

# Making green & nature-based solutions the norm for the delivery of storm overflow reduction

## Introduction

Our aim for this paper is to share the approach, key challenges and successes of implementing nature-based solutions to reduce the impact of storm overflows in Wales. As a nation, we are embarking on our largest ever Water Industry National Environment Programme (WINEP) investment to improve river health over a 25-year period aligned to the 2021 Environment Act. This investment is set against our climate change objectives, net zero by or before 2050, reversing biodiversity loss, and driving a greener economy for future generations.

Grey storage solutions are typically perceived as the simplest, quickest and cheapest approach to deliver a storm overflow solution with a single water quality outcome. But this comes at a cost; storage typically has a high whole life carbon and financial cost. Furthermore, grey storage solutions only designed as buffers for the network do not tackle the root-cause of spills and hence can be temporary solutions only. With climate change impacts, storm events are likely to increase in intensity and storage solutions may have to be expanded. The alternative is to work with nature; within that solution we can provide the same water quality outcomes along with a range of wider benefits for people, nature, and our economy and for the long-term. Nature-based Solutions (NbS) can and should play big part of our storm overflow journey; every project is a chance to deliver something better.

## Defining the challenge

There are 2,300 storm overflows in Wales. We believe some 1100 are having an impact higher than we would like. By 2040 the target is to reduce all storm overflows to very low or no environmental impact as defined by the Water Framework Directive. This means rapid investment nationally, underpinned by our 2040 net zero pledge.

## Delivering green & nature-based solutions quickly at scale | our approach

We have four fundamental considerations to maximise the delivery of NbS for storm overflow reduction:

### 1. Finding the right (affordable) opportunities

Firstly, investigate **all** catchment opportunities. Predominantly impermeable area draining to combined sewers (highways, car parks, large buildings), permeable indirect overland connections, formal land drainage, misconnected storm sewers, river ingress and infiltration. There are a range of tools available to predict where these sources may be coming from to prioritise investigations. The potential for NbS relies on finding these sources of inflow to allow for accurate costs; experience shows the cost per hectare of urban green infrastructure, for example, can range from £500k - >£5m per hectare based primarily on solution type, topography, utilities, space constraints, and ground conditions.

### 2. Hybrid Solutions

However, nature-based solutions, in isolation, are sometimes not enough to deliver the step change in performance required. If a system is under-capacity NbS cannot achieve the primary river health outcomes. Other times, the nature of the catchment means there is limited space to implement enough nature-based solutions to achieve the target. Therefore, we consider NbS alongside grey infrastructure, as a best-value hybrid approach.

### 3. Multiple capitals

Even as part of hybrid schemes, NbS have important wider benefits that often justify their cost. Taking a multiple capitals approach, such as CIRIA B£ST, will help promote greener solutions by considering natural, social, and economic factors. It is possible to quickly appraise the potential value of NbS at a

catchment scale, and then hone in during detailed design to enhance the community impact further. Furthermore, looking at multiple capitals highlights benefits that might be of interest to other organisations such as local authorities. This offers opportunities for shared investment.

#### 4. Think resilience

Another important benefit of green blue infrastructure that is often neglected is resilience. By 2050, across the majority of Wales, we are likely to experience increasing frequency of high return period rainfall and typically wetter winters. Solutions need to be resilient and adaptive. When appraising your options think about how effective you expect it to be in 25 years, and how easy could your solution be expanded to meet increasing pressures? Removing storm flow from combined systems provides an obvious benefit over trying to store it. Experience of NbS delivered over a decade ago has shown hybrid NbS offer a greater resilience to changing rainfall patterns, compared to grey end of pipe solutions.

**Aligning these four considerations will maximise the potential for NbS.**

#### Past performance review

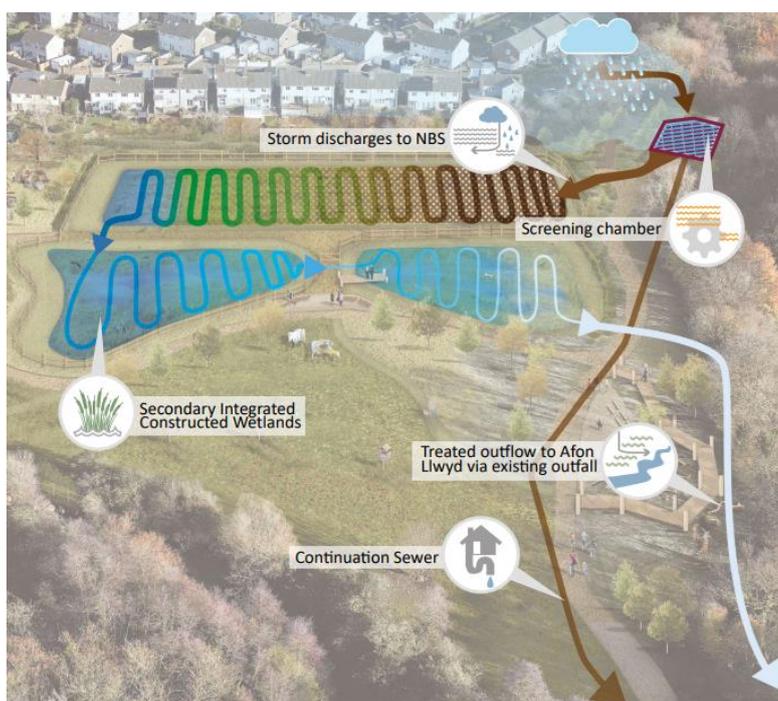
Welsh Water started implementing 42ha of surface water separation and NbS in 2012. At Cambrian Sewage Pumping Station storm overflow, a previously high spilling asset (60 times per year), a 10ha surface water scheme was implemented alongside asset optimisation. A rolling 10-year average rainfall review shows that since 2001 the total annual rainfall depth and frequency of prolonged wet periods is increasing; every year we are seeing “the wettest month on record”. Despite this, the hybrid solutions have consistently outperformed the 10 spill annual target. At the same time, grey storage systems in the region have not coped.

#### New solutions

The approach described above has allowed us to deliver several schemes for storm overflow reduction with nature-based elements. The most notable two schemes are introduced below.

##### 1. Trelewis

The Trelewis storm overflow catchment had multiple opportunities for surface water removal which was determined to be the root cause of spills. In total, 1.8 ha of impermeable area removal was paired with a spill weir raise and a new flow control to optimise the use of online storage available in the existing network. Works on this scheme has just began.



##### 2. Pont-Y-Felin

Construction has also begun on Pont-y-Felin which will be the UK's first network reed-bed and wetland system to manage storm overflow spills. The two-staged system uses:

- A primary reedbed system, which will be aerated to provide intensive pollution reduction, enhanced performance, and reduced risk of odour nuisance, and
- A secondary integrated constructed wetland, providing effluent polishing.

These treatment systems will be integrated within a new landscape parkland to enhance local understanding of the role NbS has to play in wastewater management.

## Optimising the delivery of nature-based solutions | Lessons learnt

Through the design of our first nature-based schemes, we've found the following principles ensure effective delivery and maximise benefits from green infrastructure schemes.

### 1. Community-led design

Community-led design is an inclusive and participatory approach that involves local residents and stakeholders in the decision-making process of planning and designing projects within their communities. Engaging the local community with wastewater treatment presents an opportunity to drive behaviour change. Delivering biodiversity and community benefits as part of these projects can engender a sense of stewardship over the asset and a shift in the way people think about wastewater in the environment.

During the design of Pont-y-Felin, our team consulted with the public and local stakeholders through meetings, door knocking, information events and our online virtual consultation room. This allowed to address community concerns regarding increased traffic, vermin control, and dog walking.

### 2. Optimisation

If a solution involves several parameters (such as a hybrid solution combining storage size, surface water removal, or changes to the pump performance), it can be very time consuming to explore what the best combination of these parameters is. Through a machine-learning programme called Mode Frontier we can automate hydraulic modelling software to run different combinations of these parameters and learn the relationships. This allows the software to then 'guess' at the most optimal combinations to reach a certain target. It can also optimise to certain drivers such as minimising carbon cost, or maximising cost benefit ratio. This tool can save tremendous amounts of time but also allows to understand the full potential of NbS and how to best pair it with grey infrastructure where necessary.

### 3. Case studies and future planning

Through these initial schemes, it is important to continue gathering data on and building confidence in NbS to support this new approach to storm overflow management and set a trajectory for the next 25 years. The Pont-y-Felin scheme, first of its kind in the UK, is part of multiple research programmes. In the design stage, Welsh Water funded research with Cranfield University to optimise wetland plant selection and plant density. The aim was to enhance biological processes at Pont-y-Felin, attracting native wildlife and supporting further scale-up of wetlands. Pont-y-Felin will also be part of a national research project – the Chemical Investigation Programme (2025-2030). Pont-Y-Felin's unique solution will enable a five-year investigation comparing the effectiveness of wetlands with grey solutions at dealing with water-borne pollutants such as pharmaceuticals.

In addition, extensive liaison with NRW Permitting and water quality teams has helped us align the project with principles in their approach to Sustainable Management of Natural Resources (SMNR). Working together we advanced the first wetland regulatory framework in Wales, this scheme will be setting the precedent for all future permitting across Wales, by all sectors.

Finally, new partnerships are fundamental to more efficiently deliver NbS quickly and at scale. Due to the nature of Pont-y-Felin, we have been able to work with different partners for the delivery of the scheme, such as Arm and Salix. We have also been working with multiple organisations and charities such as the Rivers Trust and Keep Wales Tidy, to better understand the regulatory restrictions and make plans for the maintenance of the asset.

### 4. Aligning skills for the future

Finally, a nature positive future needs new skills to complement and enhance our traditional skills in engineer/modelling (e.g. green economists, placemaking, social scientists...) These are the skills we want to continue developing to support the Welsh Well-being of Future Generations Act and Net Zero strategic plan.