Drainage and Wastewater Management Plans

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

Surface Water Management

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Version 1

from Southern Water

Contents

1. Introduction

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 to improve surface water management in our wastewater region.

The Baseline Risk and Vulnerability Assessment (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, 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 developed methodologies for conducting these six BRAVAs in accordance with the Water UK guidance and completed the BRAVAs in December 2020.

We identified two additional 'bespoke' objectives to complement the six national objectives and have included these in our DWMP:

7. Annualised Flood Risk - which is the flood risk arising from sewers as a result of different severities of rainfall
8. Wastewater Treatment Works (WTW) Dry Weather Flow (DWF) Compliance – to assess our compliance with the Environment Agency (EA) permit relating to the DWF arriving at a wastewater treatment works.

We are working collaboratively with partner organisations in the development of our DWMPs. Through this collaboration we have identified 6 additional planning objectives that will help us to achieve the wider environmental outcomes that our customers expect and we want to achieve. They are:

1. Secure nutrient neutrality
2. Achieve Good Ecological Status / Potential
3. Reduce groundwater pollution
4. Improve bathing waters
5. Improve shellfish waters
6. Improve surface water management

Further information on planning objectives for DWMPs can be found on our website: https://www.southernwater.co.uk/dwmp/planning-objectives.

1.2. Objective

There are two national planning objectives that relate to flooding: (i) the risk of internal sewer flooding and (ii) the risk of flooding in a 1 in 50 year storm. These two objectives help us to understand the risks to customer properties from sewer flooding.

The purpose of including this additional planning objective on surface water management in our DWMP is to assess the risks of surface water flooding and the impacts on drainage and wastewater systems. It will enable us to identify potential locations where it may be possible to work with other organisations to improve the management of surface water arising from heavy rainfall and storms.

Our changing climate means we are facing increasingly severe summer storms and warmer, wetter winters. This, added to population growth, future housing development and urban creep with higher levels of impermeable surfaces, and rising sea levels across our region will increase the pressure on our sewer networks to cope with greater flows. Realistically, there are only two options to enable us to manage increased volumes: we can either enlarge our sewer networks or we can work, with partner organisations and landowners, to reduce the volume of surface water entering our systems. A variety of measures which could be taken include separating surface and foul water drainage systems, or providing Sustainable Drainage Systems (SuDS), improved land management, and wider catchment measures to 'slow the flow'. Many of these catchment measures provide broader environmental benefits and are lower cost solutions to prevent harm from flooding and better utilise the available capacity of existing sewer networks and drainage systems.

Improving the management of surface water so that less enters our sewer networks will ultimately result in providing a greater level of protection for our customers from sewage flooding both inside and outside their homes and businesses, and reduce pollution of the environment from discharges from our sewer networks.

In this first cycle of the DWMP, our aim is to identify the areas in our region where surface water has a high potential to contribute to sewer flooding in our networks and consequently affect our customers and the environment. The risk assessment will identify where our sewer networks are likely to exceed capacity through interaction with surface waters and assess the consequences of the flooding. This will enable us to identify actions that can be included within our DWMP investment plan to reduce and manage the risks.

1.3. Background

Surface water flooding and drainage problems occur when the rate of rainfall exceeds the rate of ground infiltration and / or the capacity of the drainage system. The problems can result in the flooding of homes and businesses, highway flooding, overloaded drainage systems (causing flooding elsewhere) and water-logging of fields, parks and sports facilities and the related issue of sewage flooding.

Rainfall will either pool in the source area where the rain fell, soak into the ground, or drain away along a flow pathway on the ground surface. There are many systems that support

effective drainage, including field drains and ditches, highway drainage, surface water drainage systems and combined sewers. These systems can easily be overwhelmed during periods of heavy rainfall and lead to surface water flooding. When the rate or volume of surface water cannot enter our sewer network because it is already full or the rainfall exceeds the inlet capacity then the result is flooding on the surface of the ground. In severe cases, the surface water flooding can enter customer homes and businesses, and/or pollute the environment.

1.4. Definitions

The Flood and Water Management Act 2010 identifies Risk Management Authorities (RMAs) that have a statutory flood risk management function. The Environment Agency (EA) has a supervisory duty for all matters relating to flood and coastal erosion risk management in England. The upper tier local councils (the County Councils and Unitary authorities) have a role under the Act as a Lead Local Flood Authority (LLFA). Other RMAs with responsibilities for flooding and water management include Internal Drainage Boards, water companies, and highways authorities. LLFAs have a duty to investigate and report on flooding under Section 19 of the Flood and Water Management Act 2010. These are known as Section 19 Flooding Investigation Reports. The LLFAs also develop and publish a Local Flood Risk Management Strategy for their area setting out the roles and responsibilities of all the RMAs.

Surface Water Management Plans (SWMP) are developed by LLFAs in partnership with other RMAs to identify local flood issues and the actions that need to be implemented to manage the surface water flooding risks in the plan area.

The Section 19 reports, SWMPs and Local Flood Risk Management Strategies provide further information to support and validate this risk assessment and they will be used as we develop the DWMPs and identify the causes of risks and potential solutions to manage the risks.

1.5. Scope

This methodology summarises our approach to this risk assessment. It describes the process we have developed to identify where there are risks of flooding from surface water within the areas covered by our drainage and wastewater systems so we can understand the interactions and impacts on our systems.

This risk assessment will utilise the results from the BRAVAs on Annualised Flood Risk (Hydraulic Overload) and 1 in 50 Year Flood Risk, as well as customer flooding records and the EA's surface water flood risk maps.

The outputs from this risk assessment will be a risk band for each wastewater system (catchment) according to the scale of the risks. The method of assessment and the risk bands are described in detail in Section 3.

This assessment will not provide a full risk assessment on surface water flood risk in this first round of the DWMP. Instead, it provides an initial interpretation of the potential for surface water to impact sewer flooding as reported by our customers and where predicted in our hydraulic models. This will enable us to identify areas where further investigations to improve our

understanding of flooding mechanisms and mitigation measures are required. We will do this by comparing the zone of influence of surface water flood risk areas mapped by the EA with sewer flooding incidents reported by our customers (Sewer Incident Report Form) and predicted sewer flooding locations from modelling of 1 in 30 year and 1 in 50 year rainfall events.

Banding of the sewer catchments enables us to identify and prioritise the sewer catchments and river basin catchments where our best efforts and resources must be applied to:

- improve our understanding on how surface runoff interacts with our sewer networks, and
- quantitatively assess its impact on the capacity and performance of our sewer networks.

1.6. Reporting Requirements

We are not required to report the BRAVA outcomes for our bespoke and additional planning objectives to Water UK. However, we will publish the results on our website for consideration by our customers and partner organisations.

2. Data Sources

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

2.1. Surface Water Flood Maps

The EA produces maps to show the risk of flooding from surface water (RoFSW) as a result of rainfall in any given year. These maps forecast flooding for 1 in 30 year, 1 in 100 year and 1 in 1000 year storm scenarios. The EA's What is the Risk of Flooding from Surface Water Map? 2019 report combines nationally produced mapping and local mapping from Lead Local Flood Authorities (LLFAs) to form a single map for each of the storm scenarios.

We have downloaded this information from the EA's web-based open source database EA RoFSW. Information on the 1 in 1000 year flooding scenario is not included in our assessment as it covers an extreme event significantly beyond the minimum level of protection required in planning guidance.

2.2. Hydraulic Models

We have a number of computer based hydraulic models of our sewer networks to support the management, maintenance and investment in these systems. We use a software platform called InfoWorks ICM (Integrated Catchment Modelling) to model surface water and wastewater flows through pipes.

Approximately 141 of our 381 sewer catchments have hydraulic models. Generally, the models cover our largest and most complex sewer catchments and, collectively, they cover the sewers serving over 90% of all our customers. Of these models, approximately 103 will be used for the first round of the DWMP. The remaining 38 hydraulic models are being reviewed with the intention to use them in the future iterations of the DWMP.

We have used the hydraulic modelling results from our recently completed 1 in 30 year flood risk assessment undertaken for the 'Hydraulic Overload (Annualised Flood Risk)' objective, and the 1 in 50 year flood risk assessment undertaken for the 'Risk of Flooding in a 1 in 50 Year Storm' objective to identify nodes (sewer manholes) in the sewer network that are predicted to flood in these storm scenarios.

There are several limitations of hydraulic models. Some of our models incorporate surface water drainage systems that are identified as public sewers. However, private surface water systems are not included as we do not hold any data or information on those systems. For some locations, it will be necessary to work with other organisations to combine data and information on culverted watercourses, other surface water sewers and highways drainage in order to understand where the many drainage systems interact and perform together.

2.3. Historical Flooding Incidents

Historical flooding incidents reported by customers are recorded in our Sewer Incident Report Form (SIRF) database. These incidents are collated in a table, dating back to 2000, showing the incidents reported due to hydraulic causes.

Historically, water companies were required to maintain a register of properties at risk from flooding from the sewer network. This is called the DG5 register. The properties on the register are considered to be at risk of internal or external flooding at a 2 in 10, 1 in 10 and 1 in 20 year probability.

These properties will have been verified as at risk and reported to OFWAT, the water industry economic regulator, as being on the DG5 "At Risk" Register.

We have calculated the number of properties at risk from flooding in each wastewater catchment using the DG5 register and our SIRF database.

2.4. Partnership Knowledge on Surface Water Flooding

We are collaborating with LLFAs and the EA to share local and regional knowledge on the areas that are of the highest priority in terms of reducing the risk of flooding from surface water and improving the management of surface water. This helps to validate the results of our risk assessment.

Surface Water Management Plans have been developed in some locations where surface water flooding has occurred in order to determine the causes and find solutions. A significant amount of detailed information is contained within the SWMPs that can be drawn upon to support the development of our DWMP.

In the next stages of the DWMP, we will use this risk assessment to identify the drainage and wastewater systems where we need to understand the causes of the surface water flooding risks. Information within the Section 19 Flooding Reports, SWMPs and Local Flood Risk Management Strategies will provide a key input into our understanding of the risks.

3. Method of Assessment

The following methodology has been developed for our assessment in this first round of the DWMP programme. We have utilised asset performance data and flood risk information to understand the potential impact of surface waters on our networks.

3.1. Process for Modelled Catchments

A baseline (2020) assessment on each sewer catchment is undertaken using the following information:

- EA's RoFSW mapping information
- our records of properties on the DG5 "At Risk" Register
- our records of sewer flooding incidents on the SIRF database
- our hydraulic modelling outputs from the Hydraulic Overload (Annualised Flood Risk) and 1 in 50 Year Flood Risk planning objectives.

The process chart shown in Figure 1 illustrates how we have assessed and banded our modelled catchments for the risk of flooding from surface water.

In our recently completed Hydraulic Overload (Annualised Flood Risk) and 1 in 50 Year Flood Risk assessments, we used the hydraulic model of our sewer network to identify nodes (manholes) that are likely to flood in any given year using the 1 in 30 year and 1 in 50 year horizons.

We have adopted these flooding nodes in our assessment of surface water flood risk by bringing them into our GIS assessment tool (ArcGIS) and overlaying them with the EA's 1 in 30 year and 1 in 100 year RoFSW maps. We selected the flooding nodes that overlap the RoFSW maps to identify where surface runoff pools in our sewer network. We have compared our modelling results for the 1 in 30 year storm from the Hydraulic Overload assessment with the EA's 1 in 30 year RoFSW maps, and the results for the 1 in 50 year storm with the EA's 1 in 100 year RoFSW maps.

An area around each selected flooding node, called a flood buffer zone, is digitally mapped to represent a 'circle of influence' based on the predicted volume of flooding at the node. The size of the flood buffer zone is determined as follows:

- 15m radius for flood volumes below 25m^3
- 30m radius for flood volumes up to 100m^3
- 50m radius for flood volumes over 100m^3

Once defined, the flood buffer zones are merged for each sewer catchment and the count of properties within the zones is tabulated to represent the number of properties at potential risk of surface water flooding.

Records of flooded properties and other flooding incidents on our SIRF database have been collated and plotted with the EA's RoFSW mapping. The number of DG5 properties and SIRF incidents within the EA's 1 in 30 year and 1 in 100 year surface water maps is tabulated to represent actual records of reported flooding potentially due to surface water.

A weighted aggregate score is calculated for each catchment based on the number of predicted properties at risk, DG5 properties and SIRF incidents, described in section 3.4. Weights for scoring the number of properties predicted to be at risk is based on the likelihood of flooding for each storm model scenario. For example, the weight for scoring properties at risk in our modelling results for the 1 in 50 year design storm is based on a 1 in 50 likelihood of occurrence: 0.02.

The thresholds for assigning a risk band to each sewer catchment is based on the 75th and 90th percentiles of the weighted aggregate score and moderated using the risk banding results from the Hydraulic Overload and 1 in 50 Year Flood Risk outputs. The objective of the moderation is to align the catchments at risk of surface water flooding with the catchments we assessed to be at risk of flooding due to hydraulic overload.

3.2. Process for Non-Modelled Catchments

The procedure for undertaking a baseline (2020) assessment on non-modelled sewer catchments uses the EA's RoFSW mapping information, our records of properties on the DG5 'At Risk' Register and sewer flooding incidents on the SIRF database. Figure 2 provides a process chart that sets out how we have assessed and banded our non-modelled catchments for the risk of flooding from surface water.

As undertaken for modelled catchments, the number of DG5 properties and SIRF incidents within the EA's 1 in 30 year and 1 in 100 year RoFSW maps is tabulated to show actual records of reported flooding potentially due to surface water. An aggregate score for each sewer catchment is calculated and tabulated based on the sum of DG5 properties and SIRF incidents that overlap the EA's RoFSW as described in section 3.4.

The risk banding for the catchments is based on aggregate score thresholds derived from modelled catchments and then moderated using the risk banding identified in the Hydraulic Overload outputs as described in section 3.4.

3.3. Process Charts – Modelled and Non-modelled Catchments

The processes for assessing modelled and non-modelled catchments for the baseline (2020) planning horizon are summarised in the charts shown in Figures 1 and 2 below:

Figure 1: Process flow chart for assessing risk of flooding to prioritise need for surface water management (Modelled Catchments)

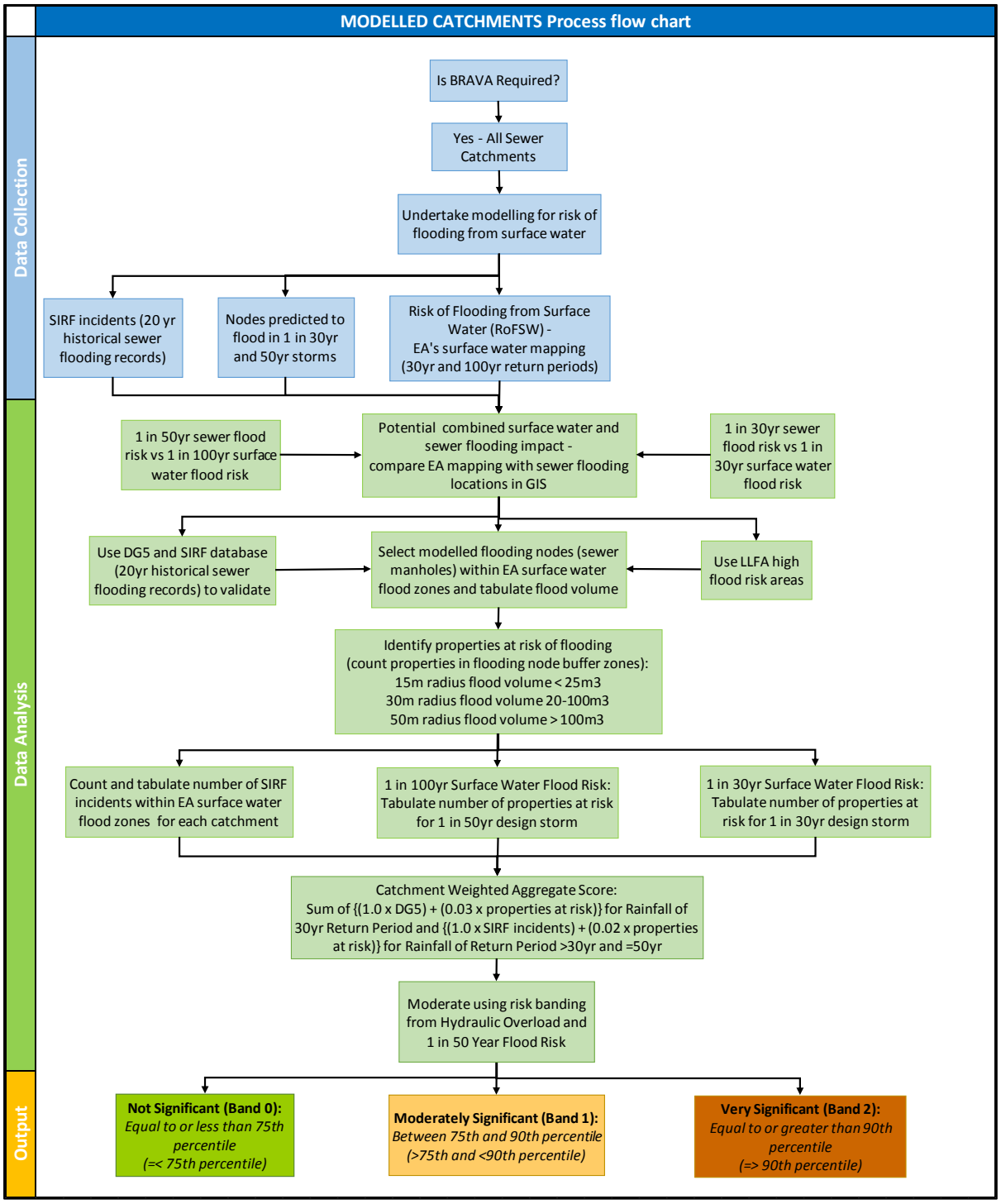
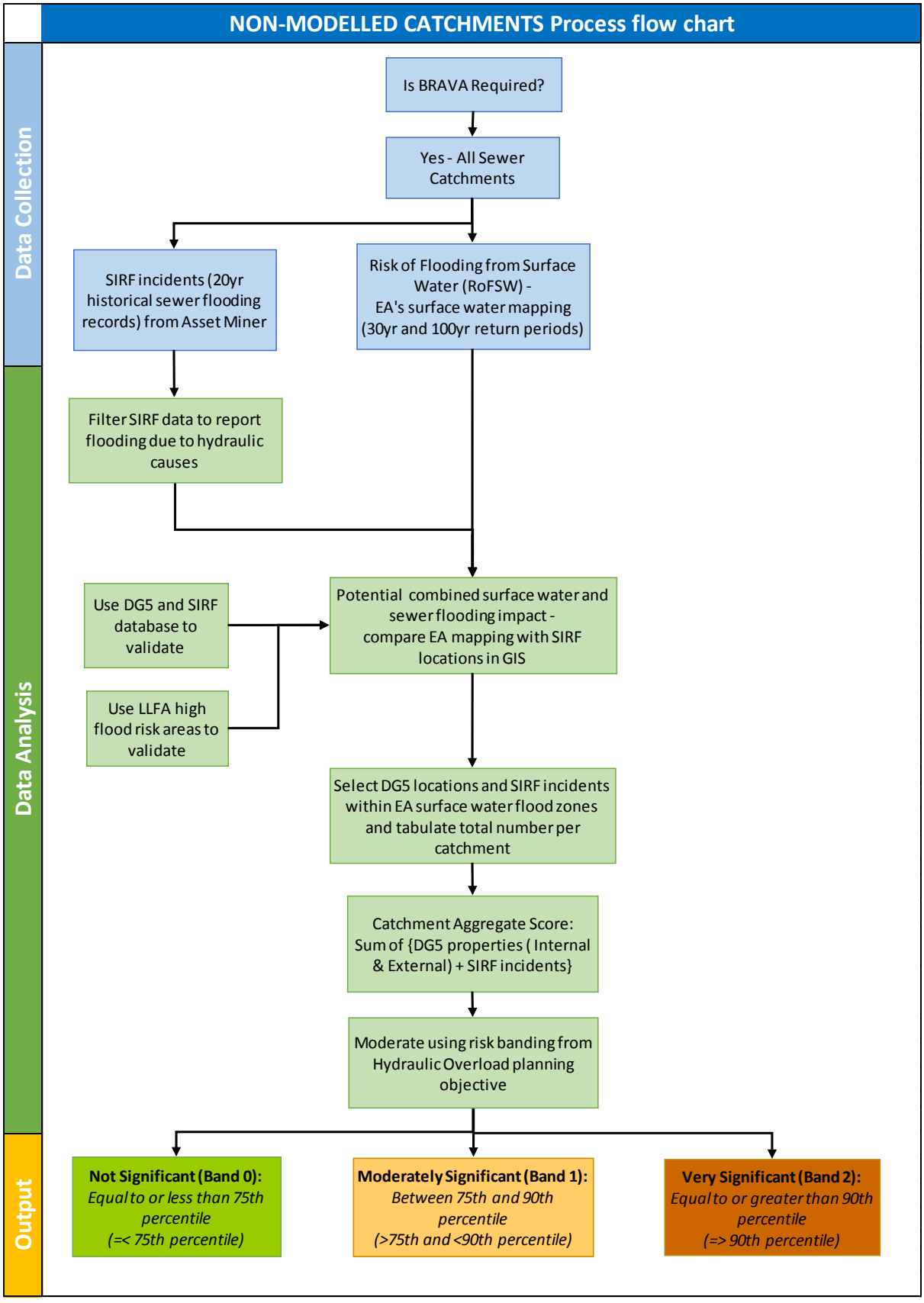


Figure 2: Process flow chart for assessing risk of flooding to prioritise need for surface water management (Non-Modelled Catchments)



3.4. Outputs from the BRAVA

The BRAVA outputs are an estimate of the risk of flooding due surface water for the baseline (2020) planning horizon in our sewer catchments. It is based on the following metrics:

(a) Modelled Catchment based on DG5 properties and model predicted properties at risk within the EA's surface water flood risk area:

- Calculate weighted score as a sum of (1.0 x number of DG5 properties) + (0.033 x number of properties at risk for 1 in 30 year design storm) within EA's 1 in 30 year surface water flood risk map.
- Calculate weighted score as a sum of (1.0 x number of DG5 properties) + (0.02 x number of properties at risk for 1 in 50 year design storm) within EA's 1 in 100 year surface water flood risk map
- Weighted aggregate score is the sum of the above weighted scores for DG5 properties and model predicted properties at risk

The output is a weighted aggregate score for each catchment that is used to set thresholds in the assessment criteria for banding the catchments.

(b) Non-Modelled Catchment based on DG5 properties and SIRF incidents within surface water flood risk area:

- Calculate score as a sum of (number of DG5 properties + number of SIRF incidents) for DG5 properties and SIRF incidents within EA's 1 in 30 year surface water flood risk map

The output is an aggregate score for each catchment that is used to set thresholds in the assessment criteria for banding the catchments.

3.4.1 Risk Bands for Modelled and Non-Modelled Catchments

The assessment criteria for banding modelled and non-modelled sewer catchments uses a weighted aggregate score as shown in the table below:

Assessment Criteria / Thresholds	Band	
Equal to or less than 75th percentile of aggregate weighted score for catchment: (<= 75th percentile)	0	*Not Significant*
Between 75th - 90th percentile of aggregate weighted score for catchment: (> 75th percentile and < 90th percentile)	1	*Moderately Significant*
Equal to or greater than 90th percentile of aggregate weighted score for catchment: (>= 90th percentile)	2	*Very Significant*

For modelled catchments, the preliminary risk banding has been compared with the outputs from the Hydraulic Overload (Annualised Flood Risk) and 1 in 50 Year Flood Risk planning objectives. A moderation has then been applied to ensure that the risk band for a wastewater catchment is no greater than the highest band for the same catchment in the Hydraulic Overload and 1 in 50 Year Flood Risk assessment results. This means that sewer catchments considered to be at risk of surface water flooding are only considered if already identified to be at risk of flooding due to hydraulic causes.

For non-modelled catchments, we have compared the risk banding in this risk assessment with the outputs from the Hydraulic Overload (Annualised Flood Risk) planning objective only. A moderation has then been applied to ensure the risk band for a catchment is no greater than shown for the same catchment in the Hydraulic Overload (Annualised Flood Risk) output. This is to ensure that we are prioritising wastewater catchments where surface water is getting into the sewer system, causing the capacity of the system to be exceeded, and creating surface water flooding.

4. Next Steps

We recognise that this BRAVA assessment for improving surface water management is only a start, although it establishes a baseline from which to build and improve the risk assessment.

There are significant development pressures across our region which will result in more housing. Although current planning regulations require developers to provide separate surface and foul water systems, new impermeable surfaces and urban creep are likely to increase the level of surface water runoff that makes its way to our sewer networks. Added to development is the likely impacts of climate change which will create further pressures. Together, these will increase the risk of surface water flooding in future years. In particular, more intense summer storms are expected to lead to surface water flooding where it exceeds the inlet capacity of sewers. We therefore need to work with other organisations to separate surface water from the foul drainage system, reduce run-off from land and “slow the flow” into formal drainage systems.

Improving surface water management is a priority for us and our partner organisations. It will reduce the impact of both sewer and surface water flooding on customers, communities and the environment.

We will continue to include this objective within future BRAVA risk assessments to address these issues and will be working with the EA and LLFAs to enhance our initial BRAVA for surface water management. We will work to identify opportunities for us to collaborate on flood alleviation schemes that will bring multiple funding streams together and deliver even greater benefits to customers and the environment.