

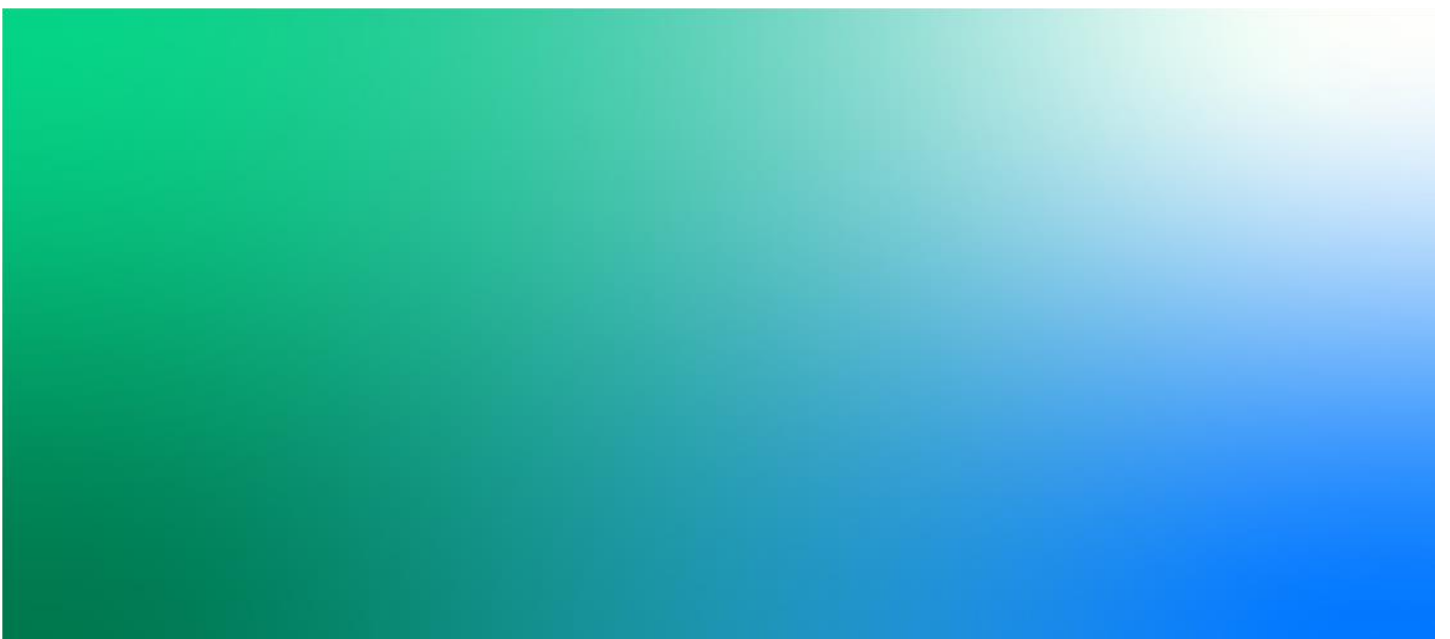


**Monkmoor STW Digesters and Sludge Tanks**

**IED Containment Assessment – Risk Identification Report**

February 2024

**Severn Trent Water Limited**



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 Client Name: Severn Trent Water Limited  
 Project Manager: Karen Chiu  
 Author: Heena Rani  
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## Document history and status

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## Contents

<b>1.</b>	<b>Site specific risks at Monkmoor STW</b> .....	<b>6</b>
1.1.	Containment Classification Assessment.....	9
<b>2.</b>	<b>Flow Paths</b> .....	<b>10</b>
2.1.	Site Characterisation.....	10
2.2.	Uncontained spill mapping and flow paths.....	13
2.3.	Assets impacted by the spill.....	14
<b>3.</b>	<b>Spill through Jetting</b> .....	<b>15</b>
3.1.	Jetting and surge flows .....	15
3.2.	Surge Flows .....	15
<b>4.</b>	<b>Flooding</b> .....	<b>16</b>
<b>5.</b>	<b>Potential Options</b> .....	<b>18</b>
<b>6.</b>	<b>Conclusions</b> .....	<b>21</b>
	<b>Appendix A. ADBA Site Hazard Risk assessment for Monkmoor STW</b> .....	<b>22</b>

## i. Background

Following initial audits by the Environment Agency (EA) in 2019 that examined the primary, secondary, and tertiary containment provisions for Severn Trent’s anaerobic digestion (AD) process and associated tanks, the EA reported *“there is no provision of secondary containment for the AD process at any of Severn Trent’s sites. Catastrophic tank failure may impact nearby receptors and the operation of adjacent sewage treatment activities”*. Jacobs was appointed to assess site risks and outline the options available for providing remote secondary containment of a catastrophic tank or digester failure across multiple Severn Trent sites. This report details the site-specific risks at Monkmoor Sewage Treatment Works (STW), the illustration of the uncontained spill event and the containment classification.

Monkmoor Sewage Treatment works is in the north-east region of Shrewsbury. The River Severn lies on the north, east and south sides of the site and the A49 lies on the east side. The boundary of the site has fields on the north and east sides and housing on the south and west sides. Figure i i shows an aerial view of the site in the context of its nearby surroundings. An initial visit to Monkmoor Sewage Treatment Works occurred for the purpose of site assessment and data collection.



**Figure i i Satellite view of Monkmoor Sewage Treatment Works**

This document precedes ‘Monkmoor STW Digesters and Sludge Tanks, IED Containment Assessment- Option and Recommendations Report, revision 1.1’ and informs the containment classification required. This report outlines the options to contain a spill from the tanks within the IED permit boundary.

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**Chapter 1** outlines the site-specific risks at Monkmoor STW for sludge holding and digestion assets and discusses the CIRIA/ ADBA containment classification assessment.

**Chapter 2** describes the site contouring, derivation of overland flow paths and any significant sludge holding tanks.

**Chapter 3** analyses the spill mapping for the Digester Area that was achieved using ArcGIS and ArcPy coding of LiDAR data and digital topographic imagery.

**Chapter 4** discusses the risks to the site from external flooding.

**Chapter 5** discusses the potential options of sludge containment.

**Chapter 6** presents the main conclusions of this assessment.

**Appendix A** presents the ADBA site hazard risk assessment completed for this site.

## 1. Site specific risks at Monkmoor STW

To model the event of a credible and catastrophic tank failure resulting in loss of containment of sludge at Monkmoor STW, the assets on site must be evaluated to identify the most hazardous failure events.

The principal sludge holding and digestion tank at Monkmoor STW is as detailed below:

- 3 Digesters in concrete construction with capacity of 1,431 m<sup>3</sup>, 1476 m<sup>3</sup> and 1,479 m<sup>3</sup>.
- 4 Pathogen Kill Tanks (PKTs) in steel construction each with 1800 m<sup>3</sup> capacity.
- 1 Pre Digestion Blending tank in steel construction of 400m<sup>3</sup> capacity.
- 1 Crude belt feed tank in steel construction with 150 m<sup>3</sup> capacity.
- 1 Import Sludge Tank in steel construction with 50 m<sup>3</sup> capacity.
- 1 SAS Belt feed tank in steel construction with 150 m<sup>3</sup> capacity, but this tank has not been included in the calculations because it contains unthickened sludge.

In addition to the tanks considered in the risk report, there are also:

- 5 Storage Tanks of brick construction with 495 m<sup>3</sup> capacity. These tanks are rectangular and subsurface.
- 3 Trade Waste Import Tanks of brick construction with 161 m<sup>3</sup> capacity. These tanks are rectangular and subsurface.

As these tanks are all subsurface, they are not considered further in this report.

For clarity, in each case, the capacities above are the total tank capacity, i.e., the maximum volume a particular tank could hold. In practice, the operational volumes are less due to freeboard and headspace, but the maximum volume is used to represent worst case scenario.

The plan in Figure 1.1 below indicates the boundary of the permitted IED area and the assets contained within.



Figure 1.1 Boundary of the permitted IED area and the assets contained in Monkmoor STW.

The site-specific risk factors that were identified at Monkmoor STW are as follows:

- The total digester volume onsite and the number of large tanks and their individual tank capacities.
- Groundwater vulnerability is ranked as “Medium-High”, information retrieved from Ground Water Vulnerability Map.
- The River Severn is situated to the north boundary of the site. The distance between the IED permitted area and River Severn is within 370m in the north direction of the site.
- Proximity to Monkmoor Road– the site is within 230m of this road.
- There are residential dwellings within 150m of the site to the west, business units are located to the north within 180m and to the north-west within 160m.
- Old River Bed, Shrewsbury is a Site of Special Scientific Interest located within 2.02 Km to the west of the site and Rea Brook Valley which is a Local Nature Reserves located within 2.41 Km to the south of the site.

**Table 1.1 Designated site review**

Site Name	Designation	Distance	Direction
Old River Bed Shrewsbury	SSSI	2200m	West
Hencott Pool	SSSI	2610m	West
Midland Meres & Mosses Phase 2	Ramsar	4170m	West
Rea Brook Valley	LNR	2200m	South

Abbreviations: LNR – Local Nature Reserves. SSSI – Site of Specific Scientific Interest  
(Table 1.1 Reference: MAGIC.gov.uk website, accessed in April 2023)

For habitat sites, the relevant distance for consideration are: International designations (SAC, MPA, SPA and Ramsar - 10km); National designations (SSSI – 2km); Nature reserves and ancient woodland (2km). (Reference: Environment Agency pre-application conservation and screening report issued March 2023).



## 1.1. Containment Classification Assessment

CIRIA C736 states how the site hazard rating and, the site risk and classification are to be calculated. The ADBA risk assessment tool was used and is attached in Appendix 1. A summary of the hazard risks for Monkmoor STW are as follows:

Source – There is a source that has been identified:

1. Domestic and trade effluent Wastewater sludges, both in a raw, semi treated and treated state.

The Source Hazard rating was determined as **High**.

Pathway – There are four pathways that have been identified:

1. The process and site drains take any liquid to the head of the works which would negatively impact the process stability on site and would eventually impact on the receiving watercourse within 1 minute of a spill.
2. The Groundwater Vulnerability is classified as Medium- High according to Ground Water Vulnerability Map.
3. There are a number of areas where a sludge spill could pass over permeable ground.
4. The site inclines from West to East, towards River Severn.

The Pathway Hazard rating was determined as **High**.

Receptor – There are two receptors that have been identified:

1. Residential area is within 150m of the site.
2. Business units are within 160m from the site.

The Receptor Hazard rating was determined as **High**.

### Likelihood

A review was completed with Severn Trent Bioresources staff and the likelihood for mitigated and unmitigated risks were calculated. The probabilities outlined in CIRIA C736 section 2.5, table 2.3 were used. Scoring was completed on the basis of a loss of containment which was not necessarily a total loss through a catastrophic failure but could in fact be a partial loss through a leak of minor spillage.

Pre-mitigation measures, operational failures were highlighted as a high risk, shortfalls in design (provision of alarms and monitoring) together with structural failure were highlighted as a medium risk also.

Following the implementation of post-mitigation measures the risk was scored as **Low**.

The final Likelihood Hazard rating was determined as **Low**.

Based on the information above the overall site risk rating was calculated to be high which means that class 2 secondary containment is required.

<u>Source Risk</u>	<u>Pathway Risk</u>	<u>Receptor Risk</u>	<u>Site Hazard Rating</u>	<u>Likelihood</u>	<u>Overall Site Risk Rating</u>
High	High	High	High	Low	Medium (Class 2)

## 2. Flow Paths

### 2.1. Site Characterisation

To understand the topography of the site, open-source LiDAR (Light detection and ranging) imaging data from the Environment Agency (EA) National LiDAR Programme, was utilised. This dataset was captured aurally and used to accurately measure the terrain or objects on the surface using a series of laser pulses on 1m pulse laser beam intervals and 1km grid tiles across the whole site. ArcGIS 10.8.1 modelling software was used to analyse LiDAR Digital Surface Model (DSM)/Digital Terrain Model (DTM) and formulate coloured hill shading and contour models. There are several products available as part of this programme, this project has utilised the DSM (Digital Surface Model) and DTM (Digital Terrain Model) alongside aerial imagery. The DSM was used with aerial imagery to locate any buildings or tanks within the site so these could be removed from the process. The 1m resolution DTM uses the last return of the LiDAR pulse, classified as the ground, and as part of the EA National Programme has been manually filtered to improve accuracy of the ground model.

The DTM was observed for the entire site as shown in Figure 2.1 DTM model for Monkmoor STW shows that the site gradually slopes from west to east. Higher elevation is to the upper west of the site, reaching 55.35mAOD. The central area is relatively around 51.75mAOD high with some lower area to the east side reaching 48.16mAOD.

Figure 2.2 shows the site annotated with Sludge thickener building, sludge blending tank, digestion tanks, PSTs, SAS tank, Sludge import tanks, Storm tanks, PKTs, Leachate Tanks, FSTs and ASPs.

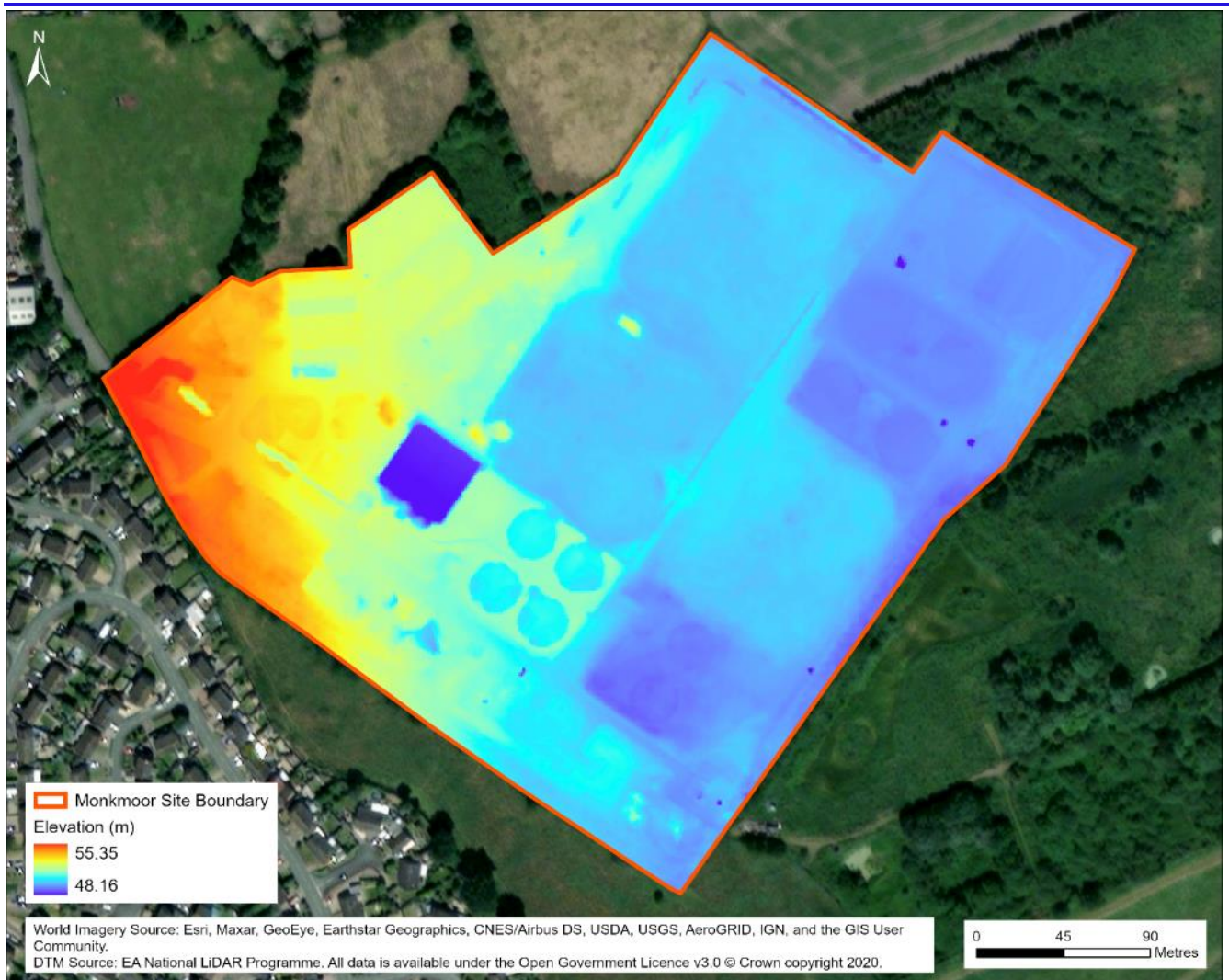


Figure 2.1 DEM/DTM imagery of Monkmoor Sewage Treatment Works Site



Figure 2.2 Labelled image of Monkmoor Sewage Treatment Works

## 2.2. Uncontained spill mapping and flow paths

In order to demonstrate the location of the flow paths and the area sludge is deposited to following the catastrophic failure of sludge tank(s) onsite, uncontained flood mapping has been completed utilising Flood modeller software.

This modelling has been completed using a spill volume of 2989 m<sup>3</sup>, which is 25% of all above ground sludge assets in the containment area. This value is larger than 110% of the largest sludge asset volume onsite.

Figure 2.3 below indicate the pathway and depths of sludge applicable to Monkmoor STW. The sludge asset where spill originated is indicated on the models.

### Modelling limitations

The software models the spill using a single density, a modelling tool is not available that can model all the variables associated with sludge storage and sludge spill i.e. Sludge density in the tank will vary from day to day, sludge density will be different at different levels in the tank and again different every day, it is likely that solids separation will occur in the area closest to the spill, but again this is variable depending upon the velocity of the liquid and the variability of the surface the sludge is travelling over.

Hydraulic modelling has been used to assess the uncontained spill following a catastrophic failure of the largest digester tank within the site. The 2D model generated uses the TUFLOW software package (Version 2020-10-AC), which can be used for simulating depth-averaged, one and two-dimensional free-surface flows exhibited with floods and tides. TUFLOW's implicit 2D solver, solves the full two-dimensional, depth averaged, momentum and continuity equations for free-surface flow using a 2nd order semi-implicit matrix over a regular grid of square elements. Furthermore, it includes the viscosity or sub-grid scale turbulence term that other mainstream software omit.

The DTM used in the model was of 1m resolution and the footprints of buildings and tanks were omitted from the model. The dimensions of the tank were used to calculate a constant flow of liquid in all directions from the circumference until it was emptied. Areas with different roughness coefficients were delineated using aerial imagery e.g., liquid would flow more easily over roads and paths than vegetated ground. The model outputs are 2m resolution with a timestep of one second. The model was run until the liquid front was no longer moving. Default parameters were used in the simulation and the model was stable with a mass balance error below the acceptable 1%.



**Figure 2.3 Uncontrolled spill of Monkmoor Sewage Treatment Works**

### 2.3. Assets impacted by the spill

In the event of a spill event on site at Monkmoor Sewage Treatment Works, the assets that will be impacted are the four digesters, the four Pathogen Kill Tanks, Leachate tanks, FSTs and ASPs, as seen in Figure 2.3.

The sludge spill mapping of an uncontained event in Monkmoor STW (Figure 2.3) showed that a potential sludge spill from two pathogen kill tanks will not be contained within the site and therefore passive containment needs to be implemented to safeguard the nearby receptors. According to the model, the spill will leave the site boundary (in the north site boundary) in approximately 1 minute following failure of the tanks.

The spillage would run partially to the east side in the site and run towards the FSTs, ASPs and fields. The rest would flow towards the north side of the site into the surrounding private fields and to Monkmoor Road.

## 3. Spill through Jetting

### 3.1. Jetting and surge flows

In addition to analysis of spill maps for the areas, jetting effects should also be considered to understand flow paths for a potential spill. Jetting is the phenomenon whereby the failure of a tank through rupture or corrosion results in the escape of a jet of liquid with sufficient force causing projection out of the tank.

In the instance that tanks lie near the boundary of the containment areas discussed in the chapter, jetting may have implications on where spills accumulate. The surrounding area of the tanks, where the spill could accumulate is the impermeable area, if the sludge assembles outside the bund the sludge will penetrate the permeable area. Both the digesters and containment tanks lie near the area boundaries.

Figure 3.1 below details the method for determining the necessary height and distance of a bund wall from a given tank to prevent jetting.

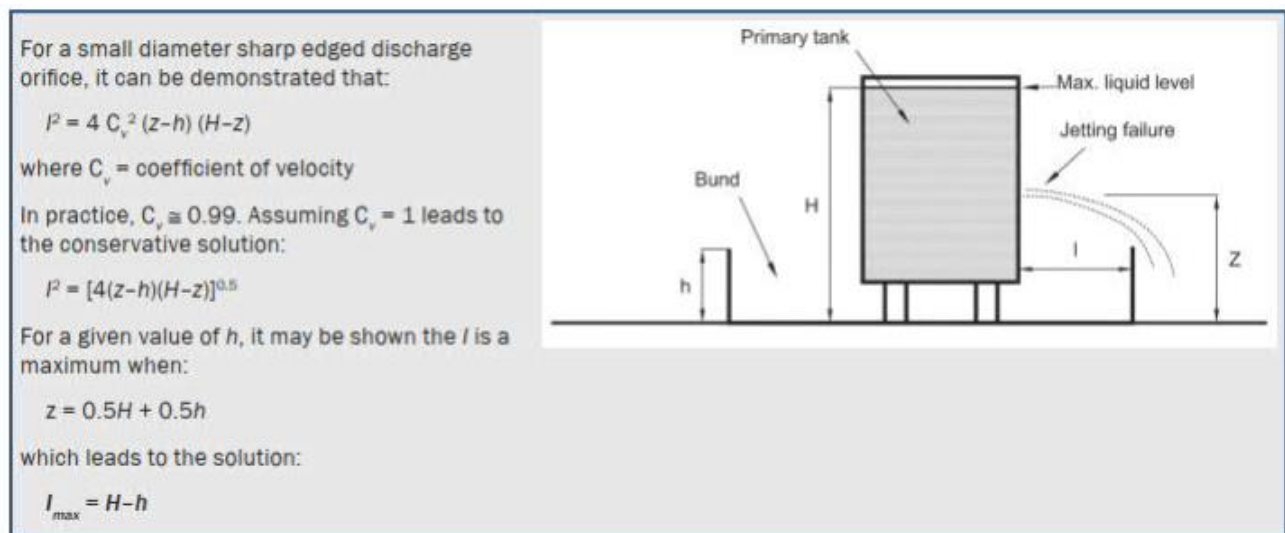


Figure 3.1 Extract for tank jetting consideration, *CIRIA guidance document C736 (Containment systems for the prevention of pollution – Secondary, tertiary, and other measures for industrial and commercial premises, 2014)*

### 3.2. Surge Flows

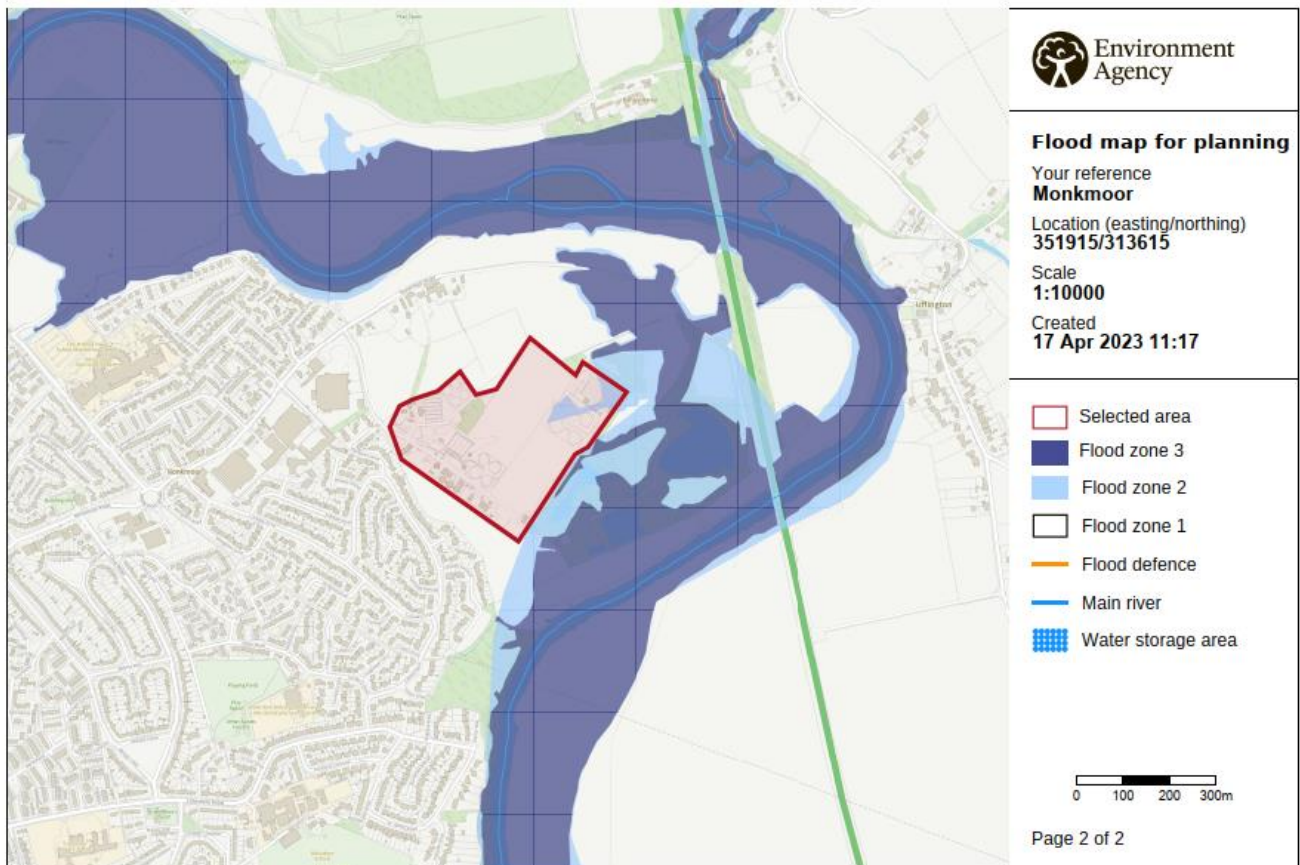
Surge effects of a catastrophic failure of the primary storage vessel will be considered in the design of the containment solution. This will consider the distance of the tanks from the bund walls and also the profile of the bund structure.

The surge allowance requirements (in the absence of detailed analysis) for different type of bund/containment structure are detailed in Table 4.7 of CIRIA C736.

- In situ reinforced concrete and blockwork bunds – 250mm surge allowance.
- Secondary containment tanks – 250mm surge allowance.
- Earthwork bunds – 750mm surge allowance.

## 4. Flooding

According to the UK Government's Flood Map for Planning, Majority of the Monkmoor STW is most in Flood Zone 1 as shown in Figure 4.1. The Flood Zone definitions listed in Table 4.1 provide additional detail of the areas of concern, which in the case of Monkmoor STW, have less than 1 in 1000 annual probability of river flooding. Given that the probability of flooding in most of the site area is low, further mitigation measures are not required. Additionally, in the Flood Risk Vulnerability Classification, sewage works are classified as 'less vulnerable,' if adequate measures to control pollution and manage sewage during flooding events are in place.



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**Figure 4.1 Extent of Fluvial flooding due to extreme weather events**



**Table 4.1 Flood Zone Definitions from GOV.UK Flood Map for Planning**

<b>Flood Zone</b>	<b>Definition</b>
Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding.(Land shown in dark blue on the Flood Map)

## 5. Potential Options

There are several options which need to be considered as part of the optioneering to deliver containment at the Sludge Treatment Centre. This optioneering has not yet been carried out and hence some of the proposed options may not be appropriate for the site on a cost, engineering, space or practicality basis.

Some of these options are applicable across a number of sites, while others are site and location specific. It is possible that more than option may be appropriate at a single site, on an asset specific basis, rather than using a single concept at the site.

If any of the incoming power supply and combustion assets are impacted by a potential spill which would impact on their ability to function, Severn Trent will seek to either re-locate or protect them with a specific containment solution

The high-level containment options are tabulated below, followed by an overview of some of the options, with regards to their practicality at the specific site. Some options may not relate to specific tanks but involve the movement of other assets such as pumps, pipework or the biogas systems to minimise the risk of damage to these in the event of a spill. This may involve relocating assets or raising them above their current level, which may alter available volumes close to tanks impacting upon bunding requirements with regards to location and height.

**Table 5.1 Potential Option of containment**

High Level Option	Details	Scope	Applicability
Replacement of tanks	Existing tanks replaced by assets which are double skinned or integrally banded.	May apply to all tanks or a subset of tanks	Will depend upon the assessed current asset lifespan. Integral bunding practicality may be influenced by tank volume
Resizing of tanks	Resizing of existing tanks to reduce either the overall number of tanks, or potential volume in a containment failure scenario	May apply to all tanks or a subset of tanks	Will depend upon the assessed current asset lifespan. May increase overall number of tanks on site. May reduce site resilience due to reduced storage volumes
Installation of tank farm bunding	Bunding of tanks on either an individual basis or for a group of closely spaced tanks	May apply to all tanks or a subset of all tanks	May be used on all tanks, however, likely to involve changes to existing pipe runs and pumping requirements, to reduce the requirement for bund penetrations by pipes. May impact on access to individual tanks For some assets, may lead to potential confined space or DSEAR concerns

High Level Option	Details	Scope	Applicability
Use of Tertiary containment	Remote bunding of tanks, which may include use of existing assets to capture spillages, such as roadways or open space	May apply to all tanks or a subset of all tanks	Likely to be applicable to all sites. However, may lead to increased requirement for impermeable surfacing to reduce infiltration in designated spill containment areas. Will depend on existing site infrastructure and may lead to land sterilisation issues
Installation of increased diameter drains and wet wells	Installation of increased diameter drainage locally to capture more of a spillage, linked to wet wells to hold spillages, prior to return to works inlet	May be possible for some tanks but will depending on existing drainage infrastructure.	May be applicable for single or multiple tanks, but the larger the covered area, the greater the potential volume needed to account for rainwater May be limited in use due to ground conditions and subsurface asset locations May have carbon related impacts due to increase in pumping requirements
Construction of sumps	Construction of engineered, sealed, sumps, to increase storage capacity locally in the event of a loss of containment	May be possible for some tanks, but likely to only have potential for a limited storage volume	Likely to be applicable mainly for smaller tanks May be limited in use due to ground conditions and subsurface asset locations May create confined spaces or raise DSEAR concerns.
Tank construction	Change to asset standards to reduce the potential risk of tank failure	May apply to tanks if they are being replaced	Will not remove need for containment, but may alter the failure mode, impacting on the speed of a spillage occurring and volume involved. Potential carbon related impacts
Process changes	Changes to process technology and techniques to reduce the requirement for post digestion storage duration to achieve the required pathogen kill level	Applicable to sites without advanced digestion techniques	May reduce to the overall volume of sludge stored reducing containment requirements. However, may increase dewatering requirements and

High Level Option	Details	Scope	Applicability
			<p>associated storage volumes</p> <p>May have wider impact on works, such as changes to gas yield or requirement for liquor treatment</p>
Movement or raising of ancillary assets	Movement of assets such as pumps, pipework and the biogas system in order to raise it above the potential spill level local to those assets.	All assets which may be impacted by a sludge spillage within the spill mapped area	<p>Applicable to all assets which may be impacted by a loss of containment.</p> <p>May involve raising levels locally through installation of plinths or similar, altering the existing spill mapping.</p> <p>May have carbon related impacts due to increase in pumping requirements</p>
Site closure	Closure of sludge assets, with transfer of sludge to alternative treatment location	<p>Would apply to all permitted assets.</p> <p>Likely to only be applicable at treatment centres with lower throughputs</p>	<p>Will depend upon the assessed current asset lifespan.</p> <p>Requires sufficient capacity at alternative treatment location</p> <p>Potential for carbon impact due to transfer of sludge</p>

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## 6. Conclusions

This section summarises the findings of the site assessment at Monkmoor STW for event of a credible failure of a sludge holding tank.

Sludge spill mapping was undertaken for an event of an uncontained sludge spill which showed that the spill will not be self-contained within the site. According to the model the spill would leave site after 1 minute and run to the fields to the north of the site but the spill has low possibility to reach the nearby watercourse.

A hazard risk assessment was carried out for the site. A site hazard rating was calculated to be high, with the likelihood of a spillage being classed as low. Based on these risks an overall site risk rating was determined to be medium, meaning that class 2 containment is required.

In addition to analysis of spill maps for the areas, jetting effects should also be considered to understand flow paths for a potential spill. In the instance that tanks lie near the boundary of the containment areas, jetting may have implications on where spills accumulate.

The majority of the site is in Flood Zone 1 according to the UK Government's Flood Map for Planning and therefore additional measures for flooding are not required.

Digital terrain models generated show the topography of the site and identify low point where sludge spills would collect on site, or flow to the north into the fields. The Pathogen kill tanks and Digesters were subsequently identified as areas of interest to perform spill mapping. The uncontained sludge spill modelling shows that a potential digester failure spill will leave the site boundaries and impact on surrounding fields.

In the instance of a credible failure scenario at Monkmoor STW, to prevent sludge from spreading into the fields and to prevent sludge possibly entering the ground water, the provision of a secondary containment system should be considered.

## Appendix A. ADBA Site Hazard Risk assessment for Monkmoor STW

Material	Physical properties	Quantity	Units	Storage	Flammability	Corrosive	Ecotoxicity (based on LD and quantity)	Environmental hazard rating	Justification
<b>Feedstock</b>									
<b>Process</b>									
Digestate (fermenter)	Liquid	< 1000	m3	Covered Tank or lagoon				H	Based on latest aquatic toxicity results from REA
	Liquid	1000 < X < 5000	m3	Covered Tank or lagoon				H	Based on latest aquatic toxicity results from REA
Separated digestate solids	Cake			Concrete pad				M	Largely immobile therefore presents only a medium risk.
Separated digestate liquid	Liquid			Covered tank				H	
							Process Overall Rating	H	Justification: Three Digesters; Four Pathogen Kill Tanks; One Pre-digestion Blending Tank; One SAS belt feed tank; One Crude Belt Feed Tank; One Import sludge tank with total capacity 12336
<b>Additives and site chemicals</b>									
Ferric Chloride	Liquid	1	IBC	IBC	Not flammable	No	Medium	M	Not present
Glycol	Liquid	1	IBC	IBC	Not flammable	No	Low	L	Not present
Cleaning products	Liquid	1	IBC	Consumables container	Not flammable	No	Low	L	Not present
Lab consumables	Liquid	20	litres	Consumables container	Not flammable	No	Low	L	Not present
							Chemicals Overall Rating	L	
<b>Fire fighting agents and cooling water spillages</b>									
Fire Fighting Agents harmful in their own right or contaminated by inventory	Liquid	>25	m3	NA	Not flammable	No	Low	L	Not present
Fire fighting and cooling water contaminated by inventory	Liquid	>25	m3	NA	Not flammable	No	Low	L	Not present
							Spillages Overall Rating	L	All the hazards are "Low" therefore the overall rating is low
							Sources Overall Hazard Rating	H	Justification: Digesters, Pathogen Kill Tanks, Pre-digestion Blending Tank, SAS belt feed tank, Crude Belt Feed Tank, Import sludge tank are present on site.

Pathway - the route from primary containment to receptor	Environmental hazard rating	Notes
<b>Site layout and drainage</b>		
If any of the site inventory has a runoff time of a few minutes...	H	Sludge would reach head of of work within 1 minute.
If any of the site inventory has a runoff time of a few hours....	H	Not applicable
If any of the site inventory has a runoff time of a few days...	M	Not applicable
If any of the site inventory has a runoff time of a few weeks...	L	Not applicable
<b>Topography, geology and hydrology</b>		
Site is raised above a nearby receptor	H	Site slopes from West to East therefore is raised above River Severn.
Chalk	H	According to the British Geological Survey the site is not in the chalk aquifer area.
Fractured chalk	H	Not applicable
Principal Aquifer	H	Aquifer of Secondary A type is present in this location.
Groundwater protection zone 1	H	Groundwater Vulnerability is Medium- High risk with soluble rock according to Ground Water Vulnerability Map.
None apply	L	Not applicable
<b>Mitigation - do these apply?</b>		
If a secondary containment system is present...	L	Not present at the moment
If the rain water drainage system in the secondary containment fails safe...	L	Not applicable
	Path & Mitigation Overall Rating	H
		Justification: Sludge would reach head of of work within a minute.
<b>Climatic conditions</b>		
Annual rainfall < 1000 mm	L	Annual Rainfall within 684.98 mm - 809.9 mm
Annual rainfall > 1000 mm	M	Not applicable
Snow accumulation is possible	M	Yes
<b>Fire Fighting Water</b>		
Inflammable materials normally present on site in large quantities?	M	Not applicable.
<b>Location</b>		
Site is in a flood plain	H	IED permitted area is in Flood Zone 1.
Site is at bottom of a hill	M	The site inclines from West to East, towards River Severn.
Site is connected to a sewage treatment works	M	IED permitted is connected to sewage treatment works.
	Site Considerations Overall Rating	M
		Justification : The site inclines from West to East, towards River Severn.
	Pathway Overall Hazard Rating	H
		Justification: Runoff time to the head of the work in 1 minute.

Receptors	Within	units					Environmental hazard rating	Notes	
<b>Watercourses and bodies</b>									
Rivers above potable water supplies	100	m					H	River Severn is within 200m from the IED permitted Zone.	
Aquifers used for public supply	150	m					M	Aquifer of Secondary type A is present at this location.	
High quality waters	1000	m					H	Not applicable	
Agricultural abstraction points	50	m					M	No Agricultural abstraction identified via desktop analysis	
High value ecosystems	1000	m					M	Site of Special Scientific Interest and Local Nature Reserves are 2000m away from this STW.	
Recreational waters	50	m					M	Not applicable	
Small treatment works	50	m					M	Not applicable	
None of the above							L	Not applicable	
							Water Overall Rating	L	Justification: The site is not near these.
<b>Habitation</b>									
Dwelling	Within 250	m					H	Housing is within 150m from the Sewage Treatment works.	
Dwelling	251-500	m					M	Not applicable	
Workplace	Within 250	m					M	Shrewsbury Business units are within 160m from the site.	
None of the above							L	Not applicable	
							Habitation Overall Rating	H	Justification: housing is within 150m from the Sewage Treatment work.
<b>Other</b>									
SSSI/SPA/SAC	1000	m					M	Old River Bed SSSI 2050m; Hencott Pool SSSI 2610m;	
RAMSAR Site	1000	m					M	Midland Mere s & Mosses Phase 2 RAMSAR 4170m;	
None of the above							L	Rea Brock Valley LNR 2200m;	
							Other Overall Rating	L	Justification: SSSI and LNR sites are located up to 2.2 km from the STW.
							Receptors Overall Hazard Rating	H	Justification: Housing is within 150m from the Sewage Treatment works.

## Calculated hazard ratings:



Source	Pathway	Receptor	Site Hazard Rating
H	H	H	High

Possible Combination			Site Hazard Rating
L	L	L	Low
<b>M</b>	M	L	Low
H	L	L	Low
M	M	M	Medium
H	M	L	Medium
H	H	L	Medium
H	M	M	High
H	H	M	High
H	H	H	High

Risk #	Description of Risk	UNMITIGATED LIKELIHOOD	Mitigation applied	MITIGATED LIKELIHOOD	Low	Site Overall Likelihood
1	Operational failures, such as failure of plant, or human failure by operators	H	Annual HAZOPs and operator training	L		
2	Shortfalls in design – lack of alarms and fail-safe devices	M	Pre-construction HAZOP identified measures - see P&IDs	L		
3	Structural failure – materials, components, detailing, corrosion or when exposed to heat and flame	M	Inspection of vessels, asset management	L		
4	Abuse – inappropriate change of use or other misuse	L		L		
5	Impact, eg from a vehicle	L	Armco barriers and concrete bollards installed	L		
6	Vandalism, terrorism, force majeure etc	L		L		
7	Fire or explosion	L		L		
8	Geological factors -subsidence etc	L		L		
9	Ageing or deteriorating assets/sub-components.	M	Inspection of vessels, asset management	L		
10	Lightning strike	L		L		

Site Hazard Rating	Likelihood	Overall Site Risk Rating	Indicated Class of Secondary Containment Required
High	Low	Medium	Class 2