J840 – STC IED Containment

Maple Lodge STC – Containment Options Report

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Thames Water

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Client Name:	Thames Water
Project Manager:	Harindra Gunasinghe
Author:	Wenna Shimmield
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4.0	09/02/2023	Updated with updated IED Plan	MH	SMNS	SC	HG

Contents

1. Executive Summary

Thames Water is required by the Environment Agency to provide secondary containment to their sludge treatment centres (STC) 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 Maple Lodge.

Maple Lodge STW serves a population equivalent of nearly 500,000 residents and businesses, receiving up to 300,000 cubic metres of wastewater per day, with an out-fall to the Grand Union Canal and the River Colne. 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.

Maple Lodge has the potential for some 62,000m^3 of liquid to escape from the sludge treatment centre in the event of tanks failure. The liquid sludge is stored in 30 tanks with individual volumes varying between 430-2200m^3, refer to section 3.4.1 for details on the tanks and volumes. The majority of the tanks are concrete. The site is manned and subject to regular tours by operations staff.

The preferred option for Maple lodge is a hybrid option of bund walls, flow guiding walls and canal below ground storage, refer to Figure 1-1. This option has the following key features:

1. Close containment of the Secondary Digesters. This will require a bund wall with a typical height of 2.0 m.

2. Containment of the northern primary digesters and SAS assets. This will require a bund wall with a maximum height of 0.57m. Spills within this area will initially be contained within the bund wall, unless they exceed a TWL of 41.96, at which point the excess spill volume will gravitate into the repurposed canal retention area via the southern road access bund ramp following a contained conveyance path.

3. Flow guidance around the southern primary digesters. To direct any spills from these tanks directly into the repurposed canal retention area.

The primary digesters and ancillary sludge tanks are contained within a bunded boundary with sufficient area to generate a depth that does not deny emergency access to equipment when the spill has been contained.

The secondary digesters are addressed by a close containment solution due to space constraints and lower traffic movements that allow the use of floodgates.

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 an eight-day recovery period. Where practicable, vehicular access into the containment areas is by ramps (speed humps) restricted to nom 250 mm in height. 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. Remedial works to existing concrete slabs/roads will be undertaken to ensure that they provide a competent surface, for example resealing of joints.

The total design spill volume comprises of 15,600 m^3 from 25% of the total sludge tank inventory volume. The 25% scenario exceeds both the 110% and single largest tank plus rainfall volumes and hence becomes the critical Design Spill Volume.

General layout of proposed solution

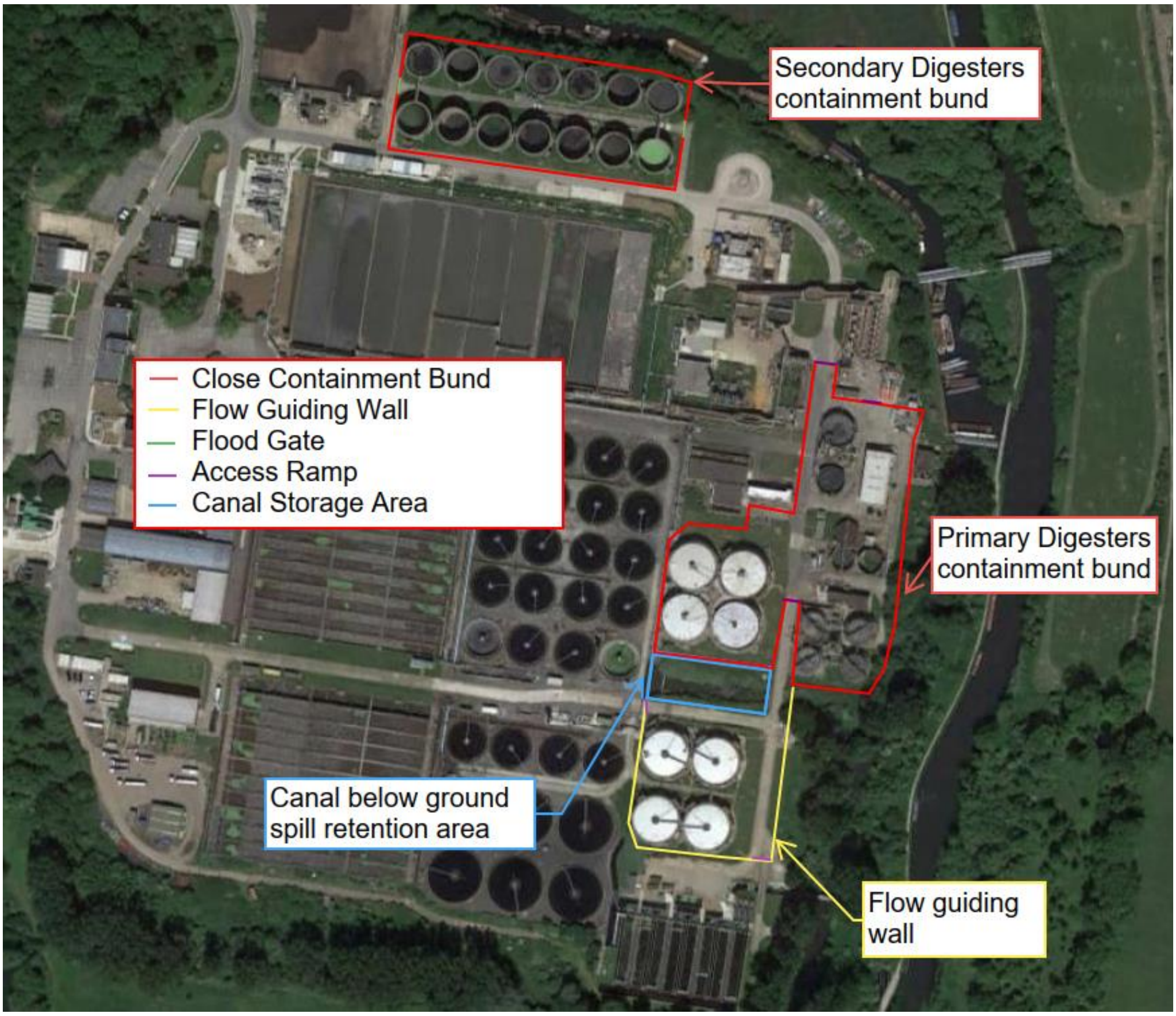

Figure 1-1- General Layout of Proposed Solution

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". 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 28 Thames Water sites. Based on CIRIA C736 and ADBA risk assessment tools this containment report addresses the site-specific risks at Maple Lodge 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 Maple Lodge STC 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 Maple Lodge STW were identified through a desktop study, Light Detection and Ranging (LiDAR) analysis and a site visit.

Maple Lodge STW (Figure 2-1 and Figure 2-2) is a large sewage works in Maple Cross, Hertfordshire, northwest of London. The site is situated in an area surrounded on the north and east by River Colne (a tributary of the River Thames) and its brooks, on the south by Lynsters lake and on the west by Maple Lodge Nature Reserve. Maple Lodge STW serves nearly 500,000 residents and businesses, receiving up to 300,000 cubic meters of wastewater per day, with an out-fall to the Grand Union Canal and the River Colne. There are 30 tanks as part of the sludge and bioresources area with an approximate total operational sludge volume of 62,400m^3 refer to Figure 2-3. The permitted area that will be the focus of this report is indicated in green in Figure 2-4.

This document has been developed from Maple Lodge STW, Risk Identification and Containment Assessment Report, which outlines the impact of an uncontained spill and the risk assessment completed.

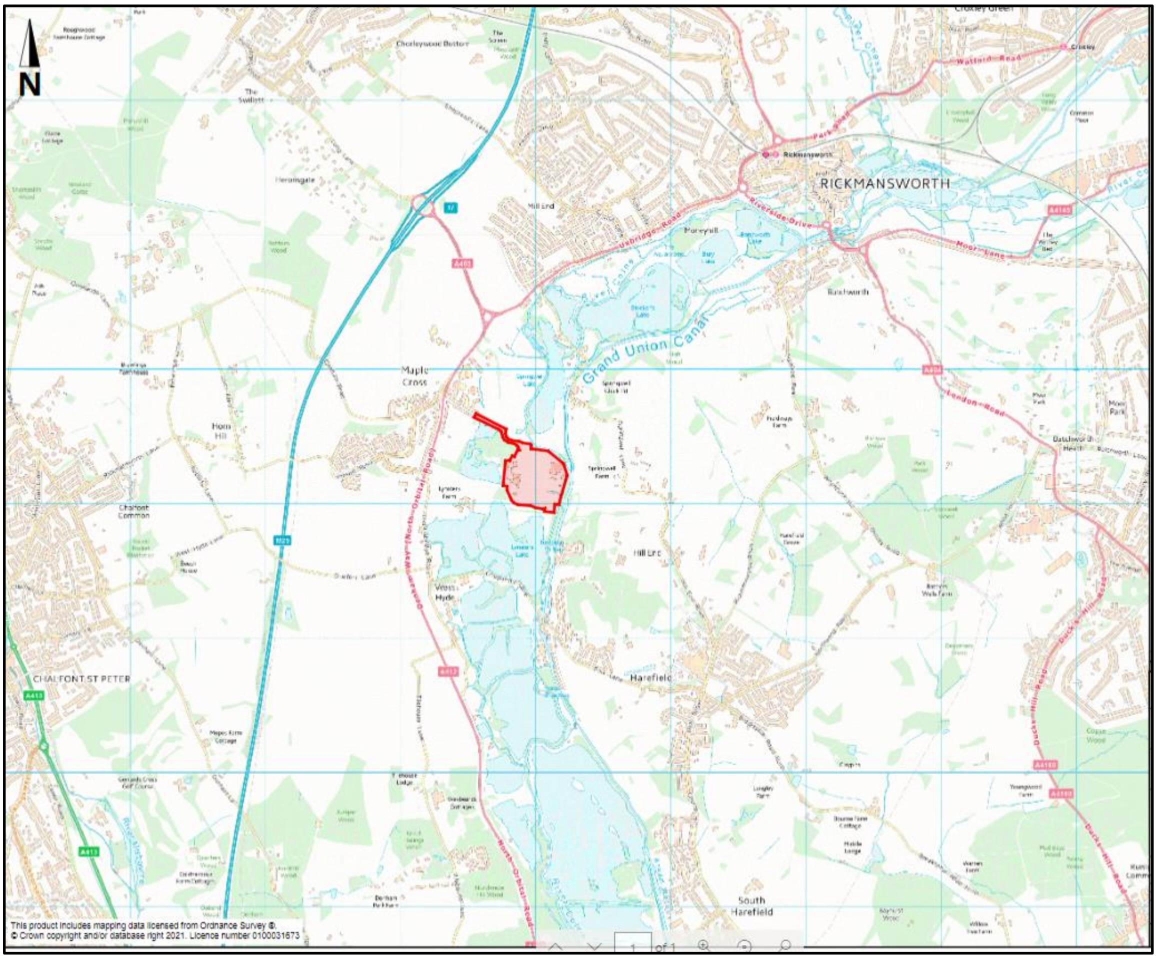

Figure 2-1 - Location Plan Maple Lodge Sewage Treatment Works

Figure 2-2 - Satellite view of Maple Lodge Sewage Treatment Works

Jacobs

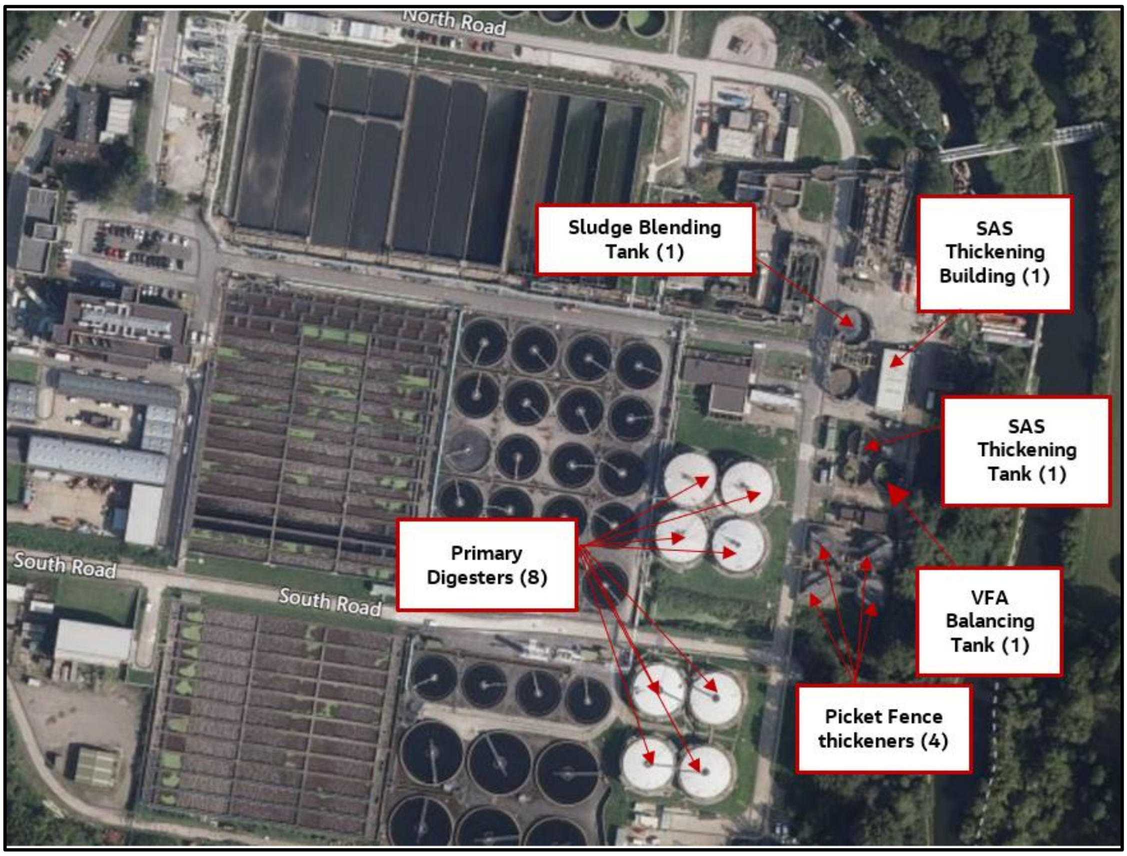

Figure 2-3 - Labelled image of the STC elements within Maple Lodge Sewage Treatment Works

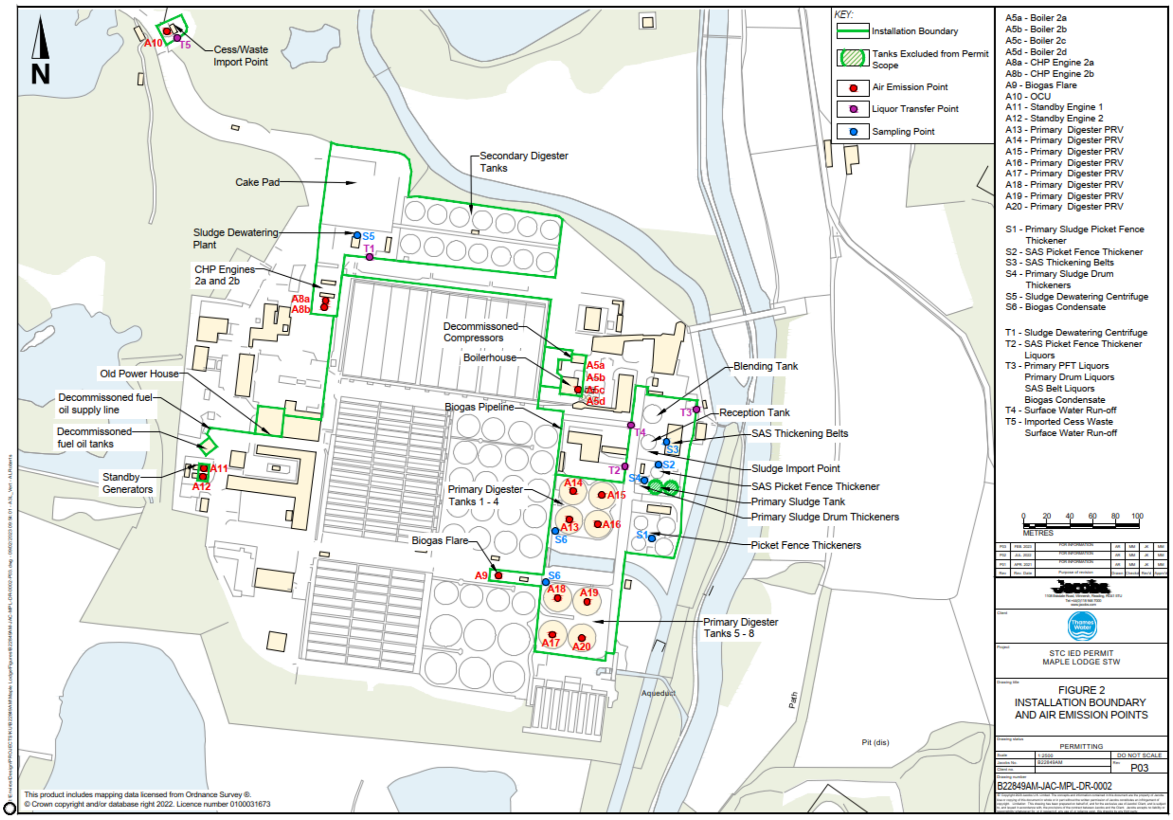

Figure 2-4 - Boundary of the permitted IED area and the assets contained within Maple Lodge STW

3. Proposed Containment at Maple Lodge

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;

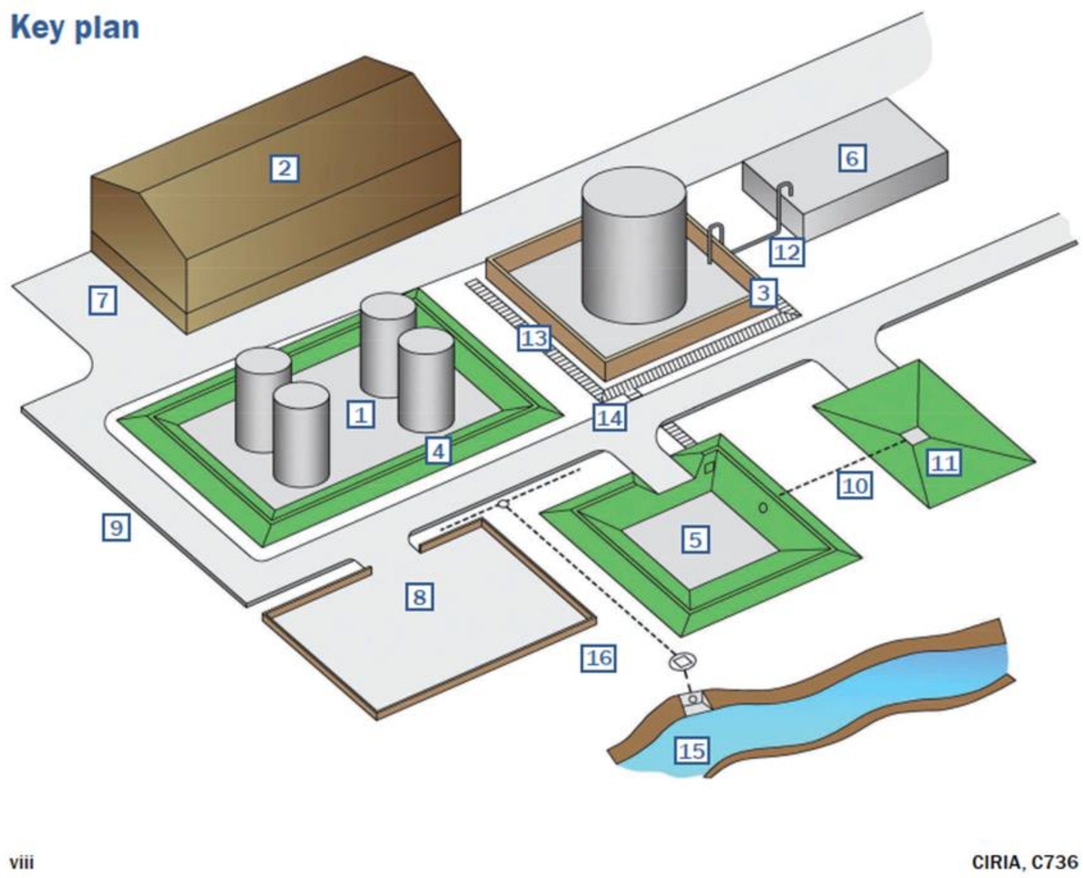

Figure 3-1 Diagram of primary, secondary and tertiary containment examples

- **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;

- 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 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 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

The sludge spill mapping of an uncontained event in Maple Lodge STW shows that a potential sludge spill will not be self-contained within the desired area and therefore passive containment needs to be implemented to safeguard the nearby receptors, refer to Figure 3.2. According to the model the spill will leave the site boundary (in the southeast site boundary) in approximately 6 minutes after the failure of one of the primary digesters.

In the event of a failure of one of the primary digesters, some of the sludge will travel eastwards towards the southeast site boundary. From here, this sludge will accumulate in the canal and then leave the site and will flow directly into River Colne where it splits into two; some of it will flow northwards while the rest flows southwards along the river channel. Part of the spilled sludge from the failed tank will travel inside the STW reaching assets on the north, south and east of the site through the internal pathways.

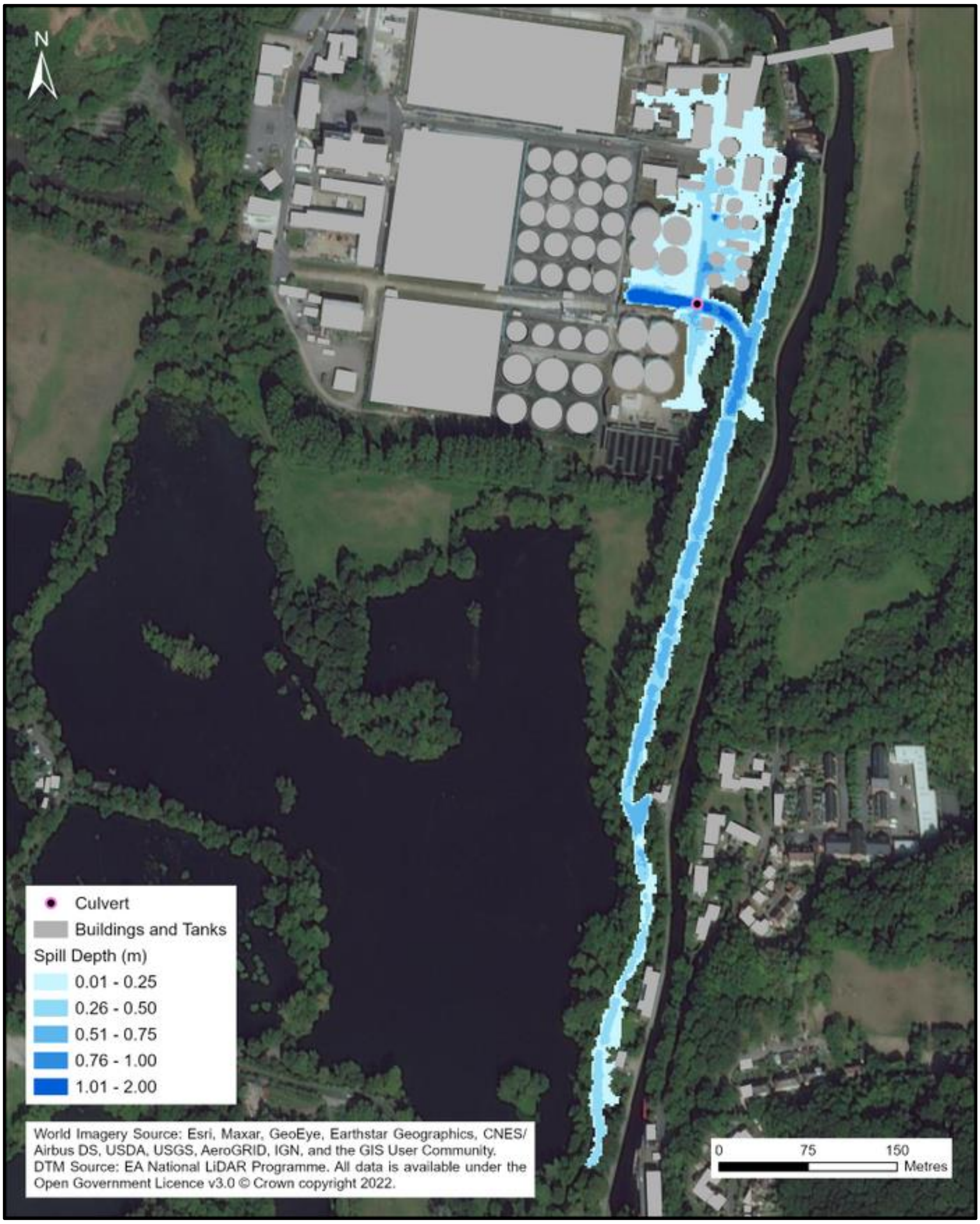

Figure 3-2 - Map of Uncontained spill event at Maple Lodge STW

3.3 Site Classification Maple Lodge

Based on the use of the ADBA risk assessment, considering the source, pathway and receptor risk Maple Lodge site hazard rating is deemed to be Medium. When considering the mitigated likelihood as low a class 1 secondary containment is required.

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

Refer to Appendix 1 for more detailed 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 [of CIRIA 736] 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

Primary Digesters Area

The total design spill volume comprises of 15,600m^3 from 25% of the total sludge tank inventory volume. The 25% scenario exceeds both the 110% and single largest tank plus rainfall volumes rules and hence becomes the critical Design Spill Volume.

3.4 Maple Lodge STW Summary of Containment volumes and assets

3.4.1 Assets for Containment

The tanks for containment are summarised in Table 1.

Table 1 – Maple Lodge Sludge Tank Inventory

Tank Purpose	Number	Operational Volume (m^3)	Total Volume (m^3)	Construction
Picket Fence Thickener	4	430	1720	Steel
Sludge Tank	1	525 *estimated by Ops	525 * estimated by Ops	Concrete
SAS Storage Tank	1	525 * estimated by Ops	525 * estimated by Ops	Concrete
Reception Tank	1	525	525	Steel
Sludge Blending Tank	1	1050	1050	Steel
Primary Digester Tank	8	3407	27256	Steel
Secondary Digester Tank	14	2200	30800	Concrete

3.4.2 Constrained Model Output

For the Secondary Digesters Area, contained modelling is unable to be computed via our modelling software due to it's small scale. Manual calculations indicate that the TWL within this bund for a spill involving 25% of secondary digester sludge is 44.20m. This correlates to a bund wall height of notionally 2.0 m high (inc. freeboard).

For the Primary Digesters and SAS assets containment area, the modelling showed that 2000 m^3 can be stored within the bunded area shown by the red boundary in Figure 3-3. The intention is that spillage within will initially be harboured within the containment bund and only gravitate to the canal storage area (via the southern access ramp) when the bund capacity exceeds a TWL of 41.96 m. This would only occur on the rare and unlikely occasion of multiple catastrophic tank failures. This is unlike the southern primary digester area, which any spill will gravitate directly into the canal storage area.

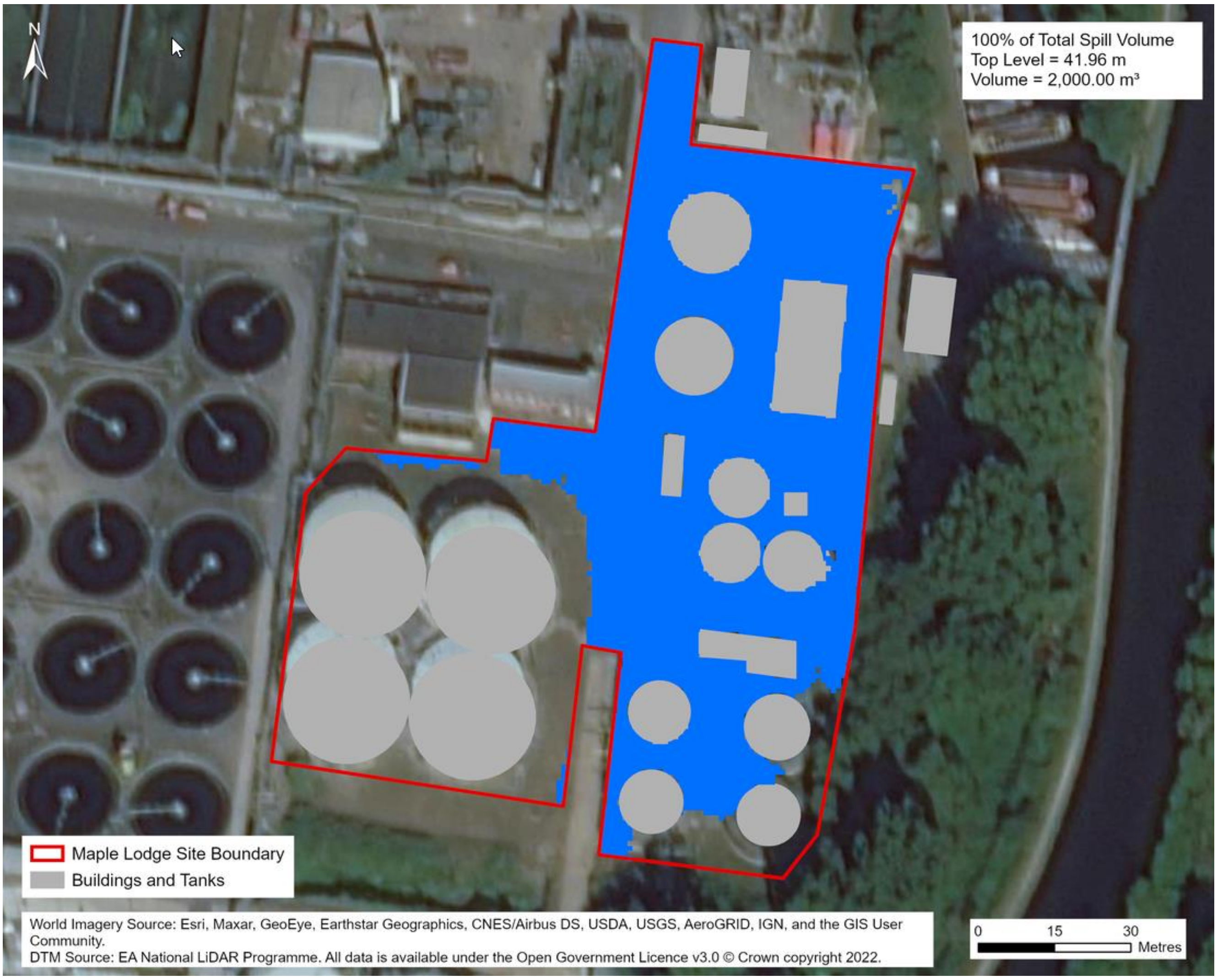

Figure 3-3 - Primary Digesters and SAS asset area contained model

The bund alignment has been selected to minimise the impact of main roads and ensure that the maximum spill volume scenario does not prevent vehicle access within the primary digester area.

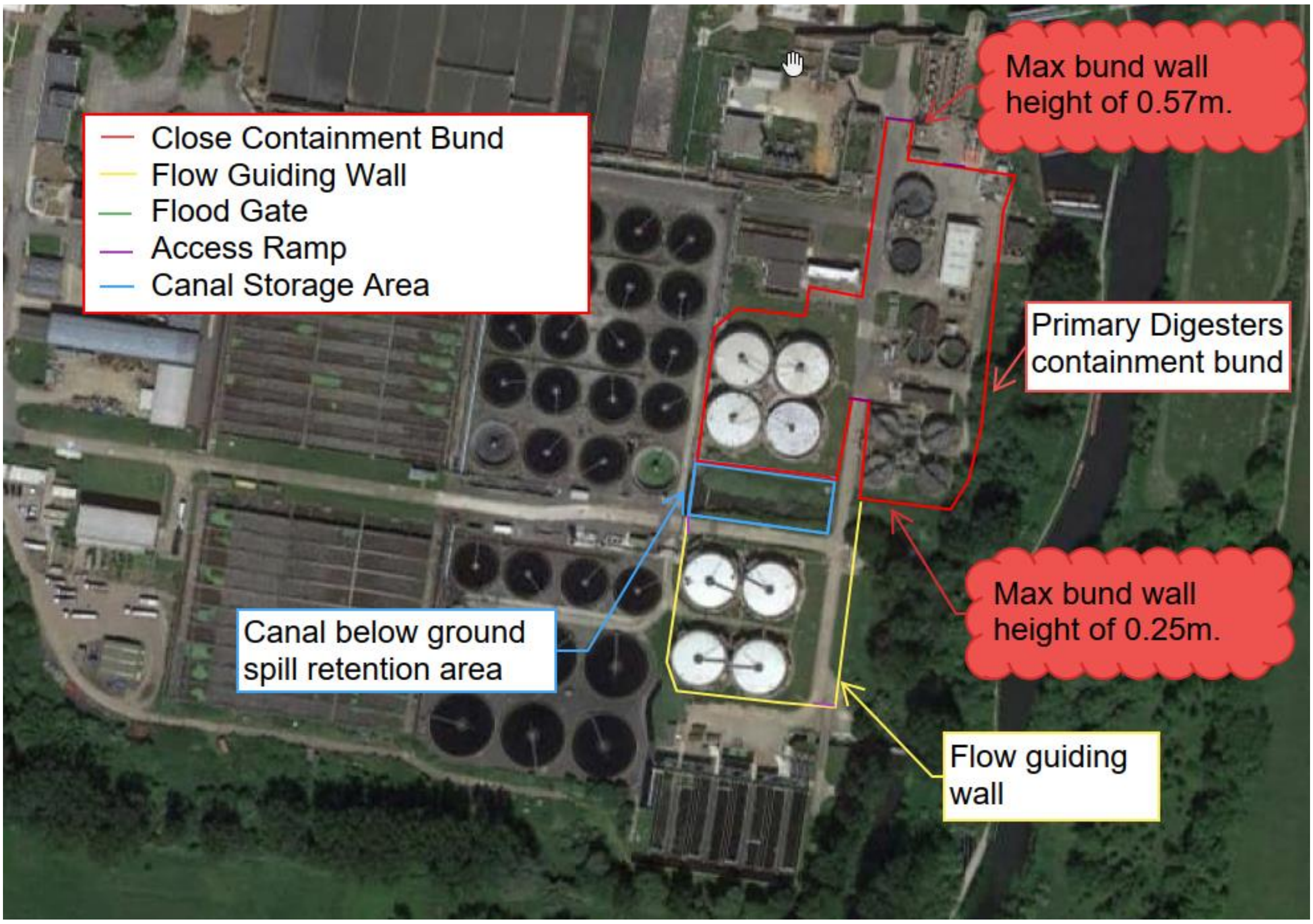

Figure 3-4 – Primary Digesters Area Containment Bund Wall Height

3.4.3 Site Topography

As can be interpreted from the site's topography shown in Figure 3-5 there is a high risk of spilled sludge flowing from the sludge assets towards the east to River Colne and south towards Lynsters Lake and the surrounding STW assets. The site has a highpoint around the central assets and grades down towards the site boundary in all directions. The local low point of the site is the canal (old channel) that runs in between the 8 No. primary digesters. For this reason, the proposal is that the old canal channel will be blocked off as a part of these containment walls and flow guiding and bunding walls will ensure that flows are directed into the repurposed canal retention area when required protecting the water course external to the site boundary. The contours for the two discrete bunded areas can be seen in Figure 3-6 and Figure 3-7.

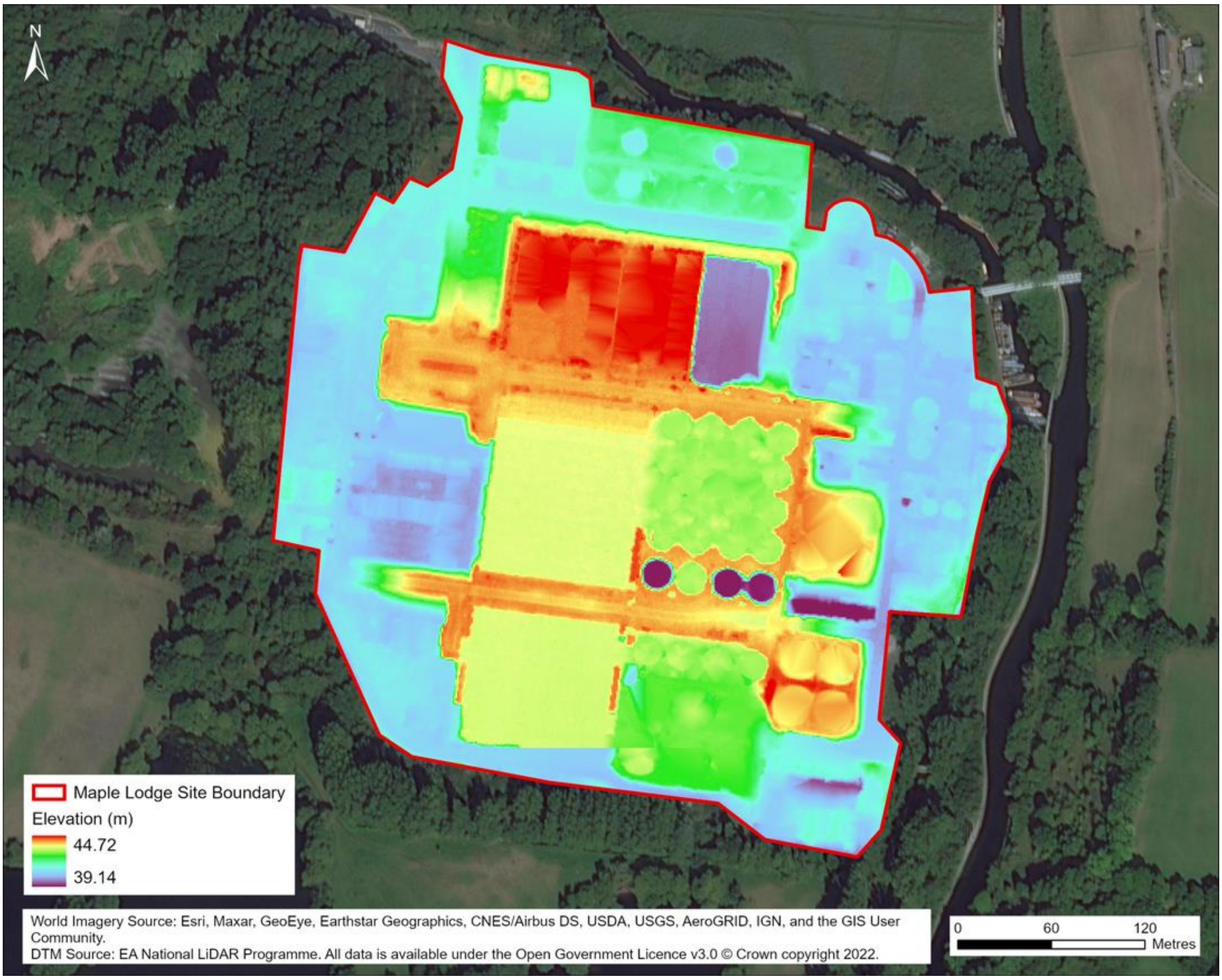

Figure 3-5 - Digital Terrain Model of Maple Lodge Sewage Treatment Works

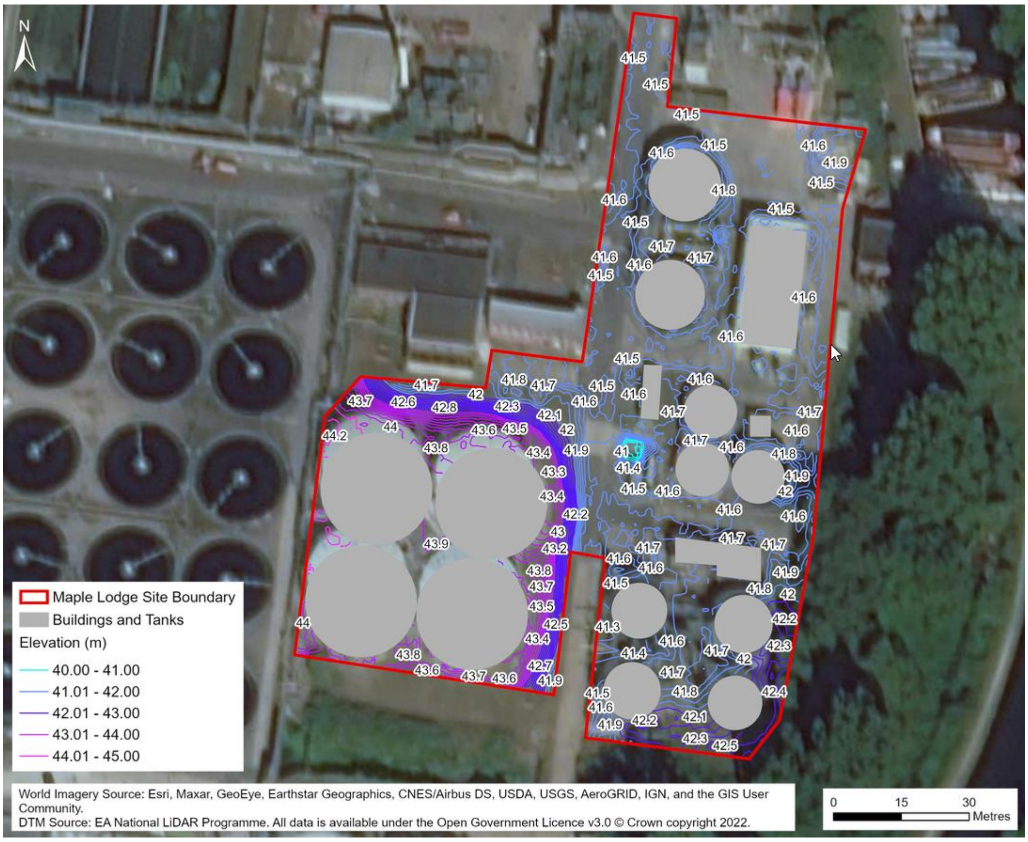

Figure 3-6 – Contour Plot of Primary Digesters and SAS assets containment area

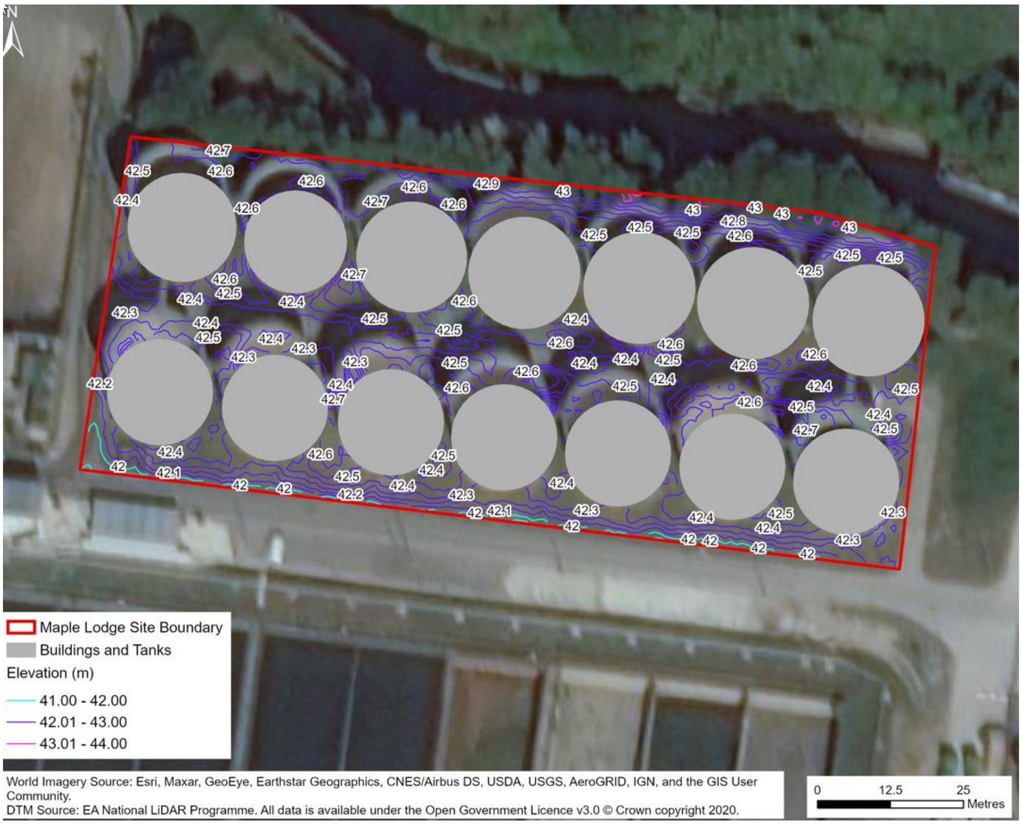

Figure 3-7- Contour Plot of Secondary Digesters Area

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 directed as 8 days. This aligns with the CIRIA guidance maximum as Thames Water operations state they cannot achieve this in a significantly shorter time, e.g. 48hrs.

3.5.1.2 Surface Cleaning

The existing ground surfaces within the containment area that are grass and gravel and will need to be replaced with an impermeable surface e.g. concrete from which sludge can be cleared up easily. This is nominally an area of some 7,000m^2.

It is noted that concreting this area 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), 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 flow guiding walls will be via ramps (speed humps) restricted to nom 250 mm in height.

Flood gates have been included at the proposed entry points into the close containment areas around the secondary digesters.

3.5.1.4 Existing Services

There may be existing services in the canal area that need to be relocated to accommodate the excavation of this area. Several above ground pipes can be seen from aerial images which may need to be relocated during construction/excavation.

3.5.2 Geotechnical and Environmental constraints

The northeast corner of the site around the 14 No. of primary digesters presents a difficult environment to build the required high bund wall (refer to Figure 3-8). From satellite images it is apparent that vegetation removal will be required for the northern bund wall. In addition, it is expected that the geotechnical conditions in this area will be complex due to the proximity the river which will likely present construction and structural difficulties.

Figure 3-8 – Secondary Digester Environmental and Geotechnical Constraints

3.6 Design allowance for rainfall

The arising average rainfall depths for a 1 in 10-year storm over the event period for Maple Lodge is 90.75 mm. It should be noted that the rainfall depths for Maple Lodge have been estimated using the depth-duration-frequency rainfall model contained in the Flood Estimation Handbook (FEH), which provides location specific rainfall totals for given durations and return periods.

The rainfall volume has not been included in the design, as according to CIRIA if the critical volume is 25% of the net volume of tanks onsite, no specific allocation for rainfall is required.

3.7 Planned Site Upgrade

Thames Water Operations noted that major upgrades to the site are proposed including large stormwater storage and THP process introduction.

This presents the following risks and opportunities in relation to the IED containment options at this site:

- Containment construction as part of the preferred option may interfere with planned upgrades and connections
- The introduction of new sludge containment assets as part of this upgrade my require additional containment strategies
- The planned construction of major storage assets could potentially be combined or repurposed with sludge containment construction for a more cost effective solution, but at this point the containment proposals seek to avoid sterilising areas with potential to accommodate new construction

4. Secondary Containment

The constituent parts of secondary containment are;

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

For Maple Lodge, where possible, existing features of the site (e.g., suitable 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 Maple Lodge 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 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 250-300mm with an approach gradient of some 5% (1 in 20) 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. Where ramps are impracticable and traffic frequency allows the solution changes to the use of floodgates.
- Local infill of grass/gravel to create an impermeable surface and facilitate containment and conveyance.
- Raised kerbs on roadways to channel spill to the remote containment area.
- All buildings within the containment and transfer areas must either have doors that lie above the top water levels detailed in Section 4.1 or do not contain sensitive equipment below the anticipated the top water level.

4.1 Containment Options

4.1.1 Option 1 – 2 No. Close containment areas and below ground canal storage

Containment Option 1 was developed in conjunction with Thames Water Operations and is illustrated in Figure 4-1.

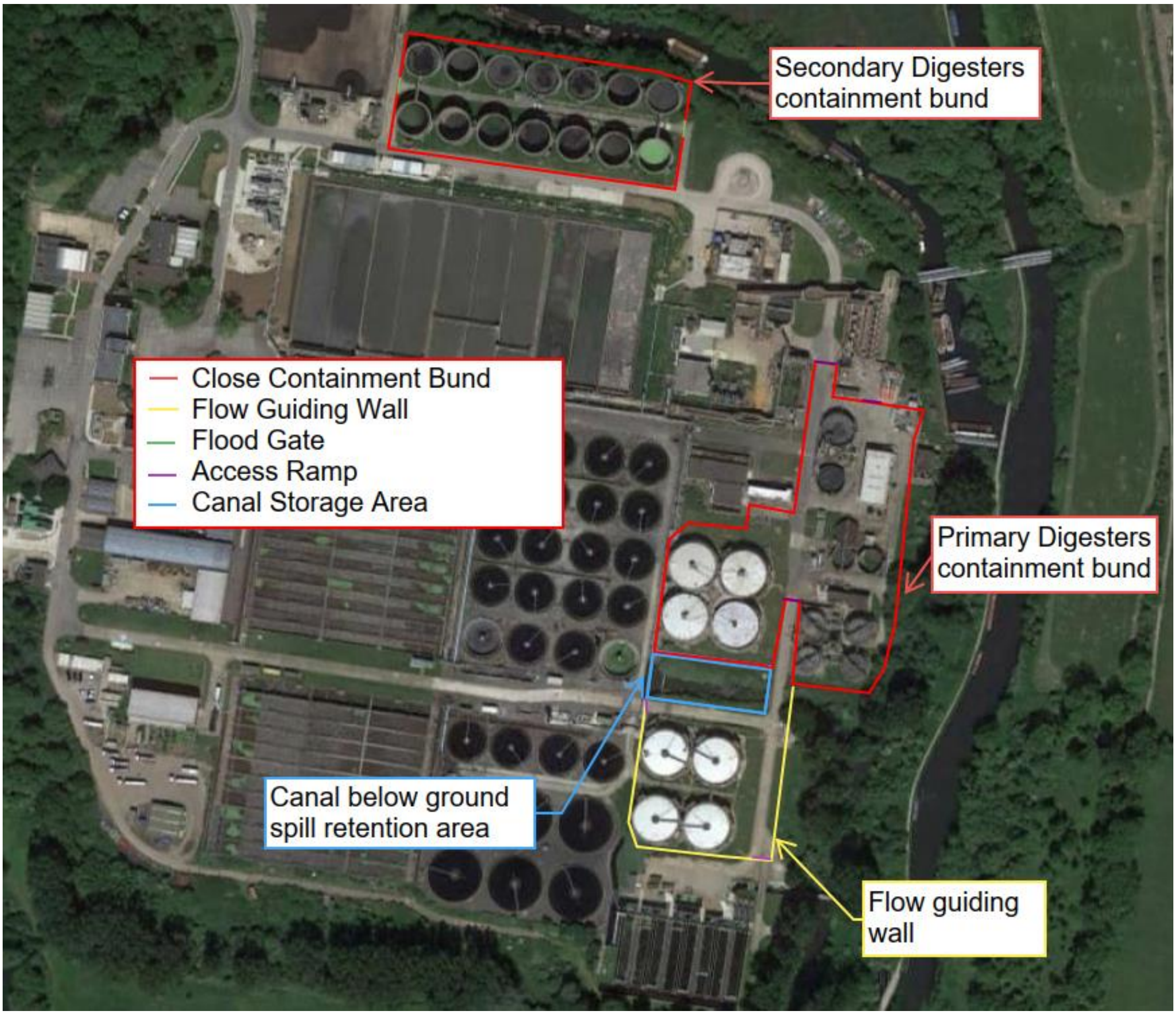

Figure 4-1- Option 1 – 2 No. Close containment areas and below ground canal storage

Option 1 comprises of 3 No. key elements which are described and illustrated individually below:

1. **Canal Storage**

The existing canal area on site between the 8 No. of Primary digesters normally holds stagnant water and picks up some site surface water drainage. This canal in it's current state provides a potential pathway for spills to reach the nearby river.

The proposed resolution for this is to block-off this canal area from the watercourse and deepen the area to act as below ground storage/containment in the event of a sludge spill. This area once excavated will nominally provide 5700 m^3 of sludge storage. The canal storage solution is illustrated in Figure 4-2 overlayed on a topography map.

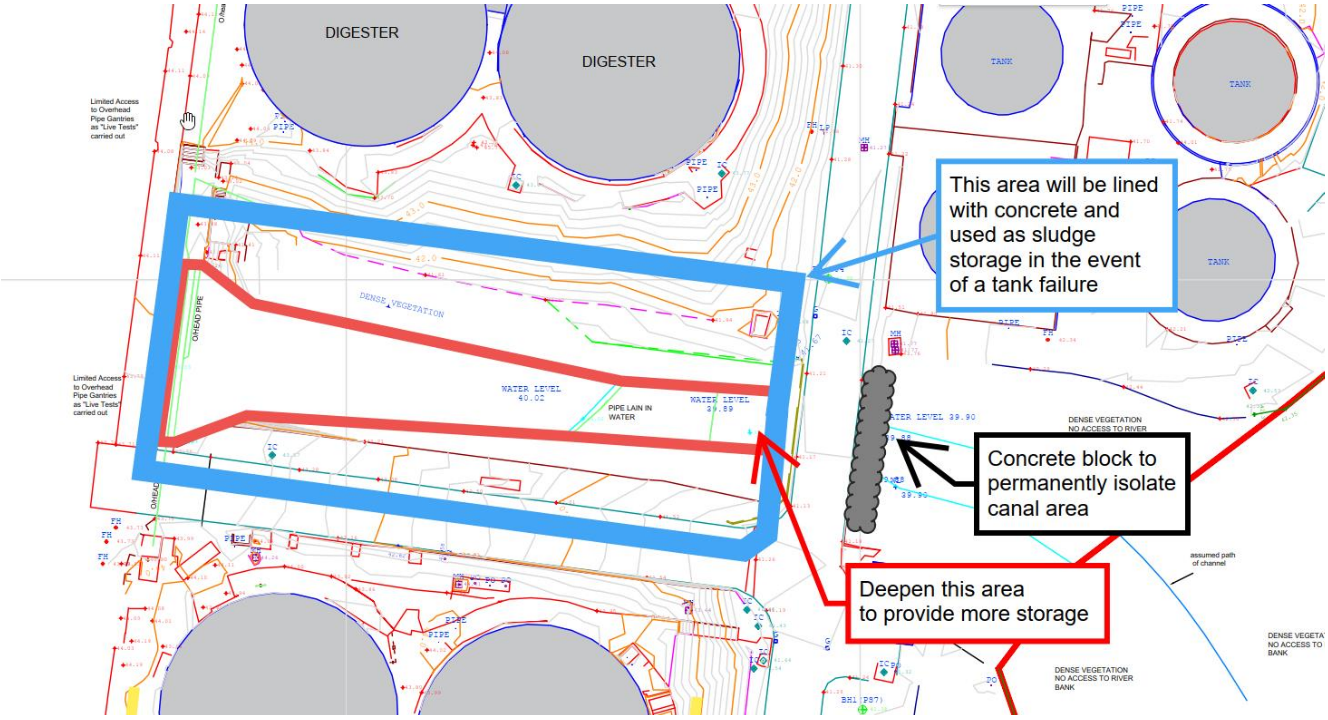

Figure 4-2 – Option 1 Canal Storage Area

2. **Close Containment Secondary Digesters**

The 14 No. secondary digesters at the northwest corner of the site need to be close contained with a high bund wall, refer to Figure 4-3. The space constraints and topography of this area limit the available options for containment, despite the environmental and geotechnical sensitivities of this area as discussed in Section 3.5.2. Operations advise that these tanks are all operational. Some are used for "emergency storage". Clarification is being sought on the frequency of usage to distinguish between regular peak buffering and infrequent storage due to unforeseen issues.

Figure 4-3 – Close Containment Bund for the Secondary Digesters

The 25% rule dictates a containment volume that results in a depth of some 1.72m and walls of some 2m in height. This wall height will require operational mitigation to address the risk of heavier than air gases (e.g. carbon dioxide) collecting on a still day. Such measures could include personal gas detectors and a topman external to the bunded area to maintain visual contact with operatives within the containment area.

3. **Primary Digesters Containment Area**

The primary digester containment area is hybrid solution of canal retention area, flow guiding wall and a close containment bund. Low height (0.25m) flow guidance walls, refer to Figure 4-4.

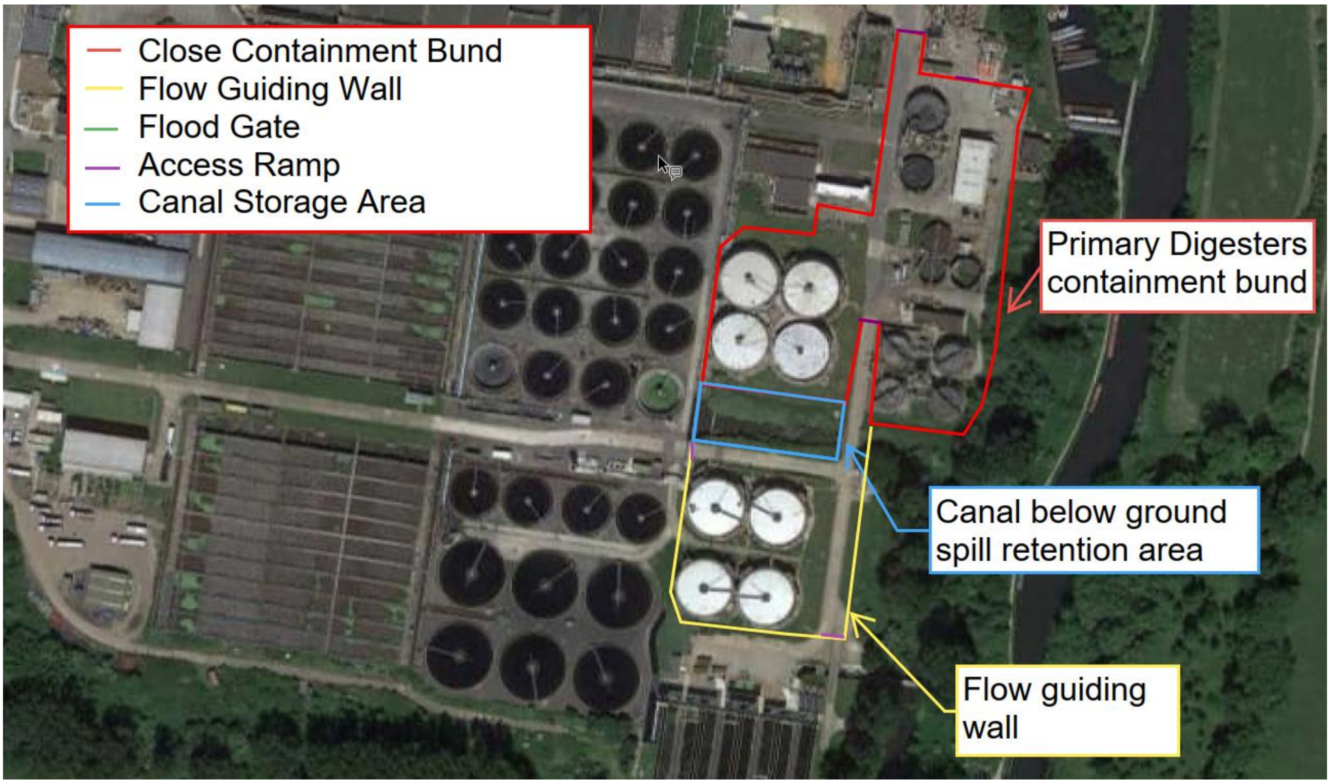

Figure 4-4 -Primary Digesters Containment Area

4.1.2 Containment Option 2 (not modelled)

Option 2 comprised of 3 No. discrete close containment areas as shown in Figure 4-5. This option was discussed with Thames Water Operations and ruled out due to the bund wall height (with associated significant foundations) and operational implications of this option, which included interaction with the final effluent culvert and gas lines. Modelling and costings associated with this option did not progress.

Figure 4-5 – Option 2, 3 No. of Close Containment Area

4.2 Mitigation of Site Specific Risks

4.2.1 Jetting and Surge Flows

Jetting distance around the primary areas has been calculated to be up to 9m. In some directions (notably west) this minimum distance is not able to be met due to space constraints. The primary digesters are steel tanks which present a higher risk of jetting compared to concrete tanks. Despite the jetting risks, the natural topography of the site typically guides flows to the canal, permanently blocking the canal connection to the River Colne as part of the containment works minimises the risk of low volume spills leaving site.

For the secondary digesters there is a risk of contamination through jetting due to the proximity of the secondary digestors to the boundary of the site and containment area for which tertiary provision has been made. The secondary digester tanks are concrete construction, for which catastrophic failure is deemed to be less of an issue. Failure is more likely to begin with major seeping from the tanks which would be spotted during routine site walkabout tours each day.

Surge effects have been mitigated by the bund profile (recurved to return flows back on itself) and the distance of the bund wall to the tanks.

4.2.2 Flooding

According to the UK Government's Flood Map for Planning, the sludge area is in Flood Zone 2 and 3, is shown in Figure 4.5. Maple Lodge STW, has a 1 in 100 or greater probability of river flooding. The sludge assets on the north and east of the site, are in a flood zone 2 but are adjacent to a flood zone 3 while the primary digesters on the southeast sit in a flood zone 3. Mitigation measures are to be further investigated for fluvial flooding given that the probability of flooding in the area is high.

Also, 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.

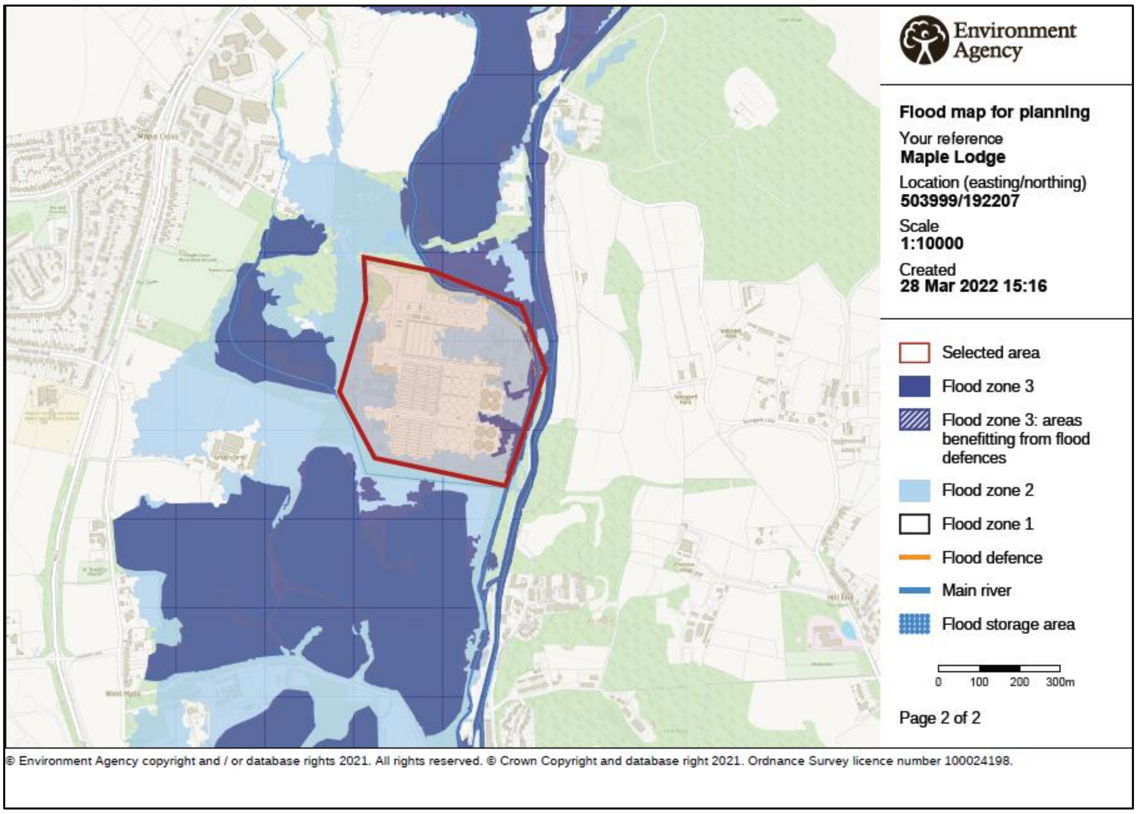

Figure 4-6 - Extent of Fluvial flooding in Maple Lodge due to extreme weather events

4.3 Identification of Preferred Option

The preferred solution for this site is Option 1. This was established in conjunction with Thames Water Operations on the basis that Option 1 represents the best use of existing land and topography onsite while also minimising the risk of spills onsite reaching the waterway via the existing canal connection.

4.3.1 H&S and CDM risks

- Construction of the northern bund wall around the secondary digesters involved working adjacent to the water.
- The re-purposed and re-worked canal will present long term 'working from height's' issues to be managed including fencing and access.
- The excavation of the canal area presents a risk of stability and flotation to be assessed.
- The 2m high containment wall to the secondary tanks restricts visibility and offers the potential for heavier than air gasses (e.g. carbon dioxide) to collect on still days; operating regime to incorporate mitigation measures (e.g. personal gas detectors and top man)
- Confirm that the containment walls do not impact the existing DSEAR equipment rating.
- Interfacing of the containment project with proposed tank remedial works.

5. Site Drainage and liquor returns

5.1 Process flow diagrams

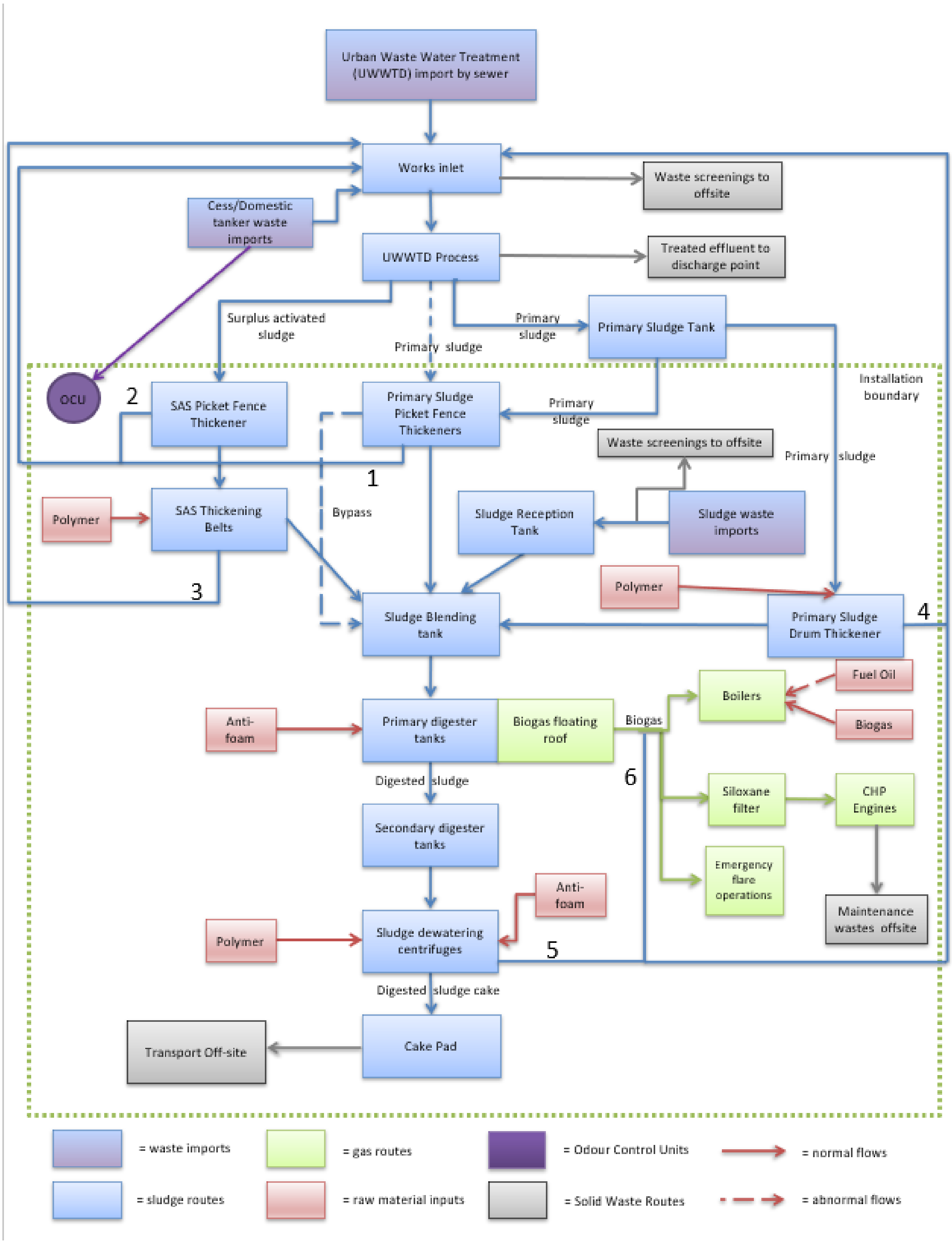

Figure 5-1 – Process Flow Diagram

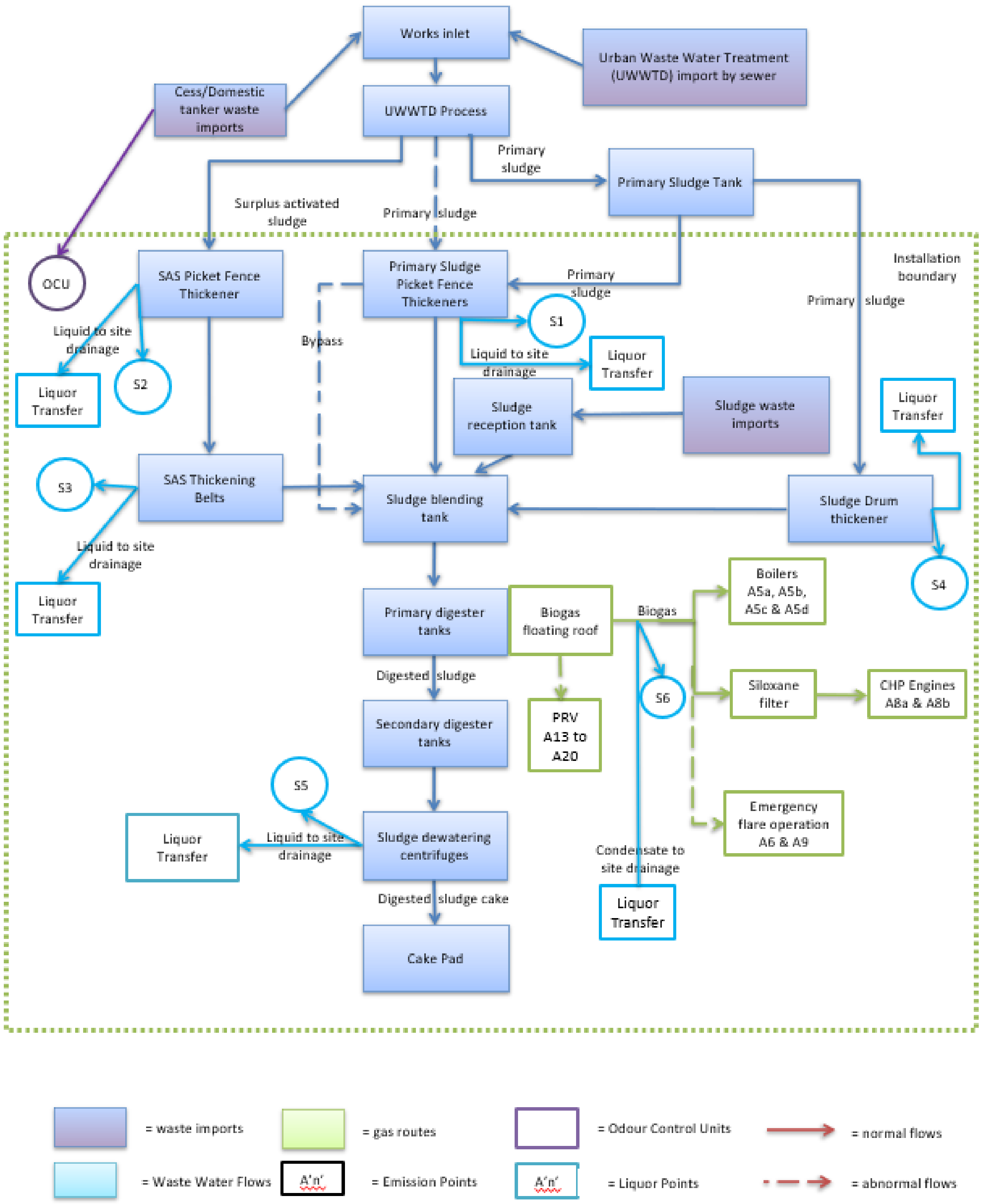

Figure 5-2 – Process Flow Liquor Diagram

5.2 Foul, Process and Effluent Drainage

Site drainage assessments are based on Maple Lodge Sewage Works Layout Plan Drawing Numbers: MAPLSIZZ-DPL-0011 to 003.

The Sewage Works Layout Plan for Maple Lodge shows all Combined/ Process/ Effluent drainage pipes, indicated by the blue lines, go back to the head of the works via pumping stations as shown in Figure 5.4. In the event of a catastrophic sludge spill, flows entering the head of the works via these pipes could adversely impact the sewage works treatment process. Therefore, in the event of a catastrophic loss of containment, this line should be isolated or pumping should be inhibited. Several float operated isolation valves are recommended to be installed on the combined sewer/stormwater lines to allow cessation of flow in unusual conditions. Operations can override the isolation action of the float valves in the event of exceptional rainfall rather than tank failure.

The surface water drains, shown as the dark green lines, will need to be rerouted away from the canal that will be blocked off as part of the containment works.

No stormwater or combined effluent drains are shown on the drawings to be present in the Secondary Digester containment area and therefore no additional scope is required in this area.

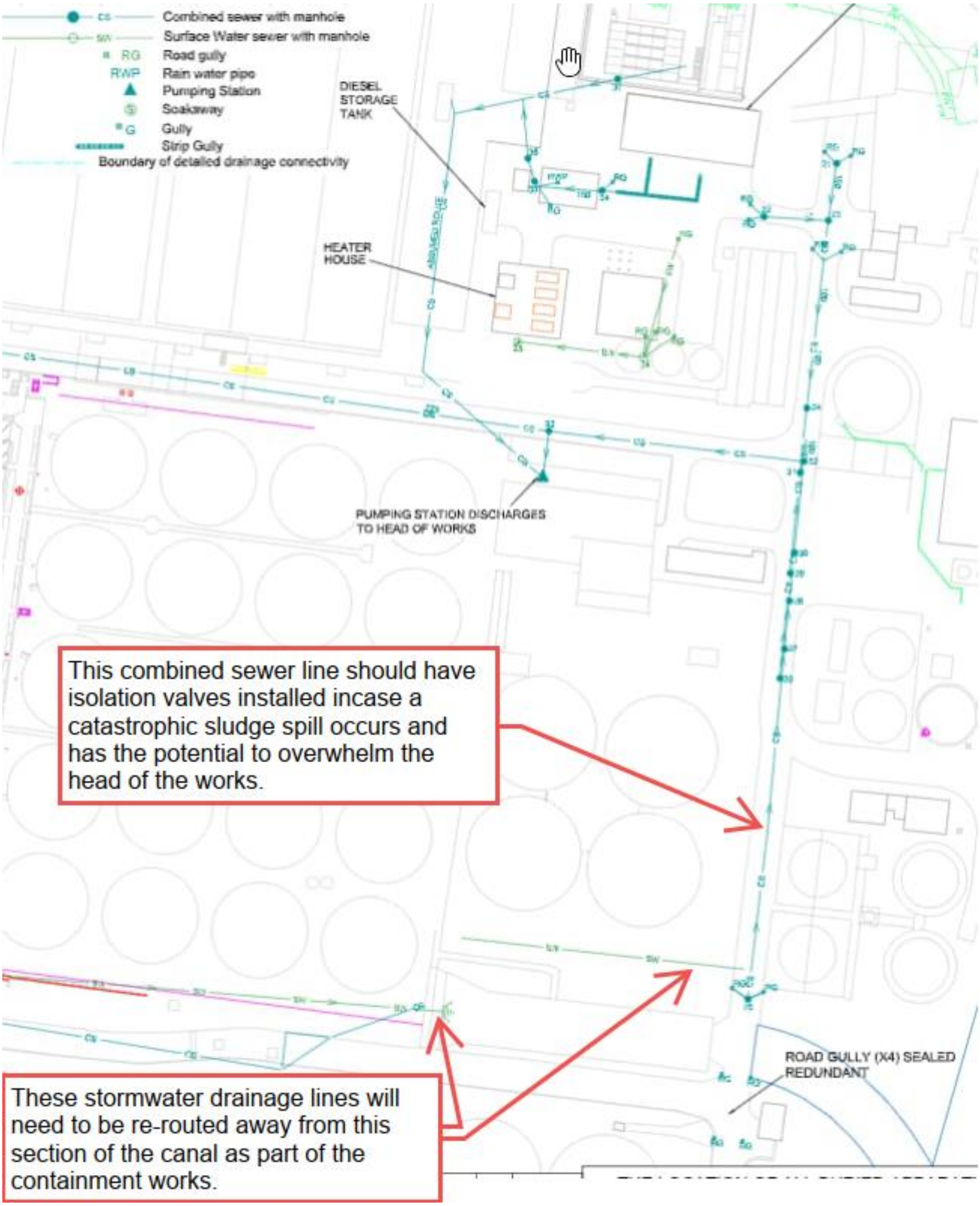

Figure 5.4 – Site Drainage Plan

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.

Returns from the storage area (normally rainwater) will be pumped due to topography. The size of the pumped return (10-20 l/s) is negligible in comparison to the FtFT.

5.4 Automatic Isolation Valves

For the catastrophic loss of containment scenarios for the digester's areas 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, allowing an alarm to be raised.

Once the spillage has been stopped and contained, any sludge in the drainage system can be released back into the head of the work in a controlled manner therefore, not creating adverse effects at the inlet.

6. Conclusions

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

In the Risk Identification Report for Maple Lodge a containment classification report was carried out. An overall site risk rating of medium was determined meaning that class 2 containment is needed.

The assessment focuses on site-specific risks and outlines the options available for providing secondary containment to mitigate the risk of a catastrophic tank or digester failure. The results of the uncontained spill mapping show that a catastrophic spill will not be contained within the site.

The containment volumes have been checked against the 110% and 25% rules and the largest tank plus site specific rainfall. In all areas, the containment volume is set by the 25% rule.

The preferred option for Maple lodge is a hybrid option of bund walls, flow guiding walls and repurposing of the old canal channel to provide below ground storage. This option has the following key features:

1. Close containment of the Secondary Digesters. This will require a bund wall with a typical height of 2.0 m. The tall containment walls will require basic measures by operations as elements of confined spaces working will apply (e.g. gas monitoring and provision of a topman)

2. Containment of the northern primary digesters and SAS assets. This will require a bund wall with a maximum height of some 0.6m. Spills within this area will initially be contained within the bund wall, until they exceed a TWL of 41.96m, in which case the excess spill volume will gravitate into the repurposed canal retention area via over-flowing the southern road access bund ramp and being conveyed by containment along the road.

3. Flow guidance around the southern primary digesters. To direct any spills from these tanks directly into the below ground canal spill retention area.

The northern primary digesters and ancillary sludge tanks are contained within a bunded boundary with sufficient area to generate shallow depth that does not deny emergency access to equipment when the spill has been contained.

The secondary digesters are addressed by a close containment solution due to space constraints and lower traffic movements that allow the use of floodgates.

Appendix 1 ADBA Site Hazard Risk Assessment Summary for Maple Lodge STW

ADBA Industry Guide and CIRIA C736 state how the site hazard rating and, the site risk and classification are to be calculated. A summary of the hazard risks for Maple Lodge STW 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 for sludge thickening.

The Source Hazard rating was determined as High.

Pathway – There are three 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 (River Colne).

2. There are several areas where sludge spill could pass over permeable ground and therefore impact watercourses and the underlying geology.

3. The site inventory has a runoff time of 6 minutes but will be subject to containment

As a consequence, the Pathway Hazard rating was determined as Medium.

Receptor – There are four potential receptors which have been identified:

1. The site drainage system and the head of the works.

2. The Colne River is located on the north and east of the site.

3. Lynsters Lake is at the south area of the site.

4. Maple Lodge Nature reserve

The Receptor Hazard rating was determined as High.

This gives an overall Site Hazard Rating of High

Likelihood – The assessment of mitigations including operator training, Hazop and the nature of the tank's design/installation is that the likelihood hazard rating is low

The resulting Site Risk and Classification becomes Medium directing Class 2 containment.

Appendix 2 Tank Covering initial review

There are 14 open top tanks within the permit boundary at Maple Lodge STC, comprising the secondary digesters. It is acknowledged that there may be emissions of biomethane and / or odour from some of these tanks, and Thames Water is preparing a monitoring exercise to determine the nature of any emissions and their quantity. Based on these outputs, the requirement for covering the tanks will be assessed, in accordance with the design of the existing tanks and HSE requirements around ATEX and DSEAR, in accordance with the applicability notes for BAT 14d.

As part of any tank cover design, the initial monitoring data will be necessary to determine if the correct routing of any gas from the tank headspace would be to the biogas utilisation system or to a new OCU. The quantification of tank emissions is needed to determine if the gas treatment assets also require upgrading, e.g. existing engine utilisation levels and gas storage system. If an OCU is the required for the gases, the quantification and nature of the emissions will be required in order to ensure that the unit is sized correctly, with the right media to deal with the substances present.

Due to the variability of air pressure on the potential release rate of gas from the tank contents, it is proposed that the monitoring exercise will involve 4 rounds of sampling over a 6 month period, to reflect levels at different ambient air temperatures and atmospheric pressures.

All proposed coverings will be subject to a cost benefit analysis, based upon the Environment Agency tool.