PROPOSED ANAEROBIC DIGESTION FACILITY AT SPRING GROVE FARM, WITHERSFIELD, NORTHW-EST OF HAVERHILL, CB9 7SW

Flood Risk Assessment and

Surface Water Drainage Strategy

Prepared for: Acorn Bioenergy Limited.

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EXECUTIVE SUMMARY

SLR Consulting Ltd has prepared this Flood Risk Assessment (FRA) and Surface Water Drainage Strategy (SWDS) on behalf of Acorn Bioenergy Limited to support the Planning Application for the construction of an Anaerobic Digestion (AD) Plant at Spring Grove Farm, Withersfield, North West of Haverhill, Suffolk, CB9 7SW (the 'Site'). A summary of the key findings from the FRA and SWDS are provided below.

Subject	Element	Findings
Site	Address	Spring Grove Farm, Withersfield, North West of Haverhill, Suffolk, CB9 7SW
	Visit	Undertaken by an experienced hydrologist on 10th May 2022
Existing Site	Description	The main AD facility Site (the 'main Site') covers an area of 12.5ha across two adjoining arable fields, 9.3ha of Bowsey Field in the west and 3.2ha of Spring Grove Field to the east. The proposed development also comprises 2No. digestate lagoons ('the northern lagoons') with a combined capacity of 10,000m^3, located some 2.5km to the north of the main Site, with a connecting pipeline. The overall Site is currently arable land. The proposed development falls completely within the planning jurisdiction of West Suffolk District Council and Suffolk County Council who act as the Lead Local Flood Authority (LLFA) for the area.
	Topography	Ground levels across the main Site generally fall in a south easterly direction from an elevation of approximately 88.5m Above Ordnance Datum (AOD) along the north western boundary of the main Site to 79.0m AOD along the south eastern boundary of the main Site. Ground levels fall bearing south from approximately 110.25m AOD in the northern corner to approximately 103.75m AOD in the southern corner, at the end of the pipeline.
	Geology & Hydrogeology	The Site consists of the *Lewes Nodular Chalk Formation and Seaford Chalk Formation (Undifferentiated) – Chalk*. These formations are designated as *Principal* aquifers. The bedrock at the Site is overlain by superficial deposits of *Lowestoft Formation – Diamicton* which are designated as a *Secondary (undifferentiated)* aquifer.
	Hydrology	The Stour Brook flows in a general easterly direction along most of the southern boundary of the main Site. There is also a watercourse along the western boundary of the main Site and another delimiting the Bowsey Field and the Spring Grove Field. The two watercourses, along the western boundary of the main Site and delimiting the Bowsey Field and the Spring Grove Field, appear to drain to the Stour Brook. In the vicinity of the northern lagoons and pipeline, the Stour Brook flows in a general southerly direction, parallel to the southern boundary of the northern lagoons and along the northern 1.2km section of the pipeline.
	Drainage	The Site is currently undeveloped and is no evidence to suggest it is served by a formal drainage system. Incident rainfall is therefore expected to 'drain' via a combination of evaporation, transpiration, and infiltration into the underlying strata.
Proposals	Description	The proposed development will consist of an anaerobic digestion (AD) facility. The Site will consist of c. 4.63ha of impermeable hardstanding and lagoons that do not allow infiltration. The AD facility will process a series of agricultural crops and manures in the region of c.92,000 tonnes per annum. The AD Plant facility will capture as much rainwater as possible for use in the process. Based on annual average estimates, rainwater capture is expected to be sufficient for approximately 100% of the process water demand. The AD facility will generate biomethane, carbon dioxide and digestate. The biomethane will be tankered from the Site to a central 'hub' where it will be injected into the UK gas grid. The carbon dioxide will be sold and the digestate will be spread to local farmland as fertiliser. The AD facility would have the capacity to produce in the region of c. 9,773,133Nm^3 of upgraded biomethane per annum).
	Lifetime	The proposed AD plant has an anticipated operational lifespan of 25 years. A 25-year operational period is therefore assumed for this application.
	Vulnerability	Table 2: Flood risk vulnerability classification of the PPG Annex 3, *waste treatment'* are classified as *'Less Vulnerable'*.

Site Flood Risk	**Fluvial**	The Site lies predominantly within **Flood Zone 1**. The central southern part of the main Site lies within **Flood Zone 3a** with a limited area beyond which lies in **Flood Zone 2**. There is also a limited section of the pipeline located within **Flood Zones 2 and 3a**. As the pipeline will be constructed below ground, consideration of the flood risk along its alignment will be limited to the construction phase. It is therefore recommended that the Construction and Environmental Management Plan (CEMP) be cognisant of the flood risk with associated impact and management measures conditions.
	Tidal	The Site is remote from any tidal extent and at low risk of tidal flooding.
	Surface Water	The central and southern part of the main Site is potentially at risk of surface water flooding. Within the main Site, where the flood extent associated with surface water flooding coincides with that associated with flooding from rivers during a 0.1% AEP event (Flood Zone 2), flood management measures have been provided. Within areas only at risk of flooding from surface water, it is proposed that all built infrastructure of the proposed AD facility be either located outside these areas or be protected from flooding. Additionally, it is proposed that the SWDS be developed to prevent pooling by providing sufficient water drainage features.
	Groundwater	While there are gravel and cobbles layer(s) present at the main Site, these would be overlain by clay and groundwater emergence is therefore considered unlikely. Additionally, groundwater level is expected to be 15m – 30m below ground level at the northern lagoons and along the pipeline. The flood risk from this source is therefore low.
	Sewers and Artificial Sources	The Site is currently arable land and is therefore not anticipated to be served by any sewers. It is possible that public sewers could be present within the A1307 to the south of the main Site. However, overland flow resulting from flooding from any sewers within the A1307 to the south of the main Site would likely be intercepted by the Stour Brook and be conveyed in an easterly direction, away from the main Site. Additionally, there are no other infrastructure likely to pose a flood risk at the Site.
Planning Requirements	**Sequential Test and Exception Test**	The Sequential Test and Exception Test are deemed to have been passed as all key elements of the proposed development will be located within Flood Zone 1 and the proposed development has been classified as less venerable, appropriate in this Flood Zone.
Summary	**Design Flood Event**	The Design Flood Event (DFE) is the 1% AEP fluvial event inclusive of an 8% allowance for climate change. A climate change allowance of 20% has also been considered for peak rainfall intensity at the main Site with no anticipated adverse impact.
	Development Levels/ Layout	Finished floor levels should ideally be at least 150mm above external hardstanding areas to prevent progression of incident surface water into the infrastructure. It is proposed that all elements of the proposed development be either located outside the surface water flood risk area or, where this is not possible, be protected from flooding (e.g. by land raising, elevated infrastructure or bunding). These mitigations have been incorporated in the scheme.
	Safe access and egress	The proposed access road through the main Site will be raised above the DFE level.
	Floodplain compensation	Flood management measures in the form of culverts will be provided. These measures result in a reduction in flood risk downstream of the main Site. However, there is a limited area within the woodland to the south west of the main Site where flood risk is marginally increased. This increase in flood risk is however considered appropriate in light of the low vulnerability use of the woodland and the decrease in flood risk at Haverhill.
	Surface water drainage strategy	As a conservative approach, a discharge to the Stour Brook to the south of the main Site has been adopted as the means of discharge of surface water runoff resulting from the proposed development. A lagoon has been incorporated within the proposed development design to control discharge of runoff. Attenuation storage will be provided within the lagoon.
	Residual Risk	Flood events in excess of the design standard have been considered in the development layout and will mimic existing flow paths.
	Conclusion	This Flood Risk Assessment and Surface Water Drainage Strategy concludes that the requirements of national, county, and local planning policy can be achieved at the Site given the nature of development proposed.

1.0 INTRODUCTION

1.1 Terms of Reference

In February 2022, SLR Consulting Limited (SLR) was appointed by Acorn Bioenergy Limited. (the Client) to prepare a Flood Risk Assessment (FRA) and Surface Water Drainage Strategy (SWDS) to support a planning application for the proposed Anaerobic Digestion (AD) Plant at Spring Grove Farm, Withersfield, North West of Haverhill, Suffolk, CB9 7SW (the 'Site').

This FRA and SWDS have been prepared by SLR, under the direction of a Technical Director for Hydrology at SLR who specialises in flood risk and associated planning matters. Reporting has been completed in accordance with guidance presented within the National Planning Policy Framework[1] (NPPF) and its associated Planning Practice Guidance[2] (PPG), taking due account of current best practice documents relating to assessment of flood risk published by the British Standards Institution BS8533[3].

1.2 Administrative Context

The proposed development falls within the planning jurisdiction of West Suffolk District Council and Suffolk County Council who act as the Lead Local Flood Authority (LLFA) for the area.

1.3 Site Location

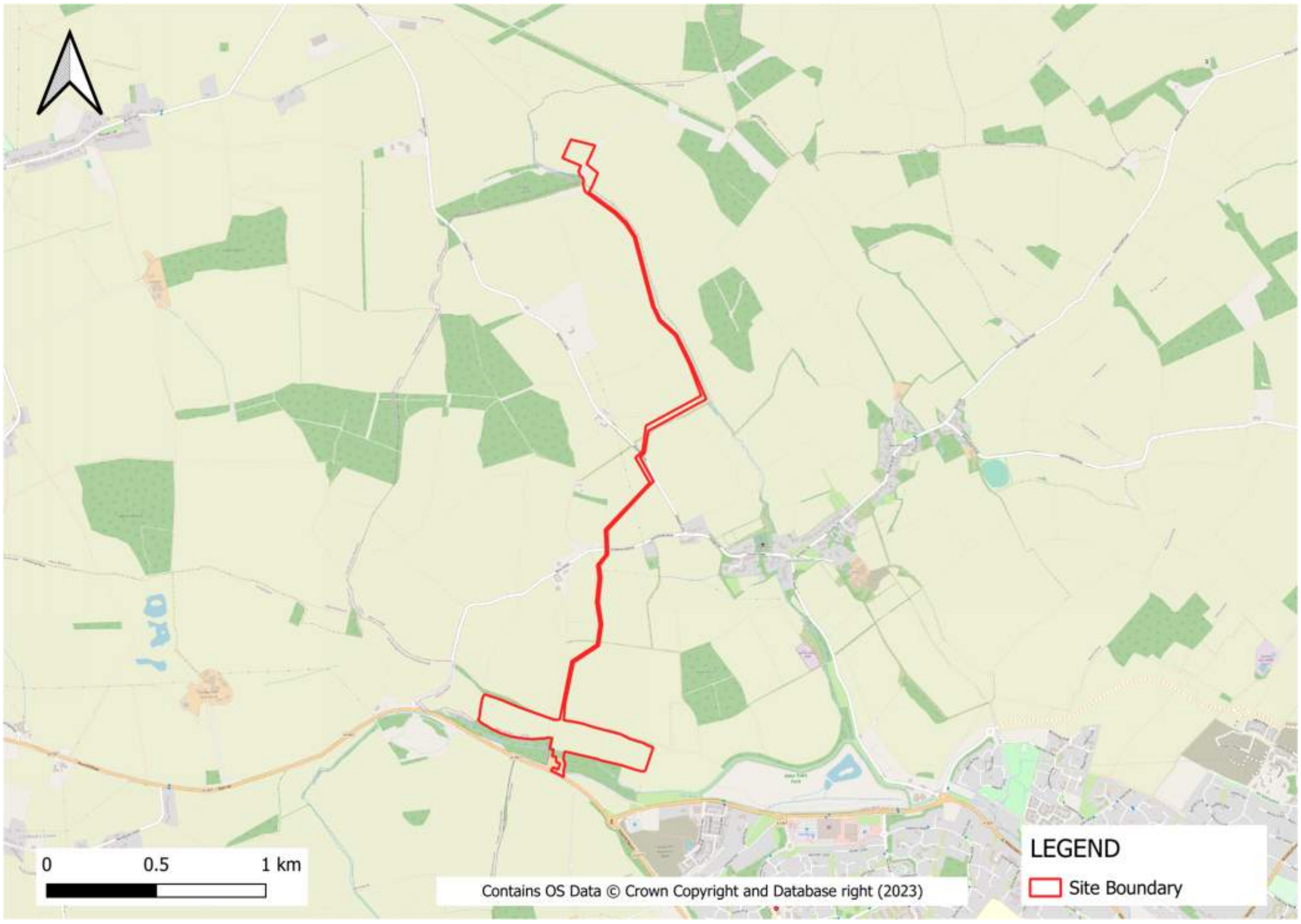
The main AD facility Site (the 'main Site') is centred on National Grid Reference (NGR) 563984, 246977, on the outskirts of Haverhill, and extends across two adjoining arable fields.

The proposed development also comprises 2No. digestate lagoons ('the northern lagoons'), located some 2.5km to the north of the main Site, and a pipeline conveying digestate between the main Site and the northern lagoons.

A site location plan is provided as **Figure 1-1**.

1 National Planning Policy Framework: Communities and Local Government (Updated July 2021)
2 Planning Practice Guidance: Communities and Local Government (Updated June 2021)
3 BS8533:2017, Assessing and managing flood risk in development: Code of Practice (December 2017)

Figure 1-1
Site Location Plan

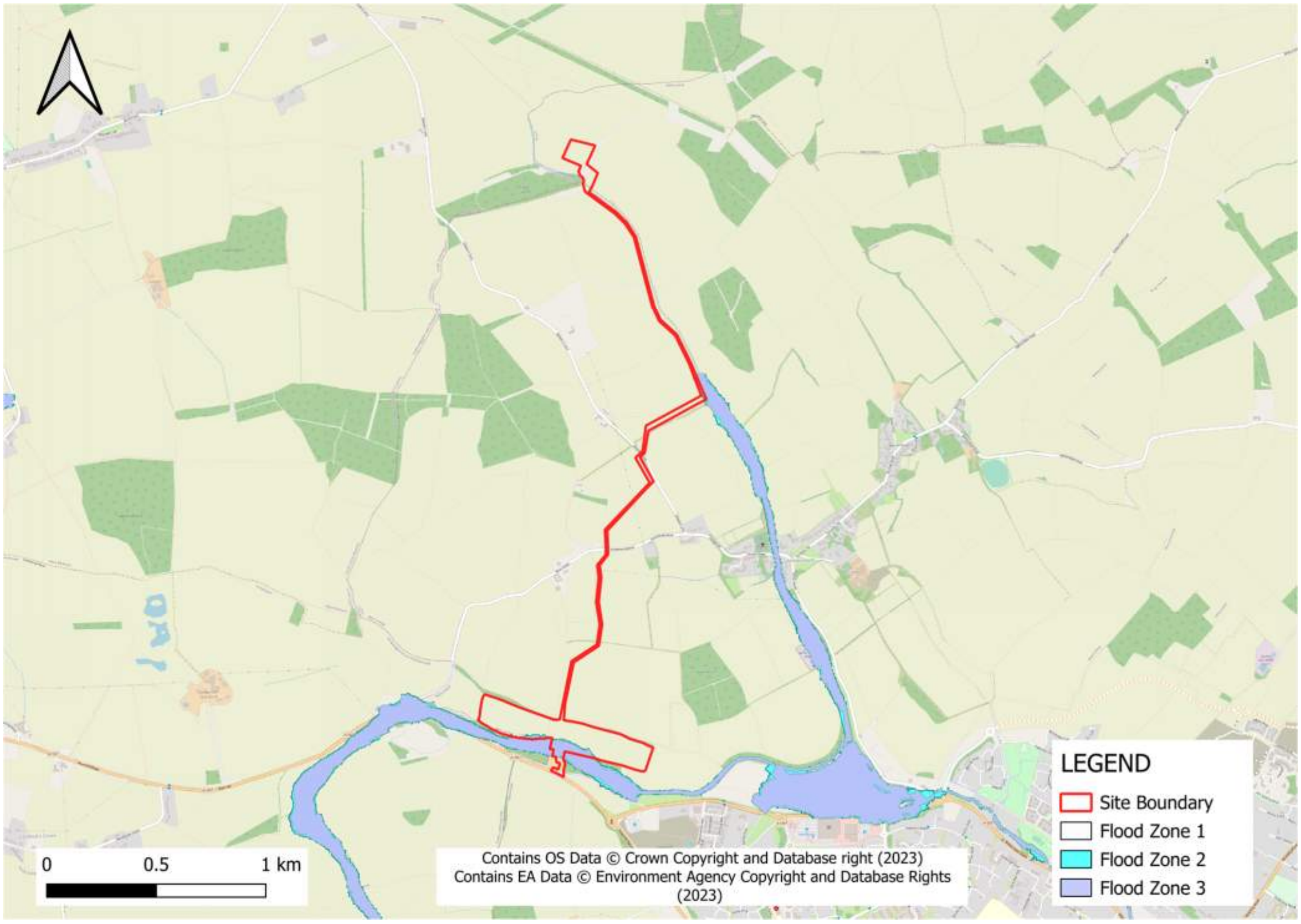


1.4 Background and Aims

With reference to the *Flood Map for Planning (Rivers and Sea)*[4] the Site lies partly within an area considered to be at risk of fluvial or tidal flooding. An extract of the Flood Map for Planning is provided as **Figure 1-2**.

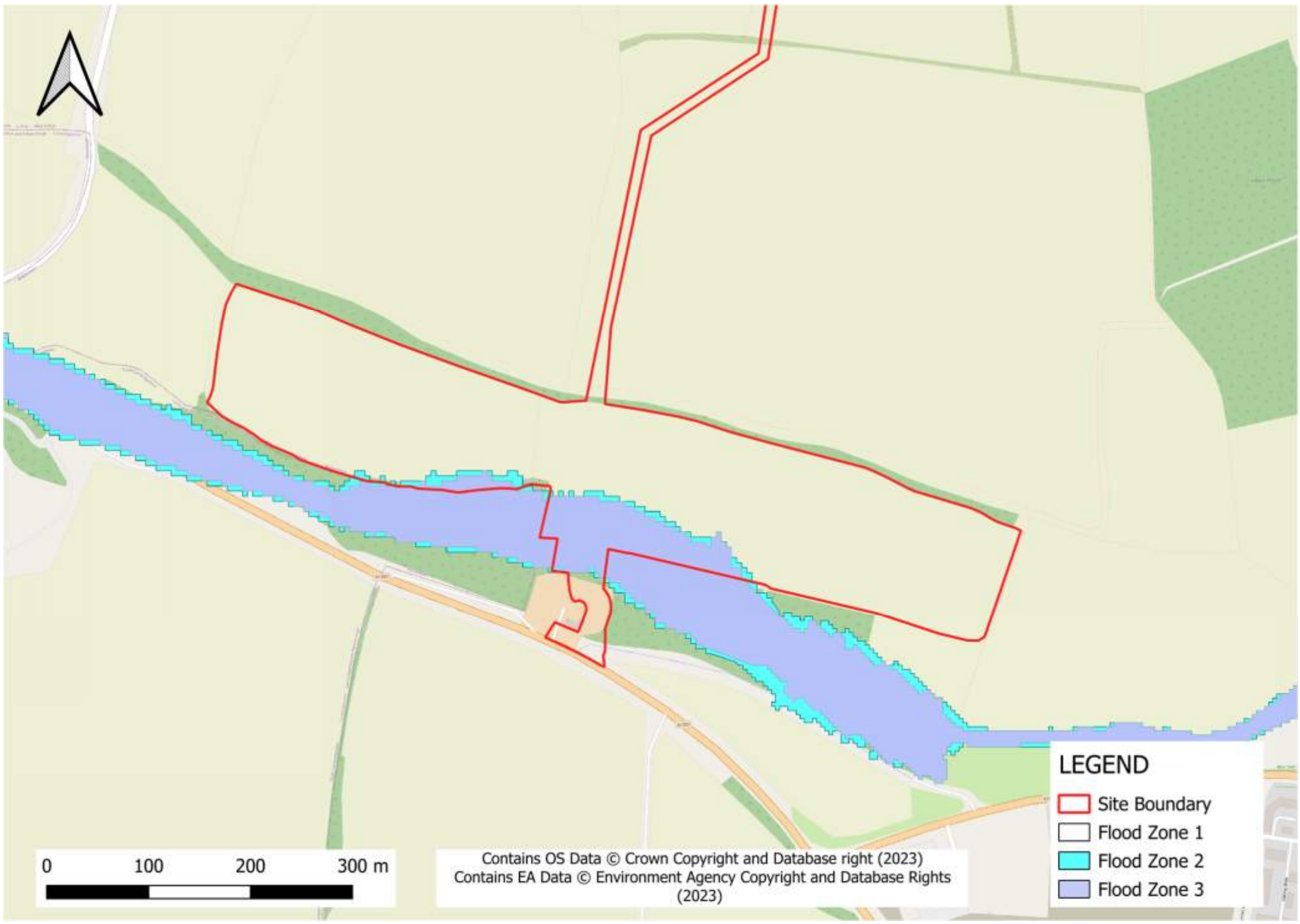
4 Government Digital Service (Accessed on 4 February 2022) https://flood-map-for-planning.service.gov.uk/

Figure 1-2
Extract of the Flood Map for Planning



Flood Zone mapping specific to the main Site is provided as **Figure 1-3**.

Figure 1-3
Extract of the Flood Map for Planning: Main Site



However, as the Site covers an area greater than 1 hectare (ha), with reference to footnote 55 of the National Planning Policy Framework (NPPF), any planning application for development at the Site would therefore need to be accompanied by a site-specific FRA.

2.0 SITE DETAILS

2.1 Existing Site Description

The main Site extends across two adjoining arable fields, Bowsey Field in the west and Spring Grove Field to the east.

As observed on imagery reproduced as **Figure 2-1**, the main Site and northern lagoons are currently arable land.

Figure 2-1
Satellite Imagery of the Site

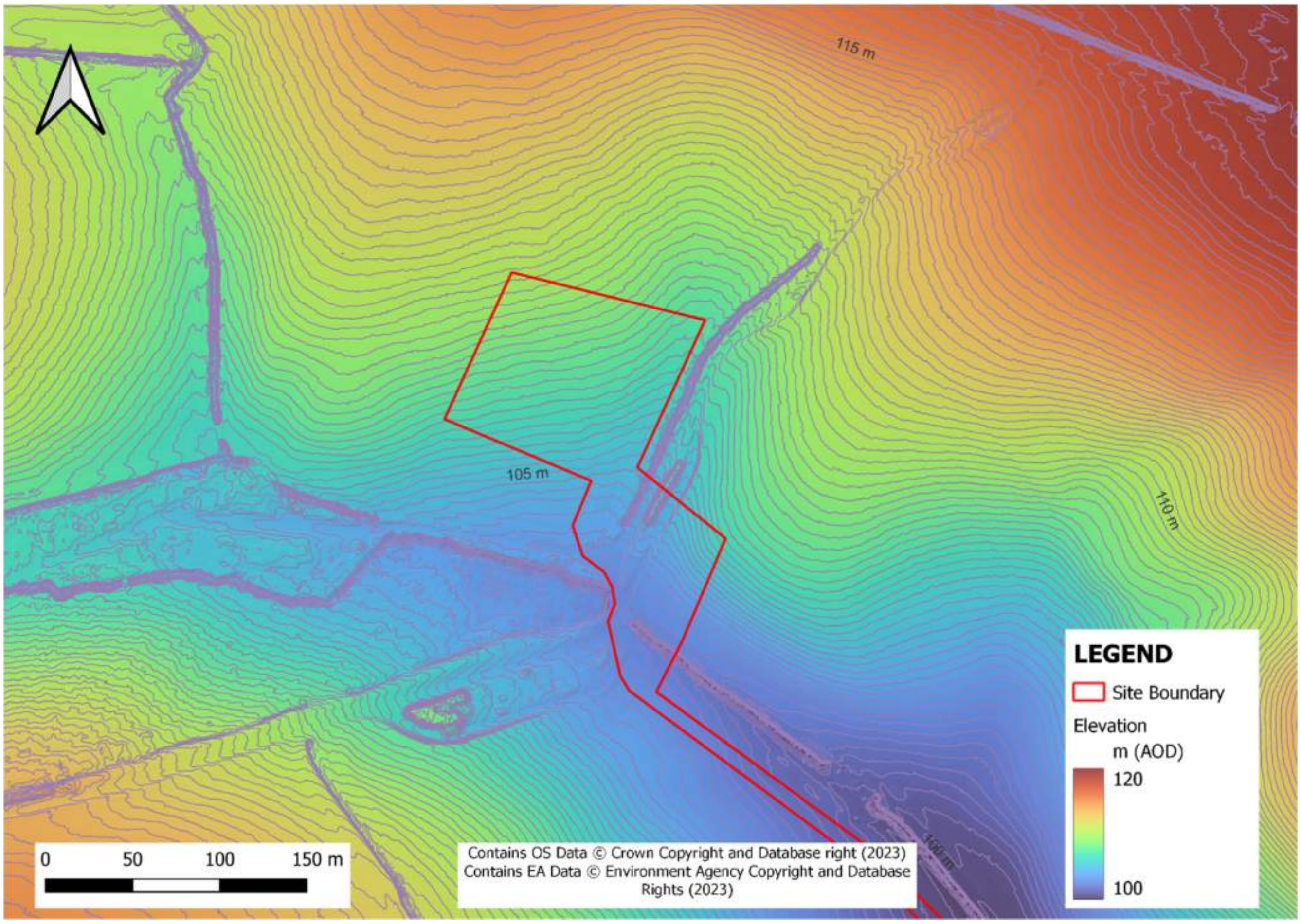
2.2 Topography

A topographic survey of the Site was undertaken by Mitcham Survey Department on 11th March 2022, a copy of which is enclosed at **Appendix 01**. The survey indicates that ground levels across the main Site generally fall in a south easterly direction from an elevation of 88.73m Above Ordnance Datum (AOD) along the north western boundary of the Site to 78.78m AOD along the south eastern boundary of the Site.

Ground levels along the pipeline and across the northern lagoons are provided by 1m resolution Light Detection and Ranging (LiDAR) aerial photogrammetric data, downloaded from the Environment Agency open data website[5].

This LiDAR data has been used to generate contours which indicate that ground levels along the pipeline vary from approximately 84.0m AOD at the main Site to approximately 103.75m AOD at the northern lagoons. With reference to **Figure 2-2**, ground levels across generally fall in a southerly direction from an elevation of approximately 110.25m AOD in the northern corner to approximately 103.75m AOD in the southern corner, at the end of the pipeline.

Figure 2-2
Northern Lagoons: Topographic Contours



2.3 Geological and Hydrogeological Context

2.3.1 Geology

Published British Geological Survey (BGS) online geology maps[6] indicate that the bedrock geology across the Site consists of the *Lewes Nodular Chalk Formation and Seaford Chalk Formation (Undifferentiated) – Chalk*. This is overlain by superficial deposits of *Lowestoft Formation – Diamicton*.

5 Environment Agency open data website (Accessed on 4 February 2022) https://environment.data.gov.uk/
6 British Geological Survey, Geoindex (Accessed on 4 February 2022) http://mapapps.bgs.ac.uk/geologyofbritain3d/

Soil composition[7] across the Site is predominantly described as *'lime-rich loamy and clayey soils with impeded drainage'* with *'freely draining slightly acid loamy soils'* within the southern part of the main Site.

With reference to the trial pit log, enclosed at **Appendix 02**, prepared by Marriott Geotechnical Drilling as part of the infiltration testing (see Section 2.3.3), clay was encountered to a depth of 1.80m below ground level (b.g.l.). The clay is underlain by gravel and cobbles of flint to the base of the trial pit.

2.3.2 Hydrogeology

Review of the online MAGIC mapping[8] indicates that the *Lewes Nodular Chalk Formation and Seaford Chalk Formation* are designated as *Principal* aquifers with '*layers of rock or drift deposits that have high intergranular and/or fracture permeability – meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifers'*.

However, the superficial deposits are designated as a *Secondary (undifferentiated)* aquifer which is *'assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type'*.

Groundwater was recorded within the trial pit excavated for infiltration testing at approximately 1.90m b.g.l. within the layer of gravel and cobbles. This rose to 1.59m b.g.l. indicating groundwater is confined beneath the clay.

2.3.3 Infiltration Testing

Infiltration testing was undertaken at the main Site on the 6th May 2022 to determine the feasibility to discharge surface water runoff to ground. The results, location and geological description of the trial pit are enclosed at **Appendix 02**.

The infiltration testing was carried out for a period of 128 minutes however the trial pit became unstable and therefore testing was abandoned.

2.4 Hydrological Context

2.4.1 Local Hydrology

With reference to the Ordnance Survey 1:25,000 scale mapping, the southern boundary of Bowsey Field area of the main Site is defined by Stour Brook which, at this location, flows in a general easterly direction. This watercourse continues to form the southwestern boundary of the Spring Grove Field area of the main Site beyond which is a disused railway line.

There is also a watercourse along the western boundary of the Site and another delimiting the Bowsey Field and the Spring Grove Field.

In the vicinity of the northern lagoons and pipeline, the Stour Brook flows in a general southerly direction, parallel to the southern boundary of the northern lagoons and along the northern 1.2km section of the pipeline

At the main Site and in the vicinity of the northern lagoons and pipeline, the reach of the Stour Brook at the Site is designated as an Ordinary Watercourse. As the Stour Brook flows away from the southern boundary of the main Site, near the south eastern corner, the watercourse is designated as a Main River.

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7 Soilscapes, Cranfield Soil and Agrifood Institute, Cranfield University, DEFRA, (Accessed on 4 February 2022) http://www.landis.org.uk/soilscapes/

8 Magic Map, DEFRA, (Accessed on 4 February 2022) https://magic.defra.gov.uk/MagicMap.aspx

The two watercourses discussed at Section 2.1, along the western boundary of the Site and delimiting the Bowsey Field and the Spring Grove Field, drain to the Stour Brook.

2.4.2 Existing Site Drainage

As discussed at Section 2.1, the Site is currently undeveloped and is not therefore expected to be served by a formal drainage system. Incident rainfall is therefore expected to ‘drain’ via a combination of evaporation, transpiration and infiltration into the underlying strata.

3.0 DEVELOPMENT PROPOSAL

3.1 Proposed Development Summary

The proposed development will consist of an anaerobic digestion (AD) facility. The Site will consist of 4.76ha of impermeable hardstanding.

The proposed development would accept in the region of 92,000 tonnes per annum of feedstock from local farms. The feedstock material would undergo a process of controlled decomposition (anaerobic digestion) within the proposed facility. The process produces biogas which is then upgraded to biomethane before being transported by tanker to a central gas injection point. Rainwater would be collected on Site for use in the process.

The AD facility would have the capacity to produce approximately 19,735,000Nm^3 of biogas per annum; this results in approximately 9,773,133Nm^3 of upgraded biomethane.

The gas upgrading process would also result in the production of CO_2 as a natural by-product. The AD plant will be fitted with the equipment required to capture the clean CO_2 to a food grade level standard; which makes it suitable for almost all industrial and commercial applications in the UK. Upgraded CO_2 would be liquefied and transported by road to end users, ideally located locally.

The proposed development layout has been considered in detail and designed sequentially so that key elements of the proposed development at the main Site as listed below has been afforded the appropriate protection for operational purposes.

Key elements of the proposed development at the main Site comprises:

- 3No. clamps
- Chicken shed
- Straw building and bunker
- Holding tanks within a containment bund
- 3No. covered lagoons
- Rainwater lagoon
- Various equipment

Details of the proposed development layout is enclosed at **Appendix 03**.

3.2 Anticipated Lifetime of Development

The proposed AD plant has an anticipated operational lifespan of 25 years. A 25-year operational period is therefore assumed for this application.

3.3 Flood Risk Vulnerability

With reference to *Table 2: Flood risk vulnerability classification* at Annex 3of *Flood risk and coastal change* category of PPG[2], *'waste treatment'* facilities are classified as '*Less Vulnerable'* developments.

3.4 Planning Context

3.4.1 National Planning Policy

This FRA report has been completed in accordance with the guidance presented in the NPPF[1] and with reference to PPG[2]. The NPPF states that Local Plans should be supported by a Strategic Flood Risk Assessment (SFRA) and develop policies to manage flood risk from all sources taking account of advice from the Environment Agency. It is crucial that Local Planning Authorities consider the risks posed by flooding within their boundary when determining planning applications.

3.4.2 County Planning Policy

In addition to national planning policy and associated guidance, Suffolk Council, as the LLFA, have expanded on the documents at national level, by giving further detail on undertaking an assessment of flood risk and the use of Sustainable Drainage System (SuDS) under the following policies:

Suffolk Minerals & Waste Local Plan Adopted July 2020

Policy GP2: Climate change mitigation and adaptation

'New minerals and waste management facilities should through their construction and operation minimise their potential contribution to climate change through reducing carbon and methane emissions, incorporate energy and water efficient design strategies and be adaptable to future climatic conditions.

Proposals for new minerals and waste facilities should where appropriate:

c) give priority to the use of sustainable drainage systems, paying attention to the potential contribution to be gained to water harvesting from impermeable surfaces and encourage layouts that accommodate waste water recycling;

d) take account of potential changes in climate including pluvial and fluvial flooding, rising sea levels and coastal erosion, and;'

Policy GP4: General environmental criteria

'Minerals and waste development will be acceptable so long as the proposals, adequately assess (and address where applicable any potentially significant adverse impacts including cumulative impacts) on the following:

a) pluvial, fluvial, tidal and groundwater flood risk;'

while not policy, it should be noted that a Construction Surface Water Management Plan has been produced by Suffolk County Council to advise developers and applicants and define the information required to assess planning applications in relation to Surface Water Drainage. It has been developed with reference to the National Planning Policy Guidance as well as utilising best practice information as set out in the Non-Statutory Technical Guidance and CIRIA SuDS Manual (C753).

3.4.3 Local Planning Policy

The Site is located within the West Suffolk District Council planning jurisdiction, for which additional guidance to development is provided within the:

- Local Development Framework St Edmundsbury Core Strategy December 2010; and
- Forest Heath and St Edmundsbury Local Plan Joint Development Management Policies Document February 2015.

The policies below relate to the assessment of flood risk at the proposed development.

Local Development Framework St Edmundsbury Core Strategy

Policy CS2 Sustainable Development

'A high quality, sustainable environment will be achieved by designing and incorporating measures appropriate to the nature and scale of development, including:

J) incorporating the principles of sustainable design and construction in accordance with recognised appropriate national standards and codes of practice to cover the following themes:

- *Surface Water Run-off – incorporating flood prevention and risk management measures, such as sustainable urban drainage;'*

Forest Heath and St Edmundsbury Local Plan Joint Development Management Policies Document

Policy DM6: Flooding and Sustainable Drainage

'Proposals for all new development will be required to submit schemes appropriate to the scale of the proposal detailing how on-site drainage will be managed so as not to cause or exacerbate flooding elsewhere. Examples include: rainwater harvesting and greywater recycling, and run-off and water management such as Sustainable Urban Drainage Systems (SUDS) or other natural drainage systems.'

The national, county and local policies relating to the management of flood risk, including the design of a sustainable surface water drainage strategy, for the Site have been considered in the following sections of this FRA.

4.0 POTENTIAL SOURCES OF FLOODING RISK

This report has been prepared in accordance with the advice and requirements prescribed in current best practice documents relating to management of flood risk in development published by the Construction Industry Research and Information Association (CIRIA)[9] and BS85333[3].

A screening study has been completed to identify whether there are any potential sources of flooding at the Site which may warrant further consideration. If required any potential flooding issues identified in the screening study would then be considered in subsequent sections of the assessment.

4.1 Potential sources of flooding

There are a number of potential sources of flooding and these include:

- Flooding from rivers or fluvial flooding;
- Flooding from the sea or tidal flooding;
- Flooding from surface water or pluvial flooding;
- Flooding from groundwater;
- Flooding from sewers;
- Flooding from reservoirs, canals, and other artificial sources; and
- Flooding from infrastructure failure.

The flood risk from each of these potential sources is discussed below.

4.1.1 Flooding from Rivers or Fluvial Flooding

4.1.1.1 Main Site

With reference to the *Flood Map for Planning (Rivers and Sea)*[4], an extract of which is provided as **Figure 1-2**, the southern part of the main Site is shown to lie within an area having a greater than 0.1% Annual Exceedance Probability (AEP) of flooding from this source.

The flood risk to the proposed development at the main Site has therefore been considered further at Section 0.

4.1.1.2 Northern Lagoons

With reference to the *Flood Map for Planning (Rivers and Sea)*[4], northern lagoons lie entirely within an area having less than 0.1% Annual Exceedance Probability (AEP) of flooding from this source.

The flood risk from this source is therefore low and is not considered further.

4.1.1.3 Pipeline

There is a limited section of the pipeline located within an area having a greater than 0.1% Annual Exceedance Probability (AEP) of flooding from rivers.

However, as the pipeline will be constructed below ground, consideration of the flood risk along its alignment will be limited to the construction phase. It is therefore recommended that the Construction and Environmental Management Plan (CEMP) be cognisant of the flood risk with associated impact and management measures conditions.

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9 CIRIA Report C624, Development and flood risk: guidance for the construction industry

The flood risk from this source is therefore low and is not considered further.

4.1.2 Flooding from Sea or Tidal Flooding

The Site is located in excess of 50km away from the coast and is elevated to levels above 78.78m AOD as discussed at Section 2.2.

The flood risk from this source is therefore low and is not considered further.

4.1.3 Flooding from Surface Water or Pluvial Flooding

An extract from the *Long Term Flood Risk Information*[10] mapping showing areas potentially at risk of flooding from surface water has been provided as **Figure 4–1**.

The surface water flood risk categories are defined as:

- **Very Low:** less than 1 in 1,000 (0.1% AEP) chance of flooding in any given year;
- **Low:** less than 1 in 100 (1% AEP) but greater than or equal to 1 in 1,000 (0.1% AEP) chance of flooding in any given year;
- **Medium:** between 1 in 100 (1% AEP) and 1 in 30 (3.3% AEP) chance of flooding in any given year; and
- **High:** greater than 1 in 30 (3.3% AEP) chance of flooding in any given year.

4.1.3.1 Main Site

Figure 4-1 identifies the main Site to be predominantly at *very low* risk of flooding from surface water with the exception of:

- Southern part of the main Site
- Corridor of the two watercourses discharging to the Stour Brook
- A flow path crossing the Spring Grove Field part of the main Site

The depth of inundation across the above flooding risk areas are shown on **Figure 4-2**, **Figure 4-3** and **Figure 4-4** however, in summary:

- **Southern part of the Site:** The flood risk within this area varies from *low* to *high* as shown on . The depth of inundation from this source could exceed 900mm during a flood event with between 1% and 0.1% AEP (*low*). However, during a flood event with a greater than 3.33% AEP (*high*), the depth of inundation would predominantly be between 300 – 900mm.
- **Corridor of the two watercourses discharging to the Stour Brook:** Flood extent during a less than 3.33% AEP event (*low* to *medium*) is limited. However, during a flood event with a greater than 3.33% AEP (*high*), the extent increases and depth of inundation could reach 300mm.
- **A flow path crossing the Spring Grove Field part of the Site:** Flooding would occur during an event with between 1% and 0.1% AEP (*low*). The associated depth of inundation could reach 300mm.

10 Long Term Flood Risk, Government Digital Service (Accessed on 4 February 2022) https://flood-warning-information.service.gov.uk/longterm-flood-risk/

Figure 4-1
Main Site: Environment Agency Surface Water Flood Risk Extent of Flooding

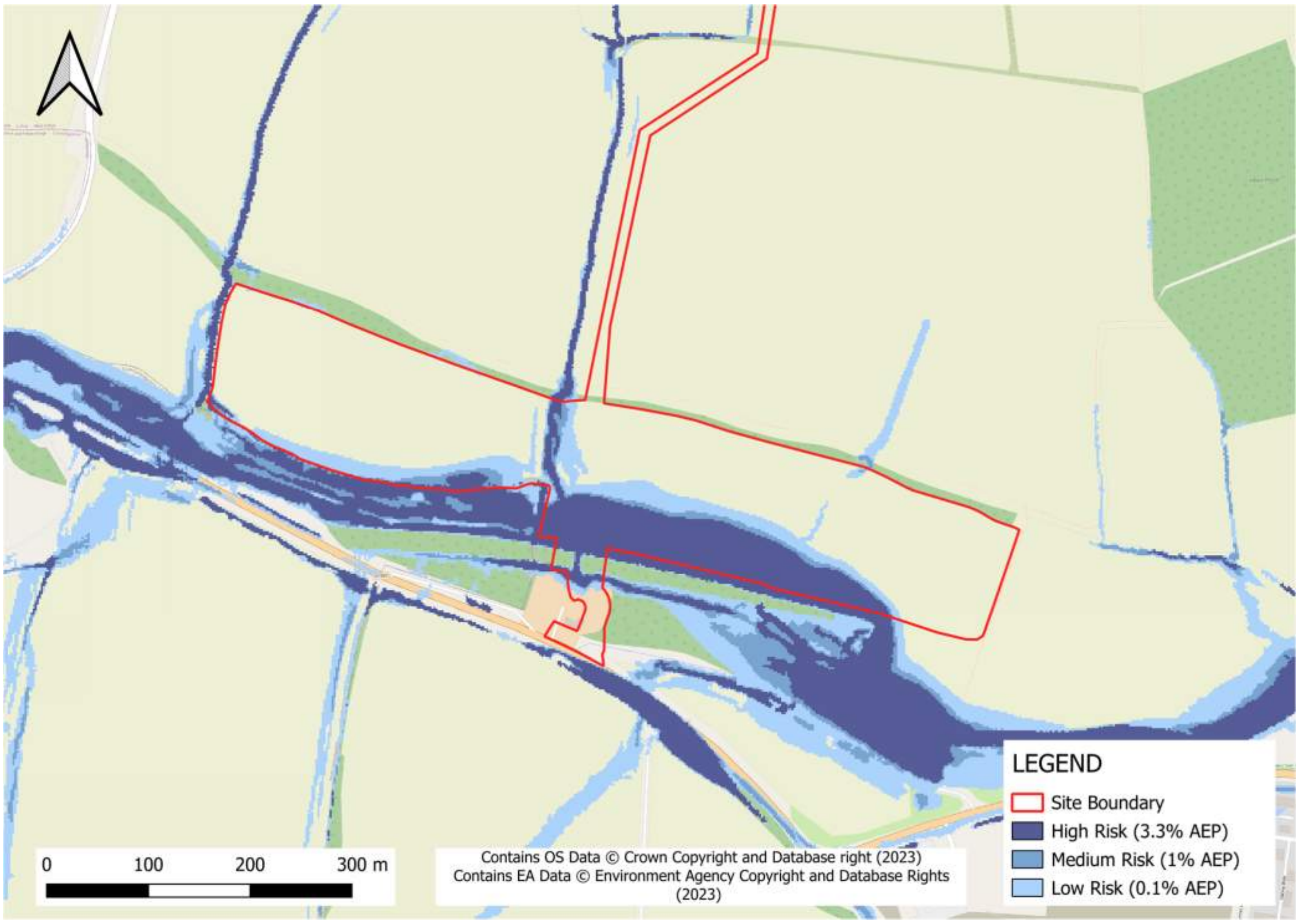


Figure 4-2
Low Risk of Flooding (0.1% AEP)

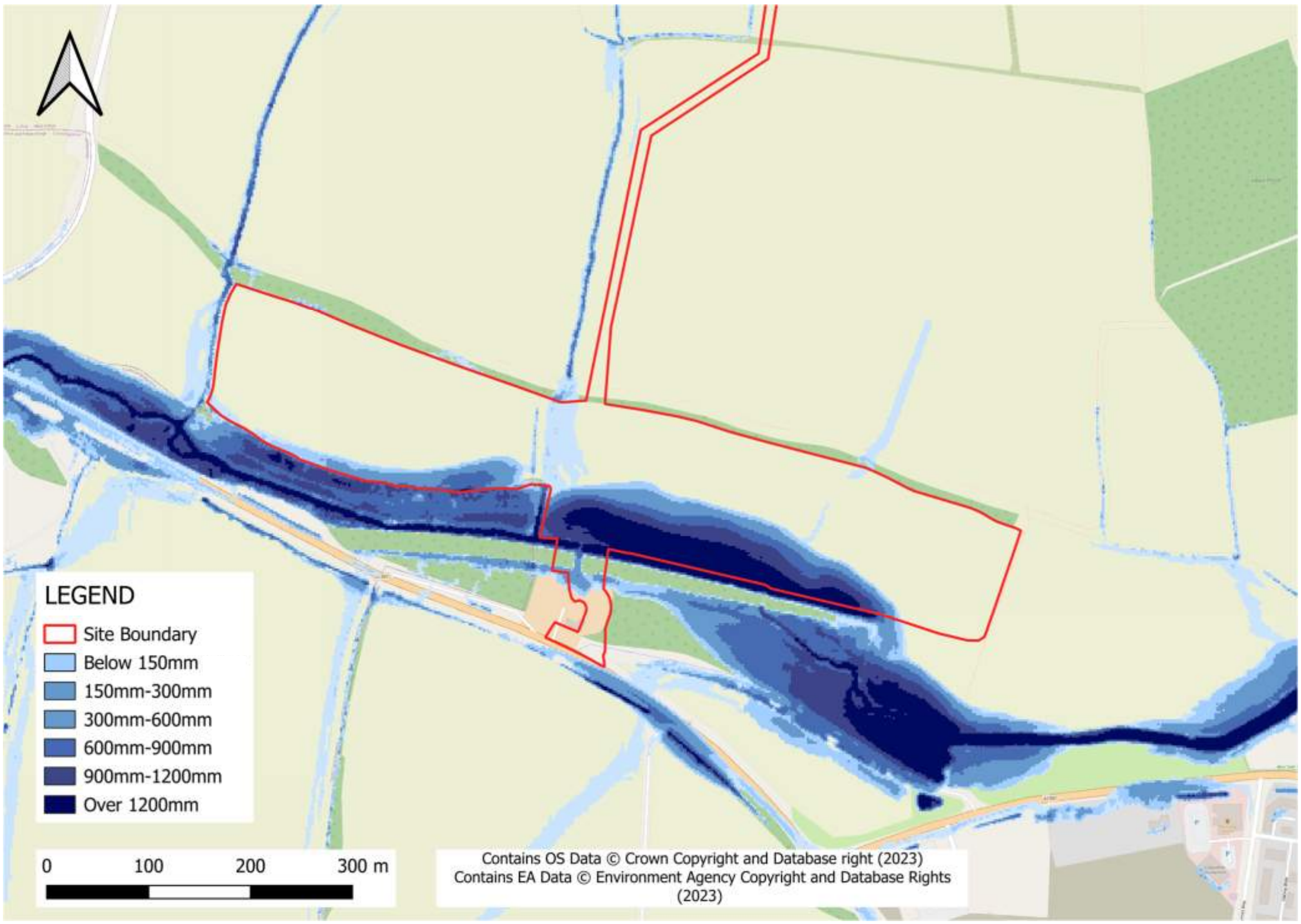


Figure 4-3
Medium Risk of Flooding (1% AEP)

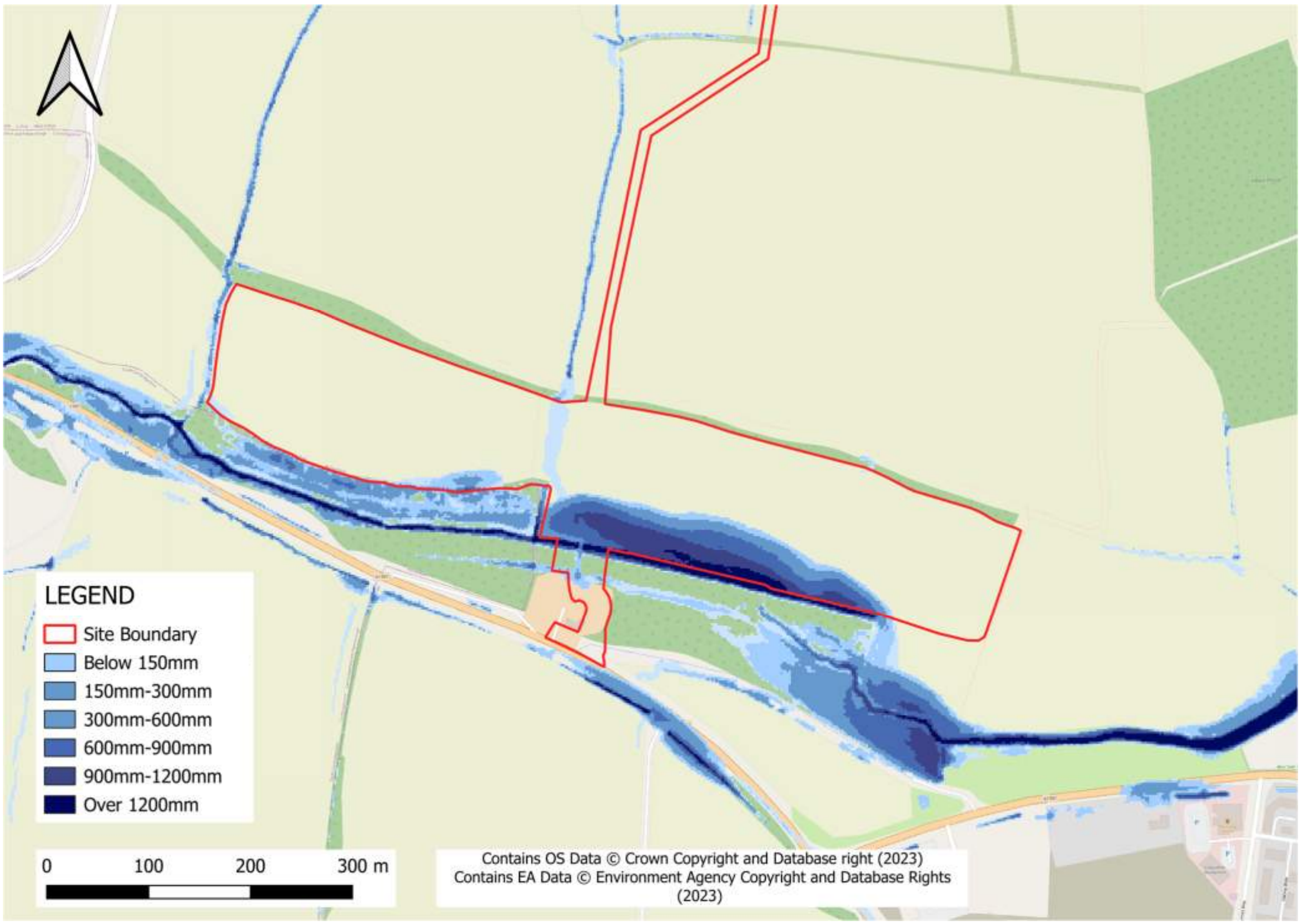
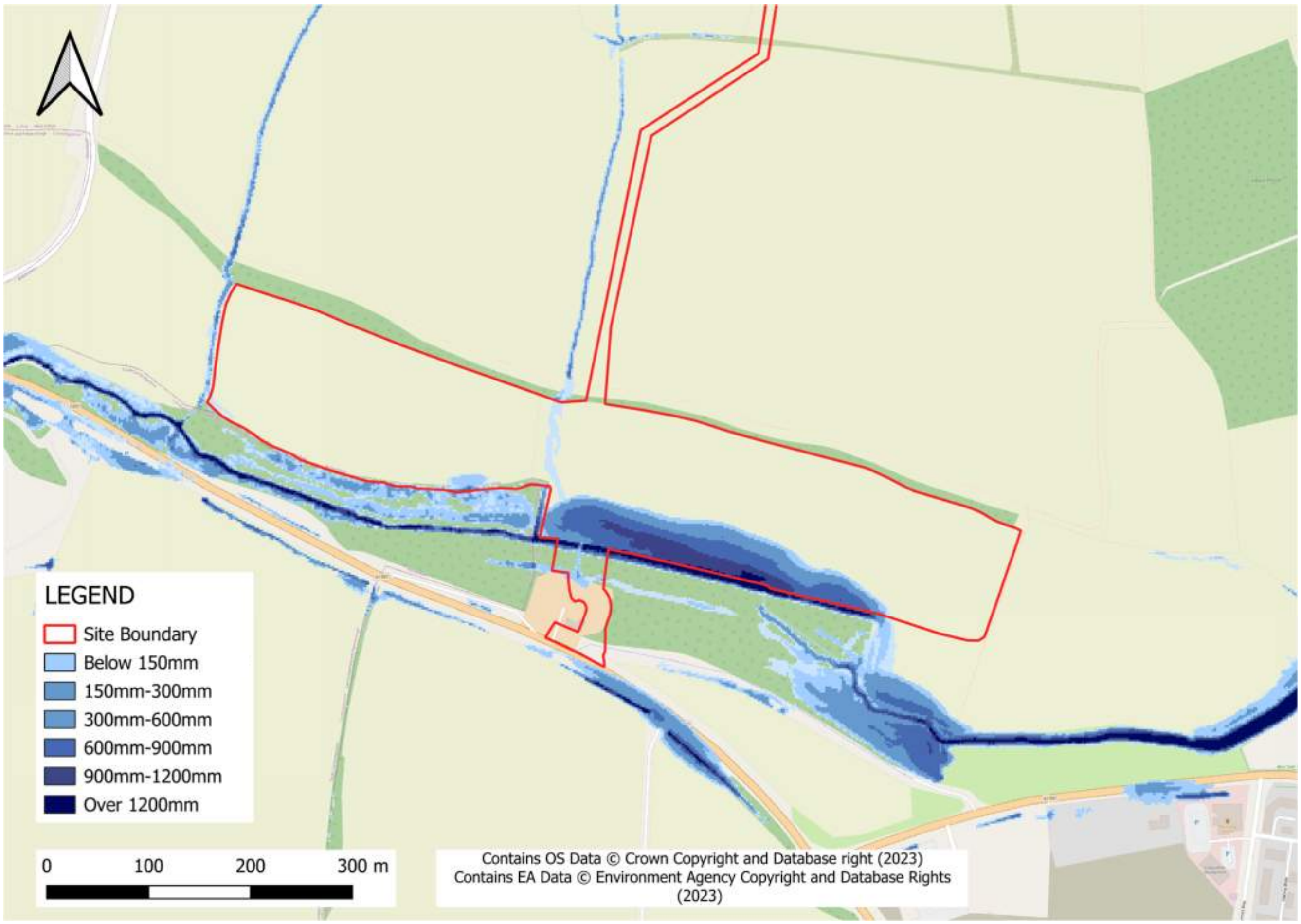


Figure 4-4
High Risk of Flooding (3.33% AEP)



Within the main Site, where the flood extent associated with surface water flooding coincides with that associated with flooding from rivers during a 1% to 0.1% AEP event (Flood Zone 2), flood management measures have been provided as discussed at Section 8.0.

Within areas only at risk of flooding from surface water, it is proposed that all built infrastructure of the proposed AD facility be either located outside these areas or be protected from flooding.

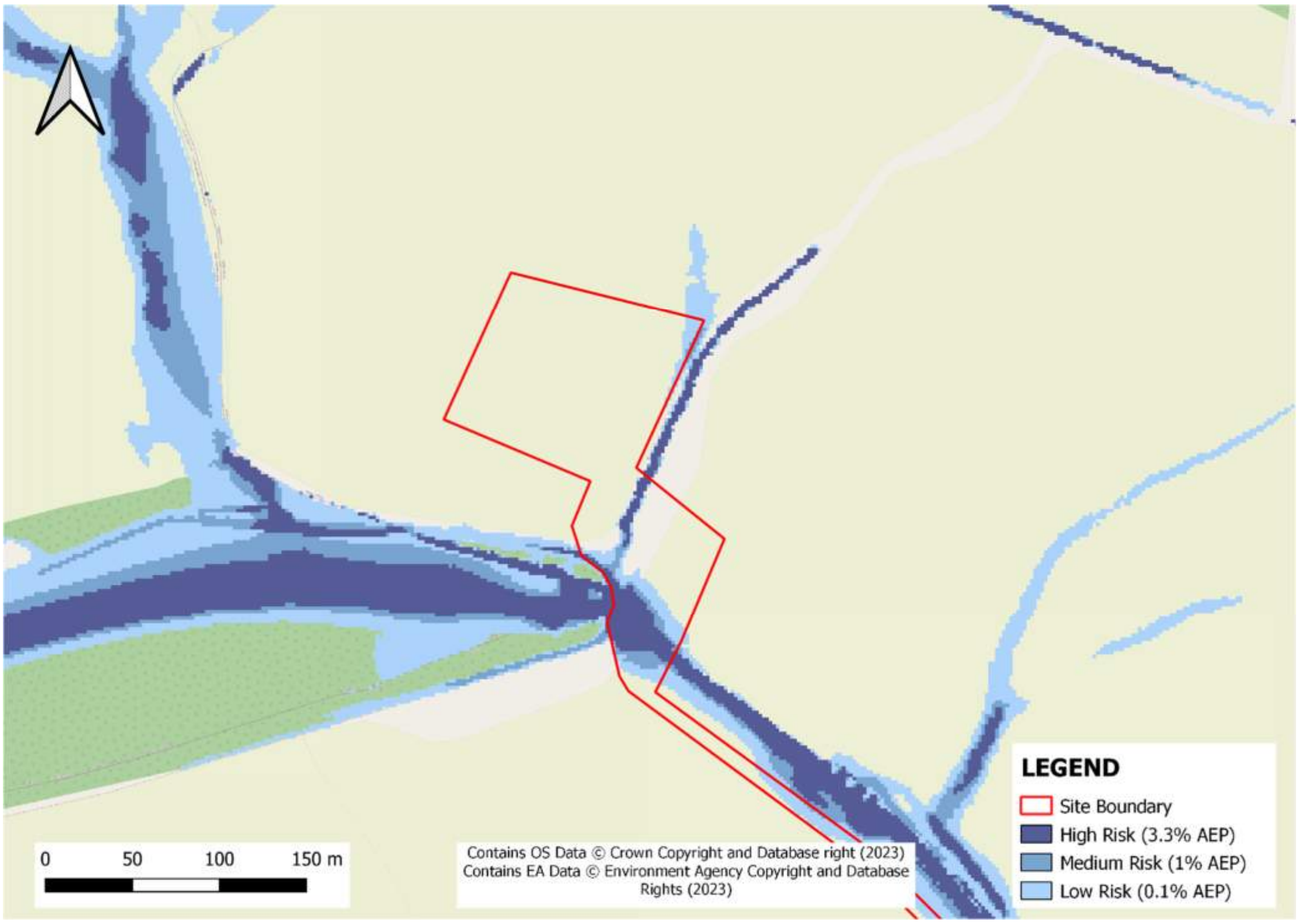
Additionally, it is proposed that the SWDS be developed to prevent pooling by providing sufficient water drainage features.

4.1.3.2 Northern Lagoons

Figure 4-5 identifies the northern lagoons to be predominantly at *medium* risk of flooding from surface water except for the western boundary of the part of the Site which is at low to medium risk of flooding from this source. However, this flood risk extent is limited to the boundary and does not extend across the footprint of the proposed lagoons as shown at **Appendix 03.**

The flood risk from this source is therefore low and is not considered further.

Figure 4-5
Northern Lagoon: Environment Agency Surface Water Flood Risk Extent of Flooding

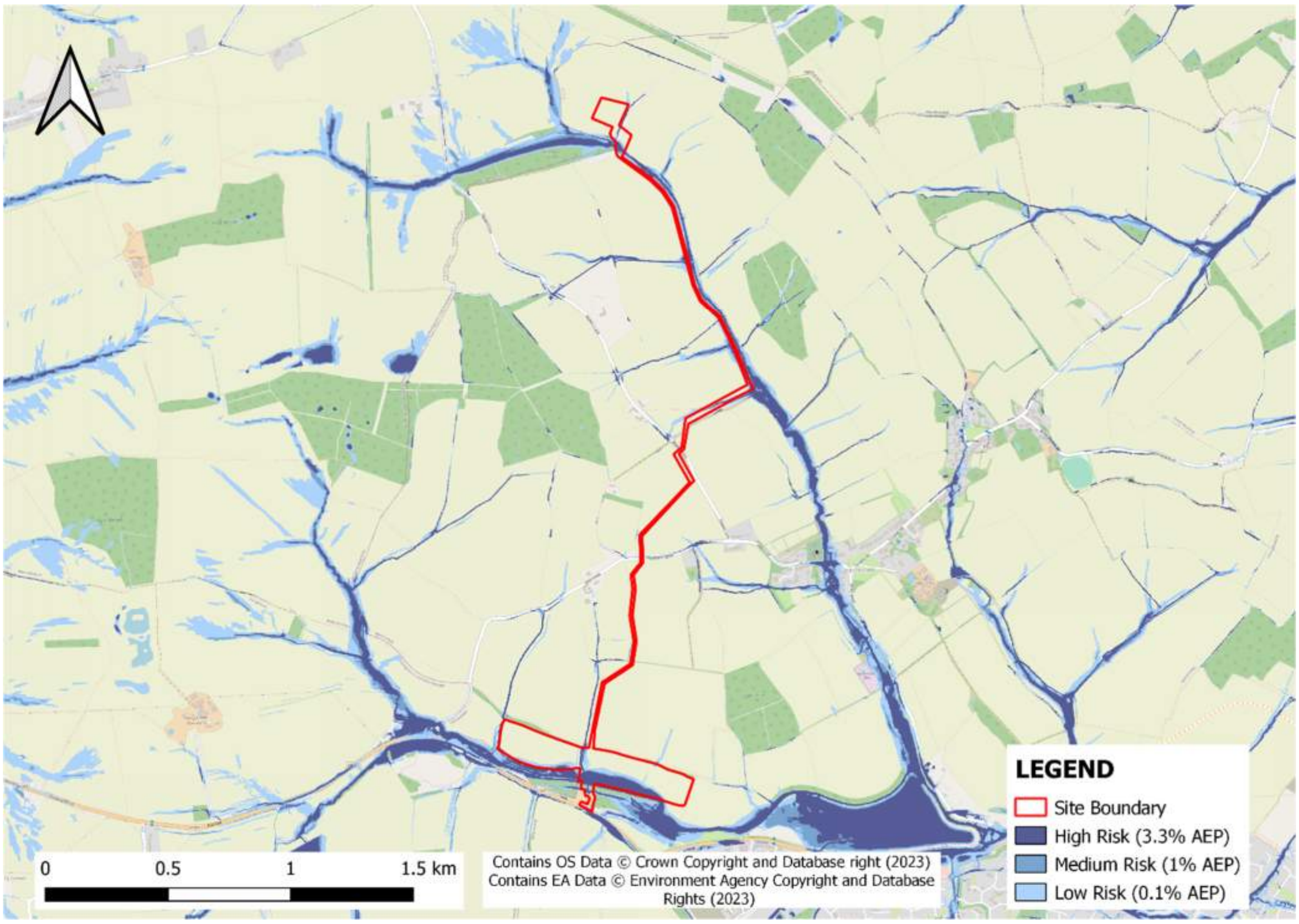


4.1.3.3 Pipeline

With reference to **Figure 4-6**, there is a section of the pipeline located within an area having a *low* to *High* risk of flooding from surface water.

However, as discussed at Section 4.1.1.3, as the pipeline will be constructed below ground, consideration of the flood risk along its alignment will be limited to the construction phase. It is therefore recommended that the Construction and Environmental Management Plan (CEMP) be cognisant of the flood risk with associated impact and management measures conditions.

Figure 4-6
Pipeline: Environment Agency Surface Water Flood Risk Extent of Flooding



4.1.4 Flooding from Groundwater

Groundwater flooding can occur where sites are located on permeable ground, particularly where there are significant variations in local topography and geology. After a prolonged period of rainfall and groundwater recharge, a considerable rise in the water table can result in this intersecting the ground surface, resulting in flooding. Due to the slow response of groundwater systems any resulting flows and inundation could persist for an extended period of time.

4.1.4.1 Main Site

As discussed at Section 2.3.2, groundwater was recorded within the trial pit excavated for infiltration testing at approximately 1.90m b.g.l. within the layer of gravel and cobbles. This rose to 1.59m b.g.l. indicating groundwater is confined beneath the clay.

As shown by **Appendix 02**, infiltration testing was undertaken within the southern part of the main Site. However, with reference to Section 2.3.1, the geology across the main Site does not vary. As such, it is expected that any gravel and cobbles layer(s) would be overlain by clay across the main Site and groundwater emergence is therefore considered unlikely.

The flood risk from this source is therefore low and is not considered further.

4.1.4.2 Northern Lagoons and Pipeline

BGS Borehole records[11] show borehole logs available at four locations within an approximate 1km buffer of the northern lagoon and pipeline. The depths of these range from 30m – 60m and all report groundwater strike, ranging from 15m – 30m b.g.l.

The flood risk from this source is therefore low and is not considered further.

4.1.5 Flooding from Sewers

4.1.5.1 Main Site

The main Site is currently arable land and is therefore not anticipated to be served by any sewers.

It is possible that public sewers could be present within the A1307 to the south of the main Site. With reference to the LiDAR aerial photogrammetric data, the elevation of the A1307 near the main Site ranges from approximately 82.0m AOD in the east to 83.23m AOD in the west.

As discussed at Section 2.2, ground levels across the Site range between 78.78m AOD and 88.73m AOD. Any potential surcharged flows from sewer(s) within the A1307 could therefore propagate across part of the main Site.

However, as the Stour Brook flows between the main Site and the A1307, the resulting overland flow would likely be intercepted by the brook and be conveyed in an easterly direction, away from the main Site.

The flood risk from this source is therefore low and is not considered further.

4.1.5.2 Northern Lagoons

The northern lagoons are currently arable land and is therefore not anticipated to be served by any sewers. It is also located away from any roads likely to have nay sewers present within them.

The flood risk from this source is therefore low and is not considered further.

4.1.5.3 Pipeline

The pipeline is set predominantly within arable land. However, it crosses Skippers Lane and Silver Street/Horseheath Road with sewers potentially present within these.

However, as discussed at Sections 4.1.1.3 and 4.1.3.3, the pipeline will be constructed below ground. Consideration of the flood risk along its alignment will be limited to the construction phase. It is therefore recommended that the Construction and Environmental Management Plan (CEMP) be cognisant of the flood risk with associated impact and management measures conditions.

4.1.6 Flooding from Reservoirs, Canals and other Artificial Sources

Based upon *Long Term Flood Risk Information*[10] mapping, the Site lies outside an area denoted as being at risk of flooding from a breach (failure) of a raised reservoir embankment.

Also, with reference to 1:25000 scale OS Mapping, there are no canals or other artificial sources located upgradient of the Site or Northern Lagoon.

The flood risk from this source is therefore non-existent and is not considered further.

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[11] BGS Website (Accessed on 3rd November 2022) http://mapapps.bgs.ac.uk/geologyofbritain/home.html

4.1.7 Flooding from Infrastructure Failure

With reference to 1:25000 scale OS Mapping, the Site is not located near to any hydrological infrastructure of which failure would increase the flood risk.

The flood risk from this source is therefore non-existent and is not considered further.

4.2 Flood Risk Summary

A summary of the potential sources of flooding and the flood risk arising from them is presented in **Table 4-1**.

Table 4-1
Potential Sources of Flooding

Potential Source of flooding	Significant Flood Risk at the Site (Y/N)
Rivers or Fluvial Flooding	Y
Sea or Tidal Flooding	N
Surface Water or Pluvial Flooding	Y
Groundwater	N
Sewers	N
Reservoirs, Canals and other Artificial Sources	N
Infrastructure Failure	N

5.0 ASSESSMENT OF FLOOD RISK

5.1 Summary of Potential Sources of Flood Risk

The flood screening assessment reported in Section 4.0 suggested that the main Site could be at risk from fluvial and pluvial flooding. The flood risk from these sources is considered below.

5.2 Probability of Site Flooding

In response to a flood data request, the Environment Agency have confirmed that they hold no detailed site-specific flood information for the main Site. SLR was therefore instructed to construct a hydraulic model to establish the flood risk at the main Site, assess the impact of the proposed development on flood risk at the main Site and elsewhere, and, if required, identify and assess suitable mitigation options.

Comparison of the fluvial extent, shown by the *Flood Map for Planning (Rivers and Sea)*[4], and the pluvial flood extent, shown by the *Long Term Flood Risk Information*[12] mapping, the two sources of flooding at the main Site are considered to be a result of similar hydrological and hydraulic conditions. The hydraulic modelling is therefore considered to capture both flood risks.

The 'present day' flood risk at the main Site was established using a dynamically linked 1D-2D ESTRY-TUFLOW model (build 2020-10-AD-iSP-w64). The methodology, modelled scenarios and detailed discussion of the results are presented at **Appendix 04**.

In summary, to establish the flood risk and, consequently, the Flood Zone(s) at the main Site, the hydraulic model was used to estimate the flood extent across the Site as a result of a 1% and 0.1% AEP rainfall event.

The results of the hydraulic modelling indicate that the main Site is at risk of flooding as follows:

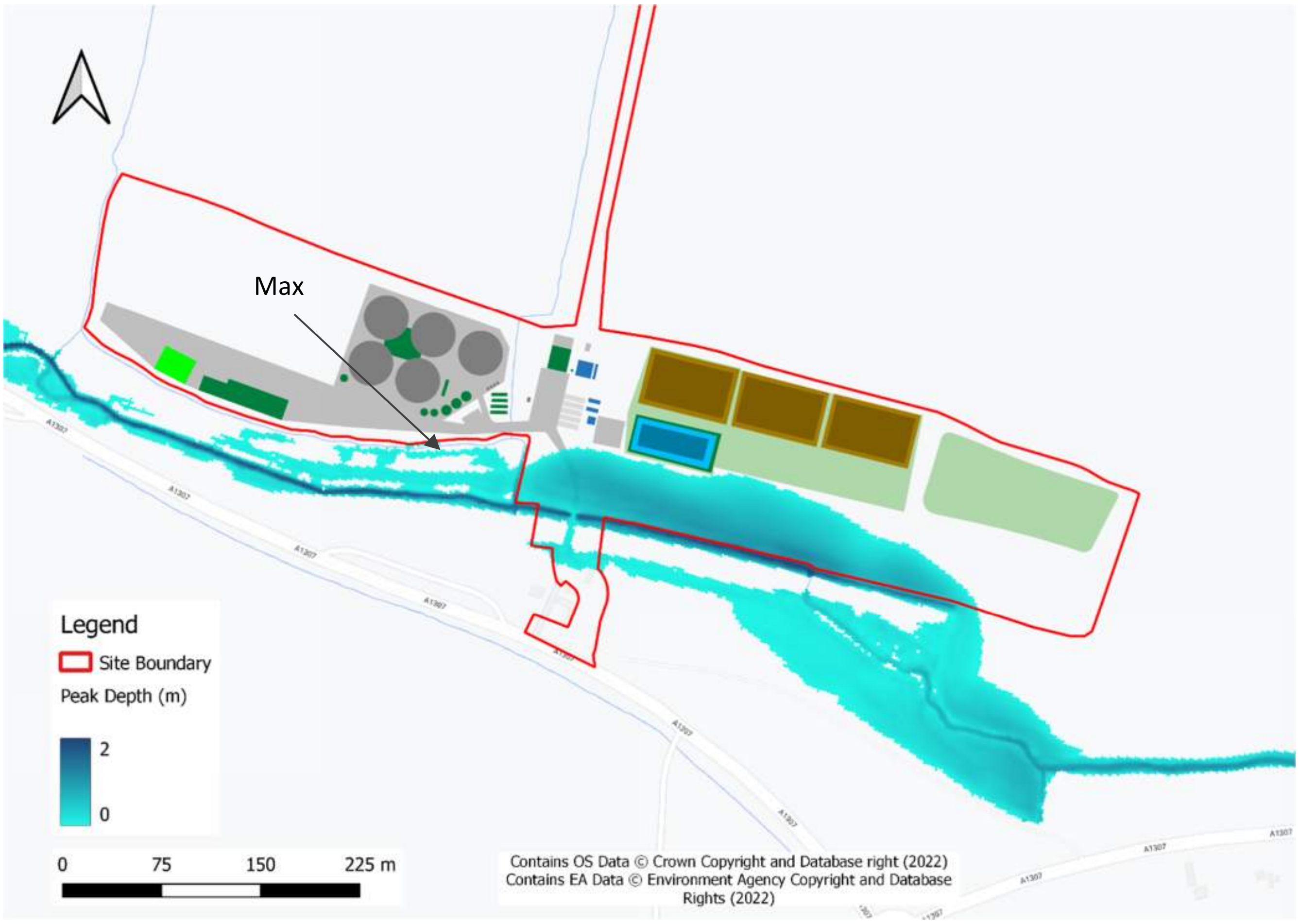
- During a 1% AEP flood event, the western part of the main Site, within Bowsey Field, remains dry except for a limited areas along the southern boundary. Under this hydrological scenario, floodwater would also propagate across the southern part of the Spring Grove Field, the eastern part of the main Site.

  Comparison of the above baseline flood extent and the proposed development layout enclosed at Appendix 03 indicates that flooding of the proposed development within the main Site would be limited to the central part of the access road during a 1% AEP flood event as shown on **Figure 5-1**.

  The maximum flood level at the Site during a baseline 1% AEP flood event is predicted to be 80.27m AOD (see arrow on **Figure 5-1** for maximum water level location).

12 Long Term Flood Risk, Government Digital Service (Accessed on 4 February 2022) https://flood-warning-information.service.gov.uk/longterm-flood-risk/

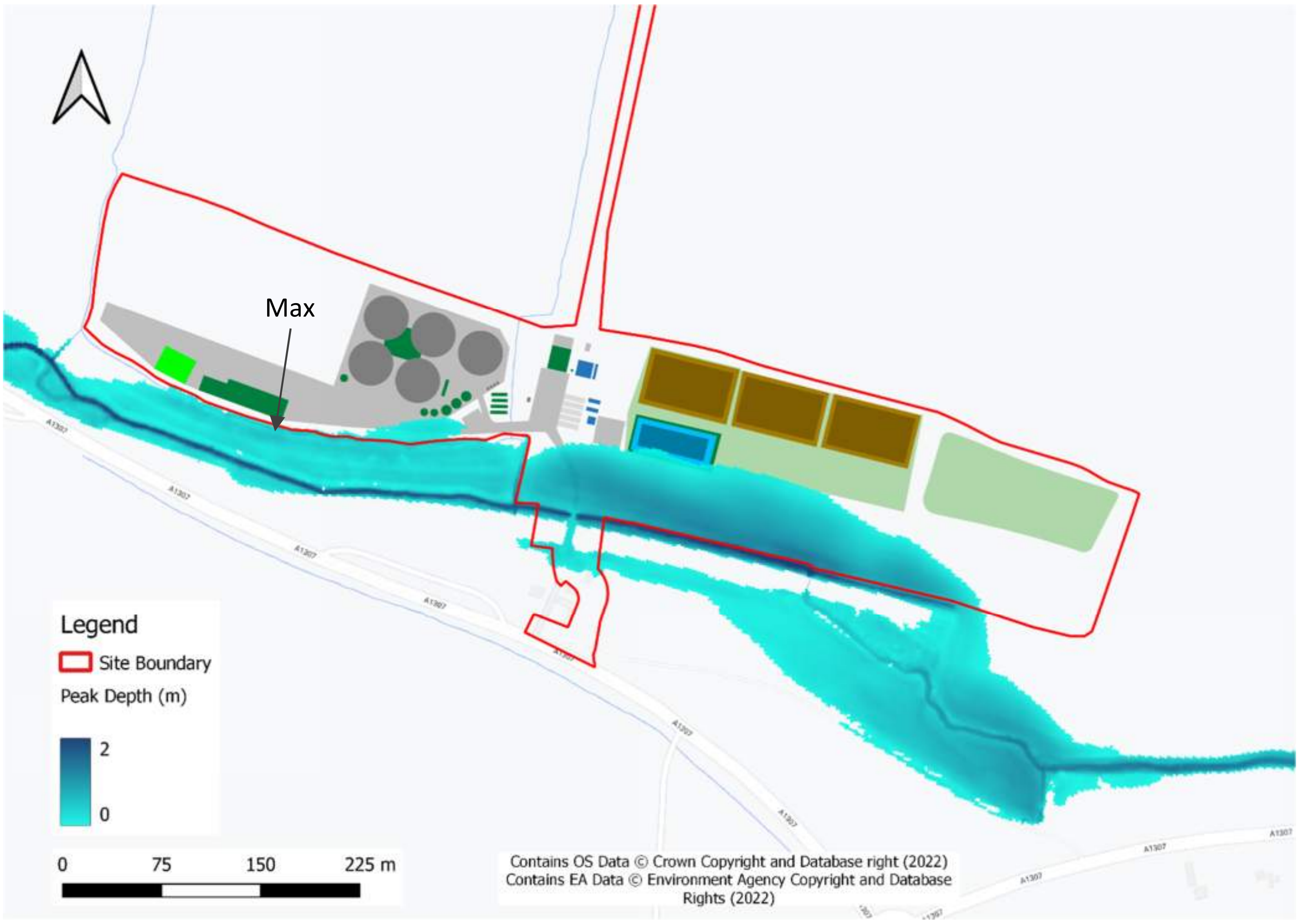
Figure 5-1
Predicted Peak 1% AEP (Baseline) Flood Depth



- During a 0.1% AEP flood event, within Bowsey Field, floodwater would extend across the eastern part of access road. Within the eastern part of the main Site, flooding would extend to the southern part of the (rainwater) lagoon and the central part of the access road as shown on **Figure 5-2**.

  The maximum flood level at the Site during a 0.1% AEP flood event is predicted to be 81.18m AOD (see arrow on **Figure 5-2** for maximum water level location).

Figure 5-2
Predicted Peak 0.1% AEP (Baseline) Flood Depth



However, as discussed at Section 8.0, measures have been proposed at the main Site to manage flood risk resulting from a 1% AEP rainfall event inclusive of an allowance for climate change (see Section 7.1).

5.3 Flood Zone

The definition of flood zones is provided by *Table 1: Flood zones* at PPG Annex 3and is summarised below:

- *Zone 1 - low probability* (Flood Zone 1). Land having a less than 0.1% annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map for Planning – all land outside Zones 2, 3a and 3b)
- *Zone 2 - medium probability* (Flood Zone 2) Land having between a 1% and 0.1% annual probability of river flooding; or land having between a 0.5% and 0.1% annual probability of sea flooding. (Land shown in light blue on the Flood Map)
- *Zone 3a - high probability* (Flood Zone 3a) Land having a 1% or greater annual probability of river flooding; or Land having a 0.5% or greater annual probability of sea. (Land shown in dark blue on the Flood Map)
- *Zone 3b - the functional floodplain* (Flood Zone 3b) This zone comprises land where water from rivers or the sea has to flow or be stored in times of flood. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. Functional floodplain will normally comprise:

- land having a 3.3% or greater annual probability of flooding, with any existing flood risk management infrastructure operating effectively; or
- land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as 0.1% annual probability of flooding).
- Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map)

Based on the results of the hydraulic modelling discussed at Section 5.2, the main Site lies on the fringes of Flood Zones 1, 2 and 3a.

6.0 POLICY STATUS FOR PROPOSED DEVELOPMENT

6.1 Flood Risk Compatibility

As discussed at Section 3.3, the proposed development is classified as a *Less Vulnerable* and, with reference to Section 5.3, the Site has been assessed to lie on the fringes of Flood Zones 1, 2 and 3a.

Therefore, with reference to *Table 3: Flood risk vulnerability and flood zone 'incompatibility'* at PPG Annex 3 (reproduced as Table 6-1), the proposed development would be considered an 'appropriate' form of development.

Table 6-1
Flood Risk Vulnerability and Flood Zone 'Incompatibility'

Flood Risk Vulnerability Classification (PPG Table 2)		Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Flood Zone (PPG Table 1)	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	Exception Test Required	✓	✓	✓
	Zone 3a	Exception Test Required	x	Exception Test Required	✓	✓
	Zone 3b (functional floodplain)	Exception Test Required	x	x	x	✓

Key: ✓ Development is appropriate x Development should not be permitted

6.2 Sequential Test

NPPF Paragraph 162 advises that the aim the Sequential Test is to '*steer new development to areas with the lowest risk of flooding from any source*'. Furthermore, it states:

> '*Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower risk of flooding*.'

The *Flood Map for Planning (Rivers and Sea)*[4] (Figure 1-2) and the local SFRA provide the basis for applying this test. As discussed at Section 0, all key elements of the proposed development as listed at Section 3.1 will be located entirely within Flood Zone 1 (i.e., has the lowest risk of flooding) and is situated on a slight downslope, allowing surface water to readily drain off the Site.

It has therefore been deemed that the Sequential Test has passed.

6.3 Exception Test

The Exception Test is required to show that the sustainability benefits of the proposed development to the community outweigh the flood risk. The sustainability benefits of the development are considered fully elsewhere in the planning application however, renewable energy generation is clearly a key element in reducing carbon emissions. The Exception Test also must show that the development will be safe for its lifetime and will not increase the flood risk elsewhere.

As discussed at Section 3.3, PPG identified that the *Less Vulnerable* located within Flood Zone 1, 2 and 3a is not required to pass the Exception Test as the development is already deemed appropriate.

7.0 CLIMATE CHANGE

In July 2021 the EA issued updated guidance on the impacts of climate change[13] on flood risk in the UK to support NPPF. This advice sets out that peak rainfall intensity, sea level, peak river flow, offshore wind speed and extreme wave heights are all expected to increase in the future as a result of climate change.

The guidance acknowledges that in relation to certain factors there is considerable uncertainty with respect to the absolute level of change that is likely to occur. As such, in these instances, the guidance provides estimates of possible changes that reflect a range of different emission scenarios.

PPG recommends that considerations for future climate change are included in FRA's for proposed developments. The consideration of climate change for this Site considers the possible changes in peak river flows and peak rainfall intensity.

Concerns relating to offshore wind speed, wave height and sea level are only of relevance in contexts that are in direct proximity to the open coast or other large open bodies of water. This is not the case for this Site and, therefore, potential changes in these are not considered further.

7.1 Peak River Flow

An extract of the Environment Agency's *Climate change allowances for peak river flow in England* map is reproduced in Table 7-1 for the *Combined Essex Management Catchment*.

Table 7-1
Peak River Flow Climate Change Allowances in the Combined Essex Management Catchment (1981-2000 baseline)

Management Catchment	Allowance Category	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2125)
Combined Essex	Upper End	27%	37%	72%
	Higher Central	13%	16%	38%
	Central	7%	8%	25%

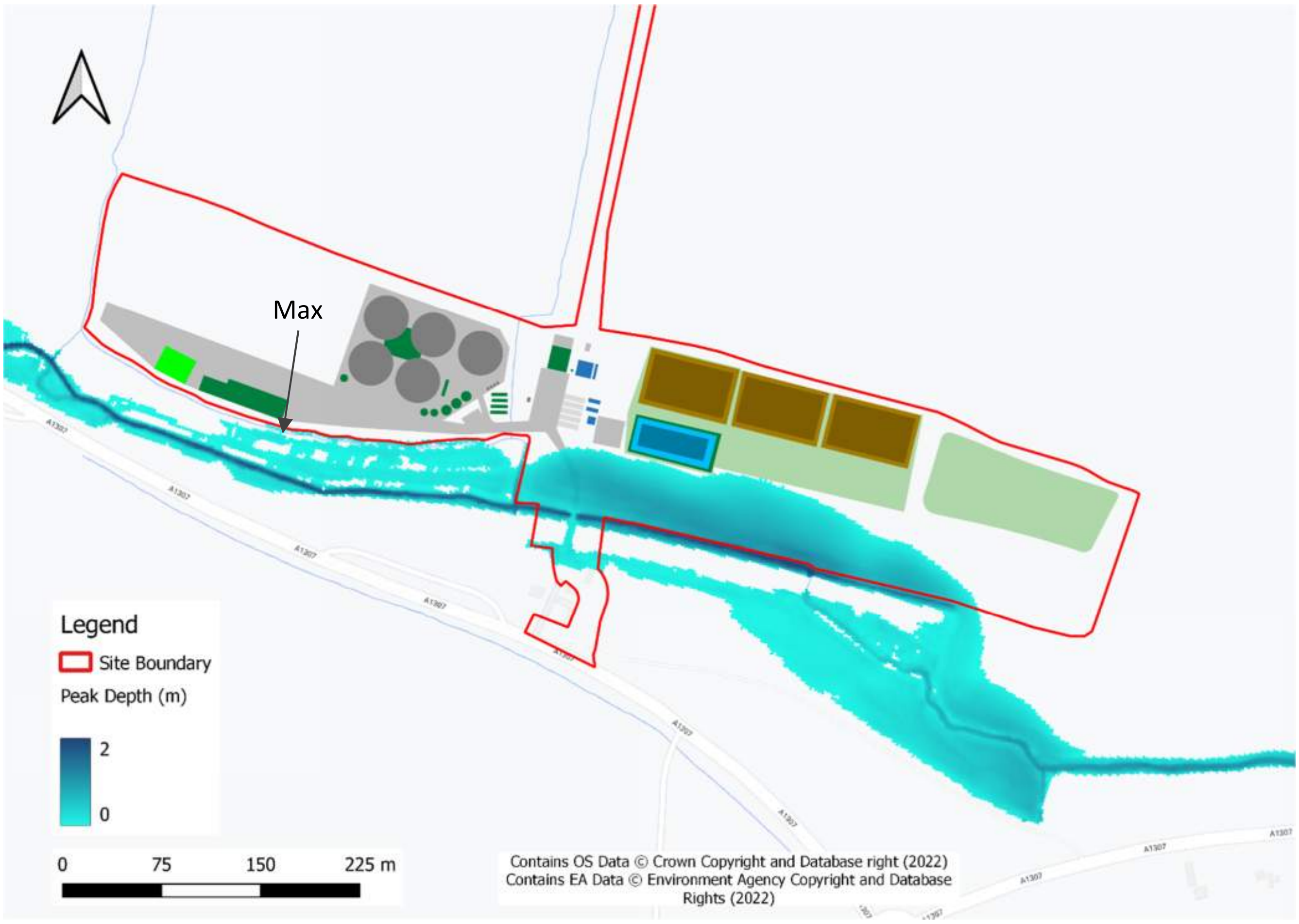
With reference to Section 5.3, the Site lies partly in Flood Zones 2 and 3a. The Environment Agency advise that for '*Less Venerable Infrastructure'* in Flood Zones 2 and 3a, the *central* allowance category should be applied to assess the impact of climate change on fluvial flood risk.

Over the 25-year lifetime of development (to 2047), a *Central* allowance of 8% has been assessed.

The hydraulic model was therefore used to establish the flood extent resulting from a 1% AEP rainfall event inclusive of an allowance for climate change (+8%), the Design Flood Event (DFE). Results of this modelled scenario indicate that flooding of the proposed development within the main Site would be limited to the central part of the access road as shown on **Figure 7-1**.

13 Environment Agency, February 2016 (updated October 2021). Flood risk assessments: climate change allowances (Accessed October 2021 at https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances)

Figure 7-1
Predicted Peak DFE (Baseline) Flood Depth



Under this hydrological scenario, the western part of the main Site, within Bowsey Field, remains dry except for areas along the southern boundary. Floodwater would also propagate across the southern part of the Spring Grove Field, the eastern part of the main Site.

The maximum flood level at the Site during a DFE event is predicted to be 80.56m AOD (see arrow on **Figure 7-1** for maximum water level location).

7.2 Peak Rainfall Intensity Allowance

The most recent advice on climate change is provided by the Environment Agency[14]. An extract of *Combined Essex Management Catchment peak rainfall allowances* is reproduced as **Table 7-2**.

14 Environment Agency, February 2016 (updated May 2022). Flood risk assessments: climate change allowances (Accessed 3rd November 2022) https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

Table 7-2
Peak Rainfall Climate Change Allowances in the Nene Management Catchment

Management Catchment	AEP (%)	Allowance Category	Total potential change anticipated for the 2050s	Total potential change anticipated for the 2070s
Combined Essex	3.3	Upper End	35%	35%
		Central	20%	20%
	1	Upper End	45%	40%
		Central	20%	25%

As discussed at Section 3.2, the proposed AD plant has an anticipated operational lifespan of 25 years (to 2048). The Environment Agency recommends that flood risk assessments for developments with a lifetime up to 2060, the central allowance for the 2050s epoch should be assessed. As detailed in **Table 7-2**, this equates to a 20% uplift which has been used to design the SWDS.

8.0 FLOOD RISK MANAGEMENT MEASURES

As discussed at Section 5.0, the main Site is at risk of flooding during a 1% and 0.1% AEP rainfall events and during a DFE rainfall event. To manage this flood risk, management measures have been developed and assessed. Details of each mitigation scenario, and the baseline conditions against which the impact was assessed, are detailed at Section 2.1 of Appendix 02. However, in summary, it is proposed that a small existing culvert be replaced by a 10m wide x 2m high bridge to improve conveyance of flow.

These culverts will be located along the Stour Brook, beneath an elevated roadway to provide access from the A1307 to the main Site.

As a result of installing the elevated access road, the road embankment obstructs the propagation of flow downstream for larger AEP events. As shown in **Figure 8-1,** to reduce the attenuation upstream of the road embankment, and any further downstream detriment, the following has been optioneered:

- a series of 10 flood relief culverts (each 600mm diameter) are proposed between the bridge and the main Site; and
- improvement works on the existing downstream culvert underneath the old railway embankment.

The flood relief culverts are designed to convey the attenuated floodwaters from the western woodland area through to Spring Grove Field to the east.

The provision of additional storage within the Spring Grove Field and the area immediately upstream of the flood relief culverts was shown to have little to no benefit on the overall peak depths and was excluded from consideration.

In contrast, improvement in flow conveyance on the existing railway culvert helps offset the increase water levels around the proposed bridge area.

Figure 8-1
Proposed Flood Risk Management Measures

The predicted peak differences in flood depths due the proposed access road and mitigation measures are shown in **Figure 8-2**. The inclusion of the elevated access road blocks a previous flow route in the baseline scenario which results in an area of benefit in a downstream field adjacent to the watercourse (area shaded green). However, by decreasing flow conveyance downstream of the access road, higher water levels of approximately 30mm are predicted (area shaded red). The mitigation measures alleviate some of the extent of detriment to the west of the access road by conveying flow to the east. However, there remains a limited area within the woodland to the south west of the main Site where flood risk is marginally increased.

Figure 8-2
Predicted Peak Depth-Difference at the 1% AEP + CC 8%

9.0 DRAINAGE PHILOSOPHY

9.1 Summary

The AD facility would capture as much rainwater as possible for use in the process. Based on annual average estimates, rainwater capture is expected to be sufficient for up to 100% of the process water demand.

Two primary drainage systems would be adopted, for the clean (surface water runoff) and contaminated (foul) water systems.

In accordance with Anglian Surface Water Drainage Policy[15] and Surface Water Checklist Guidance[16], the Site has been designed to manage all flows up to and including the 1% AEP rainfall event inclusive of allowance for climate change (20% as discussed at Section 7.2).

The Site will be provided with hardstanding and secondary containment constructed in accordance with industry best practice standards to prevent pollution to surface water and groundwater. The clamps, storage bunkers, digestate storage bay, connecting concrete apron and digestate off-take area all drain to the sealed drainage system (leachate system).

The Site has been designed in accordance with CIRIA C736 and Water Resources (Control of Pollution) (Silage, Slurry and Agricultural Fuel Oil) (England) Regulations (SSAFO). The silage clamps have been designed in accordance with the latest SSAFO regulations and in accordance with CIRIA 759. An Environmental Management System (EMS) will be in place prior to the commencement of site operations. The scope for the EMS applies to all processes and activities undertaken by the operator at the installation.

Accordingly, the Site has been designed to have a clean water lagoon to capture surface water runoff. However, the invert level of this lagoon will be designed such as to ensure that sufficient capacity remains for the 1% AEP rainfall event inclusive of allowance for climate change (+20%), to allow for flood management.

9.1.1 Contaminated Water

Contaminated runoff, caused by silage residue, from the silage clamps and sections of hardstanding area will be collected through a series of drainage channels, pipes, and chambers and be brought into a below ground holding tank. From this tank, runoff will be pumped to three 400m^3 holding tanks within the containment bund where it will be reused within the process.

The process has a yearly demand of 62,000m^3, equating to 2ls^{-1} continuous flow. This offers a sustainable drainage system, compliant with the hierarchy.

The contaminated water strategy is outlined in **Appendix 05**.

9.1.2 Clean Water

Surface water runoff would be collected from the remaining Site area, comprising building roofs and certain sections of hardstanding, and conveyed to the lagoon using a network of channel drains and underground pipes. It is anticipated that petrochemicals may be present within the surface water runoff from the hardstanding areas, which would be separated and removed through a full retention petrol interceptor.

Runoff would then be discharged into the adjacent watercourse at greenfield rates.

The runoff from within the bunds has the potential to become contaminated through process residue. This would be collected through a channel drain and discharged into a pump chamber where it would be sampled and pumped to the lagoon (if clean) or reused in the process (if contaminated).

15 Anglian Water, January 2022. Anglian Water's Surface Water Drainage Policy (Accessed on 13 October 2022 at https://www.anglianwater.co.uk/siteassets/developers/drainage-services/surface-water-drainage-policy-january-2022.pdf)

16 Suffolk County Council 2022, 'Construction Surface Water Management Plan'

The SWDS is outlined at Section 10.0.

10.0 SURFACE WATER DRAINAGE STRATEGY

10.1 Context

Without mitigation, the proposed development could lead to an increase in the rate and volume of surface water runoff generated due to the increase in impermeable coverage. To comply with current guidance and best practice, sustainable drainage systems (SuDS) are required to manage the quantum of surface water runoff discharge off-Site.

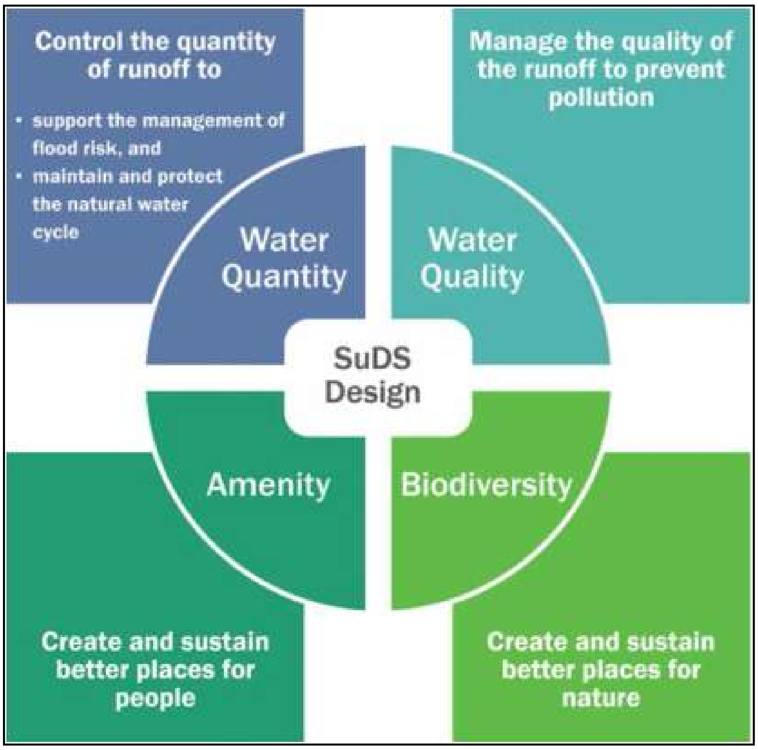
This SWDS sets out high level principles for managing storm water on the Site in line with best practice and has been produced in support of the planning application.

This Strategy is intended to demonstrate that, given the nature and quantum of development proposed, it is feasible to drain the Site in line with policy and best practice guidance.

10.2 Sustainable Drainage Systems

The current best practice guidance document, The SuDS Manual (CIRIA Report C753)[17], promotes sustainable water management through the use of SuDS. There are four main categories of SuDS which are referred to as the 'four pillars of SuDS' as shown in **Figure 10-1**.

Figure 10-1
Four Pillars of SuDS (after CIRIA Report C753)

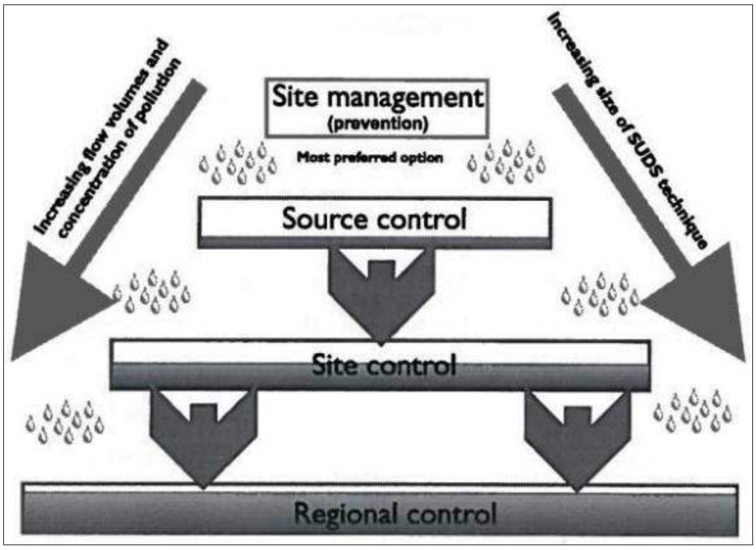


The SuDS Manual identifies a hierarchy of SuDS for managing runoff, which is commonly referred to as a 'management train' and is depicted in **Figure 10-2**:

17 CIRIA (2015). Report C753, The SuDS Manual

- **Prevention** – the use of good site design and housekeeping measures on individual sites to prevent runoff and pollution (e.g. minimise areas of hard standing).
- **Source Control** – control of runoff at or very near its source (such as the use of rainwater harvesting).
- **Site Control** – management of water from several sub-catchments (including routing water from roofs and car parks to one/several large soakaways for the whole site).
- **Regional Control** – management of runoff from several sites, typically in a retention pond or wetland.

Figure 10-2
SuDS Management Train



It is generally accepted that the implementation of SuDS, as opposed to conventional drainage systems, provides several benefits by:

- Reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream;
- Reducing the volumes and frequency of water flowing directly to watercourses or sewers from developed sites;
- Improving water quality over conventional surface water sewers by removing pollutants from diffuse pollutant sources;
- Reducing potable water demand through rainwater harvesting;
- Improving amenity through the provision of public open spaces and wildlife habitat; and replicating natural drainage patterns, including the recharge of groundwater so that base flows are maintained.

10.3 Proposed Drained Area

It is proposed that all impermeable surfaces of the proposed development comprising roofs, external hardstanding operational area, parking area and access road, be positively drained. All other impermeable areas drain to the dirty water system.

Section 3.2.7 of The SuDS Manual recommends that the potential increase in the *'impermeability of the contributing catchment through the design life of the drainage system should (…) be taken into account.'*

Section 24.7.2 of The SuDS Manual defines urban creep as:

‘any increase in impervious area that is drained to an existing drainage system without planning permission being required, and therefore without any consideration of whether the capacity of the receiving sewerage system can accommodate the increased flow.’

The SuDS Manual recommends that an allowance of 10% is made in respect of urban creep. However, as the proposed development is non-residential, the application of urban creep does not apply.

The post-development land use is shown in **Drawing SW1** and shows an area of 1.91ha to contribute to surface water runoff.

10.4 Proposed Discharge Arrangement

With reference to The SuDS Manual, the hierarchy of preferred disposal options for surface water runoff from development sites in decreasing order of sustainability is as follows:

1. Infiltration to Ground;
2. Discharge to Surface Waters; or
3. Discharge to Sewer.

Table 10-1 summarises the suitability of disposal methods suitability in the context of the Site and the proposed development.

Table 10-1
Suitability of Surface Water Disposal Methods

Surface Water Disposal Method (in Order of Preference)	Suitability Description	Method Suitable? (Y / N)
Infiltration to Ground	Any infiltration features would require a 1m differential between the base of the feature and the groundwater level and therefore if infiltration is adopted at the main Site, this could only occur in the shallow layers which are largely impermeable clays. Infiltration to ground is therefore not considered a viable means of discharge of surface water runoff resulting from the proposed development.	N
Discharge to Surface Waters	As discussed at Section 2.4.1, there several surface water features at the Site. It is therefore proposed that surface water runoff resulting from the proposed development discharge to the Stour Brook, to the south of the main Site, albeit at an attenuated rate as discussed at Section 10.6.1. This method of discharge has been therefore adopted for the SWDS.	Y
Discharge to Sewer	As a discharge to surface waters is considered feasible and is preferred to a discharge to sewer, the latter has not been considered.	N

10.5 Proposed Outline SuDS Strategy

It is proposed to manage surface water runoff from the development via the following ‘Conveyance’ and ‘Site Control’ options as summarised in **Table 10-2**.

Table 10-2
Summary of Surface Water Management Strategy Options

Management Train Mechanism	Application	Potential Suitable Features
Source Control	For the interception of surface water runoff at the source such as office roofs, parking lots and equipment hardstanding.	
Conveyance	To convey surface water runoff from 'Source Control' mechanisms to 'Site Control'.	• Channel drains • Underground pipes
Site Control	Provides the required surface water attenuation / storage prior to controlled discharge to the water environment.	• Lagoon

Due to the likelihood of contamination from the hardstanding and other open areas of the Site, it is recommended that SuDS source control and conveyance features are not adopted on the Site. It is therefore proposed that channel drains and underground pipes are used to intercept and convey runoff across the Site. 'Site Control' feature in the form of a lagoon is considered to be a viable option in terms of the management of water quantity and has been integrated into this SWDS.

As discussed at Section 9.1.2, surface water runoff along the channel drains and underground pipes, will be conveyed to a proposed lagoon. This will be located within the south eastern part of the Site as shown on **Drawing SW2**, at the lowest elevation, such that surface water runoff from the channel drains and underground pipes can be conveyed by gravity.

The lagoon has been designed to provide the required attenuation without flooding during rainfall events up to and including a 1% AEP rainfall event +20%.

10.6 Water Quantity Design Standard

10.6.1 Control of Runoff Volume

Section 3.3.1 of The SuDS Manual sets out volume control criteria for:

- Frequent rainfall events.
- Extreme rainfall events.

Frequent rainfall events

The SuDS Manual requires *'the prevention of runoff from the [Site] for the majority of small (frequent) rainfall events (or for the initial depth of rainfall for larger events)'*. This is known as *Interception* and 'Inception of about 5mm is normally achievable.'

With reference to Section 24.8 of The SuDS Manual:

'*Inception can be delivered using one or a combination of process:*

- *Rainwater harvesting*
- *Infiltration*
- *Evapotranspiration using temporary shallow ponding or storage within the soil or upper aggregate layers.'*

As discussed at Section 9.1, rainwater harvesting will be incorporated within the design of the AD facility. Interception is therefore provided.

Extreme rainfall events

For extreme rainfall events, the drainage system should be designed such that '*the volume of runoff from the Site (or development) area [does] not exceed the volume of runoff from the equivalent area in its natural undeveloped or "greenfield" state*'.

As summarised within **Table 10-1,** surface water runoff resulting from the proposed development will discharge to surface water.

In line with Section 3.3.1 of The SuDS Manual, it is proposed that *'all the runoff from the site for the 1:100 year [1% AEP] event [to] be discharged at either a rate of* $2ls^{-1}ha^{-1}$ *or the average annual peak flow rate (i.e. the mean annual flood, QBAR), whichever is greater.'*

Table 24.1 Summary of runoff estimation methods of The SuDS Manual recommends the application of the Revitalised Rainfall-Runoff Method (ReFH2) to estimate greenfield runoff rates. ReFH2 has therefore been used to estimate greenfield runoff rate for the 50% AEP (1 in 2 year) rainfall event as summarised at **Table 10-3**. It should be noted that QBAR has a return period of approximately 1 in 2.3 years, however, only integers can be inputted into ReFH2. A conservative QBAR peak runoff rate has been estimated assuming a 1 in 2 year return period.

The descriptors for the Site extracted from the Flood Estimation Handbook[18] (FEH) Web Service were used in the ReFH2 analysis with the AREA set to 1.00ha.

With reference to **Drawing SW1**, the proposed development will render impermeable an area of 4.76ha. Of this impermeable area, only 1.91ha will be drained to the proposed surface water system as shown on **Drawing SW1**, the remaining impermeable area will drain to the proposed foul water system.

While the area draining to the foul water system will not discharge into the water environment, greenfield runoff rate from the total proposed impermeable area of 4.76ha is considered available for the surface water system to discharge at.

Table 10-3
Summary of Pre-Development Greenfield Runoff Rates for Drained Area

AEP (%)	Estimated Greenfield Runoff Rate	
	$ls^{-1}ha^{-1}$	$ls^{-1}4.76ha^{-1}$
50	2.6	12.4

As the QBAR peak runoff rate of $2.6ls^{-1}$ is greater than $2ls^{-1}ha^{-1}$ and has been adopted in the design of the SWDS.

10.6.2 Control of Peak Rate of Runoff

Section 3.3.2 of The SuDS Manual sets out peak rate of runoff criteria for:

- Events likely to impact on morphology, ecology or capacity of the receiving surface waters, or the capacity of receiving sewers.
- Extreme events.

Events likely to impact on morphology, ecology or capacity of the receiving surface waters, or the capacity of receiving sewers

[18] Centre for Ecology and Hydrology (CEH), 2017. Flood Estimation Handbook Web Service (Accessed on 29th April 2022) https://fehweb.ceh.ac.uk/GB/map

As discussed at Section 10.6.1, the SWDS has been designed such that the Stour Brook, to the south of the main Site, will be limited to QBAR of $12.4ls^{-1}4.76ha^{-1}$ for all AEP rainfall events assessed up to and including the 1% AEP +20%.

Therefore, it is considered that the proposed development will have no significant impact on the '*morphology, ecology or capacity of the receiving surface waters*' by virtue of the rate or volume of surface water runoff.

Extreme events

In line with Section 3.3.2 of The SuDS Manual, the SWDS '*should be designed so that peak runoff rates for extreme rainfall events (…) are constrained to the greenfield rates of runoff for the same event*.'

As a conservative approach, the SWDS has been designed such that any discharge into surface waters is restricted to QBAR for all AEP rainfall events assessed up to and including the 1% AEP +20%.

10.7 Water Quality Design Standard

Due to the likelihood of contamination from the hardstanding and other open areas of the Site, it is recommended that SuDS source control and conveyance features are not adopted on the Site. Consequently, a full retention interceptor & catchpit will be adopted to mitigate runoff contaminants. Additionally, the proposed AD plant will operate under an Environmental Permit, with a strict operational & maintenance procedure in place. These procedures are developed to ensure compliance and protection of the local receptors.

As part of the environmental permit a detailed maintenance schedule will be regulated against. This shall cover the drainage, external surfacing, buildings & concrete containment bund as a minimum.

The drainage maintenance document typically outlines daily, weekly, biweekly, monthly, quarterly & year inspection work to be carried out, along with the necessary actions required.

As part of the actions under the permit, water quality checks will be required on the outfall locations, covering TSS, PH, volume & hydrocarbons. These will be recorded and submitted to the Environment Agency under the permit conditions annually or more frequently (pending permit conditions).

Therefore, the proposed surface water drainage system shall conform and be regulated to a robust, audited & recorded operational & maintenance plan. This will ensure the performance of the drainage system is maintained throughout the life of the plant.

10.8 Attenuation Volume Estimate

Based on a total contributing area of 1.91ha as discussed at Section 10.3, using the MicroDrainage 'Source Control' module, the attenuation volumes required for the proposed development in response to a range of AEP rainfall events up to and including the 1% AEP rainfall event +20% have been estimated as follows:

Table 10-4
Drainage Performance and Sizing

AEP (%)	Maximum Allowable Discharge (ls^{-1})[1]	Maximum Proposed Discharge (ls^{-1})	Maximum Water Depth (m)	Maximum Attenuation Storage Required (m^3)	Half Drain Time (minutes)
50	12.4	12.2	0.201	321	295
3.3		12.4	0.409	671	463
1			0.549	917	628
1 +20%			0.666	1,130	775

Notes: [1] Refer to Section 10.6.1.

The proposed lagoon, located as shown on **Drawing SW2**, will provide a storage of approximately **1,193m^3** over an area of approximately 1,860m^2 and a depth of 0.7m above the invert level of the outflow control (hydrobrake).

It should also be noted that the lagoon has been designed with a minimum freeboard of 300mm which, when accounted for, provides a storage area of 1,772m^3 over a footprint of 2,000m^2 and a depth of 1.0m above the invert level of the outflow control.

The hydrobrake is set to a diameter of 165mm to provide the required flow control.

Details of analysis are enclosed at **Appendix 06**.

With reference to the National Standards for sustainable drainage system[19] published by Defra:

'Drainage systems must be designed so that (…) flooding from the drainage system does not occur:

a) *On any part of the site for a 1 in 30 year [3.33% AEP] rainfall event; and*
b) *During a 1 in 100 year [1% AEP] rainfall event in any part of:*
    - *a building (including a basement); or*
    - *utility plant susceptible to water (e.g. pumping station or electricity substation); or*
c) *On neighbouring sites during a 1 in 100 year [1% AEP] rainfall event.'*

The proposed SWDS meets the above criteria with no flooding during the range of AEP rainfall events assessed up to and including the 1% AEP rainfall event +20%.

10.9 Design Exceedance Arrangement

The proposed SWDS has also considered residual events i.e. those that are in excess of the design rainfall event.

It is understood that the containment bund will be designed to contain all surface water runoff from within this area. Additionally, all roads will be designed with a perimeter kerb and levels across the Site will be set such that surface water runoff during an exceedance event will be contained within the Site.

[19] Defra, December 2011. National Standards for sustainable drainage systems - Designing, constructing, operating and maintaining drainage for surface runoff

11.0 PRINCIPAL OPERATION AND MAINTENANCE REQUIREMENTS

All surface water drainage and pollution control features associated with the Site would remain private and would be maintained and regulated by the Environment Agency under the Environmental Permit.

An operation and maintenance plan for the maintenance requirements for the various aspects of the drainage system for the proposed development that the developer would adopt will be defined when the Site is operational to suit specific conditions in accordance with the Environmental Permit.

12.0 CONCLUSIONS

SLR Consulting Limited (SLR) was appointed by Acorn Bioenergy Limited. (the Client) to prepare a Flood Risk Assessment (FRA) and Surface Water Drainage Strategy (SWDS) to support a planning application for the proposed Anaerobic Digestion (AD) Plant at Spring Grove Farm, Withersfield, North West of Haverhill, Suffolk, CB9 7SW (the 'Site').

12.1 Flood Risk

Flood risk has been assessed in line with BS8533[3], taking account of national, county and local planning policy and guidance, and all potential sources of flooding to the Site have been considered.

A screening assessment of the flood risk posed by sources including fluvial, tidal, surface water, groundwater, sewer, reservoirs, canals and infrastructure failure has been undertaken. The screening assessment concluded that the main Site is partly at risk of flooding from rivers and surface water. Hydraulic modelling to establish the fluvial flood risk at main Site, and also captures the pluvial flood risk, indicates that the main Site lies on the fringes of Flood Zones 1, 2 and 3a.

However, all key elements of the proposed development will be located outside the 1% AEP flood extent.

The flood risk to the proposed development is considered negligible and, therefore, in terms of both the Exception and Sequential Tests, the Site is suitable for development.

It should be noted that allowances for changes to peak river flows have been considered. An 8% uplift to the 1% AEP peak river flow was therefore assessed. Results of this assessment indicate that flooding of the proposed development within the main Site would be limited to the central part of the access road.

Flood management measures in the form of culverts will be provided. These measures result in a reduction in flood risk downstream of the main Site. However, there is a limited area within the woodland to the south west of the main Site where flood risk is marginally increased. This increase in flood risk is however considered appropriate in light of the low vulnerability use of the woodland and the decrease in flood risk immediately downstream of the Site.

The hydraulic model results predicts no measurable increase in flood risk to residents and property further downstream in Haverhill.

12.2 Drainage Philosophy

Two primary drainage systems will be adopted, for the clean (surface water runoff) and contaminated (foul) water systems.

In accordance with Suffolk County Council design requirements and the Environment Agency climate change guidance, the proposed clean water system will be designed to manage all flows up to and including the 1% AEP rainfall event +20%.

The runoff corresponding to the contaminated water system would be harvested and used to meet around 100% of the water demand of the AD process.

Such an arrangement (which depends on management controls) will need to be agreed with the LLFA (planning) and Environment Agency (permitting).

12.3 Surface Water Drainage Strategy

In line with national, county and local policies, the development must make allowance for a 20% uplift in peak rainfall to accommodate for climate change, which has been included within the SWDS for the Site.

The SWDS has been developed to demonstrate that the requirements of national, county, and local policies can be achieved at the site given the nature and the quantum of development proposed. Greenfield runoff from the Site currently discharges to the Stour Brook, directly or indirectly via a network of drains. The proposed development will seek to restrict discharge into the Stour Brook at the 50% AEP greenfield rate of $2.6ls^{-1}ha^{-1}$.

The attenuation storage required to achieve the greenfield rate for surface water runoff resulting from the proposed development will be provided within a lagoon. Runoff to the lagoon will be conveyed by a network of channel drains and underground pipes. The lagoon will provide the required attenuation of runoff prior to discharge into the Stour Brook.

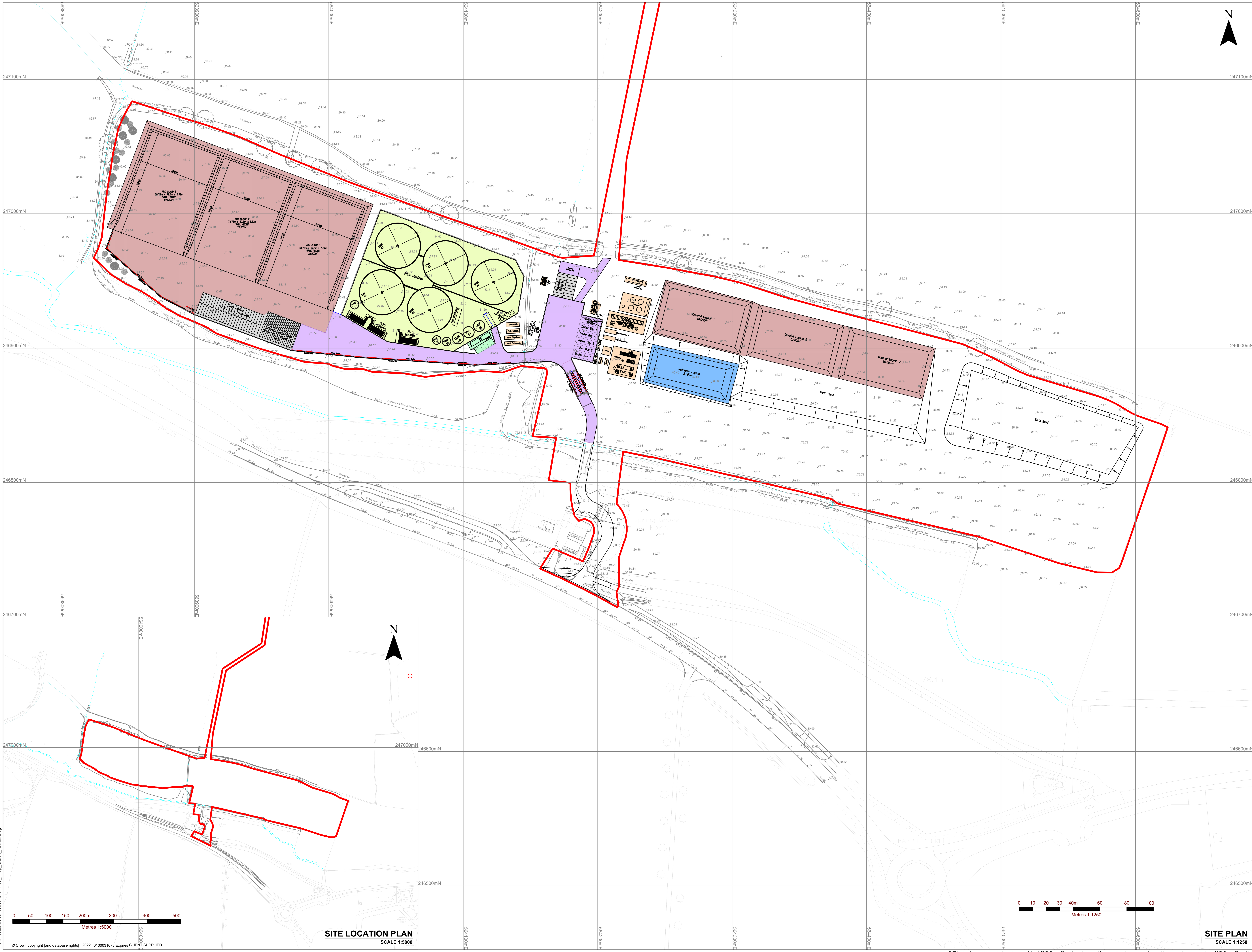
The proposed AD plant has been designed in accordance with CIRIA C736, Water Resources (Control of Pollution) (Silage, Slurry and Agricultural Fuel Oil) (England) Regulations (SSAFO) and CIRIA 759. Additionally, the plant will be operated under strict operational & maintenance procedures to ensure protection of the local receptors.

In common with most drainage strategies put forward in support of planning applications, the strategy presented here will need to be subject to detailed design and relevant approvals before construction commences.

DRAWINGS

Drawing SW1: Proposed Areas

Drawing SW2: Surface Water Drainage Strategy



SITE LOCATION PLAN
SCALE 1:5000

SITE PLAN
SCALE 1:1250

NOTES

1. DRAWING GENERATED FROM INFORMATION SUPPLIED BY THE CLIENT, DRAWING REF: 29351/P/101, REVISION R, DATED: 20.04.2023.

LEGEND

- SITE BOUNDARY
- EXISTING WATERCOURSE

CONTAMINATED RUNOFF CATCHMENTS

- CONTAMINATED RUNOFF AREAS

CLEAN RUNOFF SUB-CATCHMENTS

- ATTENUATION FEATURE
- EQUIPMENT RUNOFF
- HARDSTANDING
- ROOFS
- HARDSTANDING WITH PETROCHEMICAL
- CLEAN BUND RUNOFF

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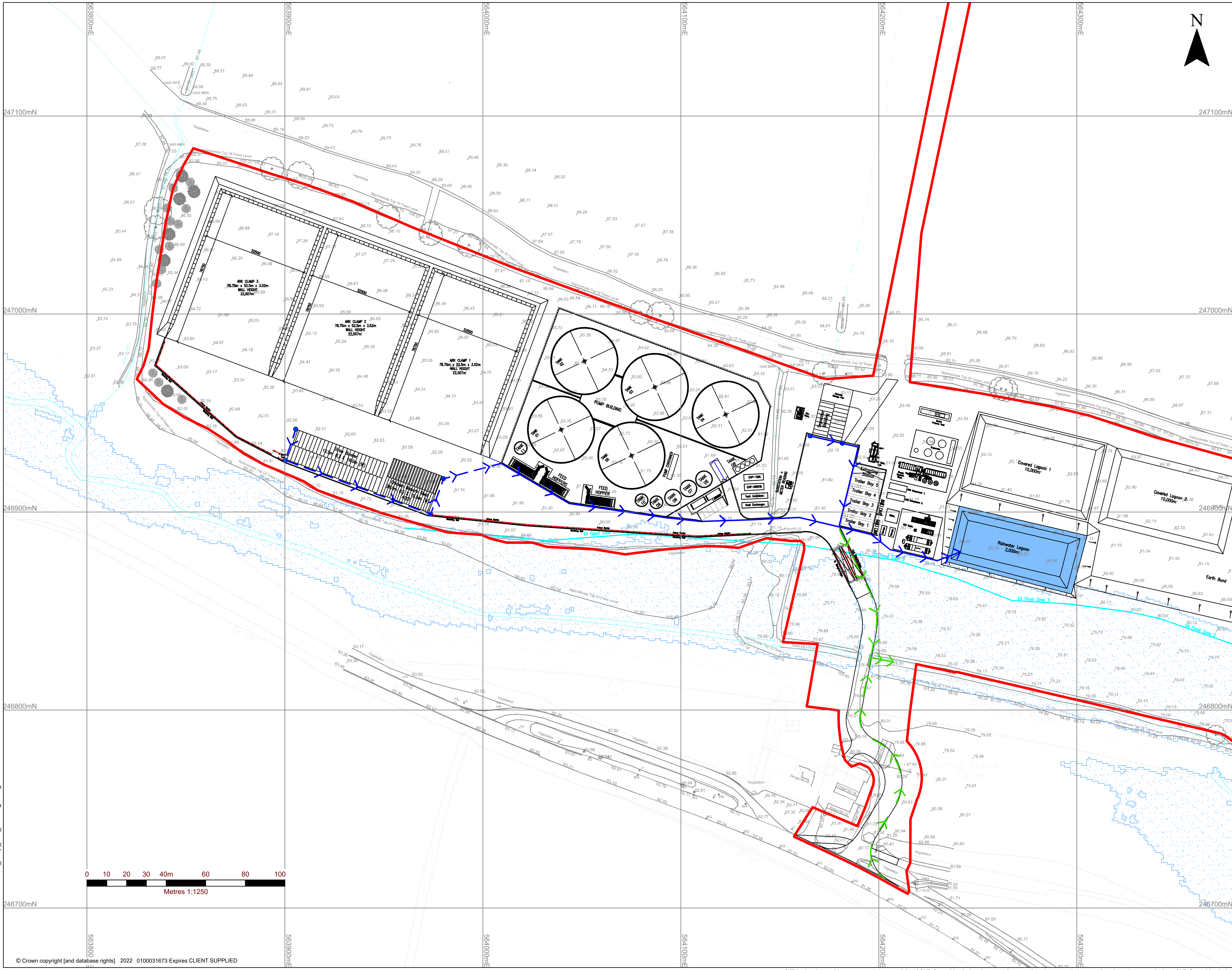
THURLOW ESTATE 2 AD PLANT

SURFACE WATER DRAINAGE STRATEGY

PROPOSED CATCHMENT AREAS

SW1

Scale	Date
AS SHOWN @ A1	AUGUST 2023



404.11923.00004.005.18.SW2.3_Prop_SW_Drainage.dwg

N

NOTES

1. DRAWING GENERATED FROM INFORMATION SUPPLIED BY THE CLIENT, DRAWING REF: 29351/P/101, REVISION R, DATED: 20.04.2023.

LEGEND

- SITE BOUNDARY
- EXISTING WATERCOURSE
- ANTICIPATED RAINWATER DOWN PIPE LOCATION
- CHANNEL DRAIN
- PIPE
- OVERSIZED CHANNEL DRAIN
- LAGOON

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THURLOW ESTATE 2 AD PLANT

SURFACE WATER DRAINAGE STRATEGY

PROPOSED SURFACE WATER DRAINAGE STRATEGY PLAN

SW2

Scale	Date
1:1250 @ A2	AUGUST 2023

APPENDIX 01

Topographic Survey

Legend

- Building
- Top of Bank
- Bottom of Bank
- Top of Face
- Bottom of Face
- Top of Ditch
- Bottom of Ditch
- Contour (mAOD)
- Track
- Fence
- Water Area
- Vegetation
- Pipe
- Overhead Electricty Lines
- Overhead Phone Line
- Hedge
- Manhole
- Gate
- Borehole
- Tree
- Survey Station
- 23.56 Spot Level (mAOD)

Notes

SURVEY FIXED TO THE OS ACTIVE NETWORK USING GPS

MITCHAM
Survey Department
The Old Stables, Berkeley House,Burwell
Cambridgeshire CB25 0DY
Tel:(01638) 741226
Fax:(01638) 743151

Site	Title
THURLOW ACORN BIOENERGY	TOPOGRAPHICAL SURVEY

Scale	Date	Drawn	Mitcham Ref	DWG No
1:1500 @ A1	11/03/22	SC	TL-01-22	TL-01-22-A

APPENDIX 02

Infiltration Testing Details

SOP FORM 3.3.3 - SOIL INFILTRATION RATE TEST

(See B.R.E. Digest 365, 1991, Soakaway Design.)

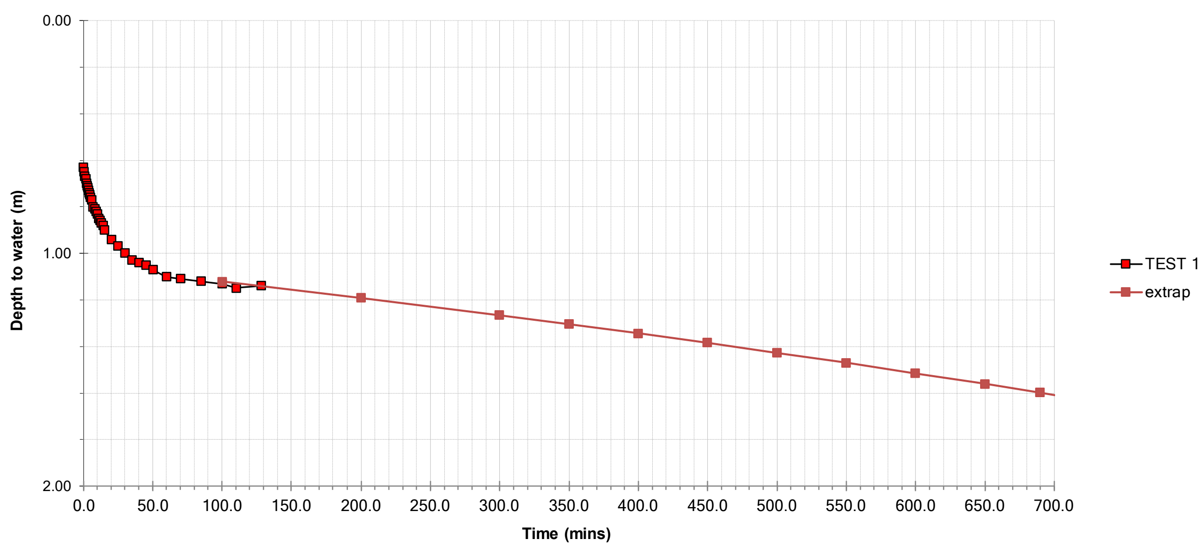
Project:	Thurlow	**Trial Pit No.:**	TP01	
Project No.:	404.V11923.00004.0005	**TP Length:**	3.40	m
Date of Test:	06/05/2022	**TP Width:**	0.70	m
		TP Depth:	2.20	m
		Groundwater Level:	N/A	mbgl

Remarks -
Partial Collapse of pit after 23 mins. After 128 mins, the pit collapsed further and testing was terminated due to instability.
A curve has been exrapolated to derive a rate for the site.

TEST 1		TEST 2		TEST 3	
Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
0.0	0.63				
0.5	0.65				
1.0	0.67				
1.5	0.68				
2.0	0.70				
2.5	0.71				
3.0	0.72				
3.5	0.73				
4.0	0.74				
4.5	0.75				
5.0	0.76				
6.0	0.77				
7.0	0.80				
8.0	0.81				
9.0	0.82				
10.0	0.83				
11.0	0.85				
12.0	0.86				
13.0	0.87				
14.0	0.88				
15.0	0.9				
20.0	0.94				
25.0	0.97				
30.0	1				
35.0	1.03				
40.0	1.04				
45.0	1.05				
50.0	1.07				
60.0	1.1				
70.0	1.11				
85.0	1.12				
100.0	1.13				
110.0	1.15				
128.0	1.14				

	Unit	TEST 1	TEST 2	TEST 3
Effective Storage Depth	m	1.57		
75% Effective Storage Depth	m	1.18		
(i.e. depth below GL)	m	1.02		
25% Effective Storage Depth	m	0.39		
(i.e. depth below GL)	m	1.81		
Effective Storage Depth 75%-25%	m	0.79		
Time to fall to 75% effective depth	mins	33.30		
Time to fall to 25% effective depth	mins	900.00		
V (75%-25%)	m3	1.87		
a (50%)	m2	8.82		
t (75%-25%)	mins	866.70		
SOIL INFILTRATION RATE	m/s	**4.07E-06**		

DESIGN SOIL INFILTRATION RATE, f	**N/A**



Marriott GEOTECHNICAL DRILLING

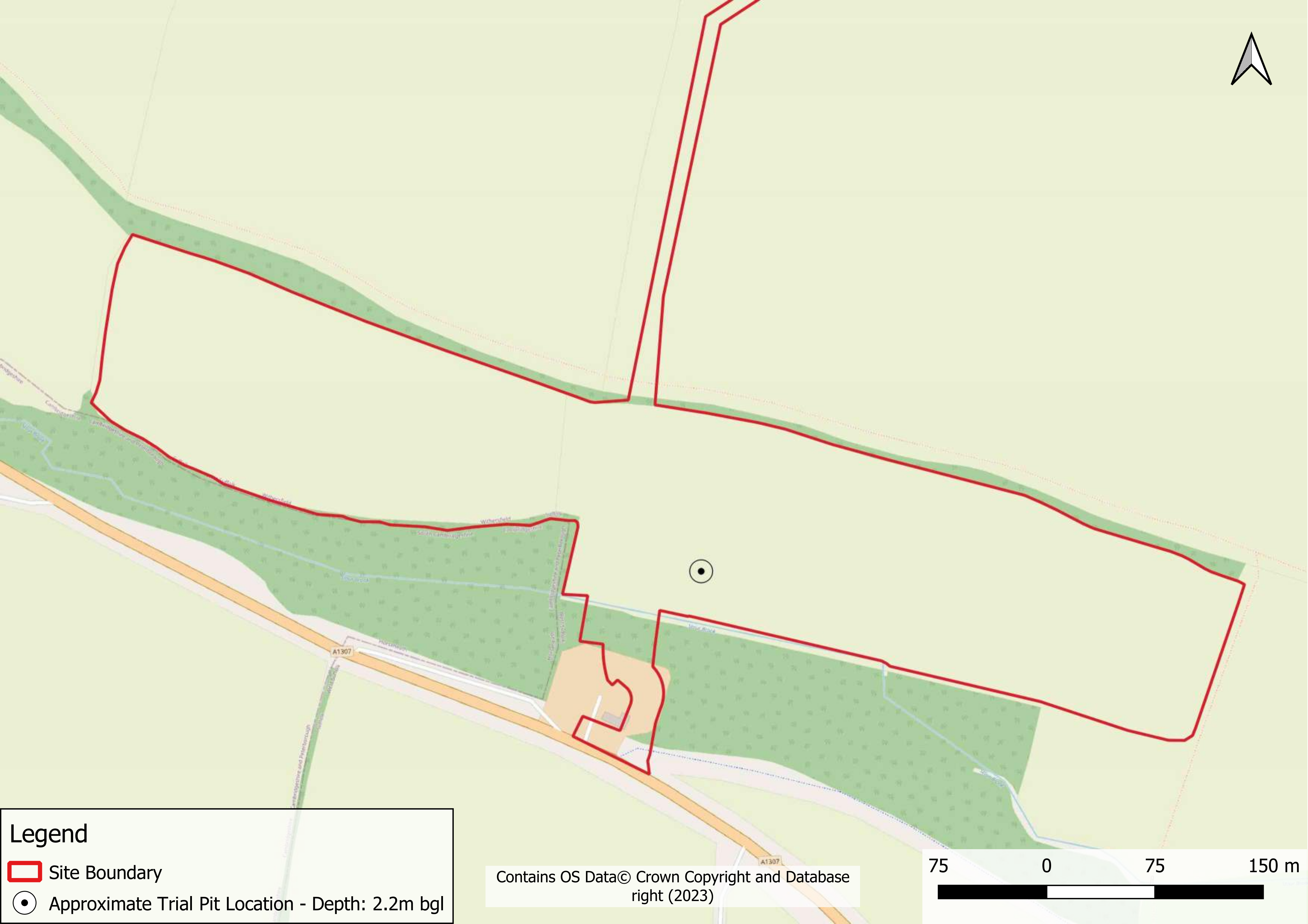
Soil/Rock Field Description Sheet

Project: Thurlow Estate (SLR)	**Project No.: 16259 - TE**	**Trial Pit No.: TP01**
Date: 06/05/2022	**Logger: L. Williams**	**Sheet No 1 of 1**

Strata Depth (m below ground level)		**Soil/Rock Description**
Top	**Bottom**	
GL	0.30	Dark brown firm slightly gravelly slightly silty CLAY with fine to coarse angular to rounded gravel of flint and chalk. (Agricultural reworked)
0.30	1.80	Light brown firm to stiff CLAY with rare angular fine gravel of flint.
1.80	2.20	Light brown GRAVEL and COBBLES of flint.
		END of Trial Pit at 2.20m (due to pit instability).

Remarks

Trial Pit Dimensions: 3.4m x 0.7m. END of Trial Pit at 2.20m (due to pit instability).
Water strike at 1.90m. Water level rose to 1.59 after 15min.
Trial pit became instable between 1.80 and 2.20m.
Soakaway test carried out (see separate sheet).
Logging not carried out for geotechnical purposes.
Trial Pit backfilled on completion of soakaway test.


A1307
A1307
Legend
Site Boundary
Approximate Trial Pit Location - Depth: 2.2m bgl
75 0 75 150 m

APPENDIX 03

Details of the Proposed Development Layout

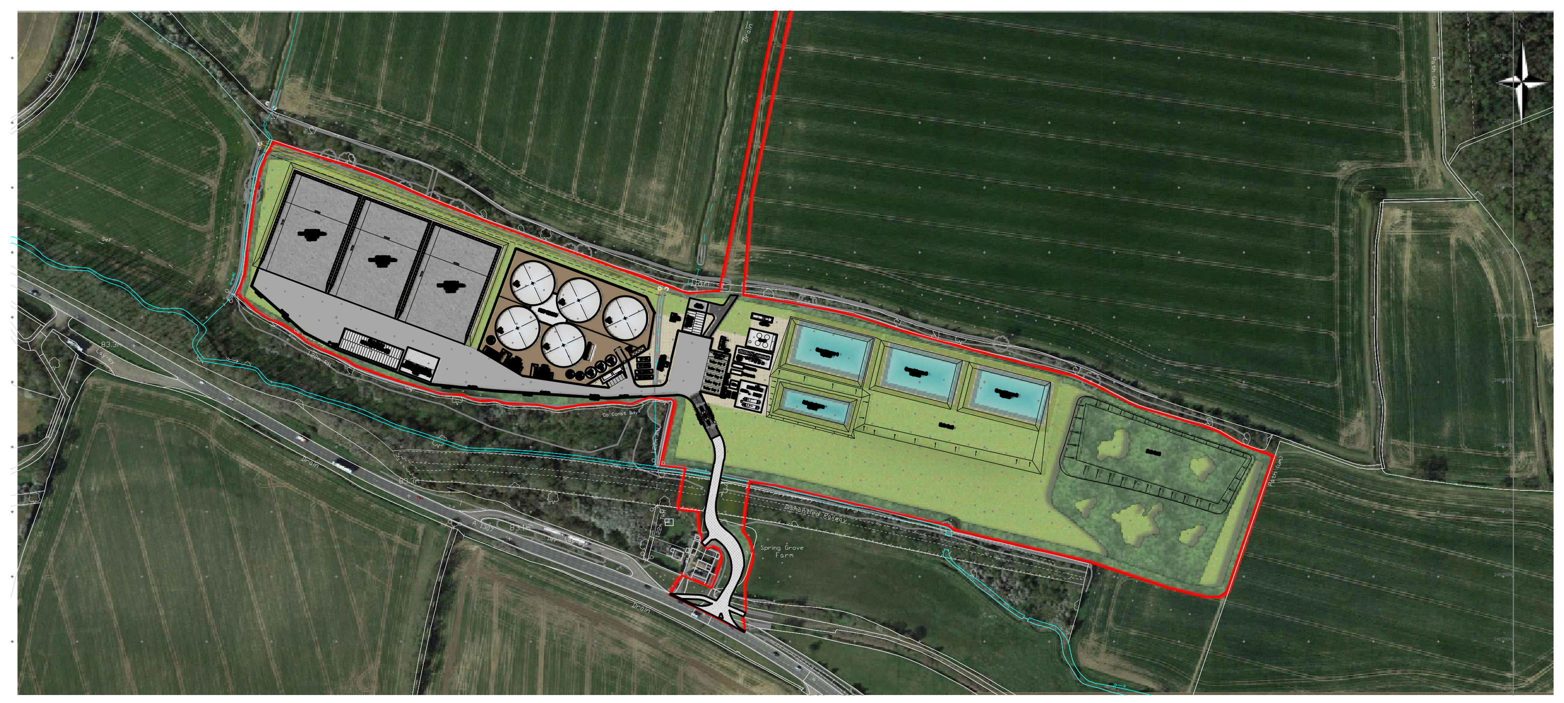
AS NOTED ON A1 FRAME

Site Plan.

Scale: 1:1250 @ A1.

0 10m 20m 30m 40m 50m

Scale 1:1250 @ A1



Site Location Plan.

Scale: 1:5000 @ A1.

0 50m 100m 150m 200m 250m

Scale 1:5000 @ A1

NOT FOR CONSTRUCTION

NOTES:-

1. All dimensions must be checked on site and not scaled from this drawing.
2. The Contractor shall make a survey of the site and shall be responsible for obtaining all dimensions and levels necessary for the proper fabrication of the structure as indicated.
3. All levels shown on this drawing are relative to Agreed Topographic survey
4. This drawing is to be read in conjunction with 29351/100 Series Drawings.
5. All existing invert levels are to be confirmed by contractor prior to construction. Connection subject to approval.

Existing Watercourse

Gas Line with Easement Offset

Site Red Line Boundary (16.17Ha)

Rev	Date	Description	DR	CH
U	30/08/23	Landscaping Image Updated	WG	JHC
T	17/08/23	Redline & Entrance Updated	JHC	JHC
S	31/05/23	Layout Amendments	WG	JHC
R	20/04/23	Layout Amendments	JH	JHC
Q	19/04/23	Layout Amendments	JHC	JHC
P	09/03/23	Layout Amendments	WG	JHC
N	08/03/23	Redline Updated	WG	JHC
M	08/03/23	Redline Updated	WG	JHC
L	01/03/23	Redline Updated	WG	JHC
K	28/02/23	Redline Updated	JHC	JHC
J	22/02/23	Redline Updated	JHC	JHC
i	26/01/23	Redline Updated	JHC	JHC
H	23/08/22	Bund updated	JR	JHC
G	15/08/22	SLR Flood Extent Added	JHC	JHC
F	10/08/22	Draft-Lagoon Update	JHC	JHC
E	02/08/22	Draft Layout	DJC	JHC
D	13/06/22	LAYOUT AMENDED	DJC	JHC
C	05/04/22	CONCEPT LAYOUT	DJC	JHC
B	04/03/22	CONCEPT LAYOUT	JHC	JHC
A	24/02/22	CONCEPT LAYOUT	JHC	JHC

UVDB empowered by Achilles Registered

Link-up empowered by Achilles Qualified via Audit

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Client: acorn

Job Title: AD Plant. Spring Grove.

Drawing Title: Site Layout.

Status: Planning

Scale: As Shown | Date: Jan' '22

Drawn By: J. Collins | Checked: JHC | Approved: JHC

Drg. No.: 29351/P/101 | Rev: U

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