J840 – STC IED Containment

Beckton STC – Containment Options Report

December 2023

Thames Water

Project No: J840
Document Title: Beckton STC – Containment Options Report

Document No.:
Revision: 2.0
Date: 18/12/2023
Client Name: Thames Water
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File Name: B22849AZ Beckton STC – Containment Options Report

Document history and status

Revision	Date	Description	Author	Checked	Reviewed	Approved
1.0	16/12/2022	First Issue	JH	SMNS	SC	HG
2.0	18/12/2023	Updates to PFD/IED Plan/Tank Names	CR	SMNS	SC	HG

Contents

1. Executive Summary

Thames Water is required by the Environment Agency to provide secondary containment to their sludge treatment centres to satisfy provisions of the Industrial Emissions Directive and to safeguard the operation of the adjacent sewage treatments works. Twenty-five sludge treatment centres have been identified where containment proposals are required. This report deals with the proposals for Beckton.

Beckton STW serves a Population Equivalent (PE) of 3.5 million in Newham, East London. The sludge treatment centre shares the same site as the sewage treatment works.

CIRIA Report 736 – Containment systems for the prevention of pollution sets out principles and direction. This report sets out options to apply the CIRIA 736 principles within the accepted constraints of a retrofitted solution.

There are 43 tanks in total containing sludge the total operational sludge volume of approximately 78,290m^3, with individual volumes varying between 30 to 4750m^3, refer to section 3.4.1 for details on tanks and volumes. The site is generally low lying and flat. There are 2 containment areas to consider at Beckton and the containment volume for each set by a different rule:

Containment Area	Volume	Rule
Main Sludge Tank area	13458m^3	25%
Riverside Blending and mixing Tank area	320m^3	Largest tank plus rainfall

An initial review, together with TW Site Operations, was carried out to confirm the normal operations of the sewage treatment work would not be compromised by any proposal. In the review, close containment and wide containment options were discussed. Within the discussions, major site upgrades and plans were raised to install and replace new plant. This constrained the ability to progress a wider area containment solution which would have included the Lee Tunnel Shaft site.

In addition, the design spill volume of 25% of all tanks was discussed and this volume would dictate the bund height. This is the worst-case scenario and surpasses the more likely scenario of a single, largest tank failure i.e. a primary digester. Refer to Section 4.1 for details on the options reviewed and Section 4.3 for the preferred option. A summary of the preferred option is tabulated overleaf:

Table 1 – Summary of the proposed containment option

Containment Area	Description of containment
Main Sludge Tank Area	• Along the eastern containment boundary, reinforced retaining walls typically 1-1.5m for 260m after reprofiling of ground will provide close containment with top level of containment at 5.32mAOD. • Close containment with top level of containment at 5.32mAOD, reinforced retaining walls typically 0.5-0.75m after reprofiling of ground for 730m where the ground level is higher than the eastern boundary. • 4 ramps will provide access for vehicles as area is frequently visited during the day and reprofiled road levels to 4.78mAOD allow the use of ramps.
Riverside Blending and mixing Tank area	• Close containment with top level of containment at 4.07mAOD on the South and East border. • Reinforced retaining concrete wall to be constructed will be 1.25m at its highest to contain spillage. • The foundation of the retaining walls limit need for additional concrete to cap grass areas. • There will be minimal bunding at 250mm on the North and East border with steps provided for pedestrian access to the area. This is to zone off the area in case of a spill and as freeboard but the ground level is higher than the spill depth so minimal containment height is required. • This is a possible opportunity to locally lower ground level and thus lowering the bund height at the maximum spill depths.
Summary	• Option 1 reduces impact to operational access as no containment boundaries impact major cross-site access roads. Ramps cross minor access roads servicing the sludge area. • Designed to contain 25% of all tank volumes (main area) and secondary smaller area dictated by largest tank plus rainfall.

Float valves will also be installed onto surface water drains to prevent spilled sludge from returning immediately to the head of the works.

Bund heights are being set to provide freeboard considering both static conditions when the containment has been filled and during the transient condition at initial failure. There is the potential for some flow to overtop the access ramps during the conditions of the initial burst which is addressed by tertiary containment and conveyance to the site drainage system which discharges to the inlet works.

In addition to the creation of bunds, which due to space constraints are likely to be formed from concrete, existing grass or gravelled areas will be replaced with a bound impermeable material (high cement replacement concrete) to provide a surface that can be cleared of sludge to meet a four-day recovery period. Where space is available, reinforced retaining concrete walls will be installed to reduce the concrete capping required to provide an impermeable surface at the proposed design level.

Vehicular access into the main containment area is by ramps (speed humps) restricted to nom 250-300mm in height; traffic movements on site make the use of permanent flood gates impracticable. Whilst the site is identified as requiring Class 2 containment (impermeable soil with a liner), the proposed solution is intending to use concrete (with no liner) on the basis of the impermeability of the concrete, inherent strength, and long-term mechanical resistance. The general layout of the proposed solution is presented in Figure 1-1 below:

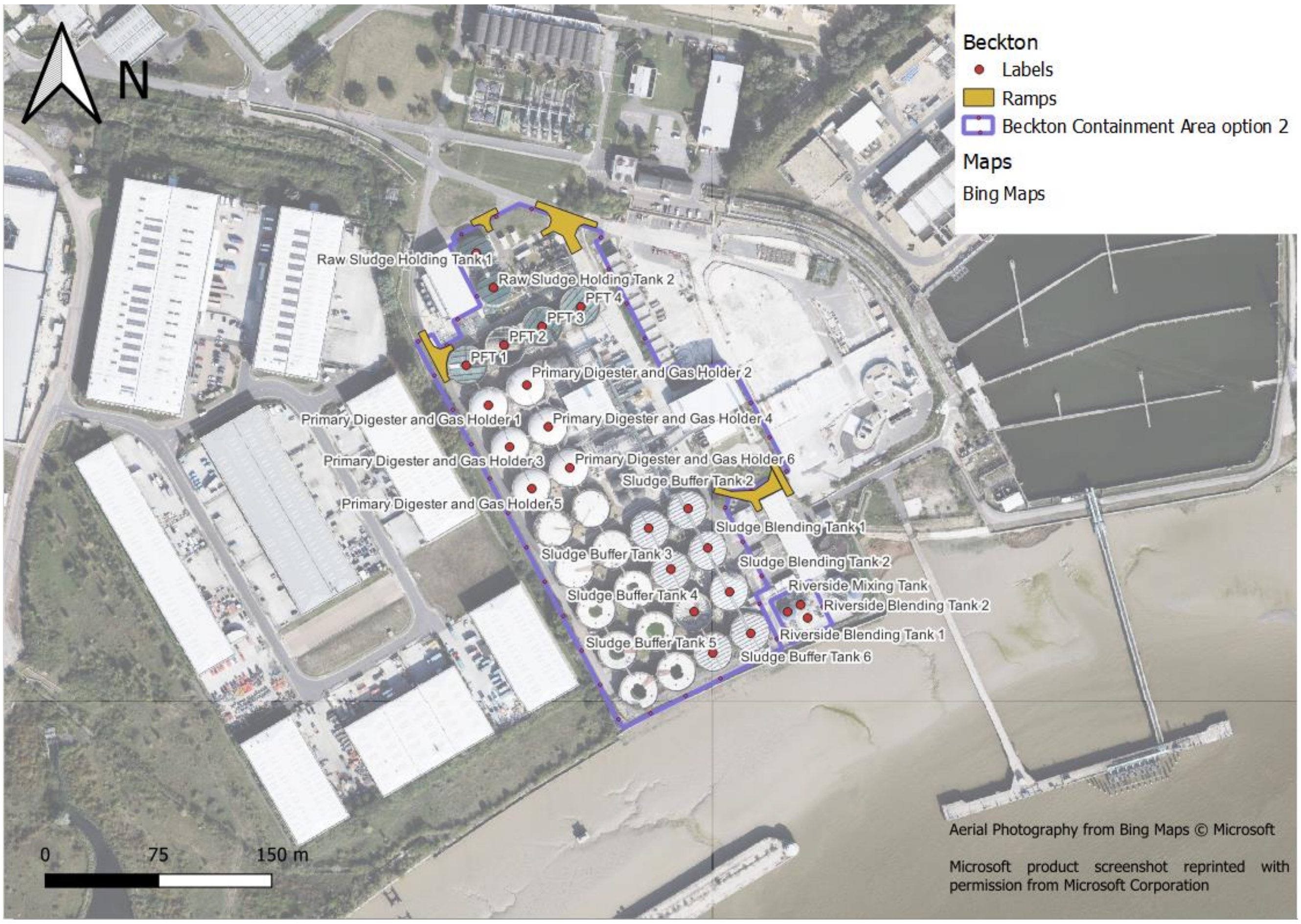

Figure 1-1 - General layout of containment for Beckton STW

2. Background

Following initial audits by the Environment Agency (EA) in 2019 that examined the primary, secondary, and tertiary containment provisions for Thames Water'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 Thames Water'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 25 Thames Water sites. Based on CIRIA C736 and ADBA risk assessment tools this containment report addresses the site-specific risks at Beckton and outlines the options available for providing remote secondary containment in the event of a catastrophic tank or digester failure.

The current assessment identified gaps between the existing conditions of the sludge assets in Beckton STW and the requirements to meet the industrial standard (i.e., CIRIA C736 and The Anaerobic Digestion and Bioresources Association Limited (ADBA)). Site-specific risks, credible failure scenario and design containment volume for the Beckton STW were identified through a desktop study, Light Detection and Ranging Analysis (LiDAR) analysis and a site visit.

Beckton STW is located in Newham, East London. The site is situated northwest of the confluence of River Roding and River Thames. River Roding engulfs the STW from the north down to the southeast, while River Thames borders to the south of the site. The STW is adjacent to various commercial industries/ businesses to the west, a Recycling and Reuse centre to the northwest and the main road (A13) to the north. Beckton STW serves a Population Equivalent (PE) of 3.5 million and has a maximum daily flow of 2,336,000 m^3/d. Figures 2-1 and 2-2 show the site and main assets.

Figure 2-1 - Satellite image of Beckton STW

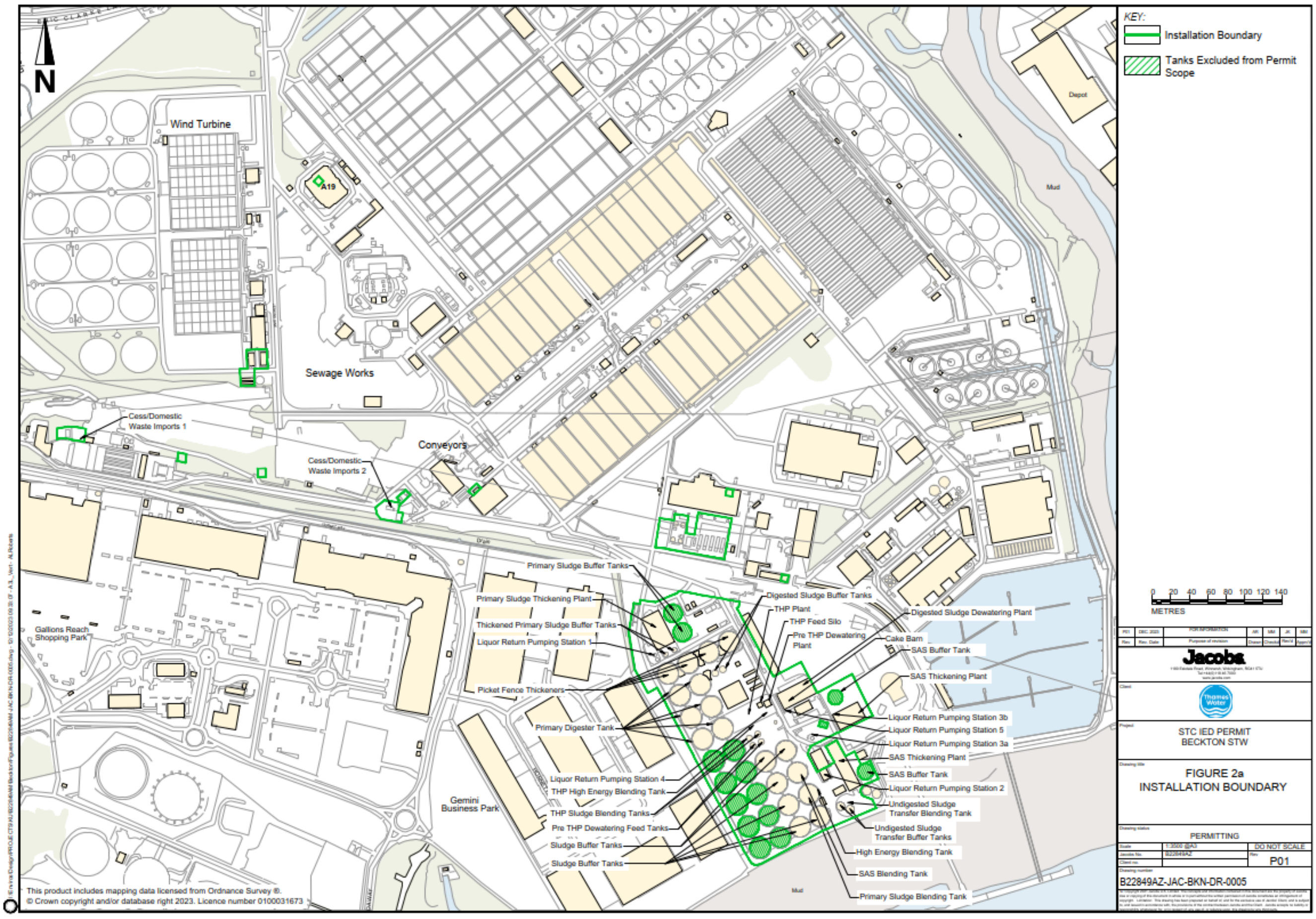

Figure 2-2 - Boundary of permitted IED area and the assets

3. Proposed Containment at Beckton STW

3.1 CIRIA C736

This containment option report has been prepared using CIRIA C736 as the basis of design and guidelines. Where a deviation from C736 has been recommended it is highlighted in the text.

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;

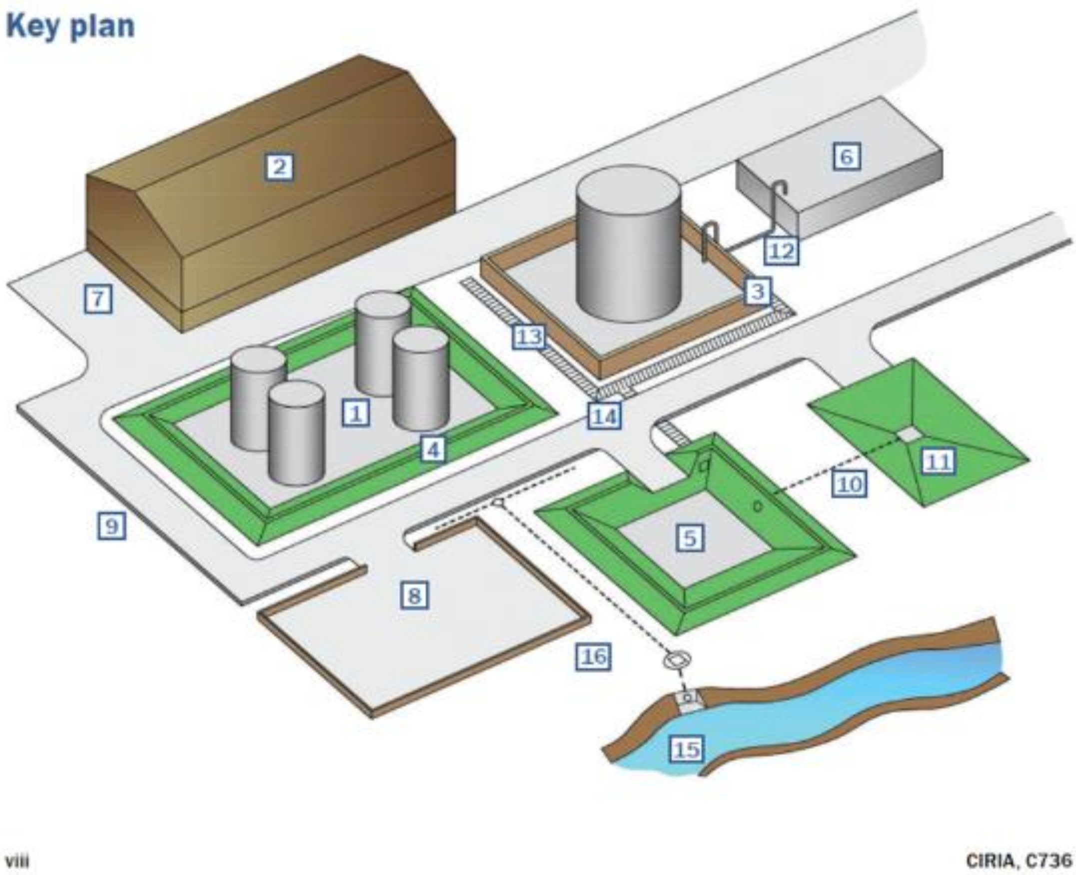

Figure 3-1 Diagram of primary, secondary and tertiary containment examples

- 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 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).

3.2 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.

3.2.1 Uncontained Spill modelling

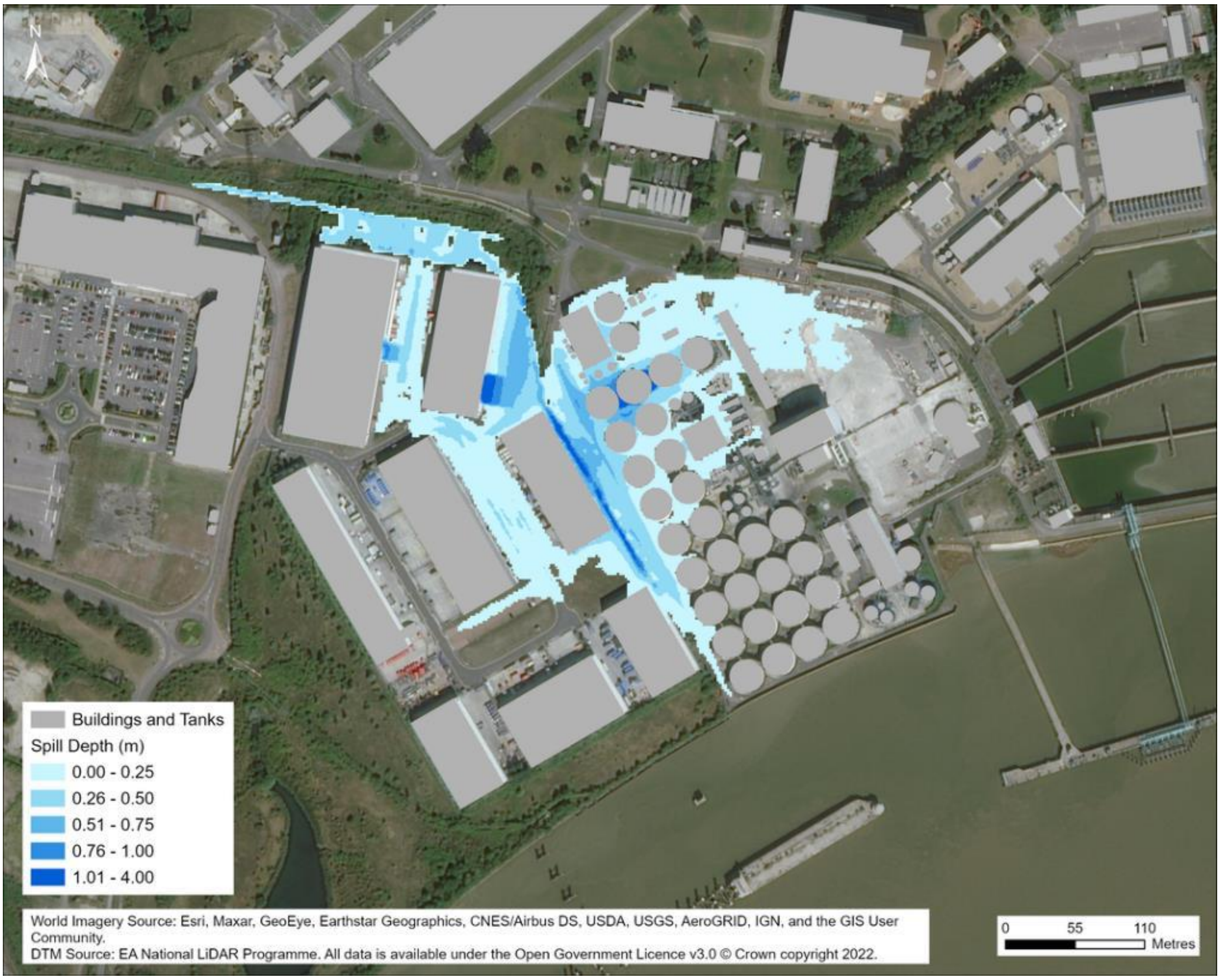

Figure 3-2 Uncontained Spill Model Results

Figure 3-2 shows the sludge spill mapping of an uncontained event in Beckton STW. A potential sludge spill from the Primary Digester will not be self-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 (by the south-west site boundary) in approximately 3 minutes following failure of one of the Primary Digesters.

The sludge content will then split and part of it will travel north-east within the STW although the majority will travel south, will pass nearby the Secondary Digesters and will leave the site by the south-west site boundary and enter the adjacent Gemini Business Park.

3.3 Site Classification Beckton

Based on the use of the ADBA risk assessment, considering the source, pathway and receptor risk Beckton site hazard rating is deemed to be medium. When considering the mitigated likelihood as low a Class 2 secondary containment is required.

Table 2 Risk rating

Source Risk	**Pathway Risk**	**Receptor Risk**	**Site Hazard Rating**	**Likelihood**	**Overall Site Risk Rating**
High	Medium	Medium	High	Low	Medium (Class 2)

Refer to Appendix 1 for summary of the ADBA risk assessment tool.

3.3.1 Spill Volume Summary

There are two components that contribute to the required capacity of secondary containment, the source spill volume requiring containment and rainfall. Section 4 of CIRIA 736 forms the basis of this assessment. Section 4.2 reviews current industry practice relating to source spill volume, section 4.2.8 then summarises current industry practice relating to source spill volume in a tabular form. It can be seen from section 4.2.8 that sewage sludges and associated regulations / guidance are not listed.

Within section 4.2.1 there is detailed reference to the use of 110% of the largest tank or 25% of the total tank inventory volume, whichever is greater, and the rationale for this. CIRIA recognises that this approach is not quantitative or based on a risk assessment and are arbitrary methods. Section 4.3 and 4.4 provide guidance on a quantitative risk assessment methodology and this is what is being used for the calculation of the required capacity for containment in this report.

3.3.2 Total Spill Volumes

For each containment area, the containment volume has been checked against the largest tank + rainfall, the 110% and 25% rule and for each the largest tank + rainfall applies.

The total design contained volumes comprise:

1. Main sludge tank area: 13458m^3
2. Riverside Sludge Blending and mixing tank area: 320m^3

Table 3 Estimating critical spill volumes

Main sludge tank area		
25% Rule	**13458**	Emerging critical case
110% Rule	**4362**	
Largest + rainfall	**7336**	
Riverside Sludge Blending and mixing tank area		
25% Rule	**135**	
110% Rule	**275**	
Largest + rainfall	**320**	Emerging critical case

3.4 Beckton STW Summary of Containment volumes and assets

3.4.1 Assets for Containment

The tanks for which containment is required are summarised in Table 4 below:

Table 4 List of tanks and volumes

Tank Purpose	No.	Operational Volume (m^3)	Total Operational Volume (m^3)	Material
Picket Fence Thickeners	4	4,750	19,000	Concrete
Thickened Primary Sludge Buffer Tanks	2	200	400	Steel
Primary Sludge Blending Tank	1	3,500	3,500	Concrete
SAS Blending tank	1	3,500	3,500	Concrete
Sludge Buffer Tanks	6	4,750	28,500	Concrete
High Energy Blending Tank	1	30	30	Steel
THP High Energy Blending Tank	1	30	30	Steel
THP Sludge Blending Tanks	2	235	470	Steel
Pre THP Dewatering Feed Tanks	2	183	366	Steel
THP Feed Silo	2	85	170	Steel
THP Process Tanks				
THP Pulper Tank	2	80	160	Steel
THP Reactor Tank	6	40	240	Steel
THP Flash Tank	2	80	160	Steel
Primary Digester Tanks	6	3,965	23,790	Concrete
Digested Sludge Buffer Tanks	2	250	500	Steel
Undigested Sludge Transfer Blending Tank	1	40	40	Steel
Undigested Sludge Transfer Buffer Tanks	2	250	500	Steel

3.4.2 Digital Terrain Model

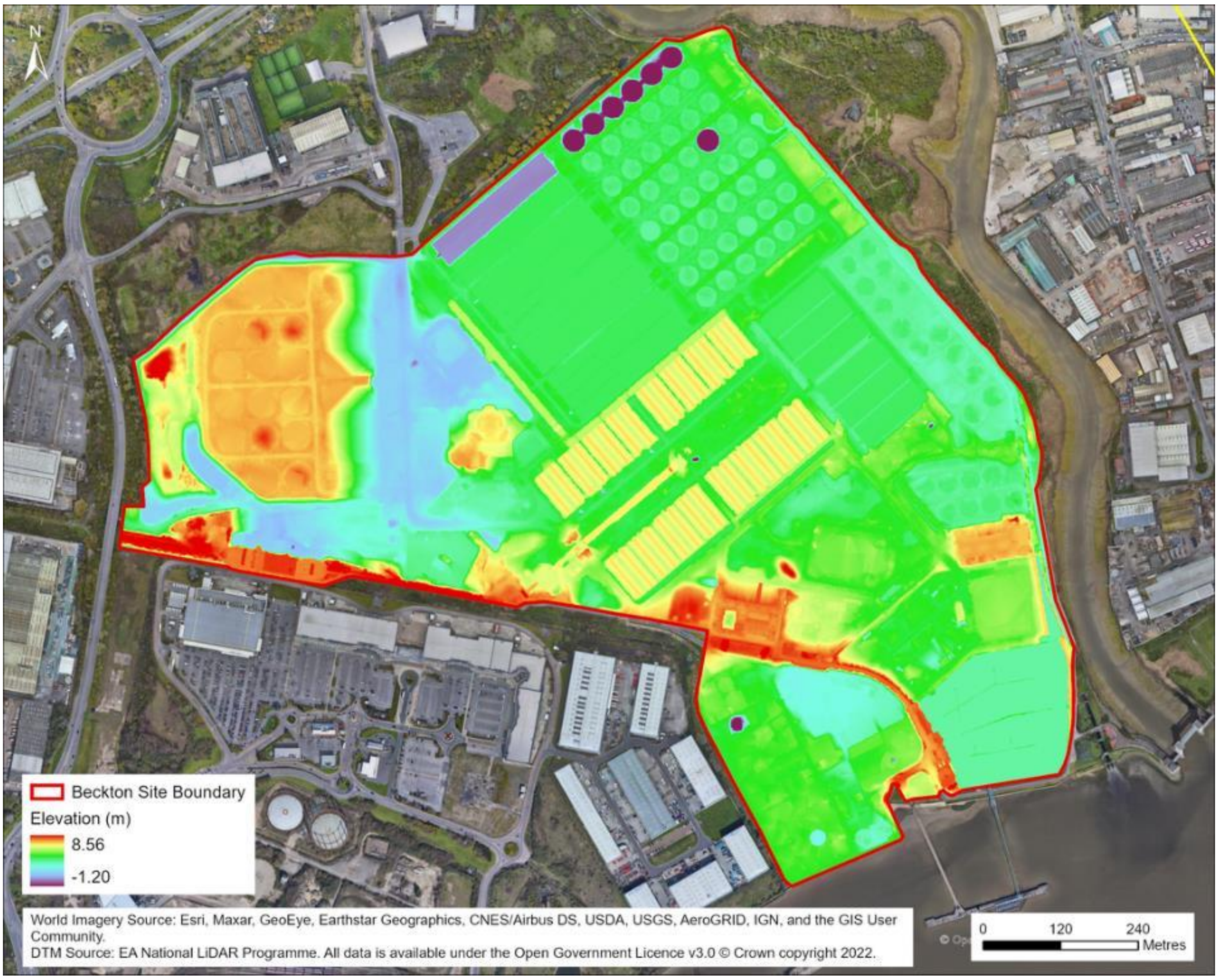

Figure 3-3 Digital Terrain Model of Beckton Sewage Treatment Works

The closest surface water course to the site is the River Thames on the southern boundary where the works discharges final treated effluent. Considering the topography of the sludge area, the high-resolution contouring (Figure 3-3), revealed that the sludge area is generally flat. There is a gap along the south boundary berm between the sludge buffer tanks and the Beckton transfer sludge blending tanks, and if spilled sludge reaches this location, the risk of spilling into River Thames would be inevitable. There are also several gaps between the tanks located on the periphery of the southwestern boundary which would be filled with sludge in the event of tank failure and high probability that the sludge would spill into the Hornet Way, the Gemini Business Park Industrial area and the River Thames.

3.4.3 Contained Model Output and Contour Maps

Figure 3-4 Contour lines within Main Sludge Tank area

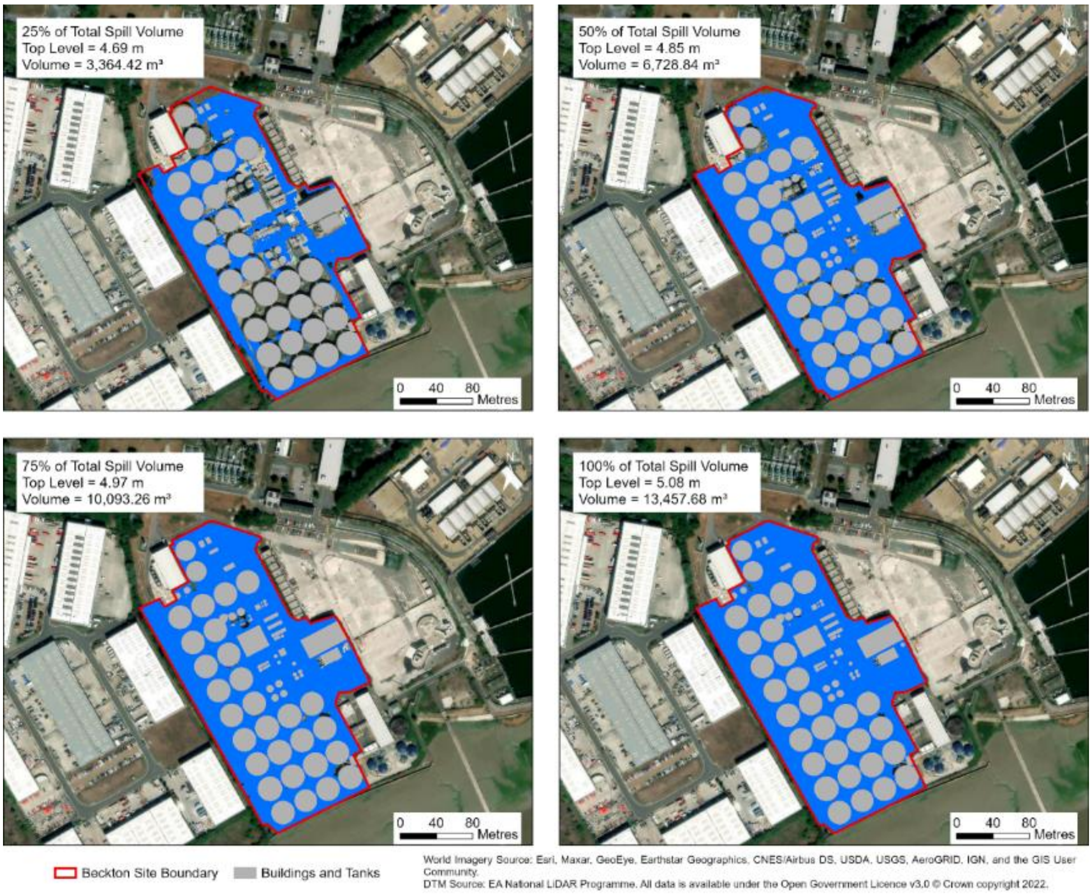

Figure 3-5 – Contained model output for area 1 showing top level of liquid at 5.08mAOD

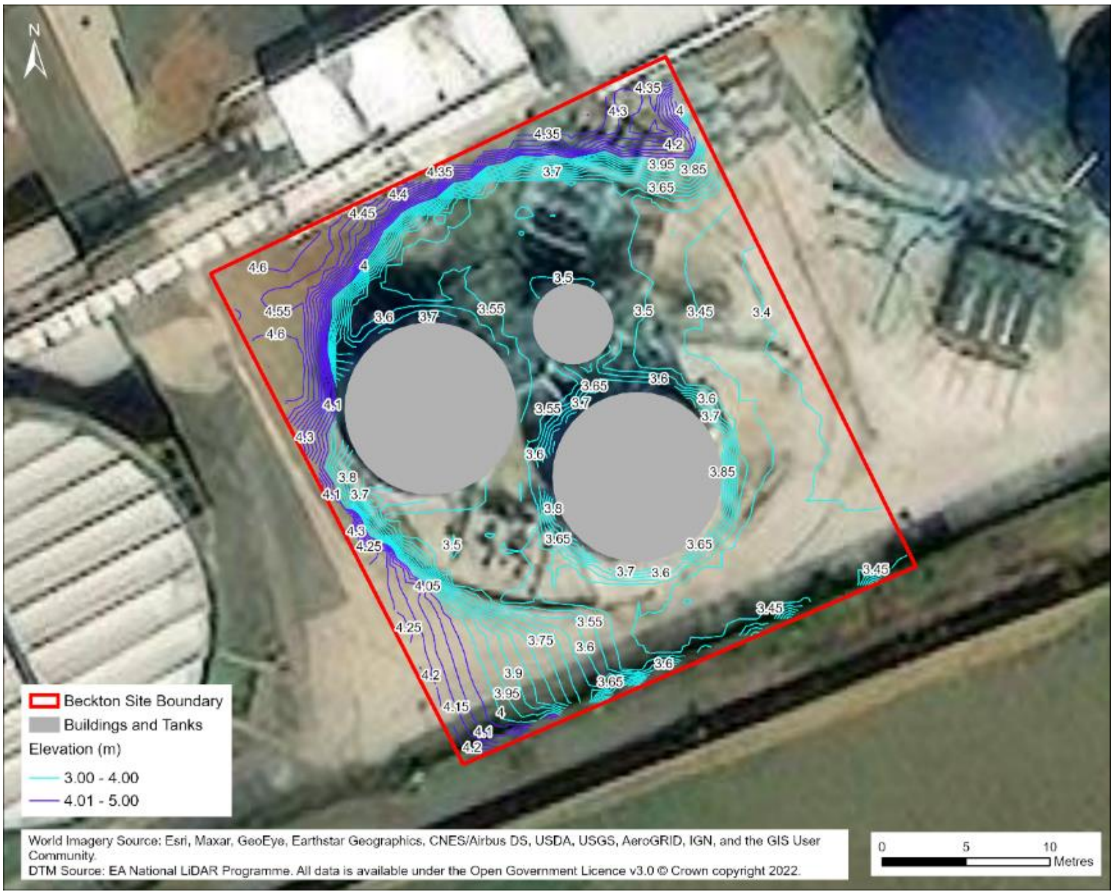

Figure 3-6 – Contour lines within Riverside Blending and mixing Tank area

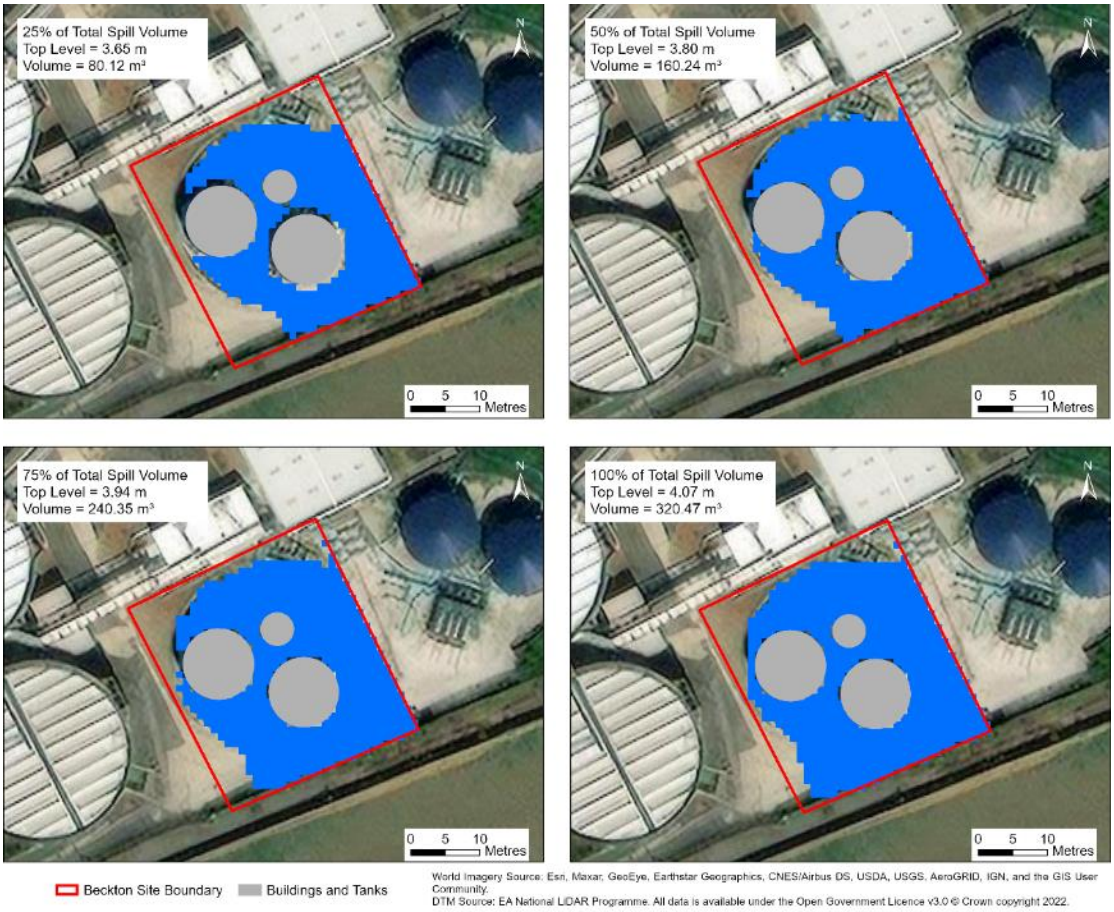

Figure 3-7 - Contained model output for area 2 showing top water level at 4.07mAOD

Table 5 – Levels associated with each containment area

Area	Top Water Level (mAOD)	GL at access (mAOD)	Depth at access (m)	Top level of containment (mAOD)
Main Sludge Tanks area	5.08	4.78	0.3*	5.33
Riverside Sludge Blending and mixing Tank area	4.07	4.2	0.0	4.32

*after reprofiling of the ground required to allow construction of ramp at these access points

Table 5 above identifies typical water levels, depths and containment levels for the areas.

The access point at the Riverside tanks area is above the standing containment water level. The ground withing the containment area will be reprofiled and the depth of water within the containment will be in the order of 0.5m.

It also shows the proposed height of any containment bunding according to the top water level. The containment bunding is set by adding 250mm to the top water level to provide freeboard to prevent overtopping from the surge effects.

3.5 Identified Constraints

3.5.1 Operational constraints

3.5.1.1 Clean-up time

The time to recovery and return site back to operation has been set at 3-days following direction by Thames Water. The containment volume, when not dictated by the 110% or 25% containment rules allows for three days of rain during the recovery period and one day of rain immediately preceding an event.

3.5.1.2 Surface cleaning

The existing ground surfaces around the sludge treatment tanks consist of grass and gravel in areas, that will need to be replaced with an impermeable surface, such as concrete, to facilitate the cleanup. The impermeable surface will be gently sloped to aid with the sludge spill flow path towards the drainage network.

It is noted that concreting these areas may slow emergency access to underground surfaces and there is a trade-off between the advantages of digging up existing surfaces (in grass or gravel) vs. decreasing the clean-up effort required in the event of a sludge spill.

Whilst the site is identified as requiring Class 2 containment (impermeable soil with a liner and leakage detection system), the proposed solution is intending to use concrete (with no liner) based on the impermeability of the concrete, inherent strength, and long-term mechanical resistance. Remedial works to existing concrete slabs/roads will be undertaken to ensure that they provide a competent surface, for example resealing of joints.

3.5.1.3 Access and Traffic Thoroughfare

Vehicular access through the bunding walls will be via containment ramps to provide a barrier for the liquid on roads that still need to be accessible to vehicles for site operation. The maximum height of these will be 300-350mm to avoid issues with vehicle passage.

3.5.1.4 Existing Services

An above ground pipe can be seen from aerial images which may need to be relocated during construction/excavation.

3.5.2 Geotechnical and Environmental constraints

Much of the site is composed of made-up ground from previous civil works, these mounds can be seen in the map of the sites topography and will need to be considered when placing foundations for the bunding, especially to the west of the primary digesters and the east of the secondary digesters where an old lagoon was once present.

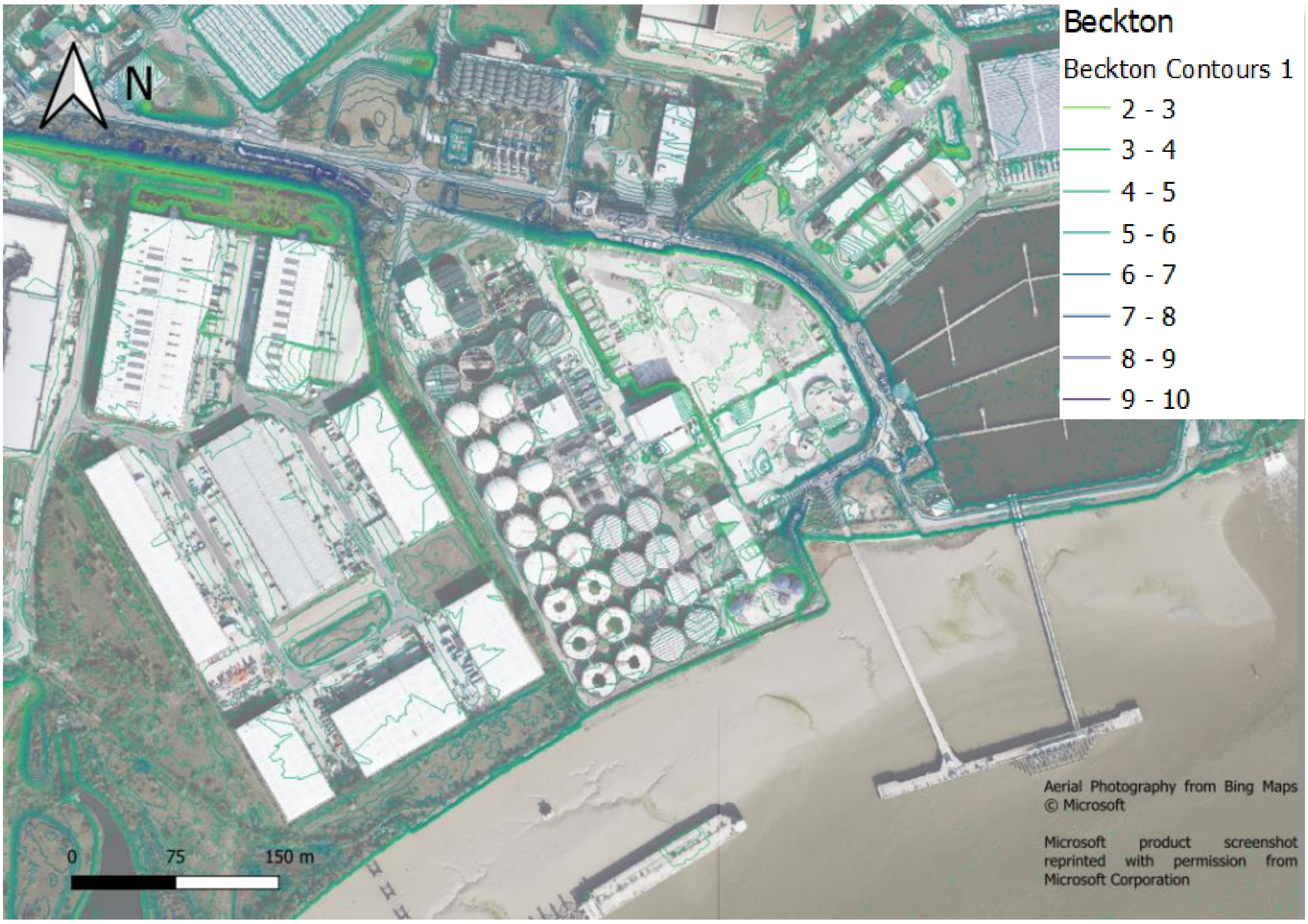

Figure 3-8 - Map of Beckton STW showing contours

The existing shrubbery within the containment area shall be removed and area infilled with concrete. To compensate for the loss of shrubbery, alternative areas shall be identified onsite for compensation planting or planting containers installed onsite.

3.5.3 Other constraints

None

3.6 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 the incident and for the duration of the incident, a three-day period in this case. The arising average rainfall depths for a 1 in 10-year storm over the event period for Beckton is 71 mm. It should be noted that the rainfall depths for Beckton have been estimated using the depth-duration-frequency rainfall model contained on the *Flood Estimation Handbook* (FEH), which provides location specific rainfall totals for given durations and return periods.

3.7 Planned Site Upgrade

Thames Water Operations noted significant site upgrades and expansion to the east of the proposed sludge tank containment area. This area is disused and is located north of the existing Lee Tunnel Shaft. The shaft area has large exclusion zones surrounding it for access, crane lifts and lay-down areas for operations and maintenance of the tunnel.

There are plans for new process equipment in the currently disused area and a new GBT building and cake barn extension.

Within the proposed containment area, there are plans for the 8 disused tanks west of the sludge buffer tanks to convert these for THP upgrade works.

Further investigation is required considering future upgrade and expansion works of the site to develop the containment solution. Thames Water have plans for future works that have been requested.

4. Secondary Containment

The constituent parts of secondary containment are;

- The contained area itself.
- Isolation of the drainage from both the contained area and from the transfer system.

For Beckton, where possible, existing features of the site (e.g., building structures and impermeable surfaces) are used as much as possible to provide the remote secondary containment to reduce cost. The options considered, modifications and their functionality at Beckton STW are listed below:

- Bund/walls to contain liquid. The heights of bund/walls given in Section 4.1 are the minimum heights required such that that top of the bund/wall is equal to the top water level plus a 250mm freeboard consideration for potential surge (to reflect the planned use of concrete walls with a recurved profile to return flow back on itself) in accordance with CIRIA.
- Containment ramps to provide a barrier for the liquid on roads that still need to be accessible to vehicles for site operation. The maximum height of these will be 300-350mm to avoid issues with vehicle passage. The risk of spill at the ramps is mitigated by conveyance of the flow to site drainage and return to the head of the works.
- Local infill of grass/gravel to create an impermeable surface and facilitate containment and conveyance.
- Steps will provide a containment barrier and allow access in and out of the containment area where foot traffic is high, but vehicular access is not needed. These steps will have handrails to facilitate safe passage over them.

4.1 Containment Options

Two options were investigated and developed with operations. The first option considers a close containment solution for 2 individual sludge tank areas.

Table 6 – Summary of each containment area in Option 1

Containment Area	Description of containment
Main Sludge Tank Area	• Along the eastern containment boundary where the ground slopes away, reinforced retaining walls typically 1-1.5m for 260m after reprofiling of ground will provide close containment with top level of containment at 5.32mAOD. • Close containment with top level of containment at 5.32mAOD, reinforced retaining walls typically 0.5-0.75m after reprofiling of ground for 730m where the ground level is higher than the eastern boundary. • 4 ramps will provide access for vehicles as area is frequently visited during the day and reprofiled road levels to 4.78mAOD allow the use of ramps.
Riverside Blending and mixing Tank Area	• Close containment with top level of containment at 4.07mAOD on the South and East border. • Reinforced retaining concrete wall to be constructed will be 1.25m at its highest to contain spillage. • The foundation of the retaining walls limit need for additional concrete to cap grass areas. • There will be minimal bunding at 250mm on the North and East border with steps provided for pedestrian access to the area. This is to zone off the area in case of a spill and as freeboard but the ground level is higher than the spill depth so minimal containment height is required. • This is a possible opportunity to locally lower ground level and thus lowering the bund height at the maximum spill depths.
Summary	• Option 1 reduces impact to operational access as no containment boundaries impact major cross-site access roads. Ramps cross minor access roads servicing the sludge area. • Designed to contain 25% of all tank volumes (main area) and secondary smaller area dictated by largest tank plus rainfall.

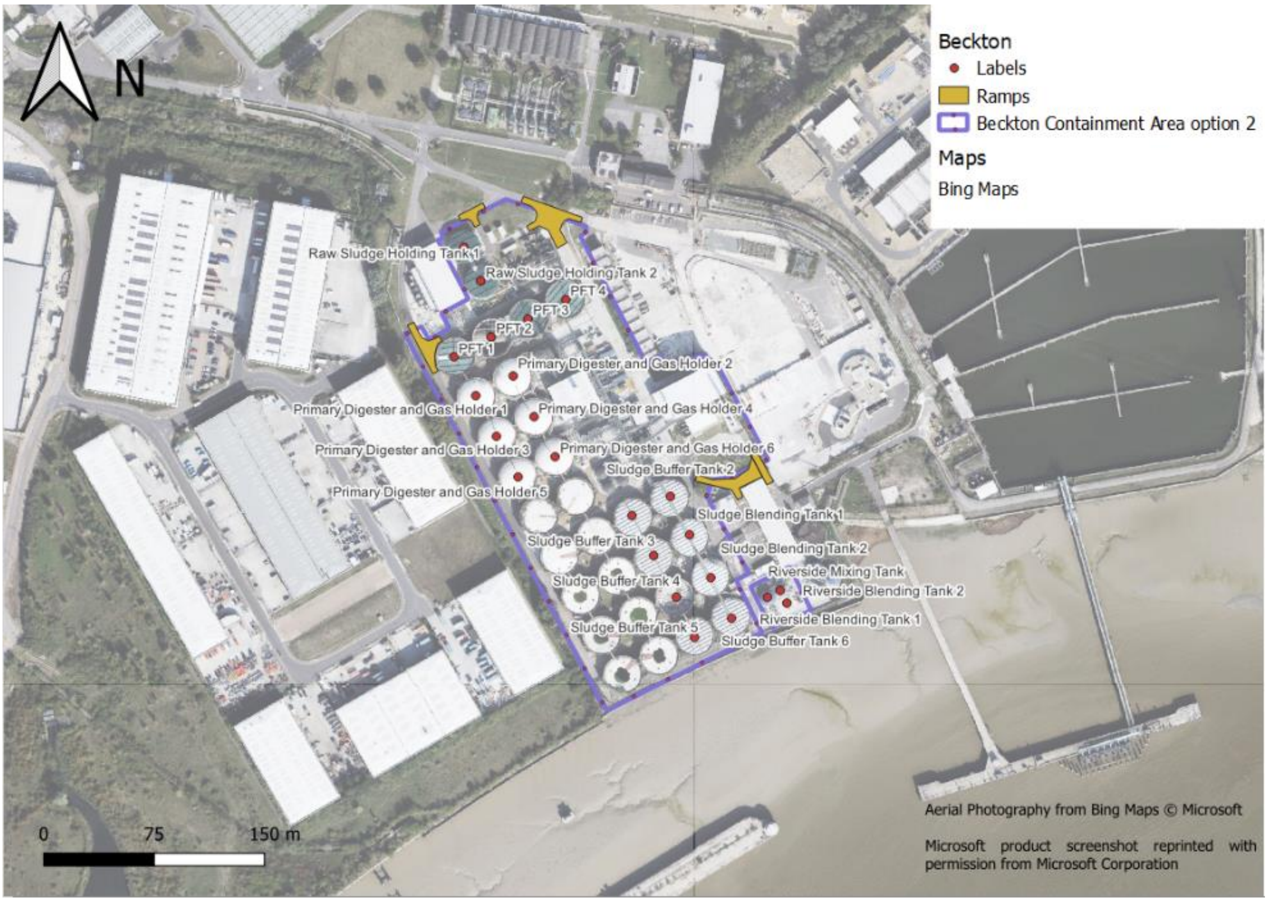

Figure 4-1 - Option 1 - Close containment solution for the Main Sludge Tank area and Riverside Blending tanks

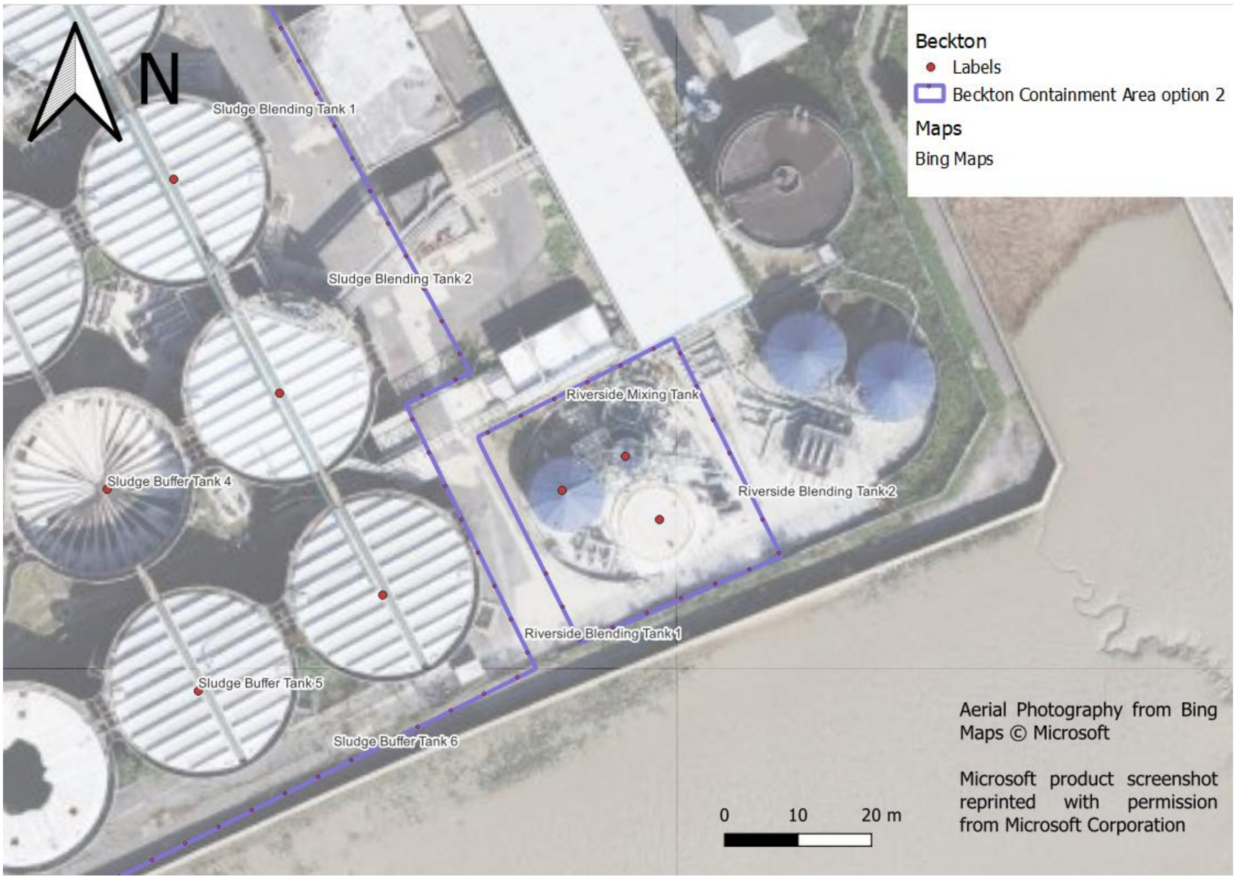

Figure 4-2 - Option 1 – Close Containment Area for the Riverside Blending and Mixing Tank

4.1.1 Option 2 – One large containment area

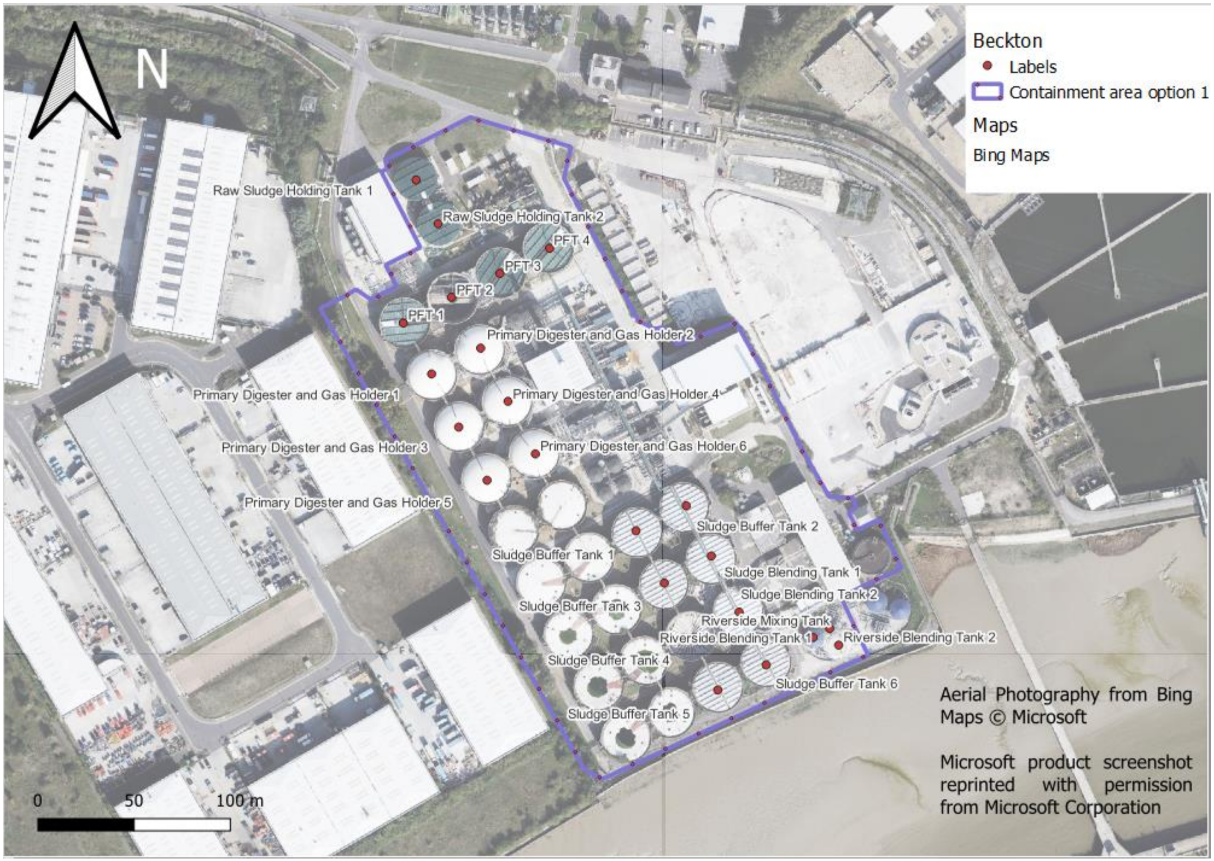

Figure 4-3 – Option 2 - 1 wide containment area

Option 2 in Figure 4-3 comprises of 1 wide containment area. This option was discussed with Thames Water Operations and ruled out as operatives indicated due to the significantly lower ground level around the Beckton Sludge Blending tanks, that these would be inundated in over 1m of water. Therefore, this option put those tanks at risk of failure or compromise with no ability to access. Modelling and costings associated with this option did not progress.

4.2 Mitigation of Site-Specific Risks

4.2.1 Jetting and Surge Flows

Due to the location of the tanks and their distance from the boundary of the containment area, there is low risk of contamination through jetting. The Raw Sludge Holding Tanks are the closest to the containment boundary at approximately 4m. Any surge or risk of overtopping will be mitigated via the use of concave concrete surface that will reflect any spill waves.

The likelihood of jetting occurring however is deemed low as failure is more likely to begin with major seeping from the tanks which would be spotted during routine site walkabout tours each day.

The natural topography of the site and the distance to the boundaries of the containment area results in a low risk of surge overwhelming the containment.

4.2.2 Flooding

According to the UK Government's Flood Map for Planning the sludge area is in Flood Zone 3 (an area with a high probability of flooding that benefits from flood defences) as shown in Figure 4-4.

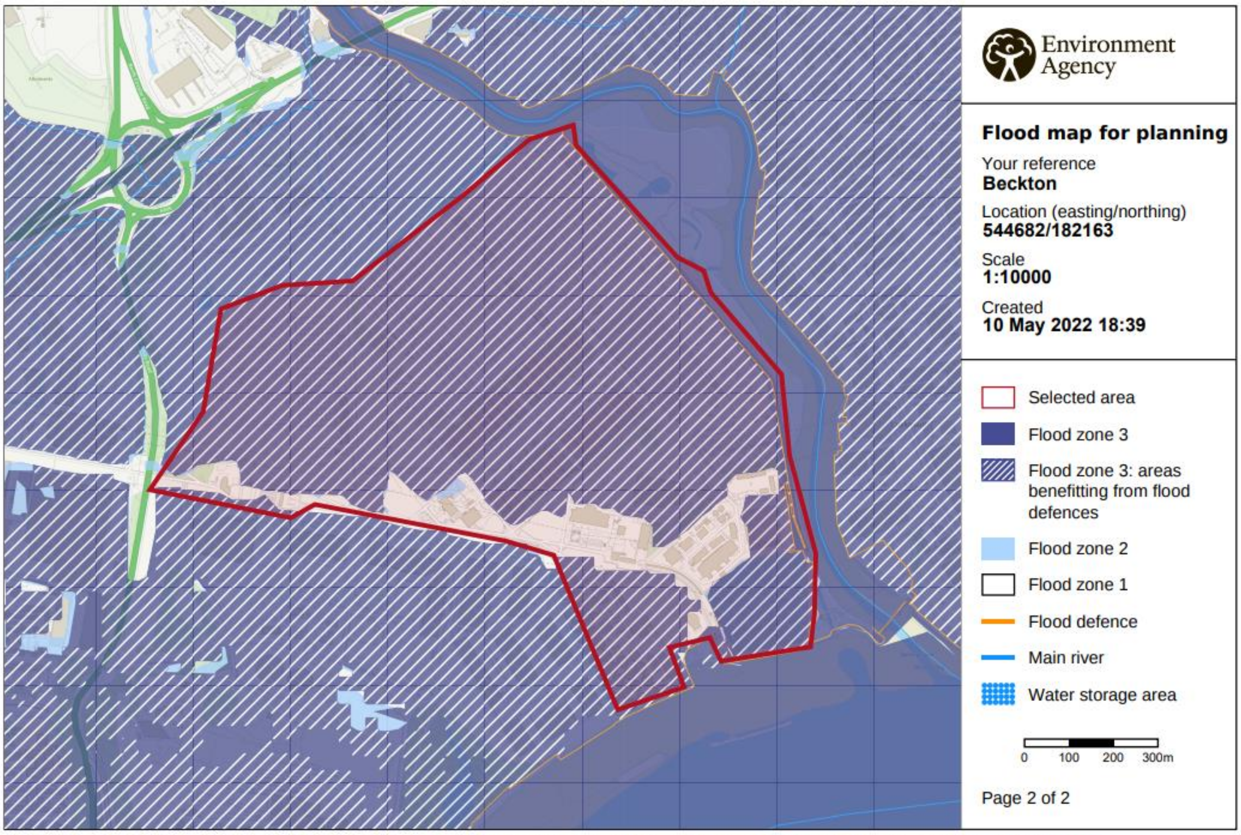

Figure 4-4 Extent of Fluvial flooding in Beckton due to extreme weather events

4.3 Identification of Preferred Option

The preferred containment proposal is Option 1 which considers the following advantages:

- Efficient use of assets/space (using roads and elevated areas to act as natural bunding)
- Practicality of installation (lower containment bund construction required)
- A lower bund wall will minimise long term site operational impacts including line of sight and ease of access.
- Access road operation simplified by use of ramps to cross containment lines rather than by the use of floodgates

H&S and CDM risks

- Flood gates not suitable for areas of high traffic movement
- Cable ducts and fibre ducts act as a potential conduit to transport sludge around site and will require sealing.
- Confirm that the containment walls do not impact the existing DSEAR equipment rating.

5. Site Drainage and liquor returns

5.1 Process flow diagram

A copy of the process flow diagram is held in Figure 5-1 below.

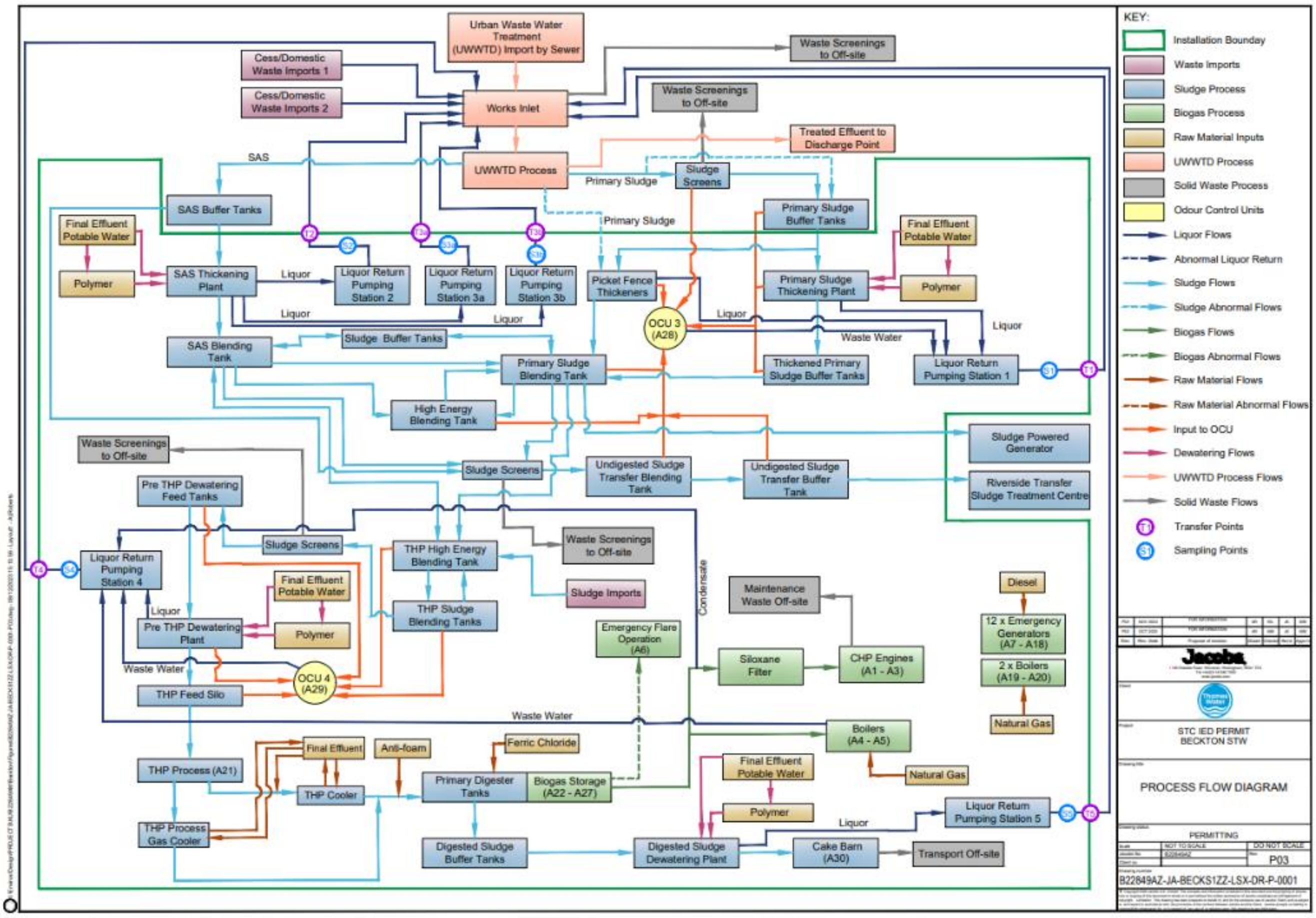

Figure 5-1 Process flow diagram Beckton STW

5.2 Foul Process and Effluent Drainage

Thames Water Operations confirmed that drainage surveys had been completed recently as part of another scheme. The surveys confirmed that all site drains return to the works inlet. This meant no additional drainage survey was required in the sludge tank area at Beckton.

Containment options onsite involve replacing existing impervious areas with concrete. This will result in a small increase in site surface waters, which are likely to have a negligible additional effect on the head of the works given the scale of flow to full treatment at Beckton.

5.3 Liquor Returns

The existing liquor return system is not being altered by the containment system, other than the control modifications proposed in Section 5.4.

Details of the liquor returns sampling are being developed outside of this report for incorporation within the permit submission.

5.4 Automatic Isolation Valves

For the catastrophic loss of containment scenarios for digester 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 generate an alarm.

In the event of a catastrophic sludge spill, flows entering the head of the works via the drainage pipes could adversely impact the sewage works treatment process. Therefore, in the event of a catastrophic loss of containment, this line 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 manual operate these valves to release flows into the existing drainage network.

- In minor or slow flow tank spill events, the sludge spill will flow into the existing 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 Beckton 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.

6. Conclusions

This section summarises the findings of the containment assessment options report for Beckton Sewage Treatment Centre.

Based upon the Anaerobic Digestion Bioresources Association (ADBA) containment assessment tool; the site carries an overall site risk rating of Medium meaning that Class 2 containment is needed.

The main features of the containment solution are summarised in the table below.

Containment Area	Description of containment
Main Sludge Tank Area	• Along the eastern containment boundary, reinforced retaining walls typically 1-1.5m for 260m after reprofiling of ground will provide close containment with top level of containment at 5.32mAOD. • Close containment with top level of containment at 5.32mAOD, reinforced retaining walls typically 0.5-0.75m after reprofiling of ground for 730m where the ground level is higher than the eastern boundary. • 4 ramps will provide access for vehicles as area is frequently visited during the day and reprofiled road levels to 4.78mAOD allow the use of ramps.
Riverside Blending and Mixing Tank Area	• Close containment with top level of containment at 4.07mAOD on the South and East border. • Reinforced retaining concrete wall to be constructed will be 1.25m at its highest to contain spillage. • The foundation of the retaining walls limit need for additional concrete to cap grass areas. • There will be minimal bunding at 250mm on the North and East border with steps provided for pedestrian access to the area. This is to zone off the area in case of a spill and as freeboard but the ground level is higher than the spill depth so minimal containment height is required. • This is a possible opportunity to locally lower ground level and thus lowering the bund height at the maximum spill depths.
Summary	• Option 1 reduces impact to operational access as no containment boundaries impact major cross-site access roads. Ramps cross minor access roads servicing the sludge area. • Designed to contain 25% of all tank volumes (main area) and secondary smaller area dictated by largest tank plus rainfall.

The contained spill modelling retains the tank contents and associated rainfall within the site boundary and the flows can be managed by TW operations for return to treatment. Road levels within the containment area are being reprofiled to enable the use of access ramps.

Existing gravelled and grass areas within the containment will be replaced with concrete. Elements of the site roads will be replaced/repaired to allow them to present an impermeable surface.

In addition to the containment elements, isolation of the site drainage system linked to the containment area will be required to mitigate the risk of unmanaged flows impacting the sewage treatment works. Freeboard allowances and the profile of the containment bund wall provides mitigation against surge effects. Jetting impact is mitigated using framed steel panels to provide additional elevation for deflection if other site features cannot provide tertiary type conveyance.

Appendix 1 ADBA Site Hazard Risk assessment summary for Beckton STC

The ADBA Industry Guidance and CIRIA C736 state how the site hazard rating of the site risk and classification are to be calculated. A summary of the hazard risks for Beckton STC are as follows:

Source – There are two sources that have been identified:

1. Domestic and trade effluent Wastewater sludges, both in a raw, semi treated and treated state.
2. Polyelectrolyte chemicals (Ferric Sulphate) for sludge thickening.

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

Pathway – There is one significant pathway that has been identified:

1. The sludge treatment centre is connected to the STW

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

Receptor – There is one significant receptor that has been identified:

1. Industrial workplaces are located within 250m to the sludge treatment centre

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

Collectively, the above generates an overall site hazard rating of **High.**

Likelihood – The mitigated likelihood is **low**, which reflects the use of materials, the tank systems do not have a history of failure, the tanks are designed to British Standards and installed by competent contractors and Thames Water undertake regular site tours giving the opportunity to identify early indications of potential issues.

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