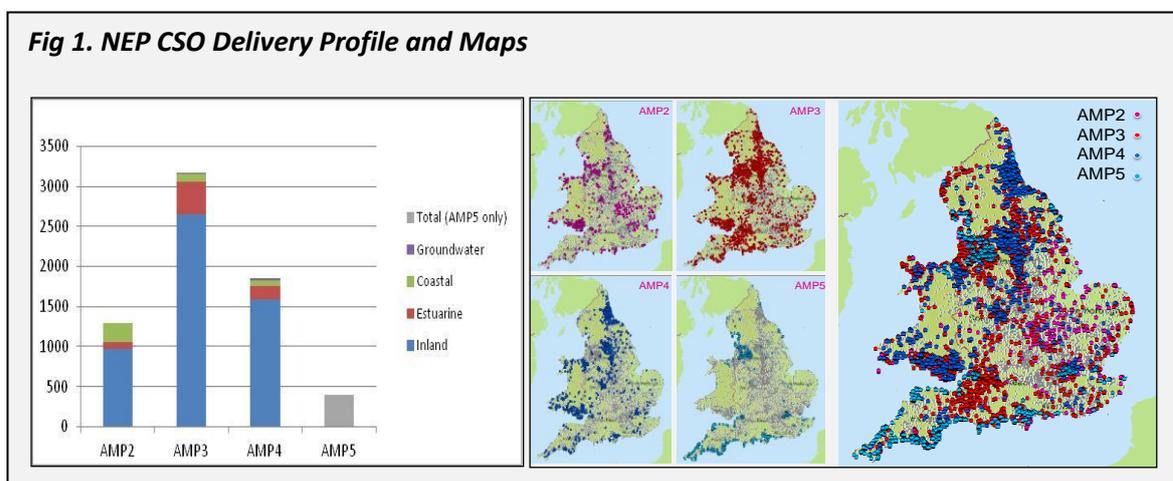
Criteria that defined unsatisfactory CSOs were introduced in the AMP2 Guidelines and can be found today relatively unchanged in the Environment Agency's Guidance EPR 7.01⁽⁵⁾.

The NEP prioritised investment by targeting on the basis of environmental impact rather than substandard⁽⁵⁾ assets. CSOs that were identified and confirmed as being unsatisfactory were brought up to a minimum standard under an Urban Wastewater Treatment Directive (UWWTD) driver to achieve a Formula A equivalent performance and screening, primarily through AMP2 and AMP3. It took 15 years to catch up from our pre-privatisation past. The Agency's position is that any future works required to meet the requirements of these minimum UWWTD requirements would now be funded from outside the NEP.

In addition to these minimum standard improvements, quality enhancement schemes were promoted, including those to achieve inland water quality, bathing water and shellfish water standards. These were promoted under, a variety of environmental drivers such as UWWTD, Freshwater Fisheries Directive and Bathing Waters Directive, to meet UPM⁽⁷⁾ (99%ile and FIS) and spill frequency or water quality standards to coastal waters.

The Programme

AMP2 improvements were focused on the most noticeable unsatisfactory CSOs within the major conurbations and coastal areas (Fig 1). Within AMP3, more robust techniques were employed in the identification of⁽⁶⁾ and confirmation of unsatisfactory CSOs (UPM)⁽⁷⁾.



Solutions focused on capital schemes, mostly upsizing capacity (conveyance and storage) and screen installation.

Innovation

The improvement programme relied upon technical innovations in hydraulic modelling⁽⁸⁾, screening⁽⁹⁾ and urban pollution management⁽⁷⁾. WaPUG (now CIWEM's UDG) has been at the centre of this innovation and its members should be proud of their achievements.

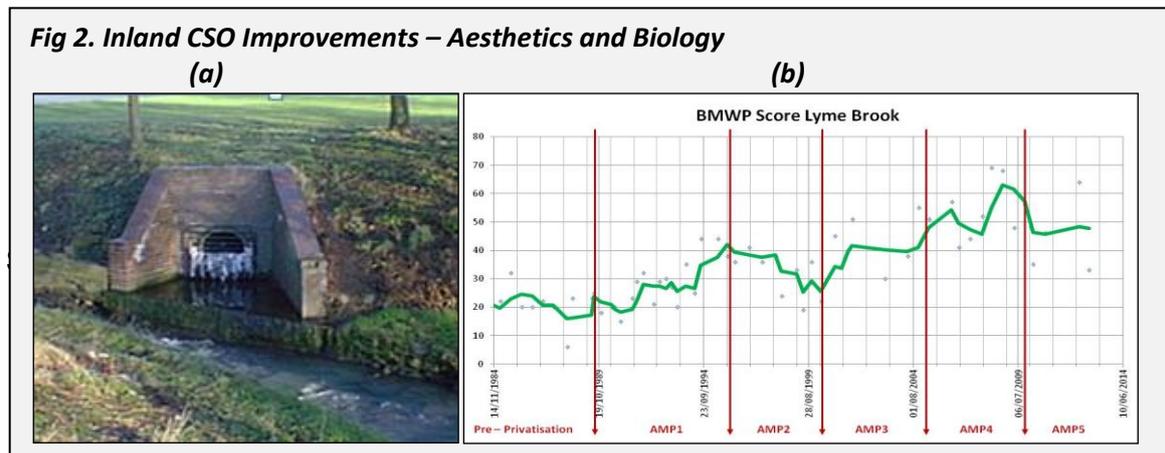
But WaPUGs / UDGs contribution has been much more than a technical one. It has brought people (Modellers and Managers from WaSCs and LAs, Software Developers, Academics and Regulators) together, across organisational boundaries, to develop a greater understanding of each other's needs and potential contributions. Delivery of the NEP has significantly benefited from this and WaPUGs outputs have been robust because of the breadth of contributions.

With innovation comes novel applications and in some cases learning. WaPUG / UDG has provided a safe environment whereby its members can share experiences through conference discussions or specialist workshops⁽¹⁰⁾ in a forum that facilitates working together to find solutions or reset expectations. This ability to self review and continued drive for improvement is at the centre of the UDG.

Outcomes

The outcomes from this investment have been clear and most noticeable in terms of aesthetic quality. Outfall structures and downstream watercourses decorated with gross sewage debris was the norm in the mid 1990's (Fig 2 (a)), but now it is the exception. The benefits have been huge to waterside amenity and in many cases local economy.

Environmental outcomes are often less obvious and routine spot chemical sampling is not designed to pick up the impact of intermittents. However if we look at how biological quality of our rivers has improved since pre privatisation (Fig 2 (b)) we can see marked improvements. However due to varying contributions from other sources it is often difficult to measure the environment and say an X percentage improvement is the result of Y CSO scheme. However the trends and in some cases step changes in biological quality of our urban rivers are clear to see.



The Present

Updating Permits

In the run up to privatisation of the water industry in 1989 it was realised that many Water Authorities didn't have a legal permit for some of their storm and emergency discharges. Temporary permits (known as Temporary Deemed Consents - TDCs) for these discharges using standard wording were issued. Some of these discharges were later found to be unsatisfactory and there was a risk of them causing pollution. The water companies invested in these assets through the AMP programme to improve them and the Agency issued bespoke permits for these, with site specific controls in order to protect the environment.

The Agency is now working with the Water and Sewerage Companies (WaSCs) to put site specific permits in place to better control the risks from the remaining assets which are still covered by TDCs. WaSCs are gathering the information required to permit these using agreed conditions under the Environmental Permitting Regulations, including site specific detail. The WaSCs have already identified outfalls that are no longer in use. This has reduced the number of TDCs from 4550 to 2865. The aim is to issue the remaining 2865 permits by the 31st March 2015.

As part of this exercise the Agency expects for WaSCs to review their asset registers against permit lists and identify any CSOs that do not have a valid permit, so that measures can be put in place to make such assets legal.

Unsatisfactory CSOs

The Agency is not able to issue permits for existing unsatisfactory storm overflows, without conditions to require improvement. WaSCs must make sure existing storm overflows do not become unsatisfactory. Where a storm overflow does become unsatisfactory we will take enforcement action or review the permit and will require remedial action to resolve the problems as soon as reasonably practical outside the NEP. The only exception to this is where an overflow becomes unsatisfactory due to new legal requirements such as the imposition of new EU Directives or new designations under existing directives. Here we will promote the affected storm overflows within the NEP.

New CSOs

The Environment Agency has a presumption against new storm overflows unless as part of a wider scheme delivering a net improvement in water quality, this is in line with our objective to prevent deterioration of the water environment.

We expect WaSCs to adequately deal with external pressures (climate, growth and creep) on sewerage to prevent the need for new proposed CSOs or existing ones deteriorating. Inadequate sewer design or maintenance is not an acceptable reason for a proposed new or deterioration of an existing CSO.

Scheme Confidence

The Agency recognises that in developing schemes involving complex modelling there is always some uncertainty over whether the required outcome will be met. The Agency has worked with WaSCs and their consultants to share our experience and expertise of the environment and to assure the Agency that industry standards such as the WaPUG Code of Practice ⁽⁶⁾ or UPM ⁽⁷⁾ is being followed. We may also ask for audits of modelling work to increase our confidence for higher risk applications. The Agency's involvement is to seek sufficient confidence to issue a permit to discharge. However the Agency's role is not one of checking or of Quality Assurance. It is the WaSCs responsibility to derive a scheme that delivers the environmental and/or performance targets set. If the scheme does not deliver the required performance then we expect this to be rectified as soon as practicable.

Environmental Standards

The Agency undertook a review of UPM standards against WFD requirements through WRc 2012 Report ⁽¹¹⁾ "*Review of urban pollution management standards against WFD requirements*". It was concluded that the UPM standards remain "fit for purpose".

The Public

PR14 business plans will be outcome focused and be influenced by the Customer Challenge Groups ⁽¹²⁾. Whereas the public have previously seldom been interested in how sewerage interacted with their lives, they are now. Media and NGOs have raised the level of public scrutiny. We (the wider industry) are quite rightly expected to know; how often a CSO spills, what the likely impact might be and what the mechanism is to resolve unsatisfactory performance. It is also reasonable to expect that we work together to plan and take action to accommodate future pressures on the system to prevent deterioration or previous improvements being eroded.

When the industry (WaSCs or Regulators or Government) is asked about sewerage we are most often in a position of defence. We find it difficult to communicate CSO performance and acceptability without getting into technical detail of modelling and water quality standards, which can be confusing to the public. When asked about CSO performance, the fact that we do not have consistent and simple means of quantifying this, might well provide a message that we don't measure, because we are worried about what we might find.

In his 2011 paper "*The public face of CSO monitoring*" ⁽¹³⁾, Ed Bramley addresses the issue of CSOs and the public. Ed identifies the expectation of the public that CSO performance should be made visible to inform environmental use. Monitoring and reporting of CSO performance is also explored in the paper as an integral part of asset management both in terms of operational activity, but also in understanding long term performance trends, particularly after significant capital spend. Stephen Nutter in his 2013 paper "*Event Duration Monitoring; from beach to river reach*" ⁽¹⁴⁾ builds on Eds 2011 paper linking CSO monitoring to customer willingness to pay, explaining the importance of the public being informed by evidence rather than emotion driven by media savvy campaigns.

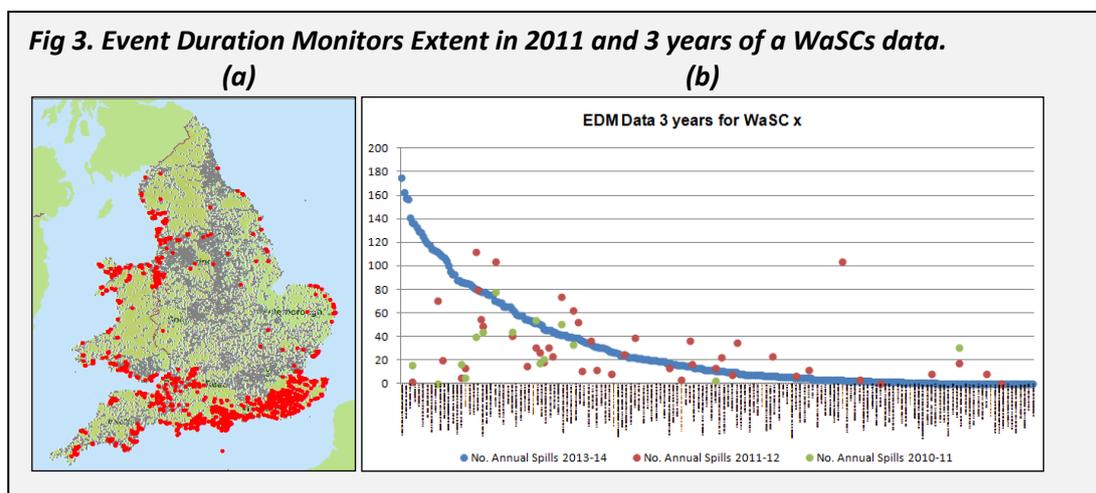
We have to ask ourselves whether a more proactive communication strategy is required that involves stakeholders at initial stages. Are the days of Decide-Announce-Defend (DAD) being replaced by the Engage-Deliberate-Decide (EDD) approach.

Regulatory Driven Event Duration Monitors

Event Duration Monitors (EDM), monitor spill events from CSOs, the data can be used for internal or external real time alerts or for longer term planning purposes.

Through AMP4 and AMP5 the Agency has required EDM installation and reporting at prioritised storm overflows that have potential to impact on designated bathing and shellfish harvesting waters. The reporting is normally made annually. We have been increasing the number of storm overflows monitored in this way. For the year April 2010-March 2011, 762 storm overflows were monitored within the permit by WaSCs (Figure 3 (a)). By the end of AMP5 the number of storm overflows monitored as regulatory requirement will be approximately 1,300.

Three years of annual spill returns for one WaSC are plotted in Figure 3 (b). The figure ranks spills for last year (2013-14), with blue markers. It is clear that more than half the overflows are spilling less than 20 times per year even in a year that includes the extreme winter of 2013/14. However not surprisingly during this period many CSOs were spilling well in excess of this frequency. Data for the years of 2010/11 and 2011/12 are also plotted ranked in the same order they were for the year 2013/14. Fewer overflows were monitored in these years. It is clear that spill frequency and relative ranking is variable between years, although the 2010/11 and 2011/12 years do follow the same trend as the 2013/14 year, other than for high frequency spilling overflows in 2013/14 being lowly ranked for the other two years. This data promotes discussion between the Agency and WaSCs and in many cases investigations have been triggered, albeit not as a permit requirement.



We also use EDM returns to assess whether improvement schemes perform at the level designed to. When EDM data shows that a scheme is not performing as expected then we are keen to work with the WaSC to understand why and compare against permit requirements.

In addition to the regulatory annual monitoring and reporting, water companies monitor many of their storm overflows to inform their day to day operations.

The Future

Future pressures

In Ofwats 2011 report “Future Impacts on Sewer Systems in England and Wales” ⁽¹⁵⁾ the effects on sewer flooding of climate change, population growth and urban creep were modelled up to the year 2040. The models predicted a significant increase in flood volumes and the number of flooded locations (median increase in flood volumes of about 51%).

This report is of great significance to those concerned with CSOs, as Sewer flooding and CSOs are intrinsically linked. Every sewerage system behaves differently but if one recognises that CSO weirs are below ground and flooding generally occurs at ground level then any increase in sewer flooding is likely to be accompanied with an even greater increase in CSO discharges (spill frequency and volume).

We previously looked to past to direct our actions, we now need to look to the future.

Prevention or Cure

Looking to the past we have focused on fixing what was broken, this has called for technical and organisational innovation. We gathered field and model evidence and pieced together the jigsaw and used models to come up with a solution relying on a capital scheme to deliver. We as an industry were very much on the back-foot, but from an external perspective we were innovating, working hard and delivering. Set against a back drop where public interest in sewerage was low, this was a very acceptable state.

The three pressures assessed by OFWAT⁽¹⁵⁾ and the consequential environmental impact will gradually increase with time if action is not taken. Deterioration in the environment is not an acceptable outcome, but the tools we have developed to deal with past problems were developed to deliver step changes in performance through capital schemes. They are more suited to curing what is broken, whereas what is now needed are preventative measures. The following are likely to have larger part to play in the future:

- **Partnerships** - Prevention could take the form of partnership working with Local Planning Authorities (LPAs) and developers to keep surface water out or even free up capacity in combined sewers to accommodate new foul flows. SuDS are an obvious tool in the toolbox.
- **Communication** - Communication for example when coupled with partnership working to tackle urban creep (paving over of front gardens) also has a potential part to play. Can those who have challenged us now work with us?
- **Predictive Capabilities** - The ability to predict where these future pressures are priorities will rely on closer working with LPAs and Developers and better predictive model capabilities. How good are our climate change predictions?

- **Permitting** - The way that we permit CSOs could be reviewed to enable a WaSC to more clearly demonstrate the potential for a regulatory impact if action is not taken.
- **Capital Schemes** - Capital schemes will always have part to play for example in achieving new environmental targets or replacement or provision of new infrastructure, but in the future these are likely to be applied within a range of other measures.

Environmental pressures

Environmental expectations and hence requirements can change. An example is the revised Bathing Water Directive. For example Water Company assets must not cause any poor bathing waters under the “revised Bathing Water Directive” by 2015, which is a more onerous requirement to that which existed in previous AMPs. CSOs that were previously satisfactory can become unsatisfactory, even without a change in their performance. Where such changes are due to new environmental obligations, the Agency will support improvement works through inclusion within the NEP.

Innovation

A planning cycle such as the one at the centre of the Sewerage Risk Management (SRM) ⁽¹⁶⁾ approach is a convenient model to map actions to. SRM promotes four stages;

Plan – Assess – Investigate - Implement

The Agency is working with the WaSCs to introduce and make “Business as Usual” three complementary approaches that contribute to addressing future risks through PR14 and beyond:

- **Drainage Strategy Framework** - **(Plan)**
- **Event Duration Monitoring** - **(Assess)**
- **Spill Frequency Permitting** - **(Investigate and Implement)**

Plan – Drainage Strategy Framework (DSF)

The DSF is a means by which the industry can plan for future pressures and engage with co-delivers / partners.

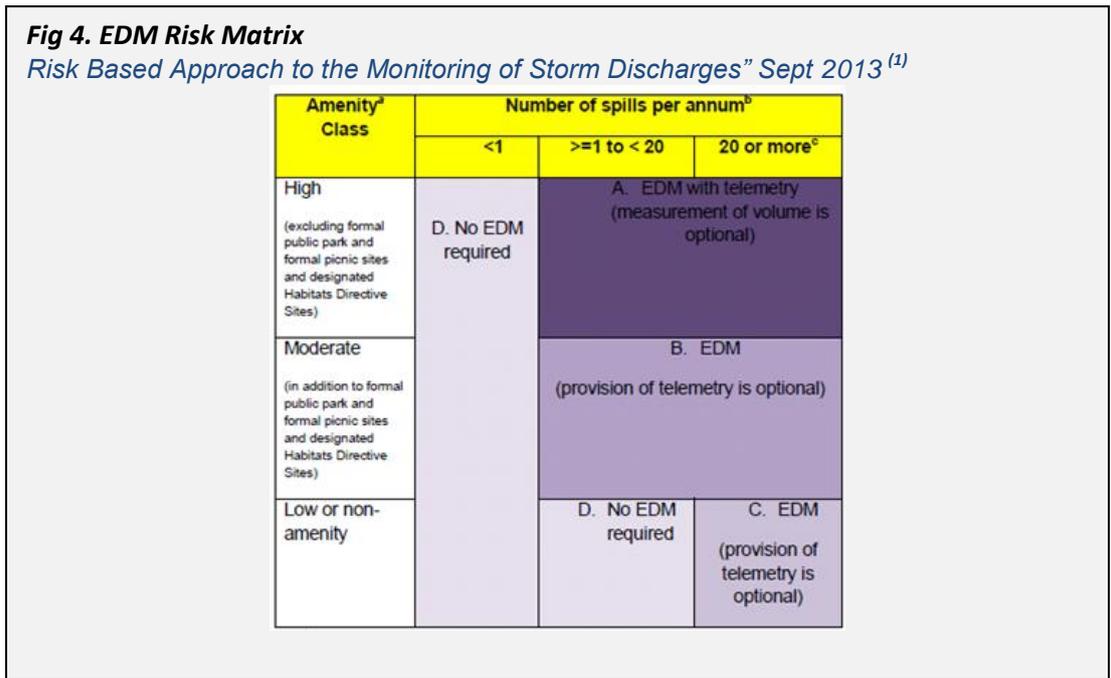
The Environment Agency and Ofwat jointly published the **Drainage Strategy Framework (DSF)** ⁽²⁾ in May 2013, which sets out guidance and best practice for WaSCs to follow in meeting the long term needs for sewerage assets. By following this framework future pressures on the sewerage system and hence CSOs will be proactively identified and evidence collated to support action being taken to prevent deterioration in performance. The Agency is aware that WaSCs have allocated for the development of Catchment Drainage Strategies in their PR14 business plans. Priority catchments should have WaSC led Catchment Drainage Strategies complete by 2020. We are already starting to see initial Drainage Strategies being produced.

Assess – Event Duration Monitoring (EDM)

Understanding CSO performance through monitoring is an important activity as described earlier and is a key part of our strategy. A risk based monitoring programme that measures CSO performance based on spill frequency provides a robust high level screening tool to prioritise and identify individual CSOs for more detailed investigation.

We are building on and reinforcing the existing regulatory driven Event Duration Monitoring (EDM) monitoring. The vast majority of (inland and coastal) CSOs will have regulatory EDM installed by the end of AMP6 (March 2020) and this will be secured through a monitoring condition on the CSOs permit to discharge. This work has been supported at Ministerial level. The (then) Minister for Natural Environment and Fisheries – Richard Benyon MP wrote to all WaSC CEOs on CSO monitoring on the 18th of July 2013 ⁽¹⁷⁾ requesting that the vast majority of CSOs be monitored by 2020.

The Environment Agency has developed the “Risk Based Approach to the Monitoring of Storm Discharges” Sept 2013⁽¹⁾ (Fig 4) which is being used by WaSCs to develop their PR14 business plans to meet the ambition set out by the Minister. CSOs that spill less often than once per year and certain CSOs that discharge to low and non amenity waters will not require EDM.



WaSCs will be required (through the permit condition) to submit annual reports detailing monitored spill frequency and duration of spill. We expect 8,500 new monitors to be installed through PR14, this is in addition to those already installed at coastal discharges as a permit requirement and those that are installed by WaSCs for operational reasons. WaSCs are currently working through the Environment Agency’s Risk Based Approach and are due to have completed schedules of which CSO require EDM and the evidence why or why not by September 2015.

We have adopted the EDM approach as it provides an appropriate level of screening that can be applied wide enough to cover those CSOs that present anything more than low risk, whilst providing a simple but effective metric to assess trends, prioritise and engage with WaSCs on unexpected performance.

There are multiple applications and benefits from EDM data:

- Facilitate engagement and communication tool
- Confirm success of capital schemes
- Assess long term trends and success of measure to deal with future Pressures
- Real time informing beach / shellfish users
- Real time reactive network management
- Inform WaSC strategy & prioritise investment
- Inform other's strategy (for example River Basin Management Plans)
- Highlight high frequency / unsatisfactory CSOs
- Contribute to verify hydraulic models
- Permit spill frequency

Investigate and Implement – Spill Frequency Permitting (SFP)

A robust planning cycle requires a mechanisms to trigger investigations and drive implementation. Regulatory permitting is the Agency's contribution to these stages of the planning cycle.

The way that we currently permit CSOs, primarily based on pass forward flow, storage and screen, does not always protect against potential deterioration for upstream pressures. In the Ministers letter to WaSCs in 2013 ⁽¹⁷⁾ the expectation was clear that secure measures are required to address high frequency CSOs. *“Where frequency of discharge is too high or CSOs are otherwise unsatisfactory measures are needed to address them”*.

The Agency is currently consulting with WaSCs on our proposed spill frequency permitting proposals which will introduce trigger permit limits, informed by EDM data (annual returns). It will be applied to the highest risk intermittent discharges that have been, or are being, designed to improve/protect coastal protected areas and will require spill frequency monitoring and an assessment against an annual or bathing season significant spill trigger limit. The permit trigger limit would be set around the maximum number of spills predicted by the WaSC in any single year or bathing season. Set this way the trigger limit is aimed at

prompting immediate action for those discharges operating a long way above their original design. Exceeding the trigger spill frequency limit would lead to an investigation being carried out by the WaSC and, where necessary, to a programme of remediation work being identified and agreed to return the discharge, where appropriate, to its original design objective. Exceedence of the trigger does not mean non-compliance with the permit. However, failure to undertake the investigation and necessary remedial works would.

We propose to apply this approach in a risk based phased manner initially to:

- Storm overflows that are being improved in AMP5 or AMP6 to improve coastal Protected Areas.
- Storm overflows that were previously improved in AMP2, AMP3 or AMP4 to improve coastal Protected Areas and that discharge into poor and risky sufficient bathing waters and/or shellfish waters not consistently meeting guideline standards.

WaSCs will need to be prepared to carry out any investigations that may arise from spill frequency triggers being exceeded. This approach has been flagged to the WaSCs for a number of years and is supported by Defra. It forms part of the Agency Pr14 planning guidance for WaSCs. We are currently at the consultation phase on the technical detail of the approach

Wider Industry Strategy and Communications

The Environment Agency expects that its 3 contributions, as detailed above; Planning (DSF), Monitoring (EDM) and Spill Frequency Permitting (SFP) will have a major part to play in a wider water industry lead strategic plan for sewerage and CSOs, which we are aware is being developed. Proactive communication on CSOs is an area that the Agency feels should be given adequate attention.

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