Drainage and Wastewater Management Plan

Summary of the methodology for the Baseline Risk and Vulnerability Assessment (BRAVA) on:

Storm Overflow Performance

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from Southern Water

Contents

1. Background

1.1. Purpose

The purpose of this document is to provide a summary of the method for undertaking the Baseline Risk and Vulnerability Assessment (BRAVA) for the planning objective on **Storm Overflow Performance**.

The BRAVA is an important step in the development of Drainage and Wastewater Management Plans (DWMPs). It is an assessment of current and future risks for each of the planning objectives below and is undertaken for the sewer catchments that were flagged during the Risk Based Catchment Screening (RBCS).

All Water and Sewerage Companies (WaSCs) are required to complete a BRAVA and report to Water UK on the following six common planning objectives:

1. Risk of sewer flooding in a 1 in 50 year storm
2. Storm overflow performance
3. Risk of WTW compliance failure
4. Internal sewer flooding risk
5. Pollution risk
6. Sewer collapse risk.

We have developed this methodology in accordance with the Water UK guidance on 'BRAVA planning objectives for national reporting' published on 29 July 2020. An extract from the Water UK guidance on the planning objective on storm overflow performance is provided in the Annex to this document.

1.2. Definitions

Storm overflows are installed in a combined sewer network to reduce the risk of flooding to homes and businesses during storm event. There are several types of storm overflows including Wastewater Treatment Work storm tanks and sewer network overflows. The latter includes Combined Sewer Overflows (CSOs), Emergency Overflows (EMOs) and Combined Emergency Overflows (CEOs). All these storm overflows have been included within this assessment.

Each storm overflow is subject to a licence/permit issued by the Environment Agency (EA). The licence specifies the flow of water that a Combined Sewer Overflow (CSO) or pumping station should accept from upstream (known as the pass forward flow) and/or the amount of water that must be held within the sewer network before a storm overflow can then start discharging to rivers or the sea.

We manage the wastewater network and systems to ensure that all our storm overflows are compliant with the Urban Waste Water Treatment Regulations (UWWTR),1994.

Water companies are required to monitor and report the performance of storm overflows in the combined sewer network to the EA. Our storm overflows are equipped with an Event Duration Monitoring (EDM) device, which records the frequency and duration of storm discharges. These are known as “spills”.

Storm overflow performance is assessed in accordance with the Environment Agency’s Storm Overflow Assessment Framework (SOAF). This framework identifies several factors that need to be considered when assessing the performance of a storm overflow, including any impact on amenity (visual impacts), impact on a receiving water body, and the frequency of the discharges. An investigation is required for any “high spilling” storm overflows, which are defined as those with spill frequencies higher than the spills per year set out in table 1. These figures are for storm overflows discharging to freshwater sites - non-tidal rivers, ponds and streams.

Table 1: SOAF – Spill frequency investigation triggers

No. of years EDM data	Investigation trigger (average no. spills/year)
1	➢ 60
2	➢ 50
3 or more	➢ 40

Note for this cycle of DWMPs, storm overflow performance will be assessed mainly upon the spill frequency as this is a good indicator of where we need to investigate the risks to water quality in more detail. We are undertaking a number of environmental investigations in the AMP7 funding period, 2020 – 2025, to determine whether storm overflows impact water quality in the receiving water body. These investigations include the development of water quality models which can then be used to improve our future BRAVA assessments for storm overflows.

1.3. Reporting Requirements

Water UK guidance requires all WaSCs to report on storm overflow performance as a common Planning Objective.

Water UK requires a 2020 baseline and a 2050 planning horizon to be reported.

The objective is to assess annual spill performance for each storm overflow. The results will be collated and reported to Water UK at a sewer catchment level (Level 3 DWMP) and at a river basin catchment level (Level 2 DWMP).

The Water UK reporting guidance for this planning objectives states that the assessment of the impact of storm overflows on the receiving water quality, amenity use and dilution does not need to be considered for this first cycle of DWMPs.

2. Data Sources

The following is a short description of the data that has been used and where it has been obtained from.

2.1. Event and Duration Monitoring (EDM) Data

The EDM data is used to assess the performance of storm overflows and determine the frequency of discharges in all our sewer catchments.

A '12 / 24 hour event counting' method is used to count the number of spills per year. The 12hr/24hr event counting criteria is performed as follows:

- event counting starts when the first discharge occurs
- any discharge(s) in the first 12 hour block is counted as 1 spill
- any discharge(s) in the next and subsequent 24 hour blocks are each counted as 1 additional spill per block
- this counting continues until there is a 24 hour block with no discharge
- for the next discharge after a 24 hour block with no discharge, the sequence begins again.

2.2. Time Series Rainfall (TSR) Data

Time Series Rainfall (TSR) models are used to simulate rainfall-runoff and predict the volume and frequency of discharges from storm overflows within a sewer catchment. Where we have hydraulic models of our sewer networks, we have used a TSR model to predict the performance of storm overflows.

For the baseline (2020) scenario, the existing TSR data is used to predict discharges from storm overflows.

For future 2050 scenarios, the TSR for 2050 is generated using the UKWIR (UK Water Industry Research) Rainfall Event Duration Uplift ('Redup') tool, which generates future time series rainfall from an existing TSR for a given location. The 2050 TSR incorporates the impact of climate change by reprofiling rainfall to account for changes in rainfall patterns and intensities.

TSR model simulation results are analysed to produce an annualised average spill count using the '12/24' spill counting criteria.

2.3. Population Growth and New Development

We hold information on the projected development within our operating area in our Developer Enquiry Tracking System (DETS) database. This contains applications for residential developments and details of the proposed size and location.

The TSR modelling assessment takes into account population growth in the catchment. The DETS data is used to establish location and extent of new development in each sewer catchment. We then use this with the existing population data obtained from the Experian 7.1 database to assess impact of growth on the performance of our storm overflows.

2.4. Urban Creep

Urban creep is increase in impervious surface with in urban area due to extension of properties or addition of new pavements which leads into increase in surface runoff.

UKWIR published a study on “Impact of Urban Creep on Sewerage Systems” in 2010. The study sets out methods of estimating urban creep. We adopted a simplified version of Method 3 of the UKWIR study to estimate urban creep within our sewerage system and used it as an input in network modelling to assess network capacity and risk of flooding.

The overall urban creep rate (m^2/annum) for a network model is calculated based on residential property types - Detached, Semi-Detached, Terraced, and Flats in accordance with UKWIR Method 3 (see Table 2 below). An urban creep uplift is calculated as a percentage of the mapped residential roof area based on OS Master Map and OS Address Base Premium. Urban creep for a modelled sub-catchment is calculated by multiplying the modelled residential roof area by the urban creep uplift. Urban creep is then applied as paved area.

Table 2: Urban Creep rate for residential properties

Property Type	Urban creep Rate m^2/Property/Year	Data Source
Detached	0.795	UKWIR
Semi-Detached	0.366	UKWIR
Terraced	0.196	UKWIR
Flat	0	UKWIR
Residential - Default	0.738	UKWIR
Non Residential	0	UKWIR

For models where the residential and non-residential areas are not defined separately by land use, a model sub-catchment property count is required. In this case the creep area is calculated from the roof area and urban creep uplift. A further modification is carried out based on the residential/non-residential roof area split to correct the urban creep calculation in mixed land used sub-catchments. This factor is not applied to some types of older models if it is not possible to carry out a reliable property count.

No urban creep is applied to non-residential properties. No urban creep is applied to modelled sub-catchments with impermeable area <5% of the contributing area.

2.5. Environmental designations

The environmental designation of the water body each storm overflow discharges to is obtained from MAGIC (Multi-Agency Geographical Information). This enables us to identify any sensitive waters, for example, rivers, that could be affected by the discharges from the storm overflows.

2.6. Combined Sewer Overflow Investigations

During the AMP6 funding period, 2015 – 2020, we completed a number of investigations into the performance of our CSOs in line with the ES's developing Storm Overflow Assessment Guidance. These investigations focused on suspected 'high-spillers' and completed biological sampling to determine if any resulted in detrimental environmental impacts.

In the current five-year funding period, we have commenced further investigations on CSOs as part of the EA's Water Industry National Environment Programme (WINEP).

This data and information will be used to support the development of the DWMP.

3. Method of Assessment

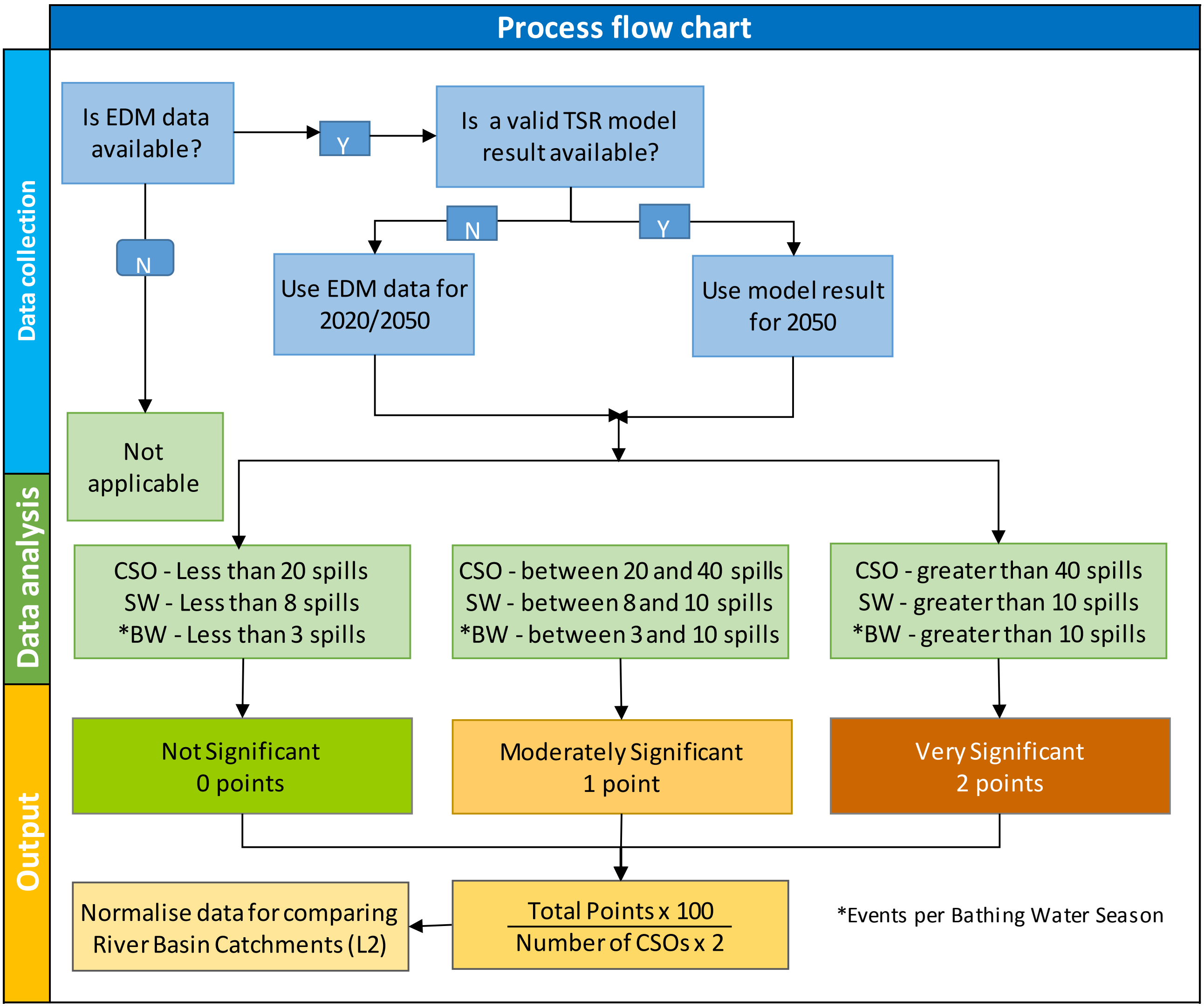
The following methodology has been developed to assess storm overflow performance.

3.1. Process – Baseline 2020 and 2050 Assessment

The baseline assessment is carried out using our hydraulic model for the sewer catchments. For catchments where a model is not available, we utilise the EDM data which has captured actual events from storm overflows.

The process developed for this assessment is shown in Figure 1. It includes details of where the information is coming from, how we assess it and how the results are used to band the catchments as 0, 1 or 2 to meet the Water UK reporting requirements, set out in section 0.

Figure 1 - Process flow chart for the 2020 baseline and 2050 Storm Overflow Performance



Where models are available for a sewer catchment, we check the model results against the EDM data to verify the model. If the number of spills are within 25% or 10 spills, then we consider the model as valid and use the model to generate the future predicted number of spills. For all other catchments we use a non-modelled approach as explained in section 3.2.

3.2 Uplift factor – for non-modelled catchments

For non-modelled catchments prediction of future spill frequency has been carried out by applying an uplift factor on EDM data. This is a simplified estimate utilising a relationship between rainfall depth and spill frequency based on established TSR and actual spill performance, see figure 2.

To determine the uplift factor for future spills the following procedure has been followed:

- Calculate the Total Rainfall Depth for each event in the current 2020 and future 2050 TSR series (10 years of data)
- For each series rank each event by depth of rainfall (Rank 1 being the largest total depth)
- Plot 'Total Rainfall Depth' against 'Ranked event by Depth'
- Utilising the current 2020 annual spill frequency (factored by 10 to convert to 10 years of data) read the corresponding Total Rainfall Depth
- From the Total Rainfall Depth forecast this to the 2050 TSR series and establish the corresponding Ranked event by Depth (factored by a 1/10th to give 2050 annual spill frequency).

The above procedure only uses rainfall depth and assumes the relationship between rainfall depth and spill frequency is linear, so this is a crude estimate. However, this will allow the identification of catchments at greatest risk of changes to spill frequency and thereby identifies catchments where hydraulic model development will be beneficial to understanding the risks.

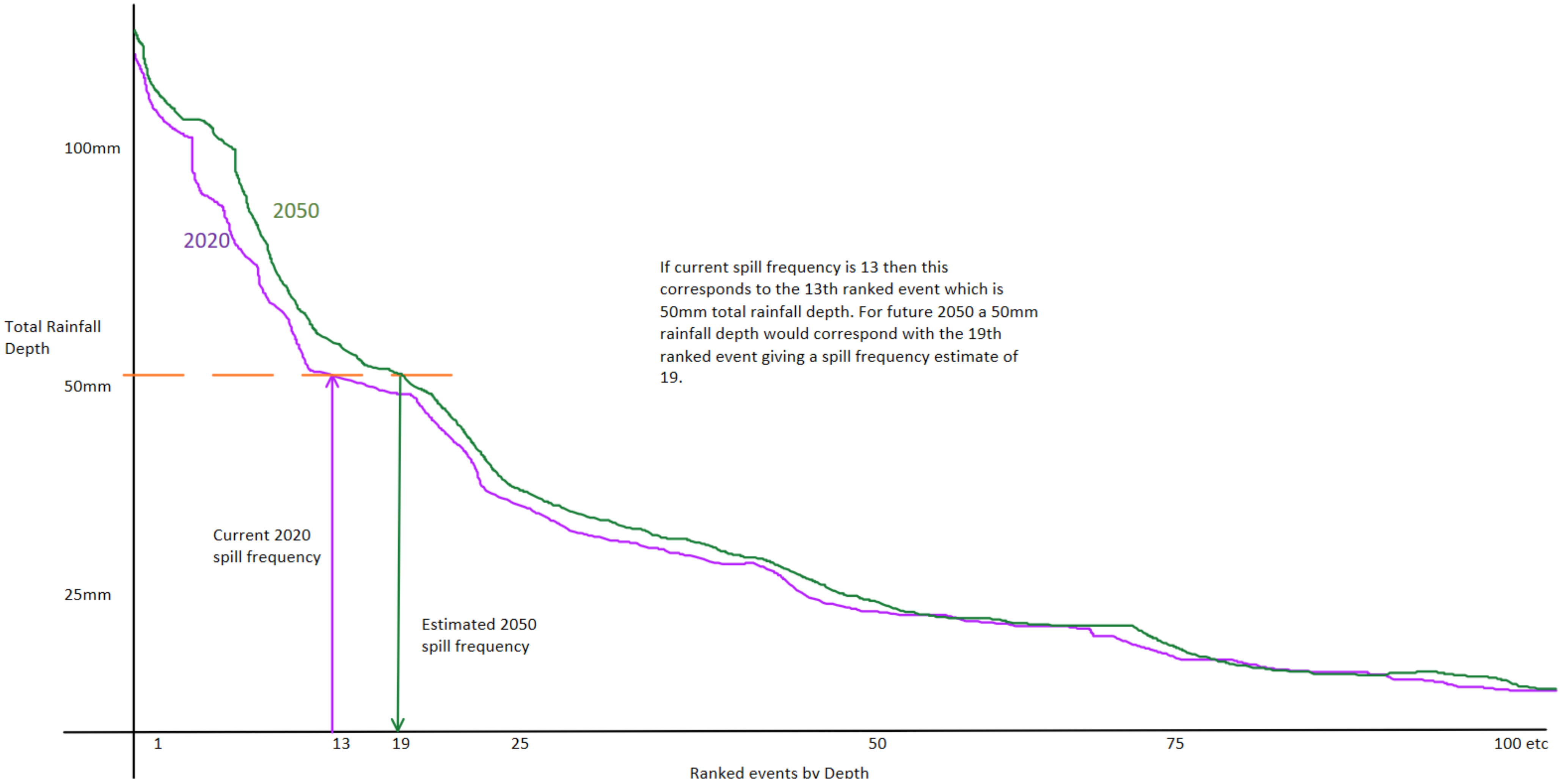


Figure 2: Graph demonstrating application of future spill frequency estimate from TSR data

3.3 Outputs from the BRAVA

The outputs from the BRAVA on Storm Overflow Performance provides a risk score for each sewer catchment. The score is determined based on Water UK guidance by a weighted points system using individual storm overflow scores, detailed below:

$$\text{Risk Score} = \frac{\text{Total of individual storm overflow scores} \times 100}{\text{Number of Overflows} \times 2}$$

In addition to the above risk score the total individual storm overflow scores in a catchment is divided by the total number of CSOs with score 1 or 2 and rounded up to define the sewer catchment banding. This approach allowed us to identify catchments with high spilling CSOs.

Table 3: Storm overflow performance bands and thresholds for Sewer Catchments (Level 3 DWMPs)

Criteria (refer to figure 1)	Bands	
Low spilling CSOs in the catchment	0	*Not Significant*
Medium spilling CSOs in the catchment	1	*Moderately Significant*
High spilling CSOs in the catchment	2	*Very Significant*

The scores for each sewer catchment are collated for reporting at the river basin catchment scale (Level 2 DWMP).

The river basin catchment score is obtained by adding the spills for each sewer catchment within the river basin catchment, then normalising this number by the 10,000 Population Equivalent (PE). This normalises the data so that comparisons can be made between river basin catchments of different sizes.

The risk scores are assigned to one of three bands as shown in Table 3 below. The thresholds and bands shown in the table below applies to the 2020 baseline and 2050 assessments.

Table 4: Storm overflow performance bands and thresholds for River Basin Catchments (Level 2 DWMPs)

L 2 Storm Overflow thresholds (No. Spills per 10,000 PE)	Bands	
Less than 20 spills	0	*Not Significant*
Between 20 and 40 spills	1	*Moderately Significant*
Greater than 40 spills	2	*Very Significant*

4. Annex: Water UK guidance on the Planning Objective

Planning Objective: Storm Overflow Performance	**<u>Objective/Definition</u>** The purpose of this Planning Objective is to assess baseline (2020) storm overflow performance and provide an indication of future vulnerability by 2050 under a ‘do nothing’ scenario due to climate change, new development, and permeable area creep. The objective being to identify those catchments at greater risk to inform Option Development & Appraisal (ODA). This assessment is to be carried out for all catchments triggering BRAVA through the RBCS process where there are storm overflow(s) in the catchment. Results will be collated and reported at a L3 TPU catchment level and at a L2 SPA. Asset specific spill performance for each storm overflow will not be reported as part of BRAVA. In line with Appendix C of the Framework, performance will be categorised as: 0 (Not Significant), 1 (Moderately Significant), 2 (Very Significant) or N/A (Not applicable). The definition of storm overflow will include both sewer network and WwTW storm tanks. Annual average spills are to be calculated using the EDM criteria of '12/24 spill counting'.	**<u>Definition clarifications</u>** Where catchments have no storm overflows/WwTW storm tanks, then catchments should be flagged as ‘Not Applicable’ For Cycle 1 of DWMPs the assessment is to exclude receiving water quality, amenity use and dilution. However, where storm overflow performance is highlighted as ‘Moderately Significant’ or ‘Very Significant’ the environmental impact should be considered as part of Option Development & Appraisal (ODA). **<u>Maps</u>** To be produced at for L2 to visually display bands 0, 1 & 2. **<u>Tables</u>** To be produced for L1, L2 & L3 and include only 0, 1 & 2 banding.

	<u>Baseline Assessment</u>
	• Assessments should be completed using the most appropriate means of determining storm overflow performance. Where available, fit for purpose hydraulic models should be used where possible. Where a suitable hydraulic model is not available then EDM data can be used with an appropriate adjustment for annual rainfall. Where an overflow did not meet EDM criteria for monitoring (e.g. low spills/low impact), then the default performance should be ‘Not Significant’ under baseline performance.
	• Hydraulic modelling assessments should preferably use 10-year TSR to determine average annual spills ('12/24 spill counting'). However, companies may use representative ‘3-year TSR’ (per CAF) or a ‘Typical Year’ dataset where appropriate. This approach ensures BRAVA does not become an overly extensive modelling exercise whilst acknowledging that full TSR may still be needed as part of ODA to address holistic catchment risks.
	• Thresholds to be reviewed once results available to ensure meaningful outputs. However proposed
		<u>2050 assessment</u>
		
		• Same methodology as Baseline modelling, with:
		  ○ Rainfall time series uplifted to include climate change using 2017 UKWIR Red-Up rainfall perturbation tool for 2050 epoch.
		  ○ Growth and creep to be added in line with best available central estimate
		• Where no hydraulic model is available, an appropriate adjustment should be applied to baseline EDM spill data.
		• Climate change uplifts should use central estimate 2050 projections.
		• Performance and aggregation to use the same baseline methodology to ensure comparability.
		• The outputs will comprise of data tables at L3, with maps at Level 2.

	thresholds for performance criteria (per CSO) are to be aligned to the CAF methodology, namely: CSO ◦ < 20 spills = 'Not Significant' (0 points) ◦ 21-40 spills = 'Moderately Significant' (1 point) ◦ > 40 spills = 'Very Significant' (2 points) Bathing Waters (events per summer) ◦ < 3 = 'Not Significant' (0 points) ◦ 4 – 10 = 'Moderately Significant' (1 point) ◦ > 10 = 'Very Significant' (2 points) • Aggregation to an L3 based on Weighted Points Score= (total number of points scored by CSOs *100)/ (total number of CSOs *2), with L2 normalisation based on 'Population Equivalent' (per RBCS). Worked examples will be provided once results are available to ensure the aggregate outputs are meaningful.	