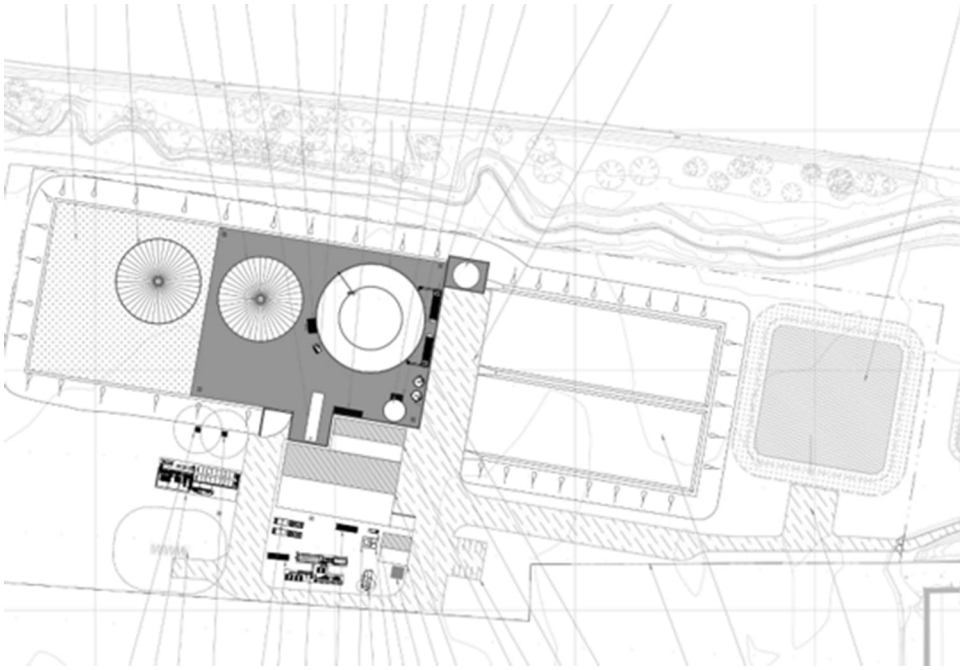
masonclarkassociates
civil and structural engineering consultants



CONTAINMENT STRATEGY REPORT

FOR

HOME FARM GRANGE ANAEROBIC DIGESTION PLANT

Commissioned by Engie Renewable Gases UK

ENGIE

Report 23073-H-RP-001-R4
26th NOVEMBER 2025

CONTAINMENT STRATEGY REPORT

FOR ANAEROBIC DIGESTION PLANT

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ISSUE LOG FOR REPORT 23073H-RP-001-R0

Rev	*Date*	*Description*	*Author*	*Checked*
R0	April 2025	**FIRST ISSUE - DRAFT**	MFS	AM
R1	May 2025	**SECOND ISSUE - DRAFT**	MFS	AM
R2	June 2025	**THIRD ISSUE - DRAFT**	MFS	AM
R3	Nov 2025	**THIRD ISSUE - DRAFT**	MFS	AM
R4	Nov 2025	**FOURTH ISSUE**	MFS	AM

Issuing office: Mason Clark (HULL). Refer to final page for full office details.

1. INTRODUCTION

1.1. Mason Clark Associates (MCA) has been commissioned by Engie Renewable Gases UK to compile a pollutant containment design report for the proposed Anaerobic Digestion Plant.

1.2. The site comprises an agricultural field located to the east of A162, Home Farm, Bond Ings, Sherburn in Elmet, LS25 6FW.

1.3. The proposed development includes the AD plant facility itself (the developable area), upgrades to the internal access track, an extension of the access road to the proposed development. The application boundary features total area of approximately 74,600 m^2.

1.4. The proposed location of the development is shown below.



1.5. The AD plant will accept approximately 75,000 tonnes per annum of feedstock from local farms. The development will generate biogas which will be upgraded to biomethane then connected via a pipeline into the national grid directly from the site. The secondary output of the AD process is digestate, which will be used on local farms in place of raw manures and artificial fertilisers.

1.6. This report has been carried out to provide a design of containment at the site and a feasibility assessment for suitable methods for containing pollutant in compliance with CIRIA C736 ‘Containment Systems for the prevention of Pollution’ and EUR 29362 EN ‘Best Available Techniques (BAT) Reference Document for Waste Treatment’.

1.7. Details of the AD Plant are included on the Resolve Bioenergy Ltd drawings, ref: 019_9006_PLA-DWG-000 – Home Farm Grane Model V2 (General Arrangement).

2. AD PLANT OPERATION SUMMARY

2.1. **The Anaerobic Digestion (AD) Plant Components**:

1. Weighbridge
2. Silage clamps
3. Front apron
4. Bund
5. Feeders
6. Power ring tank
7. Post digester tanks
8. Separation liquid tanks
9. Sub – station compound
10. Transformer compound
11. Propane tanks
12. Containerised pumping stations
13. Covered digestate lagoon
14. Drainage attenuation pond
15. CO_2 capture
16. Biomethane upgrading plant
17. GEU kiosk
18. LV distribution container
19. Transformer
20. Effluent tank
21. Flare, combustion stack
22. Fire water tank
23. Nitrogen recovery plant
24. Lighting protection masts
25. Feedstock reception building
26. Separator building
27. Site office
28. Control building
29. Car park
30. Tanker filling location
31. Odour control System
32. Oxygen generator

2.2. **Feedstock Handling and Storage**

The feedstock enters the plant via the access road and is weighed on weighbridge. This initial weighing is crucial for monitoring input quantities, ensuring regulatory compliance. Once weighed, manure is transported to feedstock reception building and silage to silage clamps, where it is temporarily stored and preserved until it's ready for processing.

2.3. **Feedstock Preparation and Buffering**

When the feedstock is ready for processing, it is transferred onto feeders, where it undergoes a secondary weighing for precise input control. Feedstock is then directed to pretank, providing a steady, controlled flow into the digester tanks. This buffering stage ensures the digestion process receives a consistent feedstock supply, optimizing biogas production.

2.4. **Anaerobic Digestion Process**

The digester tanks (also referred to as reactors) are where anaerobic digestion occurs. Inside these sealed reactors, organic matter (e.g., crop feed, animal manure, wastewater biosolids) is broken down by microbial communities in an oxygen-free environment. These microbes convert the feedstock into two primary products: Biogas and Digestate.

2.5. **Biogas processing and Injection into the National Grid**

The biogas produced in the digestion tanks is transported to the Biogas Upgrading Plant (BUP) and CO_2 removal systems, where it undergoes gas purification. This process refines the biogas into biomethane, a high-purity gas, when spiked with propane meets National Gas standards. The biomethane is then transferred via pipelines for injection into the National Grid, contributing to renewable energy supplies.

2.6. **Digestate Utilisation and Storage**

The remaining by-product, digestate, is separated into liquid and solid forms. The solid digestate is stored in the separator building. Both solid and liquid digestate is stored in the onsite lagoon, until it is required by local farmers who use this digestate as an environmentally friendly alternative to raw manure and artificial fertilizers, adding value to the agricultural community by enriching soil health and crop productivity.

2.7. **Supporting Components for AD Operations**

Each component of the AD plant plays an essential role in maintaining efficient, safe, and environmentally compliant operations. The Gas Generator unit converts some of the generated gas into electricity. The flare and combustion stack provide a safe means for burning off excess or non-compliant biogas, while the odour control unit reduce emissions and control odours. The lightning protection masts, and site office are essential for operational safety and plant management.

3. AD PLANT MATERIALS SPECIFICATION

3.1. The anaerobic digestion (AD) plant will house an inventory that encompasses feedstock, digestate, and biogas.

3.2. The feedstock undergoes a process of anaerobic digestion, yielding two principal byproducts: digestate and biogas.

3.3. The designated inventory comprises a combination of the following materials: Maize, whole crop rye, potato rejects, vegetable waste, cattle manure, chicken manure, diluted whey, concentrated whey, pig manure, cattle slurry, horse manure.

3.4. The digestate generated from the anaerobic digestion process consists of both liquid and solid fractions. It is projected that the total digestate produced will correspond to 93% of the feedstock input, with the composition delineating 23% as solid digestate and 77% as liquid digestate, as specified in the Stage 3 Planning Appraisal Document.

3.5. The inventory to be stored at the silage clamps are as follows:

- Maize silage in solid state - 20/50 (^{0}C) normal/max temperature and pH around 4-5.
- Whole crop rye in solid state - 20/50 (^{0}C) normal/max temperature and pH around 4-5.
- Potato rejects in solid state - close to ambient temperature and pH around 5-6.
- The above silage will produce effluent of similar characteristics – low pH, high BoD.

3.6. The inventory to be stored in the feedstock building are as follows:

- Chicken manure in solid state - 20/60 (^{0}C) normal/max temperature and pH around 7-8. Dry, loose bulk material stored in heaps, high in ammonium and ammonia.
- Cattle manure in solid state - 20/60 (^{0}C) normal/max temperature and pH around 7-8. Fairly wet, clumpy, bulk material stored in heaps, high in ammonium and ammonia. Likely to be some effluent/run off from manures.
- Pig manure is in solid state - close to ambient temperature with pH around 7-8.

- Vegetable rejects is in solid state - close to ambient temperature with pH around 7-8.
- Horse manure is in solid state - close to ambient temperature with pH around 7-8.

3.7. The inventory in the liquid feedstock reception tanks are as follows:

- Cattle slurry in liquid state - 10 (^{0}C) normal/max temperature to be completely contained in the vessels.
- Diluted whey in liquid state - close to ambient temperature, to be completely contained in the vessels.
- Concentrate whey in liquid state - close to ambient temperature, to be completely contained in the vessels.

3.8. Digestate – PH in liquid state with 943kg/m^3 as density, 55 (^{0}C) normal/max temperature to be stored in Reception Tank.

3.9. Digestate – PD in liquid state with 960kg/m^3 as density, 40 (^{0}C) normal/max temperature to be stored in primary digester tanks.

3.10. Digestate – SD in liquid state with 968kg/m^3 as density, 40 (^{0}C) normal/max temperature to be stored in secondary digester tanks.

3.11. Digestate in liquid state with 973kg/m^3 as density, 50 (^{0}C) normal/max temperature to be stored in dilution tank.

3.12. Materials such as concrete, steel, timber and others will be specified based on the design requirements for various components of the AD plant during the later stages of the design process.

3.13. Inventory Table

Material	Phase	Temp – normal / max (^{0}C)	Location
Maize Silage	Solid	20/50	Clamp
Whole Crop Rye		20/50	
Potato Rejects		Close to ambient	
Chicken Manure		20/60	Building
Cattle Manure		Close to ambient	
Pig Manure		Close to ambient	
Vegetable Rejects		Close to ambient	
Horse Manure		Close to ambient	
Cattle Slurry	Liquid	10	Liquid Feedstock Reception Tanks
Diluted Whey		Close to ambient	Reception Tank
Concentrate Whey		Close to ambient	
Digestate - PH		55	
Digestate – PD		40	Primary Digester Tank
Digestate - SD		40	Secondary Digester Tank
Digestate – Dilution Tank		50	Reception Tank

4. DRAINAGE DESIGN & OPERATION SUMMARY

4.1. The Facility is situated on a combination of reinforced concrete slabs, asphalt and gravel hard standing areas. The gravel hard standings will be placed on an impermeable layer, either a cohesive fill or liner. A general longitudinal fall on the ground and slabs across the facility will be provided.

4.2. The retaining walls to the silage bays will be sloping walled silage clamps. This comprises of pre-cast concrete panels resting against an earth bank, which eliminates any movement of the panel, and provide a compound for the silage.

4.3. Concrete hardstanding will be cast to form clean access, loading and circulation routes adjacent to the maturation bays.

4.4. Surface run off is to be picked up via channel drains / gulleys / Rainwater pipes and other formal inlet points.

4.5. Surface run off will be taken through a suitable treatment train to an attenuation tank and discharged at a restricted rate to a watercourse.

4.6. Drainage channels in the concrete slabs in and around the building have been designed and detailed to withstand the heavy loadings and skewing forces from the HGV wagons and loaders working on the site.

4.7. All below ground drainage is of conventional construction with flexible joints where appropriate and compatible with the depths of cover for protection to the pipes.

4.8. For the primary containment, the digester tank walls must be designed as water retaining structures and fixed to a concrete reinforced cast in-situ concrete base slab.

4.9. For the secondary containment measure, there will be a purpose-built concrete bund wall in accordance with CIRIA 736 around the tanks, with levels manipulated such that surface run off cannot leave site.

4.10. The Tertiary and final level of containment, upon failure of the primary and secondary or exceedance, it will be contained within secondary containment area.

5. RISK ASSESSMENT CONTAINMENT CLASSIFICATION SUMMARY

Please note all reference, hereafter, will refer to CIRIA C736, unless stated otherwise.

Please see Appendix A for the AD plant tank containment area and description.

Please see Appendix B for the site risk assessment.

5.1. In Section 2.3.1, source of pollutant must be identified dependent on toxicity and quantity. There is currently no toxicity rating (LC50 or LD50) for the inventory and byproduct of anaerobic digestion transported to this site. It has been recommended as by the preliminary risk assessment by Enzygo (Document Ref.: CRM.0174.002.GE.R.001.A) that no hazardous chemical storage on site and hence low toxicity of material will be assumed so for this assessment.

5.2. Using figure 2.6 in CIRIA C736, the total tonnage of maturation areas is 75,000t (i.e., the total inventory) when at full capacity at a given time, which will mean if toxicity of material can be greater than 10,000 ppm, then the source can be defined as moderate.

5.3. Potential pathways for contamination of receptors in relevant proximity are moderate, due to a presence of watercourse nearby and medium ground water vulnerability, as well as presence of transfer system in place, where surface run off is to be picked up via channel drains/gulleys/rainwater pipes and other formal inlet points. Surface run off will be taken through suitable treatment train to an attenuation lagoon and discharged at restricted rate to a watercourse. All below ground drainage is of conventional construction with flexible joints where appropriate and compatible with the depths of cover for protection to the pipes.

5.4. Potential hazard rating of the receptor sensitivity to the inventory is moderate. This is due to various reasons explained in Appendix B.

5.5. According to CIRIA C736, for Anaerobic Digestion plant containment, overall site rating is **Moderate**. The site is considered as requiring **Class 2**, i.e. intermediate degree of integrity.

5.6. It assumed that the site does not fall under those, which would have to adhere to the 'Control of Major Accident Hazards Regulations COMAH, as the chemicals produced from anaerobic digestion plant are not listed or insufficient quantity to that described in Schedule 1 within the regulations. The duty holder of the site should confirm this.

5.7. For compliance with CIRIA C736, Table 6.2 – 'Summary of key design recommendations' will be referenced to identify each relevant design recommendation for each System Containment Assessment presented in the following two chapters.

5.8. Referring BREF (EUR 29362 EN – Best Available Techniques (BAT) Reference Document for Waste Treatment) on Anaerobic treatment, key aspect include:

- **AD Plant Operation and Techniques**
  - Innovative Techniques for Anaerobic Digestion (Section 4.3 of BREF): Techniques like the separation and recirculation of dry matter in AD plant or treatment of biomass substrates can enhance operational efficiency and environmental performance. The Home Farm Grange AD Plant complies with this as there is clear separation and recirculation of inventory at various different stages of Anaerobic digestion.
- **Emission Management**
  - Monitoring and Control (Section 6.1.3 of BREF): The AD plant complies with this as there is Leak Detection and Repair (LDAR) programme as part of the planned maintenance to ensure compliance with emission limits outlined by BREF.
  - Odour Management Plan (Section 2.3.5 of BREF): The AD plant complies with this as there is an odour control unit, biofiltration or scrubbers to manage emission effectively, aligning with BREF.

6. AD PLANT DESIGN FOR CONTAINMENT CLASS 2 SUMMARY

6.1. From Chapter 4, on the recommended capacity of the bund, when two or more tanks are installed within the same bund, the recommended capacity of the bund is the greater of 110 percent of the capacity of the largest tank within the bund or 25 percent of the total capacity of all the tanks within the bund. In this case, 110 percent of the capacity of the largest tank is the critical case. Hence the bund will be designed to contain a volume of 14871m^3 of inventory in an event of an incident.

6.2. From Chapter 4, Box 4.1 on the design for fire duration, consideration for the total volume of water used to fight a fire is to be considered. The amount of freeboard required for firefighting foam should be agreed with the Fire and Rescue Service or occupational fire brigades, but the amount should be no less than 100mm.

6.3. Required volume of rainfall to retain during a storm is 740m^3. This has ignored the retention and evaporation of water from the maturation piles, and has used the area shown in orange, see appendix A.

6.4. The total capacity of the secondary containment is determined by considering the combined worst-case scenarios, i.e., tank(s) failure, fire incident, and rainstorm. The required total capacity is 15281m^3.

6.5. Concrete bund wall around the perimeter of the site is proposed as the secondary containment as well as sloping site. The calculated height of the bund wall to contain the above-mentioned volume is 1.90m. Considering 100mm freeboard for firefighting water the height of the bund wall to be 2.00m.

6.6. The bund wall is proposed to be **2.0m** high.

6.7. It is recommended that the high-risk areas such as feeder systems, gas washing system, local chemical storage, propane tanks etc., to have their own localised containment system for enhanced safety.

6.8. The Phase 2 GI report indicate in that the majority of the application site and developable area is underlain by Hemmingbrough Glaciolacustrine Formation, will comprise predominantly low permeability soil. Therefore, the proposed design for concrete bund wall as Class 2 containment system is deemed valid. The existing low permeability soil can serve effectively as the base of the containment system with impermeable membrane liner for the embankment itself. Medium vulnerability to groundwater seepage was noted, indicating that only some water is able to penetrate the low-permeability soil and reach the underlying aquifer. It is recommended to carry out infiltration test to determine whether the existing soil is suitable to use as the base for the containment system.

6.9. Referring BREF (EUR 29362 EN – Best Available Techniques (BAT) Reference Document for Waste Treatment) on containment, key aspects include:

- **Containment and Environmental Risk Management**
  - Secondary Containment System (Section 2.3.11 of BREF): As per the above-mentioned proposed containment strategy, concrete bund wall around the perimeter of the site complies with BREF for preventing soil and water contamination.
  - Water Management (Section 2.3.7 of BREF): The use site surface falls and defined gravity drainage with lagoons for runoff control aligns with the BREF guidance on stormwater and leachate management.

7. RECOMMENDATIONS

7.1. The Duty Holder should provide evidence of the toxicity rating (LC50 or LD50) for the feedstock and digestate.

7.2. The Duty holder of site must ensure the chemicals of material in the digestion and buffer tanks are not of sufficient quantity and / or listed in Schedule 1 of COMAH 1999 Regulation.

7.3. The primary containment has been assumed to be the digester tanks, buffer tanks, feeder, feedstock building and the silage clamps. Primary containment must be designed as watertight and primary containment to be provided with leak detection system as well as overflow detectors to monitor failure. The construction materials for containment systems must be resistant to stored substance (e.g., acids, alkalis etc.). It is understood that the primary containment as mentioned above, are less likely to fail. To ensure this, the proprietary tanks are maintained and inspected according to manufacturer's guidelines.

- The digester tanks and buffer tanks to be cast in-situ RC walls fixed on to an in-situ RC base. The roof construction is inflatable double membrane and concrete for digester. The walls are lined with WireTrap to protect it against H2S and biogenic sulphuric acid produced from anaerobic digestion process.
- The retaining walls to the silage bays are sloping walled silage clamps. This comprises of pre-cast concrete panels resting against an earth bank, which eliminates any movement of the panel, and provide a compound for the silage.

7.4. It is recommended that the secondary containment be composed of concrete bund wall on all four side and flood gate for access.

7.5. Permanent tertiary containment measures are considered necessary as a minimum of 25% the overflow is possible. An attenuation basin to be designed outside the secondary containment system to manage stormwater. This basin is to be sized to accommodate a 1-in-100-year rainfall event plus an additional 40% for climate change (CC). This approach is deemed a sufficient and effective tertiary containment measure, as it ensures the management of excess water beyond the secondary containment system by manipulating overland flows routes inventory towards the basin.

7.6. The hardstanding i.e., base of silage area to be impermeable material like asphalt to lay on DBM and well compacted sub-base. The hardstanding to be designed to withstand loads from vehicles and equipment, and resistant to stored chemicals. The drainage systems within the hardstanding to be impermeable and capable of capturing leaks and spill and directing it to channel drains/gulleys. See Appendix A showing drainage plan for further detail.

7.7. It is recommended that the site is to have channel drains / gulleys / rainwater pipes and other formal inlet point for surface run off, and this surface run off to be taken through a suitable treatment train to an attenuation tank. See Appendix A for drainage detail.

7.8. Local containment of components to be in place for flammable fuel with detection system. See Appendix A for details of where local containment is required.

7.9. It is recommended that the AD plant aligns with the best practices and techniques outlined in the BREF document, such as AD Plant Operation and Techniques; Emission Management for continuous monitoring and control and odour management; as well as Containment and Environmental Risk Management.

8. LIMITATIONS

All comments and proposals contained in this report, including any conclusions, are based on information available to Mason Clark Associates during investigations. The conclusions drawn by Mason Clark Associates could therefore differ if the information is found to be inaccurate or misleading. Mason Clark Associates accepts no liability should this be the case, nor if additional information exists or becomes available with respect to this scheme.

Use of preliminary infiltration value and vulnerability class by Enzygo (Document Ref.: CRM.0174.002.GE.R.001.A), this is for indicative purposes only to enable preliminary designs to progress. Where any subsequent designs rely upon infiltration and/or these test results then you should undertake further infiltration rate tests in accordance with accepted industry standard guidelines as detailed in Building Research Establishment publication BRE Digest 365.

Except as otherwise requested by the client, Mason Clark Associates is not obliged to and disclaims any obligation to update the report for events taking place after: -

i. The date on which this assessment was undertaken, and
ii. The date on which the final report is delivered

Mason Clark Associates makes no representation whatsoever concerning the legal significance of its findings or the legal matters referred to in the report.

All Environment Agency mapping data is used under special license. Data is current as of 28/11/2025 and is subject to change.

The information presented and conclusions drawn are based on statistical data and are for guidance purposes only. The study provides no guarantee against flooding of the study site or elsewhere, nor of the absolute accuracy of water levels, flow rates and associated probabilities.

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Signed on behalf of Mason Clark Associates:



Mohammed Faizan Shaikh MEng (Hons) ,GMICE
Graduate Structural Engineer

Countersigned on behalf of Mason Clark Associates:

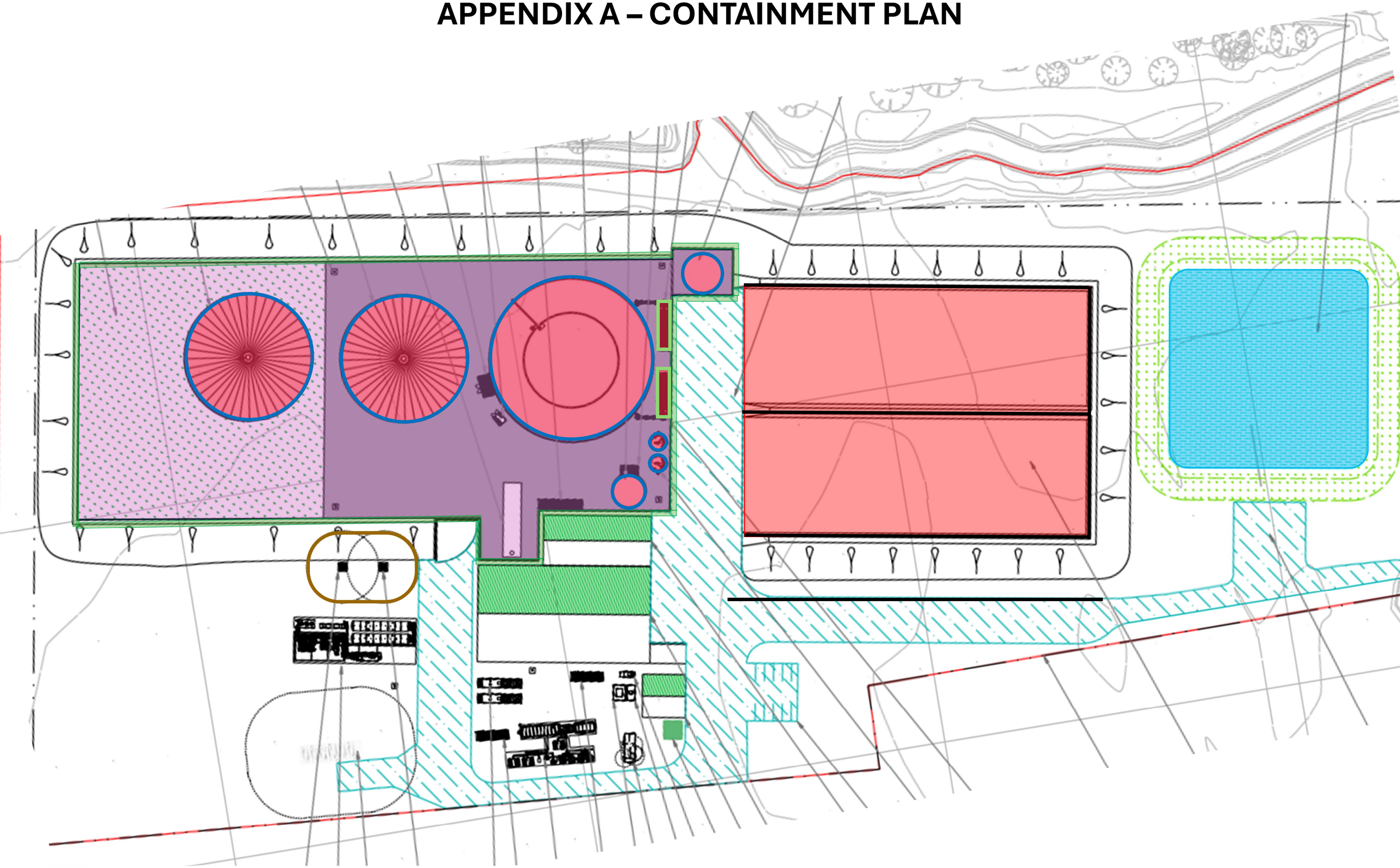


Adam Manuel MEng (Hons), CEng, MICE
Associate - Structures

APPENDIX A

Containment Plan

APPENDIX A – CONTAINMENT PLAN



Containment Area

Secondary Containment (Concrete Bund Wall) 1.4m high

Primary Containment (Tanks)

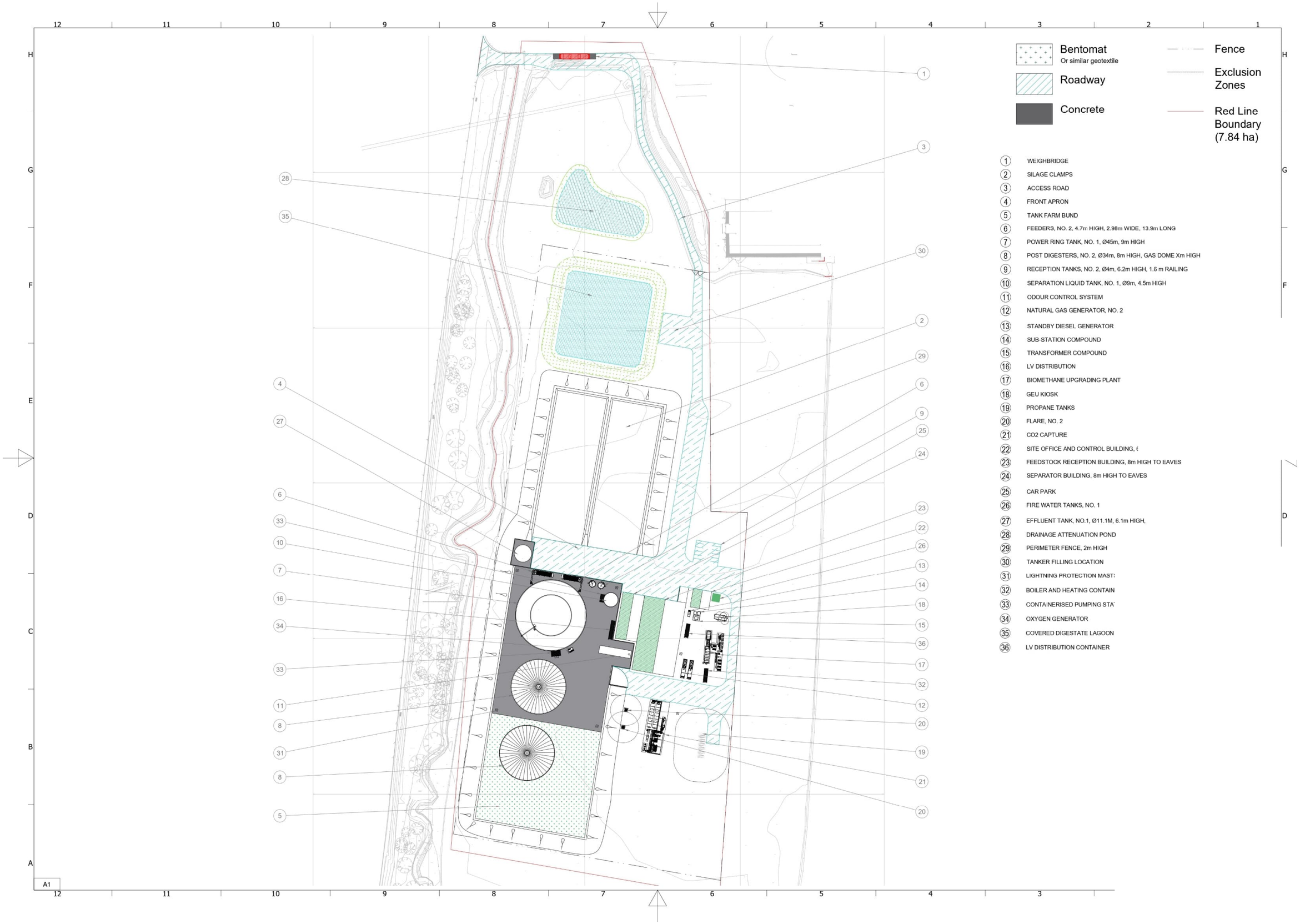
Primary Containment (Feeders)

Leaking hydrocarbons requiring localised bund

Primary Containment (Silage Clamp)

Tertiary Containment (Attenuation basin)

SITE PLAN


Bentomat
Or similar geotextile
Roadway
Concrete
Fence
Exclusion Zones
Red Line Boundary (7.84 ha)
1 WEIGHBRIDGE
2 SILAGE CLAMPS
3 ACCESS ROAD
4 FRONT APRON
5 TANK FARM BUND
6 FEEDERS, NO. 2, 4.7m HIGH, 2.98m WIDE, 13.9m LONG
7 POWER RING TANK, NO. 1, Ø45m, 9m HIGH
8 POST DIGESTERS, NO. 2, Ø34m, 8m HIGH, GAS DOME Xm HIGH
9 RECEPTION TANKS, NO. 2, Ø4m, 6.2m HIGH, 1.6 m RAILING
10 SEPARATION LIQUID TANK, NO. 1, Ø9m, 4.5m HIGH
11 ODOUR CONTROL SYSTEM
12 NATURAL GAS GENERATOR, NO. 2
13 STANDBY DIESEL GENERATOR
14 SUB-STATION COMPOUND
15 TRANSFORMER COMPOUND
16 LV DISTRIBUTION
17 BIOMETHANE UPGRADING PLANT
18 GEU KIOSK
19 PROPANE TANKS
20 FLARE, NO. 2
21 CO2 CAPTURE
22 SITE OFFICE AND CONTROL BUILDING, (
23 FEEDSTOCK RECEPTION BUILDING, 8m HIGH TO EAVES
24 SEPARATOR BUILDING, 8m HIGH TO EAVES
25 CAR PARK
26 FIRE WATER TANKS, NO. 1
27 EFFLUENT TANK, NO.1, Ø11.1M, 6.1m HIGH,
28 DRAINAGE ATTENUATION POND
29 PERIMETER FENCE, 2m HIGH
30 TANKER FILLING LOCATION
31 LIGHTNING PROTECTION MAST:
32 BOILER AND HEATING CONTAIN
33 CONTAINERISED PUMPING STA
34 OXYGEN GENERATOR
35 COVERED DIGESTATE LAGOON
36 LV DISTRIBUTION CONTAINER
A1

APPENDIX B

Site Risk Assessment

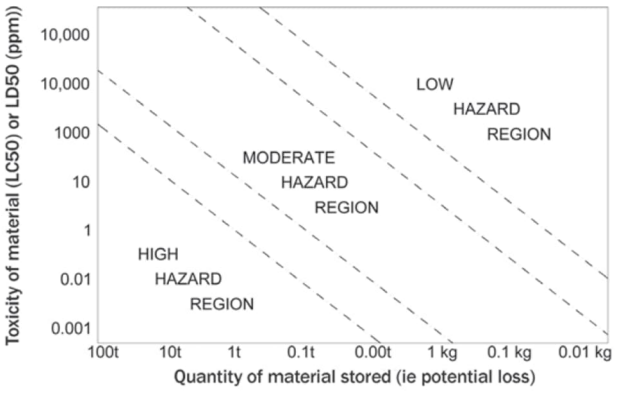
B.1.1 Source

Source hazard determined by toxicity and quantity as described in CIRIA C736.

- **Toxicity of material** – For most materials like maize silage, whole crop rye, potato rejects, chicken/cattle/turkey manure, pig/cattle slurry, digestate PH/PD/SD, specific LC50 or LD50 values are not typically provided, as these materials are not acutely toxic. Toxicity of material assumed to be greater than 10,000ppm for the inventory. This assumption needs to be confirmed by client.

- **Quantity of material** – Quantity of material stored in primary containment are as follows:
  - All Tanks – Volume: 22600m^3, Weight: 21,922t.
  - Total quantity of material in tanks at a given time ≈ 21,922t say 22,000t.

As per figure 2.6, the site falls under **Moderate Hazard Region.**



Note
LC50 is the concentration of an agent in water that kills 50% of the exposed aquatic organisms within a given time period, usually 96 hours. Similarly, LD50 is the concentration that kills 50% of an exposed population of test animals. There are many other possible measures of toxicity.

B.1.2 Pathway

Multiple combinations of pathways may exist and should be considered. List below is suggested as a check by CIRIA C736.

1. Distance between source and various potential receptors - **High**
   As per Preliminary Risk Assessment (Doc. Ref.: CRM.0174.002.GE.R.001.A)
   - No significant contamination source has been identified.
   - Medium ground water vulnerability.
   - Presence of flood zone.
   - Medium surface water abstraction.
   - High groundwater flooding.
   - Presence of water course significant risk from site, i.e., Inland River (Name – Mill Dike) on ground surface watercourse as well as underground watercourse in close distance which could be at risk of contamination.

2. Site Layout : Site has a surface fall to the upstream side, that flows into a proposed underground piped gravity drainage system which treats it and transfers it to a lagoon / existing drainage network – **Low**

3. Medium groundwater vulnerability. Presence of significant geology or hydrogeology around site (Mill Dike – ground surface watercourse as well as underground watercourse) – **Moderate**

4. Climate variation such as heavy rainfall or frozen surfaces may create pathways to reception. Area to be fully bunded and designed in a way that no pathway created to reception and also to have a lagoon – **Low**

5. Inventory is highly-flammable (Biogas and manure/fertiliser) – **High**

6. Presence of treatment plants – **Low**

7. Modification of the inventory during passage through pathway (Likely to be modified during passage) – **Moderate**

8. Inventory such as fertiliser are soluble in water – **High**

9. Risk of flooding – **Moderate**

10. Permeability of stone areas into soil - **Moderate**

Overall pathway hazard rating – **Moderate**

B.1.3 Receptor

In CIRIA C736, a receptor should be any of the following: Humans; animals; fish; plants and biota; watercourse or body; groundwater; downstream processes; or soils that would be affected (directly or indirectly) by the escape of inventory.

Hazard rating relating to sensitivity to inventory:

- Humans – **Moderate**
- Animals, fish, plants and biota - **Low**
- Flooding - **Moderate**
- Ground water vulnerability – **Moderate**
- Agricultural land around the facility – **Moderate**
- Water courses – **Moderate**

Overall receptor hazard rating – **Moderate**

2.4 Overall Site Hazard Rating

As per Box 2.1 – Suggested combinations of hazard ratings to give overall site hazard rating

- Source – **Moderate (M)**
- Pathway – **Moderate (M)**
- Receptor – **Moderate (M)**

Combination of rating – **MMM**

Suggested consequent overall site hazard rating for MMM is **MODERATE.**

This requires **Class 2 Containment System** or class 3 if preferred on cost or operational ground, i.e., intermediate degree of integrity.

B.2.1 BREF Compliance

Referring BREF (EUR 29362 EN – Best Available Techniques (BAT) Reference Document for Waste Treatment) on Anaerobic treatment, key aspect include:

- **AD Plant Operation and Techniques**
    - Innovative Techniques for Anaerobic Digestion (Section 4.3 of BREF): Techniques like the separation and recirculation of dry matter in AD plant or treatment of biomass substrates can enhance operational efficiency and environmental performance. The Home Farm Grange AD Plant complies with this as there is clear separation and recirculation of inventory at various different stages of Anaerobic digestion.
- **Emission Management**
    - Monitoring and Control (Section 6.1.3 of BREF): The AD plant complies with this as there is continuous monitoring of methane leakage and emission of ammonia and hydrogen sulphide to ensure compliance with emission limits outlined by BREF.
    - Odour Management Plan (Section 2.3.5 of BREF): The AD plant complies with this as there is odour control unit, biofiltration or scrubbers to manage emission effectively, aligning with BREF.

APPENDIX C

Class 2 Containment Calculations

Home Farm AD Plant – Class 2 Requirements to CIRIA C736

Secondary Containment System

As per CIRIA C736, Chapter 4:

Use of 110 percent and 25 percent rule – "Where two or more tanks are installed within the same bund, the recommended capacity of the bund is the greater of:

1. 110 percent of the capacity of the largest tank within the bund.
2. 25 percent of the total capacity of all the tanks within the bund, except where tanks are hydraulically linked in which case they should be treated as if they were a single tank."

Containments should be capable of retaining:

- The total volume of inventory released during an incident.
- Maximum rainfall to accumulate within containment before, during and/ or after an incident.
- Firefighting water and firefighting agents to be used during an incident.

- Volume of inventory = primary capacity of containment. No overflow, hence, assume brim-full volume.

- Rainfall:
  - Assume secondary containment regularly inspected and collected rainfall removed prior to incident
  - Assume 10% AEP
  - Capacity should allow for rain falling over containment area immediately preceding an incident (before it could be removed as part of a routine operation) and immediately after an incident (before a substance, which had escaped from the primary, could be removed from the bund).

- Firefighting water:
  - The amount of freeboard required for firefighting foam should be agreed with the Fire and Rescue Service or occupational fire brigades, but the amount should be no less than 100mm.

Containment volume to include an allowance for the total volume of accumulated rainfall in response to a 10% AEP event for:

- A 24-hr period preceding an incident.
- The duration of the incident.
- An eight-day period following an incident.

Care to be taken to include any additional areas that may drain into the containment system when making an allowance for rainfall depth in the capacity assessment

Tertiary Containment System

The need for tertiary containment system is determined by the following scenarios:

- 'Total loss' scenario
- Fire scenario
- Emergency/Temporary tertiary containment measures

The total loss scenario and fire scenario is considered in the case of design secondary containment design. The secondary containment system is designed considering the failure of primary containment, rainfall and firefighting water all occurring at the same time.

As per CIRIA C736, secondary containment systems, such as concerete bund walls, must provide a minimum of 100mm freeboard for firefighting water. The freeboard for jetting failure is calculate separate based on how far the bund wall is to the tanks. When designing secondary containment, we assume the worst-case scenario: failure of the primary containment, combined with heavy rainfall and firefighting water. The inclusion of 100mm freeboard for firefighting water and for jetting failure in the concrete bund wall design ensures that overtopping of the bund is highly unlikely, providing an added layer of security.

Hence, **permanent tertiary** containment measures are considered **unnecessary** due to the reasons mentioned above.

Permanent tertiary containment measures are considered necessary as a minimum of 25% the overflow is possible. An attenuation basin has been designed outside the secondary containment system to manage stormwater. This basin is sized to accommodate a 1-in-100-year rainfall event plus an additional 40% for climate change (CC). This approach is deemed a sufficient and effective tertiary containment measure, as it ensures the management of excess water beyond the secondary containment system by manipulating overland flows routes inventory towards the basin.

Design for Secondary Containment of new Anaerobic Digestion Plant Tanks for Failure of Tank, Heavy Rainfall and Fire.

SECONDARY CONTAINMENT SYSTEM CAPACITY

Capacity of different component:

- Tank 7 (PowerRing Digester): Φ45m and 8.5m high; Volume = 13519m^3
- Tank 8 (Post Digester – 2No): Φ34m and 7.3m high; Volume = 13256m^3
- Tank 9 (Reception Tank – 2No): Φ4m and 5.7m high; Volume = 143m^3
- Tank 10 (Separation Liquid Tank): Φ9m and 4.3m high; Volume = 274m^3
- Tank 27 (Effluent Tank): Φ11m and 5.8m high; Volume = 551m^3

Containment strategy is to contain all liquid inventory of the AD plant in one containment system. If all tanks are in one secondary containment:

As per CIRIA C736, Chapter 4:

I. Volume of Inventory

- **Case 1 Capacity:** 110 percent = 13519m^3 x 1.1 = **14871m^3**
- **Case 2 Capacity:** 25 percent (only tanks) = 0.25 x [(13519m^3) + (13256m^3) + (143m^3) + (274m^3) + (551m^3)] = **6936m^3**

Hence, Case 1 capacity is critical and the secondary containment to be designed to suit this capacity.

Total Area of containment = 12075m^2 (as per the latest CAD drawing)

II. Rainfall

Volume requirement generated by 10% AEP event, using average rainfall depths from HR Wallingford, 1986:

- Sherburn in Elmet, Leeds – Region 2
- 24 – hr duration = 32mm rainfall
- 8 – day duration = 65mm rainfall
- Duration of incident (6 hrs assumed) = 8mm rainfall

Rainfall area = Total area – (area of tanks + area of plant + area of feeders etc.)
= 12075m^2 – 3880m^2 = 8195m^2

Rainfall volume = (Total rainfall depth 10 year return period) x (minimum containment area)
= (0.029 + 0.054 + 0.00725)m x 8195m^2 = **740m^3**

III. Firefighting Water

The amount of freeboard required for firefighting foam should be agreed with the Fire and Rescue Service or occupational fire brigades, but the amount should be no less than 100mm.

IV. Volume of liquid retained in gravel

Area of gravel being saturated = Containment area (gravel area) = 4884m^2

Volume of inventory retained in gravel; assuming 150mm deep gravel with 0.45 void ratio = 4884m^2 x 0.15m x 0.45 = **330m^3**

Total secondary containment volume required = 14871m^3 + 740m^3 – 330m^3 = **15281m^3**

Allowable area of containment = Total area – (area of tanks + feeders + Scrubbing Tower + Control Panel).

- Area of tanks = (π x (45m/2)^2) + (2 x π x (35m/2)^2) + (2 x π x (4m/2)^2) + (π x (9m/2)^2) + (π x (11m/2)^2) = 3698m^2
- Feeders = 2 x [(3m x 12.5m) + ((π x 1.5^2 / 2)] = 82m^2
- Odour Control System = 20m x 5m = 100m^2

Therefore, allowable area of containment = 12075m^2 – (3698 + 82 + 100) = **8195m^2**

CONTAINMENT DESIGN CONSIDERATION

Concrete bund walls are proposed as the secondary containment.

The height of the bund wall is calculated as follows: Volume of inventory and rainfall to be retained in the secondary containment in an event of accident divided by the area of secondary containment.

The height of the bund wall = 15281m^3 / 8195m^2 = 1.86m say 1.9m

The total height of bund wall (considering 100mm freeboard for firefighting water) = 1.9m + 0.10m = **2.0m**

Since the tanks are made of precast concrete walls, failure due to jetting is not taken into consideration.

The bund wall is proposed to be **2.0m** high. The tanks and other components affected by the inventory in case of an incident needs to be raised by 0.60m to prevent damage to different components.

As per the site risk assessment, the containment classification is class 2.

BREF COMPLIANCE

Referring BREF (EUR 29362 EN – Best Available Techniques (BAT) Reference Document for Waste Treatment) on containment, key aspect include:

- **Containment and Environmental Risk Management**
  - Secondary Containment System (Section 2.3.11 of BREF): As per the above mentioned proposed containment strategy, concrete bund wall around the perimeter of the site complies with BREF for preventing soil and water contamination.
  - Water Management (Section 2.3.7 of BREF): The use site surface falls and defined gravity drainage with lagoons for runoff control aligns with the BREF guidance on stormwater and leachate management.

APPENDIX D - REFERENCES

1. **CIRIA C736 – Containment systems for the precention of pollution: Secondary, tertiary and other measures for industrial and commercial premises**

2. **EUR 29362 EN – Best Available Techniques (BAT) Reference Document for Waste Treatment (Industrial Emissions Directive 2010/75/EU Integrated Pollution Prevention and control)**

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Hull (Registered Office)	**Leeds**	**York**
Church House	Unit E	Partnership House
44 Newland Park	Millshaw Business Living	Monks Cross Drive
Hull HU5 2DW	Global Avenue	Monks Cross
01482 345797	Leeds LS11 8PR	York YO32 9GZ
www.masonclark.co.uk	0113 2779542	01904 438005
consultants@masonclark.co.uk	www.masonclark.co.uk	www.masonclark.co.uk

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