Storm effluent treatment efficacy investigation for surface and ground water induced storm overflows

Guidance note

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What is this document about?

Technical guidance for Sewerage undertakers for proposing and implementing alternative solutions to storm spill reduction for high flows within sewerage networks or arriving at Wastewater Treatment Works WwTWs inducing high frequency storm effluent discharges.

Who is this document for?

Water and Sewerage Companies

Contact for queries and feedback

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Executive summary

This guidance is concerned with Water Company proposals for treatment solutions in catchments experiencing chronic issues relating to surface and/or ground water infiltration, problem inflow, problems in the sewer network, or catchment specific problems which cause storm overflows to spill excessively or for longer periods than would normally be considered adequate for catchment ‘drain down’ time.

The implementation of alternative treatment solutions for storm overflows is an option available to sewerage undertakers under limited circumstances where it is infeasible or disproportionately expensive to adequately resolve the root cause of high frequency or long duration spills. In these instances, treatment may be the only viable option to eliminate the risk of ecological or public harm.

In order to propose and implement storm effluent treatment solutions, sewerage undertakers must meet certain criteria to evidence that sites are eligible, and once in place will be required to investigate the efficacy of these solutions to evidence that required standards are achieved. Sewerage undertakers will be required to provide annual monitoring reports on the efficacy of these solutions.

Sites that do not meet relevant legislative requirements, including those under the Urban Waste Water Treatment (England and Wales) Regulations 1994 (UWWTR), or compliance limits set within a permit may be subject to enforcement action. Operators therefore progress proposed solutions at the risk of needing to implement further investment if an efficacy investigation concludes that the quality of treatment is not adequate.

Sewerage undertakers are reminded that despite the options presented within this guidance for the treatment of effluent from surface and/or ground water induced storm overflows, that they must continue to meet and adhere to existing statutory requirements including those relating to network maintenance outlined in the UWWTR, the Water Industry Act and environmental permits. This work should be planned for and undertaken as part of sewerage undertakers' Drainage and Wastewater Management Plans (DWMPs). Irrespective of the outcome of the efficacy investigations, these statutory requirements remain in place and will not be superseded or replaced by the option of treatment for any catchments beyond those approved for implementation.

1. Introduction

In some limited circumstances it may be necessary to treat discharges if it is infeasible or disproportionately expensive to adequately resolve the root cause of high frequency or long duration spills. One of these circumstances, and the focus of this guidance, relates to storm overflows that spill frequently and/or for extended periods due to chronic issues that can be proven to relate to surface and/or ground water infiltration or problem inflow. Under these conditions, water companies may consider treatment of storm effluent as an alternative solution to storm spill frequency and duration reduction where appropriate to limit ecological or public harm.

As a result, this guidance sets out the process by which sewerage undertakers may propose and implement alternative solutions under these circumstances to meet the objectives, outcomes and ambition of the PR24 Forum Strategic Steer and the PR24 storm overflow driver & Addendum of 'no/very low ecological harm'. These include the key objectives of:

- PR24 Storm overflow driver - May 2023
- Addendum to SO Driver Paper
- PR24 Forum Strategic Steers

PR24 Storm overflow driver - May 2023

Outcomes and ambition:

NRW has been clear in all discussions that storm overflows failing to meet satisfactory condition as defined in GN066 'How to Classify storm overflow performance' must be addressed with urgency.

By 2027 at the latest:

- companies deliver strategic evidence gathered from enhanced monitoring, in line with commitments from the Better River Quality Taskforce. The evidence will support PR29 and the long-term goal of smart networks making best use of technology and real time control.
- companies will develop ambitious prioritised plans to ensure all assets achieve satisfactory in line with NRW guidance and any strategic direction from Welsh Government and the PR24 Forum. Companies should look to integrate this work with Drainage & Wastewater Management Planning and the Better River Quality Task Force.

By 2030 at the latest:

- all assets are classified against criteria set out in NRW's Storm Overflow Classification guidance.
- Companies will submit sufficient information to allow all unpermitted storm overflow permit applications to be considered by NRW and the requirements of any improvement conditions within permits will have been met.

Addendum to SO Driver Paper

Any proposal must take account of the Welsh Government steer on 'no harm (or 'very low' harm) to the environment' and be in line with legal requirements including The Well-being of Future Generations (Wales) Act 2015. This requires bodies in Wales to think about their long-term impact of their decisions, to work better with people, communities, and each other to protect the environment and future generations in Wales to ensure long term sustainable environmental capacity.

PR24 Forum Strategic Steers

We expect DCWW to invest to increase the proportion of CSOs causing no harm (or 'very low' harm) to the environment to 100% by 2040 at the latest, including all currently unpermitted CSOs.

We expect the company to achieve 60% by 2030, and 80% by 2035.

2. Objectives and scope

The implementation of alternative solutions to storm spill frequency and duration reduction will be subject to an efficacy investigation. The objectives of the efficacy investigation are:

- Develop a robust evidence base on utilising alternative treatment solutions to reliably reduce the harm of storm overflow discharges under a variety of different loading scenarios.
- Determine whether treatment solutions can effectively achieve the target of 'no/very low ecological harm'.
- Produce evidence to inform policy development and the regulatory position on treatment of storm overflows for future use.

To achieve these objectives, this guidance will:

- Outline the justification and purpose for the efficacy investigations.
- Explain the eligibility requirements for efficacy investigations on storm overflows.
- Explain the investigation parameters, required treatment standards and success criteria.
- Outline the expectations for investigations at treatment works and those on the network.
- Outline the monitoring and reporting requirements for sewerage undertakers taking part in the investigation.
- Explain the permitting and enforcement process for investigations.
- Outline contingency requirements that sewerage undertakers must have in place, should the implemented solutions fail to achieve required outcomes.
- Outline the evidence and assessment requirements to demonstrate ongoing adherence with legislative requirements.

3. Relevant statutory requirements

Sewerage undertakers are expected to comply with their existing legal obligations under the Water Industry Act 1991, as supplemented by the UWWTR 1994, along with their other outstanding legal requirements.

Sewerage undertakers are also required to comply with the requirements set out in their environmental permits, issued under the under the Environmental Permitting (England and Wales) Regulations 2016. Operators therefore progress proposals at the risk of needing to implement further investment if an investigation concludes that treatment requirements have not been met.

4. Eligibility

4.1. Evidencing surface and ground water infiltration and problem inflow

For a site to be eligible for a treatment solution, sewerage undertakers must satisfy regulators that each site relates to a storm overflow with a chronic surface and/or ground water infiltration or problem inflow issue that cannot feasibly be resolved. Examples of how sewerage undertakers might evidence this are outlined in the list below. This list is not exhaustive, nor is it necessary for sewerage undertakers to provide every piece of evidence listed for a site to be considered eligible for a treatment solution and efficacy investigation. Sites will be considered on a case-by-case basis, by weight of evidence.

- Groundwater monitoring/borehole data that evidences groundwater levels are high relative to the catchment's sewer depth. Where possible companies will be required to provide evidence of site investigations including CCTV, flow and/or other surveys and modelling data to evidence the scale and severity of an issue within a given catchment. In these circumstances, spill frequency and duration may also be exceptionally high relative to other catchments, as evidenced in the annual Event Duration Monitoring (EDM) Return.
- Misconnections with evidence of significant surface water entering the combined/foul sewer network in excess of an expected level of infiltration, in addition to an explanation of why it would be uneconomic, or present alternate risks (such as localised flooding) if the surface water was to be disconnected.
- Connections with evidence of significant surface water entering the combined/foul sewer network, including surface to foul/combined sewer connections installed as a result of the 'right to connect'. This should be accompanied by an explanation of why it would be either uneconomic, or present alternate risks (such as localised flooding) if the surface water was to be disconnected.
- CCTV/survey evidence of a chronic infiltration and/or problem inflow issues in excess of an expected level of infiltration that can be linked to excessive spills as reported in the annual EDM dataset.
- Evidence of significant infiltration in excess of an expected level of infiltration caused by issues such as poor condition sewers, CCTV/survey work or flow rate hydrographs

relative to rainfall. The Manual of Sewer Condition Classification (MSCC), published by the Water Research Centre (WRc), provides a standardised, industry-accepted system for inspecting, recording, and classifying the structural condition and serviceability of sewer pipes and manholes. Where applicable, sewerage undertakers should also demonstrate that this infiltration extends beyond a normal 24 hour ‘drain down’ period following the end of a rainfall event, causing continued spills.

- Evidence of significant problem inflow from watercourses or other sub-surface water flows that would be uneconomic to resolve or present alternate risks to resolve (such as localised flooding). Sewerage undertakers may wish to provide supporting flow hydrographs to evidence impact on expected flow rates.
- Evidence of significant problem inflows from highways drainage entering or connected to the foul/combined sewerage network, in addition to an explanation of why it would either be uneconomic, or present alternate risks (such as localised flooding) to divert this run-off elsewhere. Evidence can be provided of communication with the highway authority in pursuing opportunities for disconnection.
- To determine the extent of surface/ground water infiltration, sewerage undertakers should be able to evidence expected base flow / dry weather flows (DWF). iMax (defined in GN066 ‘How to classify storm overflow performance’) to determine the maximum expected level of infiltration in the proposed catchment. Sewerage undertakers should then evidence the level of infiltration in the catchment. Start-stop EDM data may also be used to evidence spills that have occurred outside of rainfall event response.
- Sewerage undertakers should provide evidence of any remedial work(s) or infiltration reduction undertaken in order to identify the extent to which network maintenance has or has not previously been addressed, including any engagement with Local Authorities to resolve infiltration issues on private sewer networks.
- These investigations apply to treatment of storm overflow effluent caused by surface and/or ground water infiltration and/or problem inflow. Sewerage undertakers are expected to be able to determine and evidence surface water infiltration/problem inflows separately from groundwater and other sources of infiltration. If the site is subject to a combination of causes, this should be clearly outlined in the proposal for treatment with evidence of the combination of impacts provided.
- Sewerage undertakers should provide EDM spill data that represents an abnormally high spill frequency when asset capacity design standards such as ‘Formula A’ have been met. This can be done by providing DWF and Formula A calculation expected against actual PFF, and the calculated rate of infiltration and/or inflow above expectation (iMax).
- Sewerage undertakers should provide supporting evidence that the hydraulic capacity of the catchment network and WwTW is appropriate for the population served, but continues to cause excessive spills during or following rainfall events. This could include flow monitoring to evidence that flows exceed those modelled/calculated for the catchment. Consideration should also be given to how future growth projections may impact capacity.
- Sewerage undertakers should provide a contingency plan: If an investigation fails to remain within the compliance limits set within its permit, sewerage undertakers will be expected to cease operation of the applied for solution and implement contingency

arrangements as soon as is reasonably practicable to implement spill reduction or other proven treatment methods.

4.2. Hierarchy of avoidance principles and application of risk assessment

Sewerage undertakers should first apply the hierarchy of avoidance principles, taking a catchment-wide approach to identify appropriate interventions, including nature-based solutions (NbS), to address excess storm flows in sewers. The following principles should inform how such interventions are identified and applied.

Interventions identified through the hierarchy should be subject to a structured and proportionate risk assessment. This should:

- Assess the likelihood of underperformance in delivering intended outcomes
- Identify appropriate design, mitigation and monitoring requirements
- Support a clear and auditable decision on whether the option can proceed, requires refinement, or be considered not appropriate in the given context

1. Avoid harm at source (screen and align)

- Prioritise the prevention of **environmental degradation**, where the use of proactive and preventative measures are prioritised over remedial interventions. The aim is to reduce reliance on remedial measures.
- Reduce the likelihood that Nature based Solutions (NbS) interventions undermine and or **damage existing ecosystems or ecological functions** and their resilience or disrupt natural processes.
- Avoid actions that **displace risk** elsewhere, such as increasing flood or drought risk downstream or causing biodiversity loss in another location.
- Adopt a **precautionary and evidence led approach** that is proportionate to the level of risk where scientific uncertainty exists, ensuring nature-based solutions enhance, rather than replace, natural functions. This includes favouring nature-led approaches over engineered solutions where appropriate.

2. Minimise unavoidable impacts (risk identification)

- Where intervention is necessary, **embed mitigation measures** into scheme design to reduce negative consequences through strategic planning and evidence-based decision making.
- Apply **proportionate environmental, social, and economic impact assessments** to inform decision making. These should consider ecological timing, system dependencies and catchment context.
- Ensure solutions are designed to be compatible with local ecological and hydrological practices, avoiding maladaptation or unintended consequences.

- Use a **catchment-based approach**, ensuring interventions consider upstream and downstream interactions.

3. Strengthen ecosystem resilience and long-term sustainability (design for resilience and risk mitigation)

- Prioritise interventions that enhance the ability of natural systems to adapt to climate change, pollution, habitat degradation and biodiversity pressures.
- Align with NRW's Area Statements and Welsh Government's Biodiversity and Ecosystem Resilience Duty under the Environment (Wales) Act 2016.
- Ensure the long-term viability of solutions embedding **long-term governance, monitoring, and adaptive management** frameworks/approaches/positions to secure sustained benefits.

4. Deliver multi-benefit and integrated solutions (integrate for multi benefit delivery)

- Ensure NbS interventions **deliver multiple ecosystem services**, such as carbon sequestration, water quality improvements, and biodiversity enhancement.
- Align solutions with **national policies** where applicable, including the Natural Flood Management Programme, National Peatland Action Programme, UK Forestry Standard, Woodlands for Wales Strategy, Woodlands for Wales Action Plan, Sustainable Drainage Systems (SuDS) requirements, Welsh National Marine Plan and Marine Restoration and Enhancement.
- Support a **place-based, collaborative approach**, engaging landowners, communities, and other stakeholders in solution design and delivery.
- Enhance the **well-being of communities** by ensuring solutions provide social, cultural, and economic benefits, in line with the Well-being of Future Generations (Wales) Act 2015.

5. Right solution, right place, right reason (appraise residual risk and justify)

- Ensure NbS interventions are strategically located and informed by best practice, responding to local ecological, hydrological, and socio-economic conditions.
- Integrate with existing statutory and policy land-use planning frameworks, including Drainage and Wastewater Management Plans (DWMPs), River Basin Management Plans (RBMPs), Local Development Plans (LDPs), the National Development Framework (Future Wales: The National Plan 2040), and Area Statements.
- Adopt a catchment-scale perspective, recognising the interdependencies of land, water, marine and biodiversity.
- Support an evidence-based approach in outcome confidence, ensuring interventions align with good practice, regulatory requirements, and NRW's strategic priorities.

- Decisions should be supported by a clear and auditable evidence base.

6. Monitor, evaluate, and adapt (integrate for multi-benefit delivery)

- Establish **robust monitoring frameworks** to assess effectiveness, measure impact, and ensure accountability to enable informed decisions and continuous improvement.
- Apply an **adaptive management approach**, integrating new evidence and insights from lessons learnt to refine future practice.
- **Share learning and good practice** across NRW, Welsh Government, and wider partners to inform policy development and programme delivery.
- Ensure **compliance with statutory reporting requirements**, supporting continuous improvement and transparency.
- Outputs from the application of the hierarchy and risk assessment should inform subsequent option development and appraisal.

5. Investigation parameters

Where treatment solutions are approved, sewerage undertakers are required to operate within the parameters set out below, in addition to any other existing permit and regulatory requirements. These are intended to create a sufficient testing environment, whilst ensuring that any potential risks of local adverse ecological impacts or harm to public health are minimised.

- Treatment solutions that do not incorporate conventional proven disinfection methods will not be permissible at sites that may impact designated bathing and shellfish waters, to protect public health. Sewerage undertakers may choose to put in place sufficient monitoring at (non-bathing/shellfish water) sites accepted onto the pilot to evidence that a treatment scheme can achieve disinfection for possible future use, subject to regulatory approval.
- Treatment solutions at sites that may impact bathing and shellfish waters must include established or proven methods to achieve the relevant standards and evidence how this will be achieved.
- Where sewerage undertakers seek to evidence a treatment solution's ability to achieve 'treated effluent' standards under regulation 5 of the UWWTR, performance will be measured in relation to percentage reduction requirements in order to evidence the efficacy of treatment. Further details on these requirements are included in the treatment and success criteria sections of this guidance.
- Sewerage undertakers must ensure and evidence that storm overflows and the collecting systems/network comply with BTKNEEC requirements outlined in section 7 of this guidance with reference to regulation 4(2) and Schedule 2 of the UWWTR. They must also ensure adherence with the requirements of Section 94 of the Water Industry Act 1991 to provide, improve and extend such a system of public sewers (whether inside its area or elsewhere) and so to cleanse and maintain those sewers (and any lateral drains which belong to or vest in the undertaker) as to ensure that that area is, and continues to be, effectually drained.

- A key aspect of determining the success of a treatment efficacy investigation will be demonstrating that the target of 'no/very low ecological harm' has been met; in most cases this will be evidenced by meeting the UPM FiS 99 percentile standards.
- Investigations may be permitted in high priority sites, though sewerage undertakers may choose to avoid certain sensitive locations that may be susceptible to harm, or subject to site specific issues - such as eutrophication - until efficacy is proven. Sewerage undertakers are reminded that they are required to continue to meet any existing permit obligations/restrictions of any proposed treated storm effluent site to mitigate risk.
- Whilst treatment solutions may be permitted on the sewerage network, sewerage undertakers may need to consider additional maintenance of these sites if not subject to normal flow conditions.
- Treatment efficacy investigations will run for a period of up to five years to allow for evidence gathering on the efficacy of treatment options across a range of catchments, weather conditions, and loading scenarios.
- Sewerage undertakers will not be permitted to mix treated storm effluent with continuous effluent at WwTW prior to monitoring of the treated storm effluent. All treated storm overflows must maintain a separate sample point for monitoring purposes to determine treatment efficacy, prior to any recombining with conventionally treated effluent at a common outfall location.

6. Treatment standards

A key aspect of the success criteria for treatment efficacy investigations is to determine whether the chosen treatment method can evidence that the objectives, outcomes and ambition of both:

- PR24 Forum Strategic Steer, and
- the PR24 storm overflow driver & Addendum of 'no or very low ecological harm'

have been achieved. This will require sewerage undertakers to evidence that the UPM FIS and 99 percentile standards have been achieved to ensure that receiving water's needs are protected from adverse ecological impacts. This would result in a 'treated storm overflow' standard, where no local adverse ecological impact has been evidenced. This is a minimum requirement for trials to ensure that the no/very low ecological harm objective of GN066 'How to Classify storm overflow performance' has been achieved.

Optionally, sewerage undertakers may seek to evidence that a treated storm overflow can achieve and demonstrate a '**treated effluent**' standard as defined by the UWWTR 1994. This will require sewerage undertakers to evidence treatment in line with the percentage reduction requirements outlined in regulation 5(1) and (2) of the UWWTR 1994, in order to prove treatment efficacy. Concentration limits will not be used solely in this instance due to the potential for these to be met or assisted by high levels of dilution commonly seen with high levels of infiltration. The percentage reduction standards identified in Table 1 will be used when evidencing the efficacy of a treatment process. For sensitive waters subject to eutrophication, or those with total phosphorus and/or total nitrogen limits already on the permit, these will need to be met in-line with the total

phosphorus and total nitrogen percentage reduction standards identified in Table 2, in addition to any other existing permit conditions.

In catchments with <2000 p.e. sewerage undertakers are reminded of their duties under section 94 of the Water Industry Act (1991) (1)(a) to provide, improve and extend such a system of public sewers (whether inside its area or elsewhere) and so to cleanse and maintain those sewers [and any lateral drains which belong to or vest in the undertaker] as to ensure that that area is and continues to be effectually drained; and (b) to make provision for the emptying of those sewers and such further provision (whether inside its area or elsewhere) as is necessary from time to time for effectually dealing, by means of sewage disposal works or otherwise, with the contents of those sewers.

Table 1: parameters and measurement for percentage reduction

Parameters	**Minimum percentage reduction {s001}**	**Reference method of measurement**
Biochemical oxygen demand (BOD5 at 20°C without nitrification	70—90	Homogenized, unfiltered, undecanted sample. Determination of dissolved oxygen before and after five-day incubation at 20°+1°C, in complete darkness. Addition of a nitrification inhibitor
Chemical oxygen demand (COD)	75	Homogenized, unfiltered, undecanted sample Potassium dichromate

- Reduction in relation to the load of the influent.
- The parameter can be replaced by another parameter: total organic carbon (TOC) or total oxygen demand (TOD) if a relationship can be established between BOD5 and the substitute parameter.

For sensitive waters subject to eutrophication, or those with phosphorus and/or nitrogen limits already on the permit, the standards in Table 2 also apply:

Table 2: total phosphorus and total nitrogen percentage reduction standards for sensitive waters

Parameters	**Minimum percentage reduction {s003}**	**Reference method of measurement**
Total phosphorus	80	Molecular absorption spectrophotometry
Total nitrogen	70—80	Molecular absorption spectrophotometry

- Reduction in relation to the load of the influent.
- Total nitrogen means: the sum of total Kjeldahl-nitrogen (organic N + NH_3), nitrate (NO_3)-nitrogen and nitrite (NO_2)-nitrogen.

As noted, in addition to the UWWTR, sewerage undertakers are also required to meet the Urban Pollution Management (UPM) Manual's Fundamental Intermittent Standards (FIS 99 percentile standards) for the protection of salmonid and cyprinid aquatic life. Full guidance on the UPM FIS 99 standards can be found on the Foundation for Water Research website: Urban Pollution Manual (UPM) – The Foundation For Water Research. Should any wider legal requirements apply to the site such as those relating to hazardous substances, sewerage undertakers will need to ensure these are complied with.

7. BTKNEEC and infiltration reduction

Companies have a duty under regulation 4(2) and Schedule 2 (reproduced below) of the UWWTRs to design, operate and maintain the sewer network in accordance with best technical knowledge not entailing excessive costs (BTKNEEC), notably regarding the prevention of leaks and limitation of pollution of receiving waters due to storm overflows for catchments >2000PE. This duty forms part of the general duty to provide and maintain a sewer system to effectively drain an area and deal with sewage under s.94 Water Industry Act 1991. The BTKNEEC requirements are outlined in the UWWTR, and sewerage undertakers will be required to provide evidence that solutions will meet these requirements:

> UWWTR regulation 4(2), Schedule 2: Requirements for collecting systems:
>
> 1. Collecting systems shall take into account waste water treatment requirements.
> 2. The design, construction and maintenance of collecting systems shall be undertaken in accordance with the best technical knowledge not entailing excessive costs, notably regarding:
>
> a) Volume and characteristics of urban waste water
>
> b) Prevention of leaks
>
> c) Limitation of pollution of receiving waters due to storm water overflows.

As a result of UWWTR requirements, in order for a trial to proceed to implementation, sewerage undertakers must be able to evidence to regulators that the collection system and treatment option will comply with BTKNEEC requirements for the catchment area. This includes evidencing the prevention of leaks and limitation of pollution, and that all waste water is treated under normal local climactic conditions, (i.e. unless exceptional circumstances arise, such as unusually heavy rainfall). In addition to meeting regulatory requirements, evidencing this will aid any future policy development. For trials in catchments <2000PE, sewerage undertakers are still expected to show evidence of, and a commitment to, reducing infiltration in the catchment.

Evidence of BTKNEEC solutions must be provided including:

- Sufficient evidence that the sewerage undertaker has fully investigated the root cause of the issue, including the condition of its assets, and sufficiently understands the source of the infiltration/inflow to the extent that it can reasonably progress towards developing interventions. Where applicable this should include evidence of the extent to which private sewers are the source.
- Evidence that the sewerage undertaker has sought to address maintenance issues identified during site investigations.
- Evidence that the sewerage undertaker has quantified the impacts of remedial works completed to date, so as to be able to quantify the costs and outcomes of further remedial works. For example, sealing, infiltration reduction, re-sewerage.
- Evidence that traditional options have been fully considered and costed, and benefits of different approaches quantified, to allow the BTKNEEC assessment to be completed, including:
    - Further rehabilitation/infiltration reduction activities
    - Re-sewerage
    - Spill reduction solutions e.g. storage
    - Increasing existing treatment capacity
    - Alternative forms of treatment including the trial of alternate treatment solutions systems.
- Ongoing evidence of delivering the above, in-line with UWWTR requirements, with detail shared with regulators to contribute to understanding the challenges and opportunities to address issues relating to chronic surface and/or ground water infiltration and problem inflows.

8. Implementation

8.1. Timeline and proposal process

To propose a treatment solution and efficacy investigation, sewerage undertakers must prepare a supporting evidence pack (see Proposal form for storm effluent treatment) for each site that outlines how the proposed site or catchment meets the eligibility criteria outlined in section 4: Eligibility of this guidance, and the anticipated and planned expectations of the scheme. Regulators will review proposals and notify sewerage undertakers of approval or rejection. Sewerage undertakers may be contacted to discuss the proposed schemes in greater detail prior to acceptance of the treatment solution and investigation proposal and should therefore appoint a point of contact.

Subject to approval, sewerage undertakers are expected to have implemented and activated investigations as soon as practicably possible (usually within 3 years). Investigations will run for up to 5 years from the date of implementation.

Sewerage undertakers are expected to begin investigations as soon as practicably possible to gather the maximum evidence of efficacy during the agreed period.

8.2. Permitting and enforcement

Upon approval of a proposal for a treatment solution and efficacy investigation, sewerage undertakers will be expected to develop an Operating Techniques Agreement (OTA) in collaboration with NRW, to be added to an existing permit. This will include clear expectations for treatment standards and ongoing evidence of inflow and/or infiltration reduction.

It is accepted that sewerage undertakers may require time for alternative treatment solutions such as NbS to develop in order to meet expected efficacy. Treatment standards may therefore be included as target limits within OTAs to allow for flexibility within the permit where appropriate.

Permits will continue to include compliance requirements that sewerage undertakers must adhere to, in order for the site or scheme to remain part of an investigation, in addition to relevant requirements of the UWWTR or any other statutory legal requirements that must be complied with.

Failure to adhere to these requirements may trigger a regulatory review of the scheme and could result enforcement action. Under these circumstances sewerage undertakers will also be required to have contingency arrangements ready to implement as soon as reasonably practicable to deliver appropriate spill reduction or implement an existing proven treatment method.

8.3. Data monitoring and evidence reporting requirements

By taking part in efficacy investigations, sewerage undertakers will be required to submit annual monitoring reports to NRW to evidence the efficacy of chosen treatment options. These evidence reports must include monitoring data on the parameters outlined under permitted monitoring requirements. For the purposes of effective monitoring, sewerage undertakers **will not be permitted** to mix treated storm overflow effluent with continuous effluent prior to monitoring.

Due to the nature of infiltration and problem inflow induced storm overflow activations, and the intention of trials to better understand the impact of various loading scenarios on treatment options, sewerage undertakers must implement scenario monitoring across four climatic conditions to determine efficacy. This is in addition to any existing monitoring requirements such as EDM and WwTW final effluent monitoring. Monitoring must take place on the influent and effluent of the storm treatment process, and treated effluents must not be mixed with continuous WwTW effluents prior to monitoring to ensure that treatment efficacy is fully understood.

Sewerage undertakers will be expected to take a best endeavours approach to monitor all scenarios annually, where possible. These scenarios include:

- Treatment efficacy and operation during ‘dry day’ infiltration and/or problem inflow induced storm overflow activations, and/or groundwater induced storm overflow activations (wet winter season). For the purposes of the trial this would mean 24 hours

after completion of a rainfall event to account for what is considered to be a normal ‘drain down’ period.

- Treatment efficacy/operation during rainfall induced storm overflow activations (wet winter season).
- Treatment efficacy/operation during extended dry periods (summer season).
- Treatment efficacy/operation during summer rainfall events (summer season).

The frequency of storm effluent spilling to the treatment system and any storm effluent by-passing treatment and discharging directly to the watercourse must be recorded by EDM and reflected in Schedule 3 Table S3.1 and Table S3.4 of the EPR Permit. The storm spill frequency of discharges to treatment and any treatment by-pass arrangement will be subject to the normal annual EDM regulatory return for storm spills. You must differentiate between treated and non-treated discharges when recording the spills.

Sewerage undertakers must follow recognised best practice when determining location of influent and effluent monitoring and the equipment utilised. Monitoring parameters, duration, and intervals will be agreed on a case-by-case basis for each site with regulators, though a default position could require 15-minute monitoring intervals for the first hour of each climatic scenario, followed by hourly monitoring thereafter based on the expected auto-sampling equipment available.

Sewerage undertakers must ensure that each sample taken is kept separate and analysed individually and not taken as a composite, in order to understand treatment efficacy across a range of loading scenarios.

Any failure to undertake adequate monitoring and reporting as required could result in cessation of the investigation.

In some cases, sewerage undertakers may be able to utilise existing or planned continuous water quality monitors to meet some monitoring requirements, where placement and implementation complies with the investigation requirements.

Permitted monitoring will include a range of the following parameters dependent on the specific circumstances of the trial:

- BOD
- COD
- Dissolved oxygen
- pH
- Phosphorus
- Nitrogen
- Ammonia
- Turbidity
- Total suspended solids
- Flow
- Water Temperature

- Water level (where applicable)
- Bacti - E. coli and/or intestinal enterococci
- F+ Bacteriophage

Non-permitted monitoring

Sewerage undertakers should consider monitoring and reporting on the following greenhouse gas emissions generated as part of the treatment process with an aim to contribute to the evidence base for identification of greener treatment solutions:

- CO2 emissions
- Methane
- Nitrous oxide

WaSCs may undertake this as a national club project across selected scheme trials, it is not expected that each WaSC will undertake greenhouse gas monitoring at every one of their trial sites.

8.4. Governance and assurance

Sewerage undertakers will be expected to implement all monitoring in-line with legal requirements and industry recognised best practice such as:

- Monitoring discharges to water: guidance on selecting a monitoring approach - GOV.UK
- Continuous Water Quality Monitoring Programme - provisional technical guidance for sewerage undertakers

In order to ensure this has been followed, sewerage undertakers will be required to provide assurance on this as part of their monitoring reports to regulators. Failure to do so may result in requests for additional information.

8.5. Contingency requirements

Should treatment fail to:

- meet the expected treatment standards upon completion of the investigation period, or
- remain within the permit compliance limits within the investigation period,

sewerage undertakers are required to provide a contingency option as part of the proposal, to maintain legal compliance and continue to strive to meet no or very low ecological harm target.

A solution with proven efficacy or appropriate spill reduction must be implemented as soon as reasonably practicable from the completion of the investigation period if deemed to have been unsuccessful. Cessation of the investigation will be required where there is evidence of degradation of the receiving environment.

Where a sewerage undertaker fails to adhere to the compliance requirements set within the permit, they must immediately notify regulators to undertake a regulatory review to determine whether this presents or risks a pollution incident requiring an immediate remedial response. Regulators will also consider whether this requires cessation of the investigation and reversion to the contingency arrangements.

9. Investigation outcomes, success criteria and post-investigation position

Following completion of the investigation period, sewerage undertakers will be required to provide a summary report to regulators outlining the efficacy of their treatment solution across all years for regulators to determine whether trials have been successful. Sewerage undertakers will be asked to note and/or provide comment on any monitoring anomalies/adverse weather conditions that may impact the outcome of the investigation.

Success will be assessed in accordance with the following mandatory and optional criteria.

9.1. Mandatory success criteria

- Evidence that treated effluent discharge achieves standard required to meet in river UPM FIS/99%iles. Water companies will only be permitted to discharge from a storm overflow where they can demonstrate that there is no or very low local adverse ecological impact. All solutions must therefore demonstrate as a minimum, that the solution meets the objectives, outcomes and ambition of the PR24 Forum Strategic Steer and the PR24 storm overflow driver & Addendum of 'no/very low ecological harm'. As a result, schemes must be modelled to achieve the receiving water's UPM FIS 99%iles and evidence that these have been met upon completion of the investigation.
- Treatment solutions must evidence 'treatment'. Therefore storm overflows subject to trial will be expected to evidence treatment efficacy via percentage reduction in load from influent to effluent. As a result, percentage reduction is a trial requirement applied to all sites to evidence the level of treatment achieved, regardless of catchment size.
- Evidence of ongoing efforts to ensure that UWWTR BTKNEEC requirement for the prevention of leaks has been adhered to, e.g. evidence of ongoing infiltration reduction/network maintenance. For catchments <2000PE sewerage undertakers are still expected to evidence efforts to reduce infiltration.

9.2. Optional success criteria

- Sewerage undertakers may seek to go beyond mandatory requirements and evidence that an UWWTR compliant secondary treatment (treated effluent) standard has been achieved. In this case mandatory requirements must be met in addition to achieving UWWTR percentage removal requirements. Where dilute influent shows that a parallel conventional treatment process has not achieved this percentage reduction but has met concentration limits, treatment trials will be expected to achieve a comparable percentage reduction in load.

Sewerage Undertakers may seek to demonstrate that treatment processes can achieve disinfection, in which case bacteriological monitoring must be undertaken with evidence of a log reduction in bacterial load achieved.

9.3. Post-investigation position

NRW will determine if a scheme has been evidenced to be successful, and will provide a written response to the sewerage undertaker to notify the outcome. This notification will include the following information:

- Outline position if treatment solution and efficacy investigation is successful
- Outline position if treatment solution and efficacy investigation is unsuccessful
- Comment on existing use of solution for storm effluent treatment
- Outline next steps for a permit variation to remove the efficacy investigation OTA and review permitted monitoring, reporting and compliance requirements, emission limits and any further operating techniques or improvement conditions deemed necessary going forward.

10. Contacts

If you would like to discuss a specific trial, please contact the NRW Water Policy Team / permitting team for matters relating to permitting/OTAs, or waterqualitypolicy@cyfoethnaturiolcymru.gov.uk for general enquiries.