Response to Ofwat action ref: HDD.OC.A38

"Sewer flooding - extreme storms"

Overview

This document has been put together to respond to the action below raised in response to Ofwat's concern regarding the application of the 1 in 50 extreme storm metric.

Ofwat action ref	Area/ topic	Ofwat Concern	Ofwat stated Action
HDD.OC.A38	Sewer flooding - extreme storms	**Definition** The company provides insufficient evidence that its presented risk is determined appropriately.	The company should adopt the standard definition in full, providing full details of any assumptions in its measurement and reporting methodology. Including all the information set out in section 3.6 of Developing and Trialling Wastewater Resilience Metrics, Atkins.

For Hafren Dyfrdwy we reported 6.64% of our connected population being at risk.

We confirm we are reporting against the standard definition as defined by Ofwat. Whilst this is not a requirement at this stage we have completed a RAG assessment of our ability to report against the definition. The amber assessments are a reflection of the lack of maturity in the definition and ongoing work needed to improve the consistency.

Catchment Assessment

Whilst we have 50 wastewater treatment catchments across our Hafren Dyfrdwy region, only Welshpool, Newtown, Llanidloes and Knighton have populations over 2,000 PE. As stated in the methodology (Section 3.1.1) "it is recommended that Companies exclude catchments below 2,000 pe from the more detailed assessments". However it then goes on to stated that "It is not a blanket exclusion; where Companies are aware of issues with smaller catchments (e.g. historic sewer flooding issues), these should be passed through to the more detailed assessments."

As the catchments below 2,000PE do not have a history of sewer flooding we have excluded these catchments from our analysis.

Functional Areas

Due to the size of our Hafren Dyfrdwy catchments we have not split any of our catchments into smaller 'Functional Areas'. Whilst this is an option set out in Section 3.3 of the Atkins methodology we do not feel the topography of the catchments warrants breaking catchments down into more discrete 'functional areas'. Our vulnerability risk grade assessments have therefore been assessed based on each catchment as determined by the extent of the sewerage network.

Modelling Assumptions

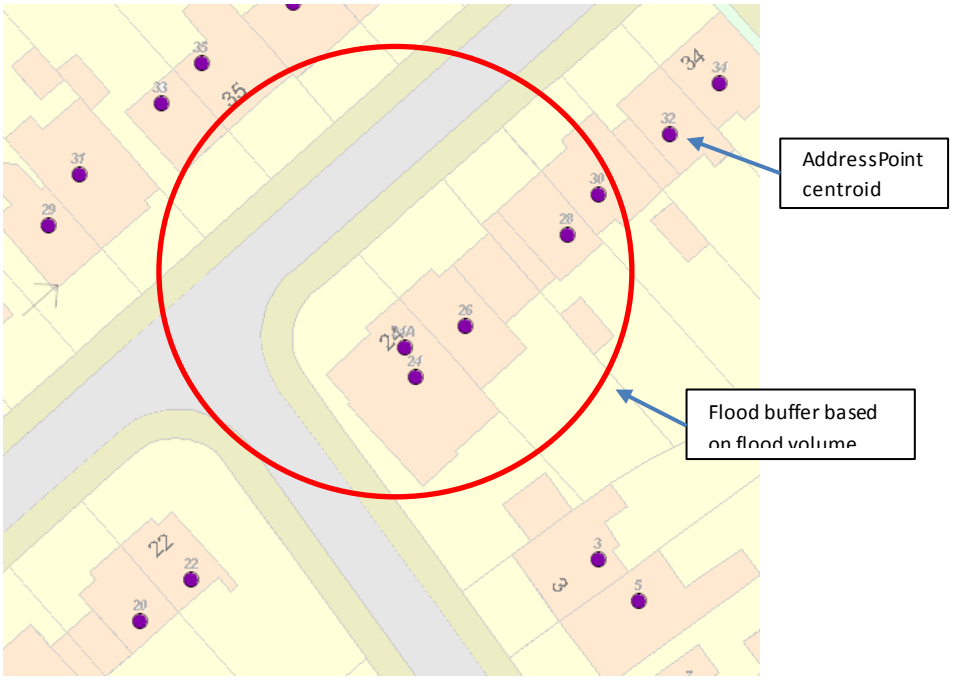
Appendix C of the methodology states that "To achieve consistency across companies, a standard modelling methodology is proposed" but then goes to state that companies can choose whether to use a buffered approach or use 2D flood routing to identify properties at risk which can then be converted to population.

Whilst Hafren Dyfrdwy have the capability to undertake 2D modelling it is felt that there are too many variables which needed to clarified to ensure consistent application of 2D modelling, for example; LiDAR granularity (as this is available in 5 metre, 1 m metre and 0.5 metre formats), what flood depth to use to represent internal flooding (a standard threshold level of 150mm above a ground level is used within the Multi-coloured Manual (MCM; Flood Hazard Research Centre, 2005)), how to deal with roadside kerbs which may or may not be represented in the LiDAR dataset, etc. Due to the variability in outputs depending on which 2D modelling parameters are used we chose to use the buffering approach in Section 2.3.2. This approach is less subjective and simpler to apply compared to 2D modelling. We will however be reviewing the use of 2D but believe that standardisation is required to ensure consistency in reporting.

For the purpose of reporting we have only included properties which flood from the foul/combined sewers. The first paragraph in Section 2 states that "For clarity, a catchment is defined here as covering all pipes, and associated population numbers, that drain to a single wastewater treatment works'. However the methodology also goes on to say "The assessment should be inclusive of all foul, combined and surface water sewers contained within the model". For the purpose of this metric we have only included properties at risk of flooding from the foul/combined sewers as these "drain to a single wastewater treatment works'. We accept that properties will also be at risk of flooding from our surface water assets where a model exists, however as demonstrated through our involvement with the 21st Century Drainage programmes Capacity Assessment Framework (CAF) the coverage of modelled surface water assets across the industry is patchy. Consequently we have not included any flooding from surface water sewers as we believe this to be in line with the methodology as they don't drain to a wastewater treatment works.

Application of Buffered Approach

When counting properties at risk we have used the AddessPoint centroid as indicated in the methodology. We have not included properties where the polygon of a property is within/intersects with the flood buffer as this is not in line with the methodology. In the example below we have only counted the 5 property address point nodes within the buffer. As this metric is intended to determine population at risk we have only included residential properties.



Occupancy Rates

In order to covert properties at risk to population at risk this has been undertaken by dividing the residential population within a catchment by the total number of residential properties in that catchment. This gives an average occupancy rate per property which can be applied to the properties identified to be at risk. This analysis has been done for each individual catchment as we felt using a global occupancy rate for the whole of our Hafren Dyfrdwy region would be less precise.

Outputs

We reported a figure of 6.64% for the 4 catchments above 2,000PE (i.e. 1,530PE at risk divided by 23, 046PE which is the overall residential population of catchments over 2,000PE).

In line with Section 3.6 the outputs would be presented as follows:

Table 6: Detailed reporting - metric coverage						
Total PE served	Total PE in excluded catchments	Percentage of total PE in excluded catchments	Total PE assessed using Option 1a	Percentage of total PE Option 1a	Total PE assessed using Option 1b	Percentage of total PE Option 1b
40,668	17,622	43%	0	0	23,046	57%

Table 7: Detailed Reporting – Option 1a collated				
Vulnerability Grade	Total PE in excluded catchments (i.e. below 2,000PE)	Number of catchments of 'functional areas'	Total PE in catchments or 'functional area' at vulnerability grade.	Percentage of total Option 1a PE
5	0	0	0	0
4	0	0	0	0
3	0	0	0	0

2	0	0	0	0
1	0	0	0	0
TOTALS	0	0	0	0

Table 8: Detailed Reporting – Option 1b collated								
Vulnerability Grade	Total number of catchments	Total number of nodes modelled	Total number of nodes predicted to flood	Percentage of nodes predicted to flood	Total PE in modelled catchments at vulnerability risk grade	Total PE associated with flooding nodes	PE associated with flooding nodes as a percentage of total modelled PE	Assessed overall model confidence grade
5	2 (Knighton & Llanidloes)	847	12	2%	5,745	360	1.56%	B3
4	2 (Welshpool & Newtown)	2164	195	9%	17,301	1170	5.08%	B3
3	0	-	-	-	-	-	-	-
TOTAL	4				23,046	1530	6.64%	B3

Table 9: Summary reporting table	
Vulnerability Risk Grade	Percentage of total population served
L	93.36%
M	5.08%
H	1.56%
TOTAL	100%

For reporting purposes we have included High and Medium risks (vulnerability bands 5, 4 & 3) giving the reported number of 6.64% overall for the Hafren Dyfrdwy region.

Use of Rainfall Parameters

The methodology does not specify which rainfall parameters to use. It has been assumed that we would be using FEH13 summer storm rainfall profiles. No allowance has been included for climate changes as stated in the methodology. We have used the appropriate FEH13 parameters for the centre of the catchment.

Appendix A

Below is a summary of the vulnerability criteria guidance provided in Appendix A of the Atkins methodology together with how these guidelines have been used to apply to Hafren Dyfrdwy catchments.

Please note the throughout the methodology the term "engineering judgement" has been used and so we have tried to interpret t he guidance to develop a structured approach which removes the risk of subjectivity to ensure a consistence application across all catchments.

To do this we have used a variety on inputs including sewer records, asset data, GIS layers, Ordnance Survey topography, and hydraulic sewer models to provide a consistent application across all catchments.

APPENDIX A - Vulnerability criteria guidance			Assumptions used to apply to Hafren Dyfrdwy catchments			
Vulnerability Grade	Vulnerability Description	Vulnerability Description Assessment	Approach	Inputs	Datasets Required	Factored Metric
5	General catchment geographic topography funnelling all flows into one area	Catchment geographic topography i.e. steep or hilly, is such that all flows are routed to one location creating a high vulnerability area; this may only be in one part of the catchment but indicates that overall the catchment has vulnerability. *If mitigation measures have been implemented (include measures up to the end of AMP6) that manage the high vulnerability then reduce grade to 4 or 3. A lower grade is not recommended as the cause of the vulnerability still exists.*	Assessment of Ground Level difference between Max and Min from InfoNet Database and the chainage between them which will identify a general catchment gradient. From this a threshold gradient will be determined. Parallel to this a sewer gradient assessment will be undertaken in InfoNet to assess the percentage of sewers in the catchment < 1:50 which will also be used. These do not display the 'funnelling' effect detailed in Appendix A hence use of EA Surface Water Flood Maps to provide an indication of Inundation Ponding locations. To obtain the funnelling concept you would need a visual assessment of topography (e.g. Thematic Map visualisation). EA SW Flood Map 30 Year extent used to determine SW accumulation. Where this exceeds 5% of the Total Area of the DAP, the score of 5 is reached.	InfoNet	• Model • Topography from InfoNet • Model Gradient from InfoNet • EA Surface Water Flood Risk Map	EA SW Flood Accumulation >5% of DAP Area

5	Catchments with a rapid response	Catchment has a rapid response (assumed time of concentration <1 hour) resulting in high flow routing through the sewer and drainage network. *If mitigation measures have been implemented (include measures up to the end of AMP6) that manage the high vulnerability then reduce grade to 4 or 3. A lower grade is not recommended as the cause of the vulnerability still exists.*	Critical Duration of the catchment used as a surrogate for Time of Concentration (ToC). This should be assessed as the median time of concentration for the catchment using a worst case flow. This critical duration assessed for a return period (5 Year) using the standard durations run.	InfoWorks Excel	• Hydraulic Model Output	Median critical duration < 60 minutes.
5	Unknown asset data	Little or no asset data is available for the catchment; this may be because there have never been issues reported. This primarily relates to information associated with critical assets; lack of information on, for example, private sewers that might be peripheral to the catchment are not considered as imparting high vulnerability.	This is either all catchments if you take the Private Sewers Scenario, or discounting this no catchments as we have an understanding on the vast majority of assets.			We have a goof understanding of all our critical assets.
5	Only drainage system in catchment / high proportion of combined sewers	Catchment where there are no natural watercourses; water company is >80% of engineered drainage routes. *If mitigation measures have been implemented (include measures up to the end of AMP6) that manage the high vulnerability then reduce grade to 4 or 3. A lower grade is not*	Need to assess the difference between combined and storm sewer percentage within the catchment which will identify the difference between a catchment reliance on the combined system, or surface water sewers which transfer flow to a local watercourse. GIS Query of presence of EA DRN within the catchment could also support this.	InfoNet	• Sewerage Network • EA DRN Network	% Ratio of Combined Sewer to SW Sewer >80% meets threshold

		recommended as the cause of the vulnerability still exists.				
4	Sewer flooding risk from historic reported incidents	Catchment has a history of reported sewer flooding incidents; all causes to be considered. *If schemes have been put in place to manage the risks then reduce vulnerability to grade 3. If schemes have not been put in place, for whatever reason, then vulnerability still exists.*	Factored Score here is Flooding Incidents / 1000 pop. Where this is >3 score is achieved.	MapInfo	• Hydraulic Flood Risk Register	> 3 incidents /1000 pop
4	Repeated blockage risk from historic reported incidents	Catchment has a history of repeated blockages on main sewers that could reduce sewer capacity. If operational practices or other interventions (e.g. proactive jetting) have taken place to manage the risks then reduce vulnerability to grade 2. If operational practices or other interventions have not been put in place, for whatever reason, then vulnerability still exists.	Blockages Layer Interrogated for Repeats within 12 Months = YES Then remove all former S24 Sewers to classify as "MAIN SEWER" Then remove all Transferred sewers Normalise Repeats against population **>3** /1000 pop meets threshold	MapInfo	• Repeat Blockages assigned to Foul & Surface water sewers (excluding PDaS as these are not main sewers)	> 3 incidents /1000 pop

4	Urban density (high population concentration)	Catchment with significant population centres; should flooding occur then this increases the likelihood of customers being impacted. The following guideline values are suggested: high density grade 4 – greater than 55 dwellings per hectare (dw/ha); medium density grade 3 – 30-55 dw/ha; low density grade 2 – less than 30 dw/ha11. However, Companies are advised to take on board local planning authority approaches if available. Within the context of urban density consideration needs to be given to the nature of the properties/developments in the catchment e.g. high levels of basements, concentrations of blocks of flats etc., and the extent to which creep could increase surface water flows. In both cases Companies should use professional judgement in applying an appropriate grade that reflects the assessed vulnerability.	Requirement to assess modelled population against DAS Boundary. This density value can vary dramatically within a region and there will be lower level spatial units that may be required, especially in Rural and RAMPS DAZ Zones. Property Type - DWELLING from Address Point Data Queried against DAP Boundaries and dwellings/ha calculated	InfoNet	• Domestic Address Points	4 - >55 Dwellings/Ha 3 - 30-55 Dwellings/Ha 2 - <30 Dwellings/Ha

3	Proximity to sea / river level	Catchments which could be subject to tidal/fluvial locking causing sewers to back up and flood under storm conditions (link to EA flood risk maps). *If mitigation measures have been implemented (include measures up to the end of AMP6) that manages the vulnerability then reduce grade to 2 or 1.*	Look here at percentage of assets which sit within the floodplain. Geospatial Query in InfoNet. The metric does not provide a minimum or maximum, so currently the metric is assuming ANY assets at risk.	MapInfo	• EA Flood Zone 2 • Sewerage Network	>5% of Assets Length against total sewerage within the floodplain
3	Large complex networks with many dependencies	Generally large catchment with significant combined sewers and interactions with surface water drainage systems; some cross catchment flows.	Significant Combined Sewers - > 1m dia CSO / Bifurcation Count against Total Km sewerage	InfoNet	• Sewerage Network CSO Database Bifurcations Layer	>1% of Sewers are Combined >1.2m and there are >0.25 BIF/CSO /km sewer
3	Dependence on pumping	Catchment contains one or more critical pumping stations (in-catchment or terminal) where high flows could overwhelm capacity (or cause failure). Asset registers. *If mitigation measures have been implemented (include measures up to the end of AMP6) that manages the vulnerability then reduce grade to 2 or 1.*	Presence of >1 terminal pumping station within the catchment. Use sewage pumping station tracker to identify if within Additional Critical Status (Top 100) Pumping Stations to Population Count. Refined Metric with focus on Pumping Stations to Population Count.	InfoNet	• Pumping Station Tracker/ Database	>2 SPS/1000 pop

3	Proximity to water table	Catchment with known high levels of infiltration which could be exacerbated by heavy rainfall effectively reducing capacity in system to remove surface/foul flows.	WRC Guidance - Day - Night DWF Ratio >4 Is this available from MCERTS or WwTW data? Look at it as a percentage of DWF and set a threshold. Is there region wide groundwater data? WwTW Card Section 6 STW Standard Operating Procedure (SOP) Infiltration Source Detection	Excel	MCERTS - WwTW Flows. June Return Catchment DWF from Model	Day/Night Ratio >3
3	Growth potential (unplanned)	Catchments with areas known to have high demand for new housing, are economically buoyant and are highly likely to develop further. Significant risk of infill growth.	Query of available Long Term Growth Data against the catchment and identify where total growth exceeds a threshold >5%? Use available growth data with longer timescale High demand determined by a threshold of planned pop v existing population. Sewered Area Catchment Data.	MapInfo	Long Term Growth Database	Growth in DAP >5% of Total Current Population
2	Consequence of flood risk management by others	Catchment where flood management by others could cause unintended consequences.	Presence of EA Protected Areas within the catchment.	MapInfo	EA Protected Areas IUD projects	Presence of any FA Schemes in DAP Catchment

2	Growth potential (planned)	Catchments with areas known to have high demand for new housing but risks are generally known.	Query of available Short Term Growth Data against the catchment and identify where total growth exceeds a threshold >5%?	MapInfo	Short Term Growth Database	Growth in DAP >5% of Total Current Population
2	Catchments with a slow response - flat sewers and septicity	Catchments that are generally flat with a slow response.	H2S Data From Atkins Assessment - Scoring Where there is data available.	MapInfo	Septicity	% of Sewer Length Achieving a score above a threshold.
1	Where no key issues identified	Where none of the catchment vulnerabilities match and there are no alternative catchment specific vulnerabilities then the catchment is to be reported under vulnerability grade 1.	Remainder of catchments		`	Any catchment not included above.