

## Strongford Digesters and Sludge Tank IED Containment Assessment - Proposed Options Report

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Severn Trent Water

Severn Trent IED Containment Studies  
19 December 2023



## Strongford Digesters and Sludge Tank IED Containment Assessment - Proposed Options Report

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## Executive summary

Strongford STW is located south of Stoke-on-Trent in Trentham, the River Trent lies on the west side of site and is surrounded by fields on all other sides, as seen in Figure i. An initial visit to Strongford Sewage Treatment Works occurred for the purpose of site assessment and data collection.

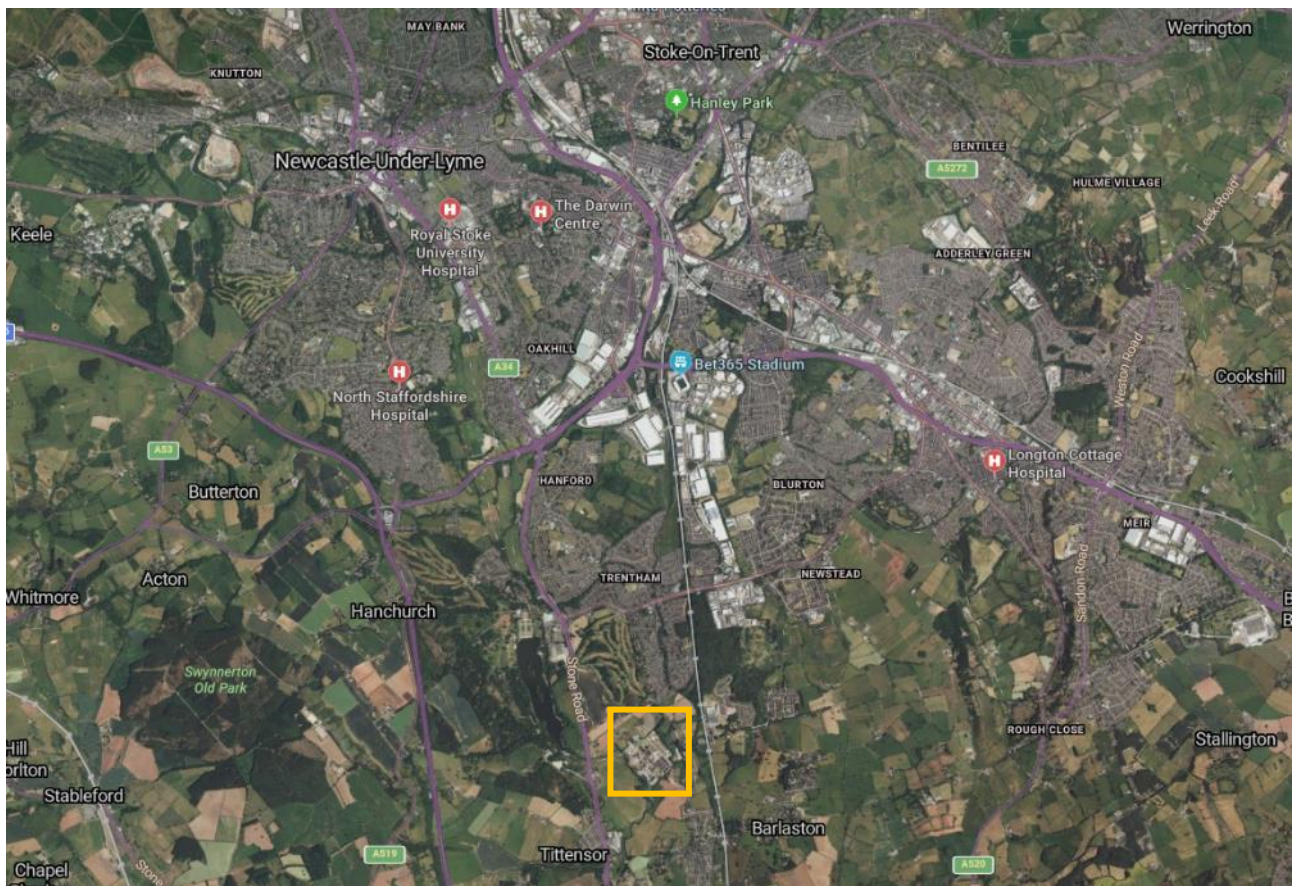


Figure i – Aerial imagery of Strongford Sewage Treatment Works

The secondary containment has been based on the following design parameters:

- Risk Report Identified that class 2 containment is required.
- The secondary containment volume required for the for the digester area is 4,390 m<sup>3</sup> and is derived from 25% of the total sludge asset stock volume.
- The secondary containment volume required for the for the digested sludge storage tank area is 3,744m<sup>3</sup> and is derived from the point of spill plus rainfall.
- The containment recovery period is 48 hours, a 3-day 1 in 10-year event has been used for rainfall.

There is a single technical solution for each area. Containment is provided to the digester area in the form of containment walls, flow guiding walls, ramps and a flood gate. Due to the topography and the development on the site there is no other viable solution to eliminate the flood gate. See figure ii overleaf. Containment in the sludge storage area is provided with containment walls and a flood gate. Consideration of utilising the cake pad area was given, however due to the maximum utilisation of the cake pad area, there would not be sufficient area to reduce the spill depth to remove the need for a flood gate see figure iii.

# Strongford Digesters and Sludge Tank IED Containment Assessment - Proposed Options Report



Figure ii – recommended solution for the digester area



Figure iii – recommended solution for the sludge storage tank area

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 were 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. Based on CIRIA C736 and ADBA risk assessment tools this containment report addresses the site-specific risks at Strongford Sewage Treatment Works (STW) and outlines the options available for providing remote secondary containment in the event of a catastrophic tank or digester failure.

This document follows 'Strongford Digesters and Sludge Tanks, IED Containment Assessment-Risk Report, revision 1.0' which outlines the impact of an uncontained spill and the risk assessment completed and contains a complete tank list inventory for the IED permit area.

**Chapter 1** provides an overview of the differing options for containment as outlined in CIRIA guidance document C736 (Containment systems for the prevention of pollution – Secondary, tertiary, and other measures for industrial and commercial premises, 2014) and the importance of this work at Strongford STW.

**Chapter 2** details the loss of stock and rainfall components to identify the containment volume required.

**Chapter 3** details the recommended options to provide remote secondary containment considering containment and transfer areas for each area investigated and discusses the optimal option at the Strongford site.

**Chapter 4** evaluates the surface water site drainage. Automated isolation valves linked to level indicators in the tanks are discussed to prevent shock loadings from being returned to the head of the works or sludge discharging into the river in the event of sludge tank failure.

**Chapter 5** addresses the site-specific risks identified in Strongford IED Containment Assessment- Risk Identification Report, namely jetting and fluvial flooding.

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

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

**Appendix B** presents the Site Surfacing Plan for this site.

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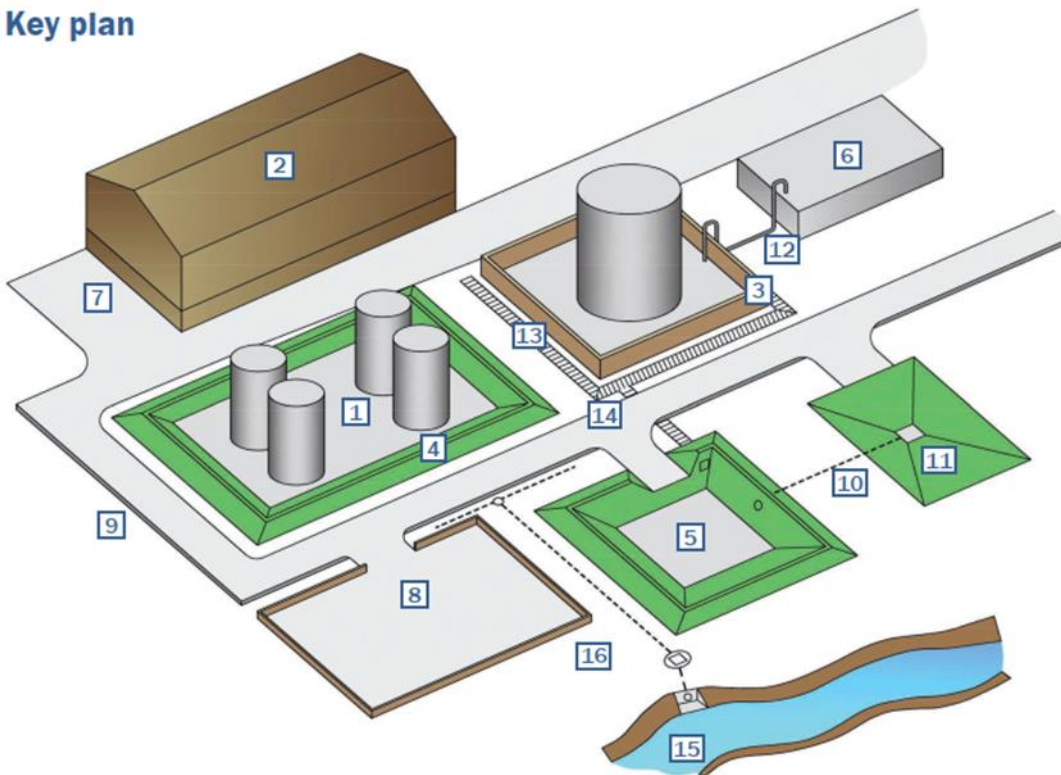
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# 1. Proposed Containment at Strongford

## 1.1 CIRIA C736

CIRIA guidance document C736 (*Containment systems for the prevention of pollution – Secondary, tertiary and other measures for industrial and commercial premises, 2014*) describes various options for containment of spillages from a credible failure scenario. It makes reference to a key plan, reproduced below:

### Key plan



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CIRIA, C736

Figure 1.1 - Diagram of primary, secondary, and tertiary containment examples

-**Primary containment** is provided by the actual tank or vessel [1]

-**Secondary containment** is provided by a bund immediately surrounding the primary vessel e.g. [3] and [4], or by a lagoon [5] or tank [6]. If containment is provided away from the primary vessels this is known as **remote containment** and may be considered as either **remote secondary** or **tertiary containment**.

-**Tertiary containment** can be provided by a number of means including lagoons [5], or impermeable areas such as car parks [8]. Roadways with high kerbing of sufficient height [9] can also form part of a tertiary containment system, or the **transfer system** to the remote containment.

-The distinction between remote *secondary* and *tertiary* containment is not always clear but, if properly designed, a combined system can be provided that is capable of providing the necessary degree of environmental protection.

The overriding concern is not the terminology but the robustness and reliability of the system which depends on a number of factors such as:

- Its complexity – the more there is to go wrong, the greater the risk. Passive systems relying solely on gravity are more reliable than pumped.
- Whether manual intervention is relied on to make the system work or whether the system can be automated to include fail-safes and interlocks.
- The ease of maintenance and monitoring of the system’s integrity, and repair of any defects.

During and after an incident any rainfall runoff from the remote secondary storage areas, from the spillage catchment areas and from the transfer systems must also be prevented from reaching any outfall(s) to surface water by closure of control valve(s).

## 1.2 Site specific risks at Strongford STW

Based on the use of the ADBA risk assessment, considering the source, pathway and receptor risk Strongford STW site hazard rating is deemed to be high. When considering the mitigated likelihood as low a 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)

## 1.3 Objectives of remote secondary containment

The objectives of the remote secondary containment measures proposed in this report are to safely contain spillages from credible failure scenarios and prevent them from:

- escaping off site
- entering surface waters
- percolating into groundwater
- being pumped back to the inlet of the sewage works in an uncontrolled manner.

The remote secondary containment will be provided by maximising the use of existing impermeable surfaced areas to provide a fail-safe passive system that relies on gravity rather than pumps. A means of leak detection that will automatically trigger isolation valves at key locations in the drainage system is also proposed.

## 2. Loss of Stock from Failure Scenario

In the Schedule 5 Notice dated Nov 2022, the EA has provided guidance on the failure scenarios to be modelled to assess the impact of catastrophic failure of sludge asset(s) within the IED permit boundary. The guidance stated, 'assessment of the impact of spill volumes using 110% of the largest tank or 25% of all tanks within a bunded area (whichever is greater)'. Contained spill volumes for containment areas have therefore been selected as the greater of 110% of the largest tank or 25% of all tanks within a bunded area or a credible spill volume (largest tank volume plus rainfall).

It was also later clarified with the EA that the total volume of sludge assets to be considered includes only above ground volumes of the assets.

### 2.1 Design allowance for rainfall

In addition to the maximum volume arising from a credible failure scenario, extra allowance for rainfall that may accumulate within the contained area before and after an incident has been made. The CIRIA guidance recommends that the containment volume should include an allowance for the total rainfall accumulated in response to a 1 in 10-year return period events for the 24 hours preceding an incident and for an eight-day period following an incident, *or other time periods as dictated by a site-specific assessment*. Given that Strongford STW is a large, manned wastewater works with ready access to pumps and tankers, and with a (controlled) disposal route via the wastewater treatment system being available, it is considered unlikely that even a catastrophic spillage would take more than 48 hours to be pumped and drained away, therefore a 3-day event period has been selected. The average 72 hours rainfall depths for a 1 in 10-year storm for Strongford STW is 61.0 mm. It should be noted that the rainfall depths for Strongford STW have been estimated using the depth-duration-frequency rainfall model contained on the *Flood Estimation Handbook* (FEH 13), which provides location specific rainfall totals for given durations and return periods.

### 2.2 Total Design Containment Volume

The containment solution for the digester area considers a spill volume of 4,390 m<sup>3</sup> – this is the 25% of total tank inventory. This is larger than the credible spill volume 3,995 m<sup>3</sup> (which considers an 19,400 m<sup>2</sup> catchment area with 61.0mm rainwater, the total design containment volume comprises 2,812m<sup>3</sup> from catastrophic tank failure, and 1,183 m<sup>3</sup> from rainfall) and larger than the 110% of the largest tank (3,093 m<sup>3</sup>).

The containment option for the sludge storage tank area considers a spill volume of 3,744 m<sup>3</sup> which is the credible spill volume which considers a 9,050m<sup>2</sup> catchment area for the Primary digesters with 61mm rainwater, the total design containment volume comprises 3,192m<sup>3</sup> from catastrophic tank failure, and 552m<sup>3</sup> from rainfall. This is higher than the 110% of the largest tank (3,511m<sup>3</sup>) and 25% of the total tank inventory (1,596m<sup>3</sup>).

### 3. Remote Secondary Containment

#### 3.1 The Containment Area

##### 3.1.1 Topography

Figure 3.1 below and Figure 3.2 overleaf shows the topography of the areas containing the sludge assets at Strongford. The topography of the digester area shows a high point in the central area with a fall towards the boundary with the final effluent channel. The topography of the sludge digester area shows the tank within the embanked area, and with the rest of the area relatively level.

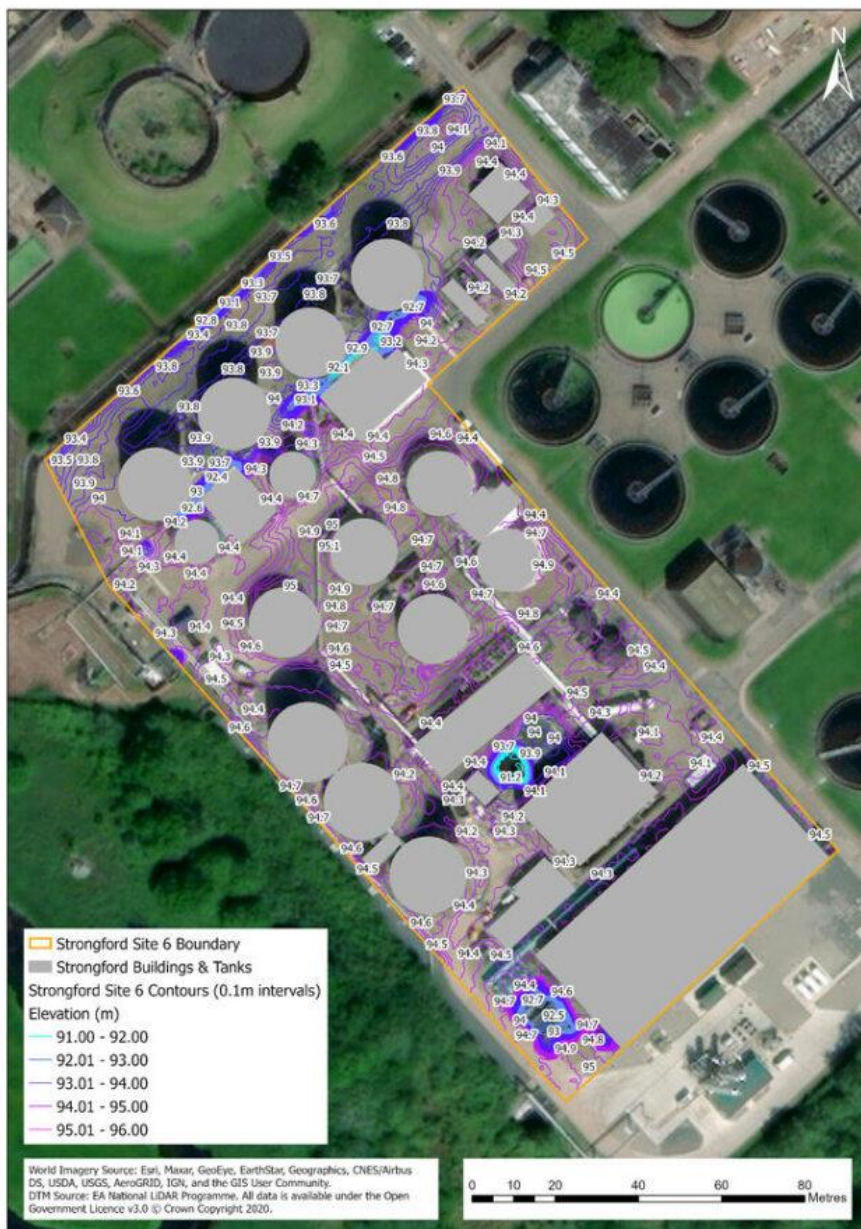


Figure 3.1 - DTM of the digester area showing contours at 10cm intervals.



Figure 3.2 - DTM of the sludge storage tank area showing contours at 10cm intervals.

Figure 3.3 overleaf shows a plan of the active sludge assets at Strongford STW.

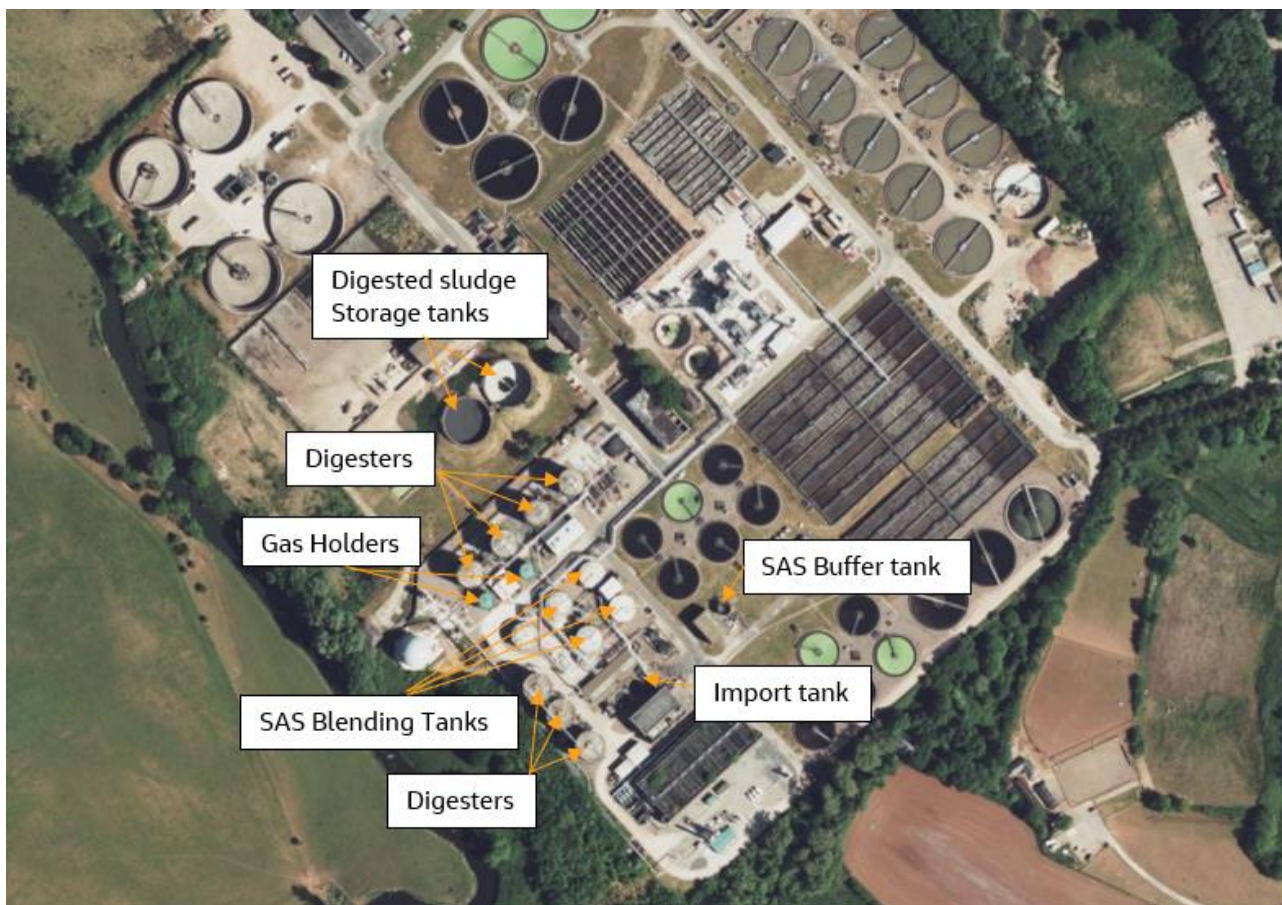


Figure 3.3 - Labelled site plan of Strongford Treatment Works

## 3.1.2 Containment Solution

### 3.1.2.1 Digester Area

To provide sufficient secondary containment to the digestion tanks, the design containment volume of 4,390m<sup>3</sup> needs to be securely contained. Extrapolating the LiDAR spill modelling, the predicted the top water level (TWL) when 4,390m<sup>3</sup> is contained in the digester area is at 94.53m AOD. Figure 3.4 shows the work necessary to convert the sludge asset area into a secure secondary containment facility. Installation of walls, flow guiding walls, containment ramps and a flood gate are required. The flood gate is required on small roadway, which is not a key throughfare for the site, and alternate routes are available. Due to the topography and the current development of the site alternate solutions to remove the flood gate are not viable. A 1.5m containment wall has been provided on the northern side of the digesters to provide a heightened barrier as protection for the final effluent channel.

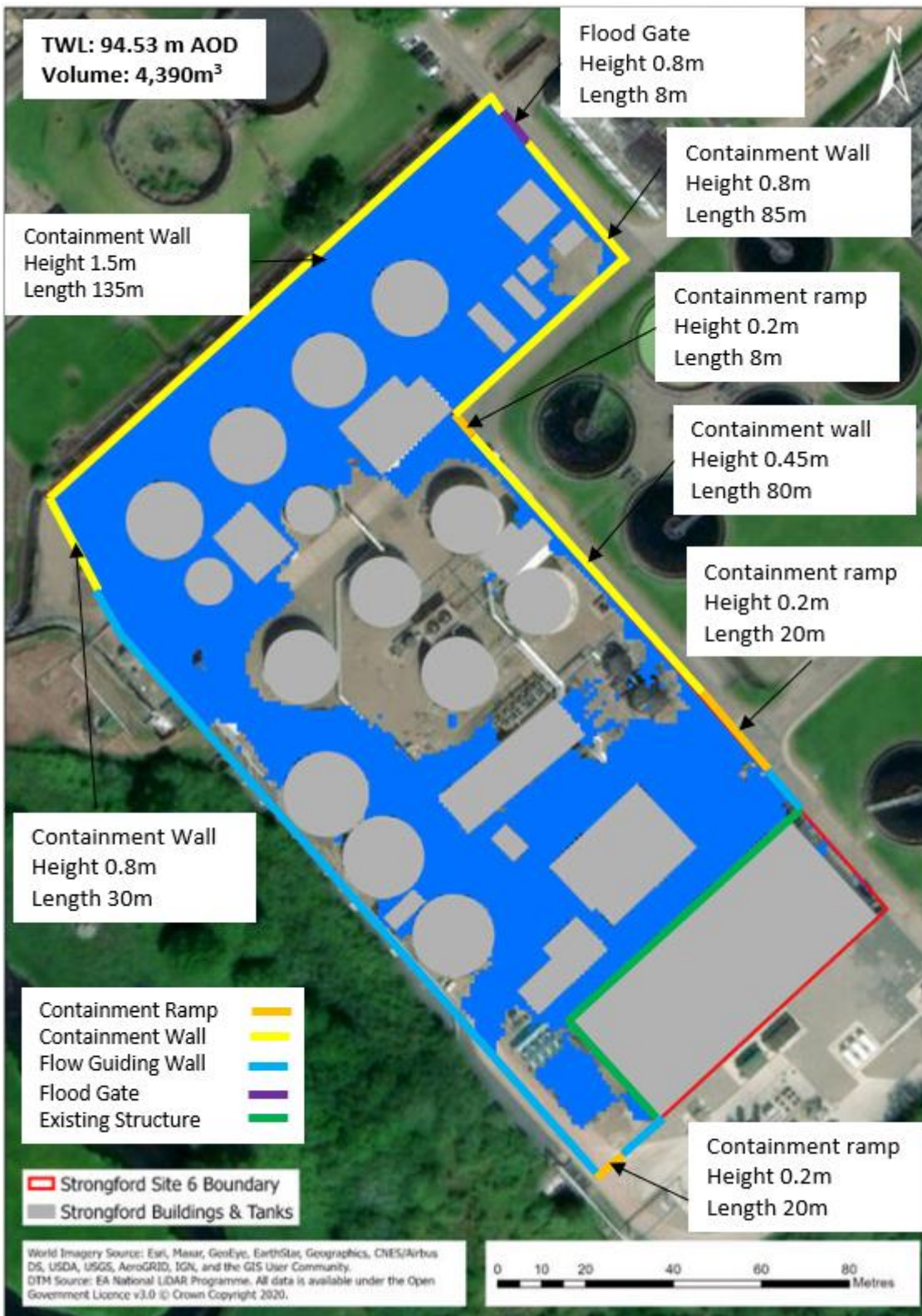


Figure 3.4 - Recommended site modifications to provide secondary containment

The position of bund walls will be finalised during detailed design ensuring the storage footprint is not compromised, and bund walls are compliant with site operations and other considerations (e.g. services).

### 3.1.2.2 Sludge Storage Tank Area

The sludge storage tank area is contained within an embanked slope. The Top Water Level of the tank has been stated by Severn Trent Water to be about 1m above the level of the embankment. As the tank is not an underground tank and the configuration of the galleries is unknown a worst case solution of containing the full volume of the tank has been considered.

To provide sufficient secondary containment to the digestion tanks, the design containment volume of 4,390m<sup>3</sup> needs to be securely contained. Extrapolating the LiDAR spill modelling, the predicted the top water level (TWL) when 4,390m<sup>3</sup> is contained in the digester area is at 94.53m AOD. Figure 3.5 shows the work necessary to convert the sludge asset area into a secure secondary containment facility. Installation of walls, flow guiding walls, containment ramps and a flood gate are required. An alternate solution to include the cake area within containment area was considered, but was discounted as it would not provide enough area to reduce the containment height to remove the need for flood gates. This has been based on based on the maximum utilisation of the cake pad. A 1.5m containment wall has been provided on the southern side of the sludge storage tanks to provide a heightened barrier as protection for the final effluent channel.



Figure 3.5 - Recommended modifications to provide secondary containment

The position of bund walls will be finalised during detailed design ensuring the storage footprint is not compromised, and bund walls are compliant with site operations and other considerations (e.g. services).

### 3.2 The Transfer System

Due to the topography of the site the transfer of liquid to the remote secondary containment occurs under gravity.

The site surfacing plan for Strongford STW, shown in Appendix B, details the current impermeable and permeable surfacing in the containment areas. The grass areas around the transfer system and tanks should be lined for the eventuality of sludge collecting on them, either through jetting from the tanks or pipework, or spillages over kerbing.

### 3.3 Remote Secondary Containment Summary

A summary of the recommended containment for Strongford STW are listed below.

Table 3.1 - Summary of solution for containment of Digester area.

	Impermeable Lining /m2	Walls/ Barriers	Ramps	Other (Isolation Valves/Building Protection/ local infill)
Transfer System	N/A	4 sections: 1 Max height 1.5m Length 135m 2 Max height 0.80m Length 85m 3 Max height 0.45m Length 80m 4 Max height 0.8m Length 30m Flow guiding kerbing to be raised to 400 mm above road level to direct and contain spillages and protect buildings.	3 Ramps to guide flow max height 0.2m 1 Flood gate Height 0.8m Length 8m	Isolation of drainage system to prevent it heading to the head of the works.

**Table 3.2 - Summary of solution for Sludge Storage Tank area**

	Impermeable Lining /m2	Walls/ Barriers	Ramps	Other (Isolation Valves/Building Protection/ local infill)
Transfer System	1 Areas of impermeable lining Approximately 4,250m <sup>2</sup>	5 sections: 1 Max height 1.5m Length 130m 2 Max height 1.1m Length 60m 3 Max height 1.0 m Length 20m 4 Max height 0.9 m Length 100m 5 Max height 1.0m Length 60m	1 Flood gate Height 1.0m Length 10m	Isolation of drainage system to prevent it heading to the head of the works.

## 4. Site Drainage

Site drainage assessments are based on Strongford Sewage Works Connectivity Plan Drawing Number DT2436/ Strongford STW.

### 4.1 Process, foul and Surface Drainage

The Sewage Works Layout Plan for Strongford shows all Foul/ Combined/ Process/ Effluent drainage pipes, indicated by red lines. Surface water drainage pipes are indicated by blue lines.

In the event of sludge entering the site returns drainage system and being returned to the head of the works, the shock load could adversely impact the sewage works treatment process. Therefore, in the event of a catastrophic loss of containment, lines to the head of works should be isolated or pumping should be inhibited.

Figure 4.1 below shows the site drainage plan for the South East side of the sludge holding area. Surface drainage water in this area collects to a drain that appears to be headed for the final effluent culvert or the river Trent and is circled in red. This drainage line should be isolated in the event of loss of primary containment in order to prevent the release of sludge to a sensitive receptor.

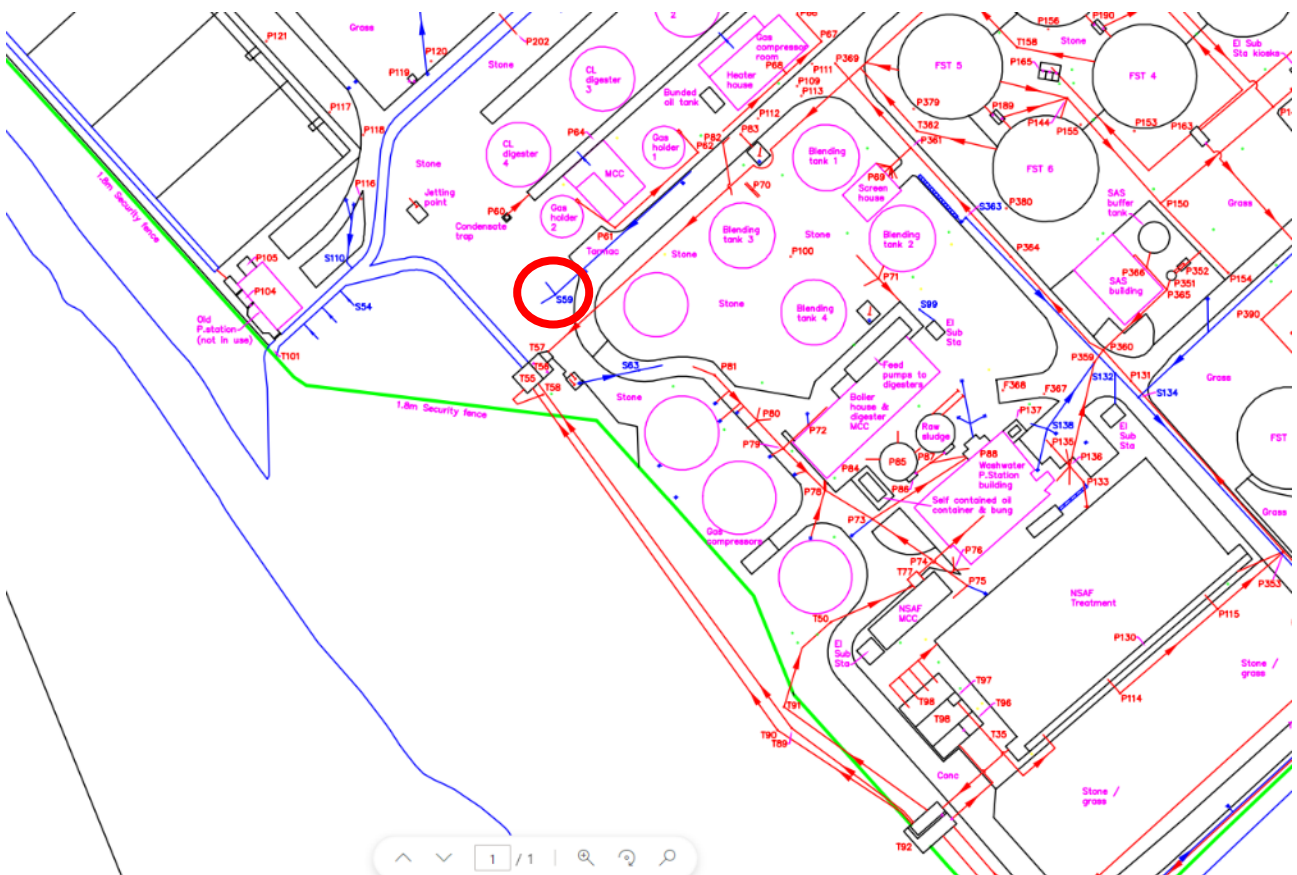


Figure 4.1 - Foul & surface water drainage on the South East side of the sludge area

Figure 4.2 below shows the site drainage plan for the South West side of the sludge holding area. Surface drainage water in this area collects to a drain that discharges to the wetland area adjacent to the site and is circled in red. This drainage line should be isolated in the event of loss of primary containment or diverted to process drains in order to prevent the release of sludge to a sensitive receptor.

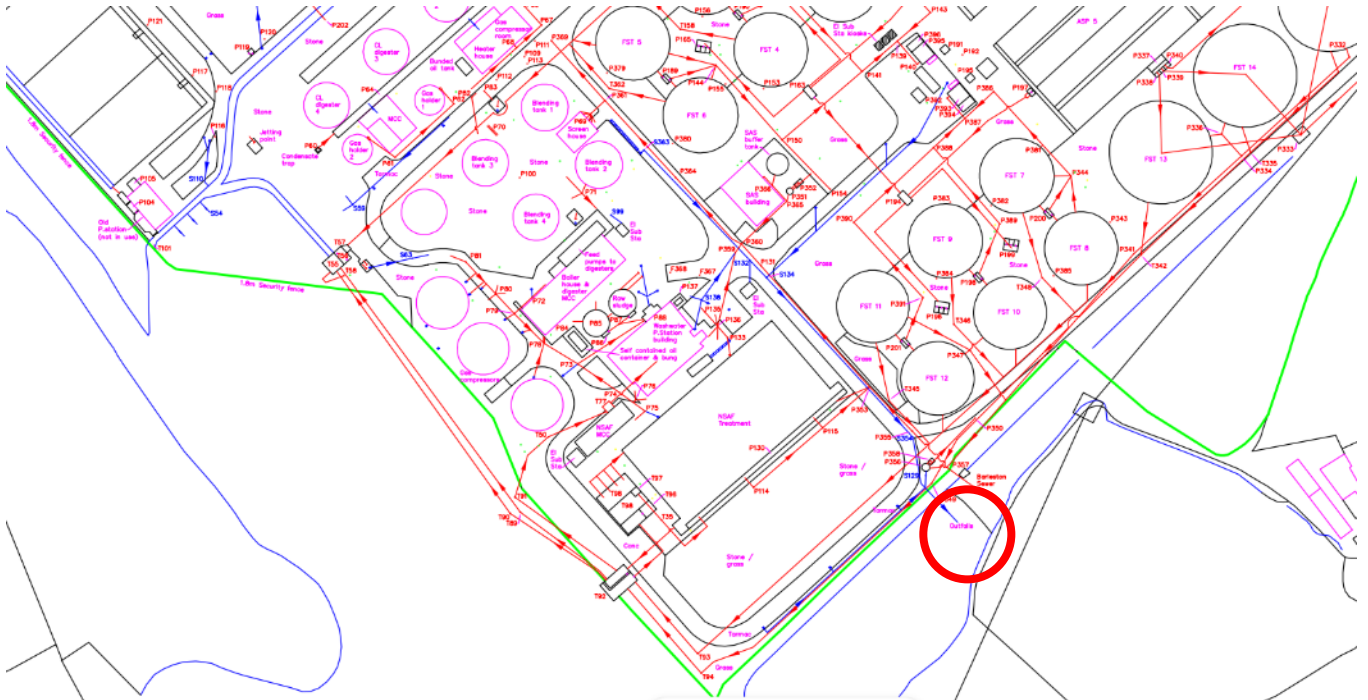


Figure 4.2 - Foul & surface water drainage on the South East side of the sludge area

Figure 4.3 overleaf shows site drainage for the north side of the sludge containment area. The arrows in blue indicate the presence of land drains and surface water from the contained area draining into the culverted watercourse passing through the site.

The surface water drainage should be isolated in the event of loss of primary containment in order to prevent the release of sludge to a sensitive receptor. Considering the proximity of the culverted watercourse to the containment area, consideration should be given to re-directing these drains to a different collection and discharge point.

There are a significant number of land drains discharging to the culverted watercourse that appear to run beneath the proposed contained area. To mitigate the discharge of sludge through ground seepage in the event of a sludge spill this area needs to have an impermeable surface.



## 4.2 Automatic Isolation Valves

For the catastrophic loss of containment scenarios for sludge area discussed, such a loss could be automatically detected by the level sensors in the tanks. A catastrophic failure would be identified by the rate of change in tank level being larger than expected at normal operation. The signal from the sensors would be used to automatically prevent any adverse impact on sewage treatment.

In the event of a catastrophic sludge spill, flows entering the head of works via the drainage pipes could adversely impact the sewage works treatment process. Therefore, in the event of a catastrophic loss of containment, the drainage lines within the containment area should be isolated.

It is recommended that float operated isolation valves are installed on all outgoing drainage lines from the containment area. These valves will remain normally open but will close when high levels in the existing drainage system are encountered. This drainage configuration will have the following impacts:

- In heavy or intense rain events these drainage isolation valves may be triggered, and operators onsite will need to manually operate these valves to release flows into the existing drainage network.
- In minor or slow flow tank spills, the sludge spill will flow into the exiting drainage network (and into the head of the works) unless operators intervene to isolate the drainage networks. Due to the flow to full treatment at Strongford being large, minor spill flows will not adversely impact the process.
- In most locations, to accommodate the new isolation valves, new manholes need to be constructed over the existing drainage lines.

## 5. Mitigation of Site-Specific Risks

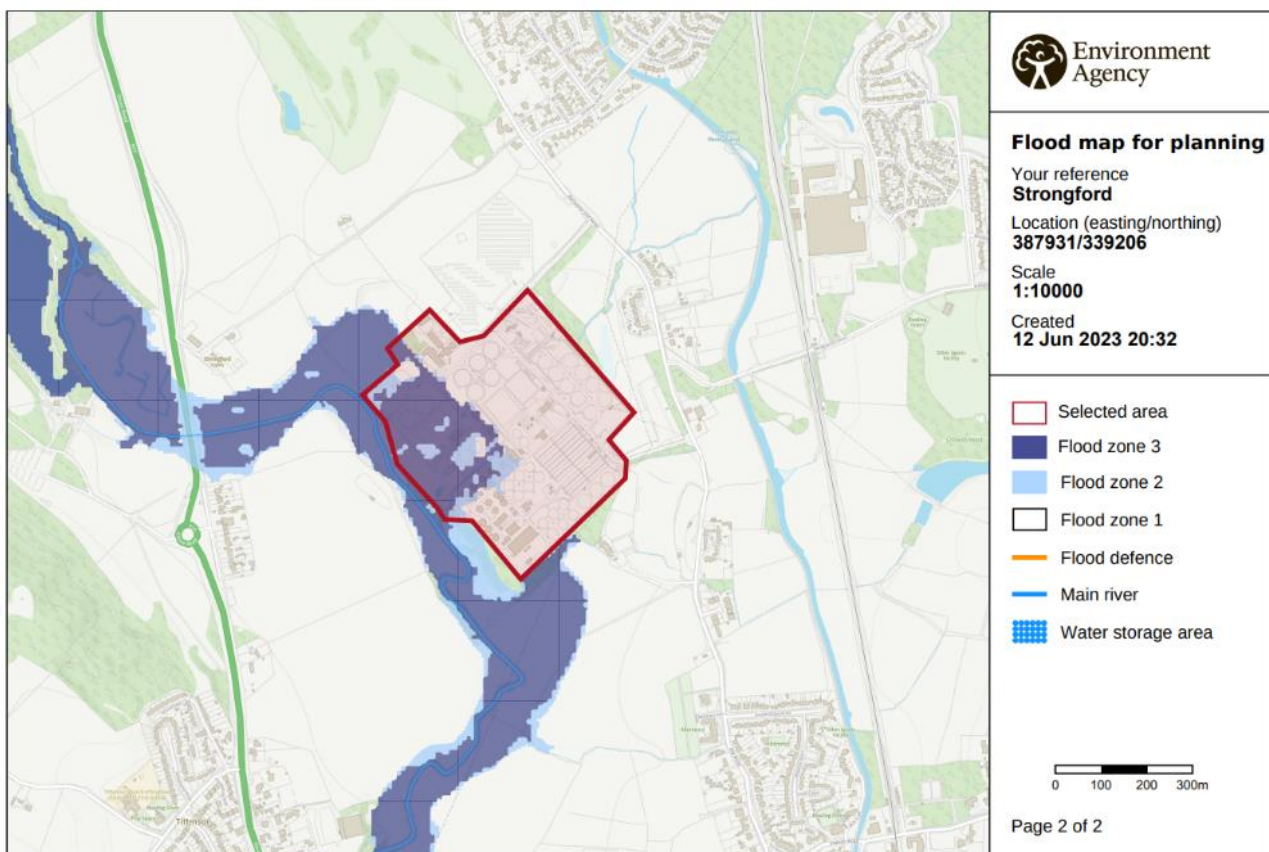
### 5.1 Jetting and Surge Flows

The risk of jetting as been considered low as the tanks are constructed from concrete, and a jetting failure is very unlikely.

Surge effects of a catastrophic failure of the primary storage vessel will be considered in the design of the containment solution. In accordance with CIRIA, the detailing of the containment walls will consider mitigation of surge by the profile of the wall; an enhanced freeboard for surge will be adopted if other measures are not practicable.

### 5.2 Flooding

According to the UK Government's Flood Map for Planning, Strongford STW is within a potential flooding zone (flood zone 2 & 3) as shown in Figure 5.1. The majority of the sludge assets in the digester area are not within a potential flood zone (flood zone 1) therefore, no modifications need to be made to the digester area to accommodate the risk. The Sludge storage tanks are within flood zone 2 & 3, there may need to be considerations within the design, depending on potential flood depths.



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Figure 5.1 - UK Government's Flood Map for Planning

## 6. Conclusions

This section summarises the findings of the containment assessment options report for Strongford Sewage Treatment Works.

In the Risk Identification Report for Strongford STW a containment classification report was carried out. An overall site risk rating of medium was determined meaning that class 2 containment is needed. The detailed requirements for class 2 containment have been outlined in the Risk Identification Report in section 1.1.

The assessment focuses on site-specific risks and outlines the options available for providing remote secondary containment of a catastrophic tank or digester failure. A single option has been provided in the form of walls, kerbs acting as flow guiding walls, ramps and a flood gate to contain spill within the digester area. Walls and a flood gate have been provided to contain the spill in the sludge storage tank area.

In the digester area the 25% of total stock volume is the dominant rule at this site. This has increased the required storage volume by 395m<sup>3</sup> compared to the storage volume required for largest tank plus rainfall.

The effect of Jetting and surge flows were also assessed and found to pose no issues in the containment areas.

Finally, assessment of the risk of flooding of the digester area at Strongford Sewage Treatment Works based on the UK Government's Flood Map for Planning is in Flood Zone 1. This means the likelihood of the sludge area flooding is very low at less than 1 in 1000 annual probability. The sludge storage tank area is within flood zone 2 & 3. Consideration of potential flood depths should be considered during the design of this containment area.

## Appendix A. ADBA Site Hazard Risk Assessment for Strongford STW

Material	Physical properties	Quantity	units	Storage	Flammability	Corrosive	Ecotoxicity (based on LD and quantity)	Environmental hazard rating	Justification
<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: Seven digesters, two digested Sludge Storage tanks, four Blending tanks, one import well, one SAS buffer tank.
<b>Additives and site chemicals</b>									
Ferric Chloride	Liquid	1	IVC	IVC	Not flammable	No	Low	L	
Glycol	Liquid	1	IVC	IVC	Not flammable	No	Low	L	
Cleaning products	Liquid	1	IVC	Consumables container	Not flammable	No	Low	L	
Lab consumables	Liquid	20	litres	Consumables container	Not flammable	No	Low	L	
							Chemicals Overall Rating	L	Section not relevant
<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	
Fire fighting and cooling water contaminated by inventory	Liquid	>25	m3	NA	Not flammable	No	Low	L	
							Spillages Overall Rating	L	All the hazards are "Low" therefore the overall rating is low
							Sources Overall Hazard Rating	H	Justification: Digesters, digested Sludge Storage tanks, Blending tanks, import well, SAS buffer tank are located at Strongford STW.

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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 cross the site boundary 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 East to West therefore is raised above the River Trent	
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 at Medium-Low risk according to Ground Water Vulnerability Map.	
None apply					L	Not relevant	
<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: surface water drains go to the River Trent
<b>Climatic conditions</b>							
Annual rainfall < 1000 mm					L	Annual Rainfall within 827.92 mm - 809.91 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	Part of the site is in Flood Zone 3 and Flood Zone 2, including part of the sludge holding area on site	
Site is at bottom of a hill					M	The site inclines from East to West, towards the River Trent.	
Site is connected to a sewage treatment works					M	yes	
					Site Considerations Overall Rating	H	Justification: Part of the site is in Flood Zone 3 and Flood Zone 2, including part of the sludge holding area on site
					Pathway Overall Hazard Rating	H	Justification: Site is flood Zone 2 and 3. Sludge leaves the site boundary within 1 minute.

# Strongford Digesters and Sludge Tank IED Containment Assessment - Proposed Options Report

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 cross the site boundary 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 East to West therefore is raised above the River Trent
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 at Medium-Low risk according to Ground Water Vulnerability Map.
None apply	L	Not relevant
<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: process drains go to the River Trent
<b>Climatic conditions</b>		
Annual rainfall < 1000 mm	L	Annual Rainfall within 827.92 mm - 809.91 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	Part of the site is in Flood Zone 3 and Flood Zone 2, including part of the sludge holding area on site
Site is at bottom of a hill	M	The site inclines from East to West, towards the River Trent.
Site is connected to a sewage treatment works	M	yes
	Site Considerations Overall Rating	H
		Justification: Part of the site is in Flood Zone 3 and Flood Zone 2, including part of the sludge holding area on site
B19589CT - DOC - 034	Pathway Overall Hazard Rating	H
		Justification: Process drains go to the River Trent. Also, site is flood Zone 2 and 3.

# Strongford Digesters and Sludge Tank IED Containment Assessment - Proposed Options Report

Receptors	Within	units					Environmental hazard rating	Notes	
<b>Watercourses and bodies</b>									
Rivers above potable water supplies	100	m					H	River Trent is within 30m from the IED permitted Zone.	
Aquifers used for public supply	150	m					H	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 located nearby the site	
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	H	Justification: Site is within 100m of the River Trent
<b>Habitation</b>									
Dwelling	250	m					H	Housing is within 250m of the site.	
Dwelling	251-500	m					M		
Workplace	250	m					M	Middleton Livery Yard and Riding Tuition are within 250m of the site.	
None of the above							L	Not applicable	
							Habitation Overall Rating	H	Justification: Housing is within 250m of the site.
<b>Other</b>									
SSSI/SPA/SAC	1000	m					H	King's and Hargreaves Woods SSSI 985m West.	
RAMSAR Site	1000	m					L	None identified	
None of the above							L	Not applicable	
							Other Overall Rating	H	Justification: SSSI Site is within 1000m to the West.
							Receptors Overall Hazard Rating	H	Justification: Site is within 100m of the River Trent, with housing within 250m

**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

# Strongford Digesters and Sludge Tank IED Containment Assessment - Proposed Options Report

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

