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Planning & Development

Flood Risk & Drainage Assessment

Conrad Energy Ltd

Land off Leys Lane, Yaxley, Suffolk, IP23 8DX

Document Control

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Executive Summary

Ashfield Flood Risk Solutions ("Ashfield") was commissioned by ITP Energised on behalf of Conrad Energy Ltd ("the client") to undertake a Flood Risk & Drainage Assessment ("FRDA"), in support of a planning application at Land off Leys Lane, Yaxley, Suffolk, IP23 8DX ("the site"). The proposed development entails the construction of a synchronous condenser site.

The Environment Agency's (EA) Flood Map for Planning (Rivers and Sea) (FMFP) indicates that the site is located within Flood Zone 1 (<0.1% AEP). The Risk of Flooding from Rivers and Sea (ROFRAS) mapping indicates that the site is located within an area that is at Very Low risk of river or sea flooding (<0.1% AEP). Based on the EA's Flood maps and there being no recorded historic fluvial or tidal flooding near the site, the risk of flooding from both these sources is considered Very Low.

The EA surface water mapping does not highlight any potential risk from this source on site and therefore the risk is considered Low. There were also no identified reported incidents of surface water flooding at the site.

All other sources of flooding (groundwater, reservoir failure and artificial sources) are also considered Low or Negligible at the site.

The development is located in Flood Zone 1 and is therefore deemed acceptable in accordance with the National Planning Policy Framework. As seen within Table 3 of the Government Guidance on Flood Risk and Coastal Change, all developments located within Flood Zone 1 are deem appropriate in a flood risk context.

Based upon the Low and Negligible risk of flooding from all potential flood sources as previously mentioned, the development is not shown to remove or reduce flood storage and will not result in an increase in flood risk elsewhere.

An illustrative surface water drainage strategy has been produced for the proposed development which shows that the site can accommodate surface water attenuation for events up to and including the 1 in 100 year storm +40% allowance for Climate Change (CC). This is based on utilising geo-cellular crate storage beneath the north-western region of the site, restricting run-off from the site to QBAR rate of 4.8l/s into the nearest drainage ditch located 120m to the north-west of the site. This drainage ditch is located within the wider ownership boundary. Attenuation requirements for this storm event comprise a maximum volume of 1457m^3.

This drainage strategy forms the fourth level of the drainage hierarchy and is the most preferred option at the site, based on the identified constraints. At the detailed design stage, further SuDS should also be considered such as bio-retention tree pits to add additional treatment, and amenity/ecological benefits.

This report therefore demonstrates that the proposed development:

- Is suitable in the location proposed;
- Is unlikely to place additional persons at risk of flooding; and
- Is unlikely to increase flood risk elsewhere as a result of the proposed development through the loss of floodplain storage, impedance of flood flows or increase in surface water runoff.

1 Introduction

1.1 Authorisation and Context

Ashfield Flood Risk Solutions ("Ashfield") was commissioned by ITP Energised on behalf of Conrad Energy Ltd ("the client") to undertake a Flood Risk & Drainage Assessment ("FRDA"), in support of a planning application at Land off Leys Lane, Yaxley, Suffolk, IP23 8DX ("the site") for a synchronous condenser as outlined in Section 1.6 of this report. The site location can be seen on Drawing 01 for reference.

1.2 Aims and Objectives

This report will look to assess flooding from all potential sources. The aims of this report are to address the requirements of the National Planning Policy Framework (NPPF) through meeting the following objectives:

- Assessing whether the site is likely to be affected by flooding from different sources.
- Providing an assessment of the vulnerability of the proposed development and its suitability in relation to the identified flood risks;
- Providing an opinion in relation to the likely impacts of the proposed development on flooding elsewhere; and,
- Where required, presenting flood risk mitigation measures necessary to ensure that the proposed development will be safe, whilst ensuring flood risk is not increased elsewhere.

1.3 Information Sources Used

In order to prepare this FRDA, the following information sources and general guidance documents have been used:

- National Planning Policy Framework (NPPF), Flood Risk and Coastal Change Planning Practice;
- Proposed Development Plans – Conrad Energy – 22/06/22;
- Topographic Survey – Stafsurv Land Surveyors – Drawing No. 12265 – 22nd April 2022;
- Drainage Survey – Subsite Surveys – 0422-GEG-003 – 29th April 2022;
- Pre-application Enquiry – DC/22/01844 – Mid Suffolk District Council & Babergh District Council – accessed June 2022;
- Mid Suffolk District Council Strategic Flood Risk Assessment (SFRA)- JBA Consulting – August 2020;
- Suffolk County Council Preliminary Flood Risk Assessment (PFRA) – AECOM Water – June 2011;
- Suffolk County Council Preliminary Flood Risk Assessment Addendum – December 2017;
- Suffolk County Council Surface Water Management Strategy – March 2016;
- Suffolk County Council Flood Risk Management Strategy (FRMS)- May 2012;
- 1m resolution LiDAR data – downloaded online - accessed June 2022;
- Environment Agency interactive flood maps – accessed online June 2022; and,
- British Geological Survey (BGS) Drift & Geology Maps - accessed online June 2022.

1.4 Report Limitations

This assessment of flood risk has looked to use the most accurate and up to date flood mapping for the location. The site boundary has been supplied by the client and the assessment of risk is based on this. This report has been prepared with due care and diligence in accordance with industry best practice and guidance. The conclusions in this report are valid only to the extent that the information provided to Ashfield was accurate and complete at time of receipt.

1.5 Site Setting

The site is located at coordinates XY: 611914, 274987 (nearest post code: IP23 8DX) and occupies an area of approximately 5.1 hectares (ha). The site is located on a plot of undeveloped pastureland off Leys Lane, approximately 497m north of the town Yaxley in Suffolk. The site currently comprises 'acid grassland', which is categorised as a nutrient-poor habitat characterised by grassy tussocks and bare ground. The site is bound to the north and east by Leys Lane, and to the south and west by farmland. The site is accessed from Leys Lane to the east. No site visit was undertaken as part of this commission.

1.6 Development Proposals

The plans for the existing layout and proposed development, which were provided by the client, can be seen within Appendix A of this report. The proposed development entails the erection of a Synchronous Condenser with ancillary infrastructure and associated works including access and landscaping.

It is understood that the development will comprise of a synchronous condenser, grid transformer, electrical equipment, ventilation equipment, a relay room, and a security fence with associated access road/track to the south.

The access route forms part of the development redline boundary, from the A140, as seen within Drawing 01. This route has already been granted planning approval (Ref: DC/21/05365) and has subsequently been constructed as part of a separate project involving works for neighbouring Yaxley substation site. This is a temporary construction road for all construction related traffic including delivery of materials, equipment and staff – for both sites. This road will be decommissioned once both works are completed. This access route therefore does not form part of the below Drainage Strategy due to this having already being assessed during the aforementioned planning process. No modification to this access road will be made as part of this development's construction process.

1.7 Topographic Mapping

A site topographic survey was made available to Ashfield to inform this report. This was undertaken by Stafsurv in April 2022 and is included as Appendix B for reference.

From review of the topographic survey, the site is shown to slope from higher topography in the south-east (48.5mAOD) to a lower topography in north-west (44.5mAOD).

Freely available 1m resolution Light Detection and Ranging (LiDAR) data has also been downloaded to inform ground levels of the wider area. A LiDAR derived levels plan is illustrated on Drawing 02 for reference. The LiDAR data also concurs with the topographic survey mentioned above.

1.8 Local Hydrology

The nearest Environment Agency (EA) designated Main River to the site is the River Dove located approximately 3.2km south-east of the site and flows in a north easterly direction. The River Dove largely forms the western boundary of the parish of Hoxne in a meandering course to the west of Hoxne village. Here it is joined by Gold Brook, before discharging into the River Waveney at the county boundary with Norfolk approximately 6.7km north-east of the site.

The nearest ordinary watercourse is located approximately 120m north-west of the site and it is indicated to be a drainage ditch within the wider client ownership boundary. There is also a small pond feature which is shown within OS mapping, within the north-western edge of the site boundary.

1.9 Local Drainage

A drainage survey has been undertaken by Subsite Surveys to reveal drainage and utility connections which can be seen within Appendix C for reference. This was undertaken by scanning the area using EML and GPR equipment. The results of this indicated there to be no services located within the site boundary and the surrounding area.

1.10 Flood History

From review of the Mid Suffolk District Council Strategic Flood Risk Assessment (SFRA) (2020), it was indicated that flooding has occurred within the postcode area that the site is located within (IP23), however, the exact locations of these incidents were not included within the report. Additionally other incidents have occurred within the district, and it is understood that the site was not impacted by these events.

The Suffolk County Council Preliminary Flood Risk Assessment (PFRA) (2011) indicated that flooding has occurred within the county; however, the exact location of these incidents were not provided, therefore, it could not be confirmed if the site was impacted.

The Suffolk County Council PFRA Addendum (2017), indicated that several incidents of flooding have occurred since 2011; however, it is understood that none of these incidents occurred at or within close proximity to the site.

Although both the Suffolk County Council Surface Water Management Plan (SWMP) (2012), and Flood Risk Management Plan (FRMP) (2016), indicated that historical flooding has occurred within the area, none of these incidents were understood to be within close proximity to the site.

The EA recorded flood outline data indicates that the site has not been affected by historical flooding events. Note that the absence of data does not mean the area has never flooded, only that there are no records held by the EA.

2 Flood Risk Evaluation

The following sections provide an evaluation of the risk posed by the key flood sources in relation to the site location. Consideration is given to the severity of flood risk to the site as a whole, making use of existing flood mapping, high-level local strategic studies and available topographic information.

2.1 Fluvial & Tidal Flood Risk

Fluvial flood risk originates from a watercourse of any size that may affect a site when the channel capacity is exceeded. This type of flooding often occurs following an extreme rainstorm event or a prolonged period of wet weather. Tidal flood risk can affect the coastline as well as estuaries and rivers that are tidally influenced. Flood events often coincide with the tidal regime, high rainfall events or other natural phenomena, which can lead to water levels covering low-lying land or exceeding natural or man-made defences.

As discussed in Section 1.8, the nearest Main River to the site is the River Dove which is located approximately 3.2km south-east of the site.

EA Flood Mapping

The EA's Flood Map for Planning (Rivers and Sea) divides the floodplain into risk-based categories and provides an indication of flood risk for the site. The EA Flood Map for Planning (Rivers and Sea) (Drawing 03) indicates that the site is located within Flood Zone 1. Flood Zone 1 is defined as land assessed as having less than a 1 in 1,000 (0.1%) annual probability of river and sea flooding. The Flood Zones show the 'undefended' scenario, where any flood defences in the locality are not represented within the mapping.

The Risk of Flooding from Rivers and Sea (ROFRAS) mapping indicates that the site is located within an area that is at Very Low risk of river or sea flooding (<0.1% AEP). This mapping takes into account the representation of any flood defences that may exist in the local area. The nearest area at risk of flooding from ROFRAS is located approximately 1.1km south of the site and is shown to be aligned with an unnamed watercourse.

The nearest flood defences to the site are located approximately 3.2km to the south-east along the River Dove. From interrogation of the open-source layer for flood defences in a GIS viewer, this is identified to comprise a of natural high ground**.** The Standard of Protection (SOP) for these defences is not specified within the open-source data.

> The overall risk of from rivers and sea at the site is considered to be **Very Low.** No further consideration is deemed necessary as part of this FRDA.

2.2 Surface Water Flooding

Surface water flooding occurs when local drainage networks are overwhelmed during an extreme rainfall event, causing water to flow over the surface and follow gravity to the lowest point where it often pools. This flood source is increasingly becoming one of the major contributors of flood risk, due

to changing weather patterns and increased extreme rainfall events occurring across the UK. This places more pressure than ever on drainage systems, which are often overwhelmed during flash flood events, normally only designed to take between a 1 in 20 and a 1 in 30 return period event.

When interpreting the surface water flood map information, it needs to be taken into account that surface water mapping is generated from information that is largely high-level. The flood mapping must be correctly interpreted in order to give a fair representation of the site's surface water flood risk and used only as a guide.

The EA Surface Water Flood Map (Drawing 04) shows that Leys Lane, which runs within the northern area of the site boundary, is within an area projected to be at low risk of surface water flooding. Low risk is defined as an area with between 1 in 100 (1%) and 1 in 1000 (0.1%) chance of flooding in a year. However, the surface water is not shown to encroach on the proposed development boundary, it is indicated to be isolated within the lane. In addition, Low risk is indicated to be within the entrance of the access road to the approximately 636m to the east of the proposed development.

The SFRA indicated that surface water flooding has occurred within the wider county area of Suffolk; however, it could not be confirmed whether the site was impacted.

> The overall risk of surface water flooding affecting the site is considered to be **Low**. Further considerations are made within Sections 3 and 4 in relation to keeping this risk to a low designation in the long-term and managing surface water on site.

2.3 Reservoir Failure

Assessment of risk of a reservoir failure may be interpreted as the extent of flooding that would occur, should any reservoir that has a capacity larger than 25,000m^3, suffer a catastrophic failure. Mapping of this nature is described by the EA as a very worst-case scenario, with a flood event of this type being extremely unlikely to occur.

The EA Risk of Flooding from Reservoir Failure mapping (Drawing 05) is based on two extents:

- Wet Day (National) - This data shows the individual flood extents for all large, raised reservoirs in the event that they were to fail and release the water held on a "wet day" when local rivers had already overflowed their banks.
- Dry Day (National) - This data shows the individual flood extents for all large, raised reservoirs in the event that they were to fail and release the water held on a "dry day" when local rivers are at normal levels.

The EA Risk of Flooding from Reservoirs Failure Mapping (Drawing 05) shows that the site would not be affected by a catastrophic failure of the nearest reservoir. The nearest area at risk from reservoir failure is located approximately 7.1km to the north-west of the site and is indicated to be associated with the Wet Day and Dry Day extent.

> The risk of flooding from reservoir failure is therefore considered to be **Negligible**, and no further consideration from this risk source is deemed necessary as part of this report.

2.4 Groundwater

Flooding from a groundwater source often occurs during or following a period of prolonged wet weather within areas that are low lying underlain by permeable rocks (aquifers). When aquifers are at their maximum holding potential, flooding at surface level can occur from beneath the ground.

Groundwater as a sole flooding mechanism is often regarded as low risk as it often relies on a coinciding rainfall, or flood event from an additional source to become a flood risk. The main contributory factor that will enhance the risk of groundwater flooding, is prolonged periods of high rainfall, which result in the groundwater saturation level rising to the point where it reaches the surface.

Online BGS mapping shows the bedrock geology beneath the property to comprise of Crag Group – Sand. This is defined by the EA as Principal Aquifers -These are 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.

The bedrock is overlain by Lowestoft Formation – Diamicton. This is defined by the EA as Secondary Undifferentiated - has been assigned in cases where it has not been possible to attribute either category A or B to a rock type.

The nearest borehole to the site with groundwater information and the same underlying geology is located approximately 130m south of the site location (ref: TM17SW5), which has a depth of approximately 125m below ground level (bgl). Groundwater was not indicated to have been identified. However, the rest level of water was identified to be at 6.94m bgl. The depth of the borehole indicates that this is a record from a well rather than a borehole.

Another borehole within the vicinity with groundwater information and the same underlying geology is located 529m to the south of the site (ref: TM17SW43), which has a depth of 25m bgl. Groundwater was indicated to be struck at 14m bgl.

Groundwater flooding has occurred within the area; however, the SFRA did not indicate that the site had been impacted by these incidents. Appendix E within the SFRA shows the areas more than 75% susceptible to groundwater flooding. The site is not indicated to be within an area susceptible to groundwater flooding, however, it should be noted that susceptibility does not account for the likelihood of groundwater flooding occurring.

> The risk of flooding from groundwater flooding is therefore considered to be **Low**. No further consideration is deemed necessary as part of this FRDA.

2.5 Artificial Flood Sources

Flood risk from artificial sources would include the failure of man-made drainage or water supply network. Although the likelihood of such an occurrence is highly unpredictable, it is recommended that any proposed designs for the site take into account the location of any existing below ground services, in order to avoid any inadvertent flooding taking place during the construction phase and in the future.

The SFRA indicated that flooding from artificial sources had occurred within the District; however, the site was not indicated to have been impacted. In addition, as seen within Appendix C, there are no foul water connections within the site which is currently undeveloped. Therefore, there would be minimal risk of flooding from this source based on present conditions.

> In summary, the overall risk to the site from artificial sources is considered to be **Low**. No further consideration is deemed necessary as part of this FRDA.

2.6 Summary

Table 1 provides a summary of the classification of risk to the site from all flood sources and indicates where further considerations are required in the context of the proposed development.

Table 1 - Flood Risk Summary

Flood Source	Overall Risk Classification	Additional Considerations
Fluvial	Very Low	None.
Tidal	Very Low	None.
Surface Water	Low	See Sections 3 and 4.
Reservoir Failure	Negligible	None.
Groundwater	Low	None.
Artificial Sources	Low	None.

3 Flood Risk in Planning Context

This report has so far evaluated all potential flood risk sources that may affect the site. The following sections describe the identified flood risks in the context of the proposed development and provide recommendations, where required, for the mitigation or reduction of those risks to enable safe development.

3.1 Flood Risk Status

The EA flood maps have been analysed for potential flood risk at the site. The combination of the site being located within Flood Zone 1 and there being no identified reported incidents of nearby flooding, equates to fluvial and tidal risk at the site being Very Low.

Surface water risk is considered Low based on there being no risk designation within the site boundary from the EA maps and no identified reported incidents of surface water flooding at the site.

All other sources of flooding are also considered Low or Negligible at the site.

3.2 Development Viability

The development is located in Flood Zone 1 and is therefore deemed acceptable in accordance with the National Planning Policy Framework. As seen within Table 3 of the Government Guidance on Flood Risk and Coastal Change, all developments located within Flood Zone 1 are deem appropriate in a flood risk context.

Based upon the Low to Negligible risk of flooding from all potential flood sources as mentioned within both Section 2.6 & 3.1, the development is not shown to remove or reduce flood storage and will not result in an increase in flood risk elsewhere, through the implementation of a suitable drainage strategy (this is outlined in Section 4 for reference).

3.3 Drainage

As part of the development design, it should be ensured that any modifications do not increase surface water flooding elsewhere. This should be done by minimising hard surfacing where possible and by adopting the use of permeable surface materials. It is understood that the ground surfaces between the machines will comprise of gravel (type 1), which will allow for some percolation into the ground.

To mitigate the developments impact on the current runoff regime it is proposed to incorporate surface water attenuation as part of the development proposals. Further information on the drainage strategy for the proposed development is provided within Section 4.

4 Drainage Strategy

4.1 Introduction

This section looks to identify means of managing future flood risk on site, which would be attributed to surface water and drainage. The FRDA has thus far identified that the site is currently at low risk of surface water flooding. The principles for the future management of drainage on site have been outlined within this section to ensure that risk can be sustainably managed for the lifetime of the development.

4.2 SuDS Summary

New developments are required to ensure that the discharge of surface water can be sustainably managed, and not increase the risk of flooding on site or elsewhere. Suffolk County Council as the Lead Local Flood Authority (LLFA) require drainage strategies for developments to follow the National Planning Policy Framework, Planning Practice Guidance and DEFRA Technical Standards. A development should utilise sustainable urban drainage systems unless there are practical reasons for not doing so and should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible in line with a specific drainage hierarchy. The Runoff Destination drainage hierarchy will be used as the basis for designing the proposed surface water drainage strategy for this development site.

The proposed development is understood to have a lifespan of 50 years. An allowance of 40% for climate change has been included within the calculations. MicroDrainage version 2020.1 has been used for undertaking surface water calculations within this section.

4.3 Site Conditions

As discussed in Section 1.5, the whole site comprises an area of approximately 5.1ha, which currently consists of permeable grassland surfaces as well as the existing temporary access road (previously granted planning approval as further detailed within Section 1.5). The development site is approximately 1.7ha which comprises the synchronous condensers. The drainage survey undertaken by Subsite Surveys indicated the site to not be served by any surface water or foul water drainage. Therefore, there are no manholes or downpipes in close proximity. There is a small surface water pond within the north-west corner of the site however, a review of the Phase 1 environmental report (Phase 1 Geo-Environmental Assessment, Geo Environmental Group, May 2022) described this to be an overgrown depression with little to no water present. Anglian Water wastewater sewer records (included as Appendix D) indicate the nearest surface water sewer to be located approximately 680m to the south-east of the site.

4.4 Existing Site Runoff

Runoff Volume

Volume of run-off for proposed developments is compared for a 100 year return period, 6 hour storm. The proposed development area (1.7ha) is greenfield in nature and the runoff volume for this area has

been calculated using the Source Control module within MicroDrainage to be **351m³**, results are included within Appendix E.

Runoff Rate

The run-off rate for the greenfield site area (1.7ha) has been estimated using the ICP SUDS calculation within MicroDrainage and are presented within Table 1. Calculations are included within Appendix E.

Table 1 - Existing Site Runoff

Return Period (Yrs)	Greenfield Area Runoff Rate (l/s)
1	4.2
2 (QBAR)	4.8
30	11.6
100	17.2

4.5 Proposed Site Runoff

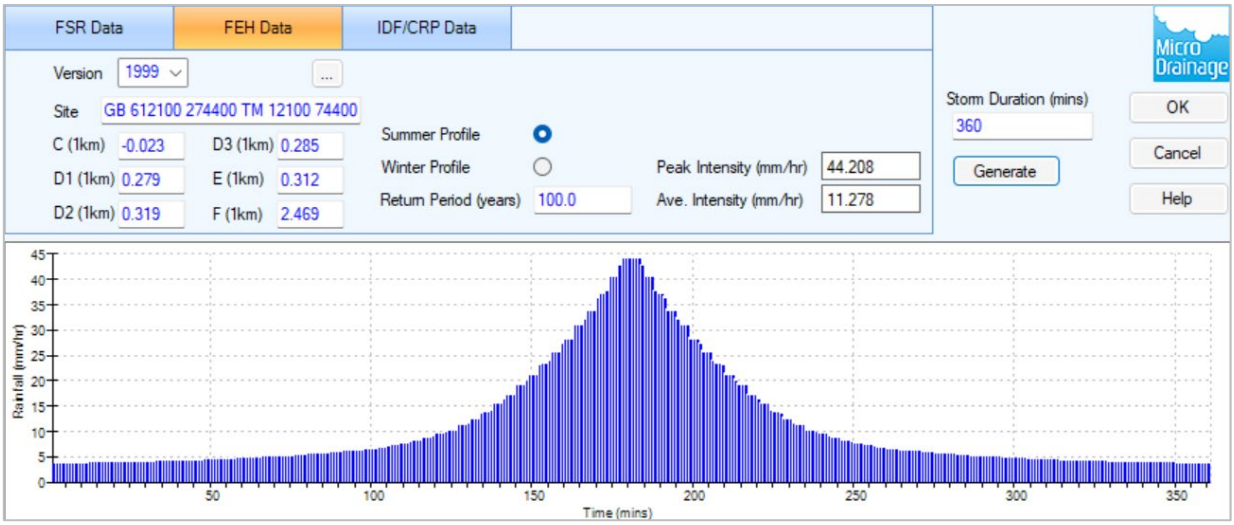
Runoff Volume

The proposed development will comprise of approximately 1.7ha of drained surfaces.

The proposed runoff volume from this area can be derived using an average rainfall intensity of 11.28mm/hr as calculated using FEH rainfall data within MicroDrainage. The calculated volume is as follows:

$$Average\ Rainfall\ Intensity\ (mm\ per\ hour) x\ 6\ (hours)\ x\ Site\ Area\ (ha)\ x\ 10 = Runoff\ Volume\ (m^3)$$

$$11.28\ x\ 6\ x\ 1.7\ x\ 10 = 1151 m^3$$



Runoff Rate

In order to comply with the Non-Statutory Technical Standards for Sustainable Drainage Systems[1], runoff should not exceed existing greenfield rates for the 1 and 100 year return period events. The current approach for surface water management in England requires outflows and volumes from new developments to be restricted to Greenfield values where appropriate.

The existing QBAR runoff rate at the site is calculated to be 4.8l/s. A runoff rate of 2l/s/ha would equate to a rate of 3.4l/s. As per Suffolk County Council Guidance[2], the higher of these two rates should be used to inform drainage design.

Long Term Storage

A requirement for long term storage has been identified and a discharge rate proposed which meets the requirements of sites discharging additional surface water volume. The proposed development therefore complies with this criterion and no further restrictions are necessary.

Drainage Hierarchy

Thus far, as part of this FRDA, the design scope of the development has been established, as well as determining all probable local drainage features within close vicinity of the site. This section looks to outline the most suitable ways of managing surface water as part of the proposed development, through utilising options that are as high up the drainage hierarchy as possible, outlined below. At the end of each bullet point, Ashfield has provided site specific comments:

- **Store rainwater for later use** - Rainwater could be stored at the site for later use through the provision of water butts at ground level. However, as the site is not for residential use there is limited usage for any stored water.
- **Use infiltration techniques, such as porous surfaces in non-clay areas** - bedrock geology is Crag Group – Sand which is overlain by Lowestoft Formation - Diamicton. The borehole log previously mentioned in Section 2.4 of this report has also been reviewed for the type of soils present. This log showed soft brown Sandy Clay soils, which is categorised as 'Very Poor' infiltration within Table 25.1 of the CIRIA SuDS manual 753. Therefore, infiltration is not likely to be suitable as a method for surface water disposal and has been discounted at this stage without any soakaway testing available.
- **Attenuate rainwater in ponds or open water features for gradual release** – As previously mentioned in Section 1.8, there is a pond feature within the north-west corner of the site boundary. However, site investigation during the 2022 Phase 1 Environmental report indicated this to be overgrown with little to no water within it. Therefore, this alone is not considered appropriate for attenuation.
- **Attenuate rainwater by storing in tanks or sealed water features for gradual release** – potential for this on site (discharge points discussed below).
- **Discharge rainwater direct to a watercourse** – As previously mentioned in Section 1.8, there is a drainage ditch located approximately 120m to the north-west of the site. This is considered to be the most appropriate runoff discharge point from the site's drainage system. Ground levels for the site and wider area are shown to fall towards the north-west as seen within the

[1] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/415773/sustainable-drainage-technical-standards.pdf
[2] https://www.suffolk.gov.uk/assets/Roads-and-transport/Flooding-and-drainage/Strategy-Apendicies/2018-10-01-SFRMS-SuDS-Guidance-Appendix-A-.pdf

topographic survey and the LiDAR (Drawing 02) allowing for surface water to fall via gravity towards the drainage ditch.

- **Discharge rainwater to a surface water sewer/drain** – As previously mentioned in this report, the nearest surface water sewer is located approximately 680m to the south-east of the development site. This would require large scale excavation works to connect the site with this sewer and therefore it is not considered appropriate for this development.
- **Discharge rainwater to the combined sewer** – As per the Anglian Water sewer records (Appendix D), there are no combined sewers within the vicinity of the site.

The fourth level of the above hierarchy will be adopted at the site. Attenuation of rainwater can be provided within below-ground geo-cellular crate storage (lined with an appropriate membrane to prevent water coming in and out of the structure), for gradual release into the drainage ditch located 120m to the north-west of the site.

4.6 Site Runoff Summary

The following tables summarise the calculated runoff volumes and rates for the proposed development.

Table 3 - Existing and Proposed Runoff Volumes

Existing Volume (m^3)	Proposed Volume (m^3)	Difference (m^3)
351	1151	+800

Table 4 - Existing and Proposed Runoff Rates

Return Period (Yr)	Existing Runoff Rates (l/s)	Maximum Proposed Runoff Rate (l/s)
1	4.2	4.8
2 (QBAR)	4.8	
30	11.6	
100	17.2	
100 + 40%	-	

4.7 Surface Water Drainage Strategy

For the purpose of this planning application, an illustrative surface water strategy has been prepared to demonstrate that the necessary drainage parameters can be accommodated within the development:

- Maximum discharge rate equivalent to the QBAR runoff rate = 4.8l/s.
- Attenuated surface water storage up to the 1 in 100 year plus 40% Climate Change (CC) storm event (40%).
- Provision of SuDS drainage principles.

It is envisaged that the final drainage layout, outfall locations, SuDS and approach to storage will be determined at the detailed drainage design stage, however, an illustrative drainage strategy is discussed below.

Attenuation Requirements

Using a restriction of 4.8l/s, the volume of attenuation required for the site has been calculated for storm events up to the 100 year + 40% storm. Simulations have been run using the MicroDrainage Source Control module and the results are summarised in Table 5 with calculations included within Appendix E.

Table 5 - FSR/FEH Modelled Attenuation Requirements (1 in 100 year +40% CC storm)

Rainfall Method	Critical Storm	Maximum Volume (m^3)
FSR	1440 min Winter	1257
FEH	2160 min Winter	1457

As the FEH has the higher maximum volume, the attenuation design will be based on this more conservative method. The Source Control simulations demonstrate that there is adequate storage for all storms up to the 1 in 100 year +40% CC storm event, with a restriction of 4.8l/s and that no flooding occurs at this event.

Sustainable Drainage Systems

An illustrative surface water drainage strategy has been outlined for the proposed development, shown in Drawing 07. This is based on the second level of the 'Runoff Destination' drainage hierarchy seen within the Suffolk SuDS Guidance.

This demonstrates how the required attenuation volume can be accommodated within the site using a lined below ground geo-cellular storage in the northern region, restricting discharge to a rate of 4.8l/s. The geo-cellular storage structure has a plan area of 1600m^2, a depth of 1m and 1m of cover from ground level to the top of the structure. The precise details of the layout will be confirmed at the detailed design (reserved matters) stage.

At the detailed design stage, further SuDS should also be considered such as bio-retention tree pits to add additional treatment, and amenity/ecological benefits. Additional measures such as filter drains and rainwater harvesting should also be considered which will be in line with the first level of the aforementioned drainage hierarchy.

In addition, the client should incorporate, where possible, either permeable paving or porous asphalt into the design of accessible areas of the site. This would also have its own sub-base which will drain into the geo-cellular structure.

4.8 Residual Risk and Designing for Exceedance

In the event that the capacity of the attenuation is exceeded, flood water will be directed away from the condenser, and pool within the field area to the north of the site. In addition to the volume of storage provided within the main attenuation, there will be capacity within upstream pipes and manholes which has not been accounted for at this stage and a further level of redundancy to the network will therefore be provided.

4.9 Maintenance

Requirements for ongoing maintenance of the drainage network will form part of the Operation and Maintenance manual for the site and should be undertaken by the building management. Any specialist or proprietary products that are specified should have a manufacturer specific maintenance regime which should be included within the document.

All drainage features should be located in open areas which are readily accessible. Table 6 below indicates likely maintenance requirements for the geo-cellular storage structure proposed.

Table 6 - Geo-cellular Storage Maintenance Requirements

Maintenance	Action	Frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then six monthly.
	Debris removal from catchment surface (where may cause risks to performance).	Monthly.
	Where rainfall infiltrates into blocks from above, check surface of filter for blockage by silt, algae or other matter. Remove and replace surface infiltration medium as necessary	Monthly (and after large storms).
	Remove sediment from pre-treatment structures.	Annually, or as required.
Remedial work	Repair/rehabilitation of inlets, outlet, overflows and vents.	As required.
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed.	Annually and after large storms.

4.10 Foul Discharge

The proposed development is for a synchronous condenser and therefore is not considered to require any provision of foul drainage.

4.11 Summary

Based on the above findings, an appropriate drainage strategy has been outlined which incorporates discharge to the nearest drainage ditch, away from the site. This forms the fourth level of the 'Runoff Destination' drainage hierarchy and is the most preferred option at the site. Further SuDS shall also be considered such as bio-retention tree pits to add additional treatment, and amenity/ecological benefits.

5 Conclusion

The site has been assessed for flood risk from a variety of flood sources. The combination of the site being located within the EA designated Flood Zone 1 and there being no identified reported incidents of nearby flooding, equates to fluvial and tidal risk at the site being considered Low.

Surface water risk is considered Low based on there being no risk designation within the site boundary from the EA maps and no identified reported incidents of surface water flooding at the site.

All other sources of flooding are also considered Low or Negligible at the site.

This report has outlined recommendations for the development to incorporate during the design stage which will seek to keep the risk designation of surface water as Low. To ensure the positive drainage of the site in the post-development scenario, an illustrative outline drainage strategy has been designed so as to manage surface water on site, and that no flooding shall occur up to and including the 1 in 100 year + 40% CC storm event.

This report therefore demonstrates that the proposed development:

- Is suitable in the location proposed;
- Is unlikely to place additional persons at risk of flooding; and
- Is unlikely to increase flood risk elsewhere as a result of the proposed development through the loss of floodplain storage, impedance of flood flows or increase in surface water runoff.

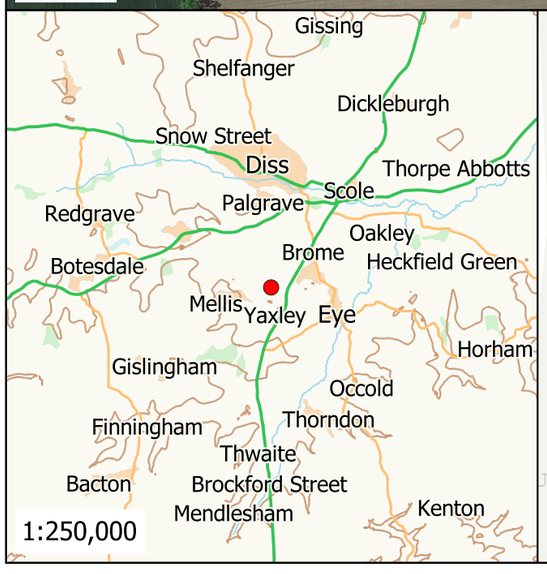
Limitations of this report

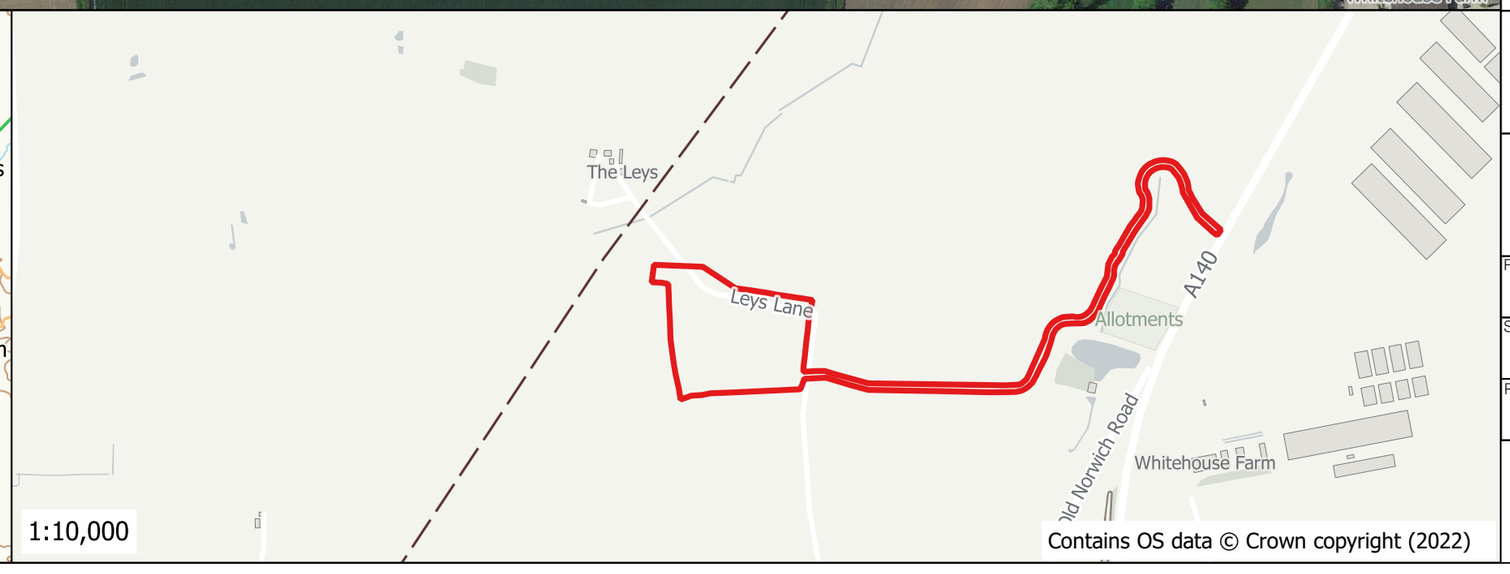
This report has been prepared by Ashfield Flood Risk Solutions Limited (Ashfield) for the sole benefit of the client.

This report has been prepared solely for the benefit of Conrad Energy Ltd (the "Client") and has not been assigned to any other third parties. If reliance on this report was required by a third party, this could be arranged for an agreed fee. This report should not be used by the client in relation to any other matters not covered specifically by the scope of the report. If this report does not contain a signature in the Document Control window, then this is an uncontrolled electronic copy and should not be relied upon by the client or any other recipient, as Ashfield cannot give assurances on the source or content of the document. Ashfield has used all reasonable skill, care and diligence in the preparation of this report.

The Flood Risk Assessment report has been designed to satisfy planning requirements, as outlined in Section 1. It is a desktop review of information provided by the client and from selected private and public databases. It only includes a site investigation where specifically referenced. This report does not make a detailed site-specific assessment of the suitability of the existing drainage on the Site. Ashfield accepts no responsibility for the accuracy or completeness of third-party data reviewed within this assessment.
This report is provided under Ashfield Solutions Limited Standard Terms and Conditions.

Drawings





Legend

- Site Boundary
- Site Location

Client

Conrad Energy Ltd

Project

Land of Leys Lane, Yaxley, Suffolk, IP23 8DX

Title

Site Location Plan

Report No.	Drawing No.	Revision
150522-F01	01	-
Scale	**Date**	**Frame Size**
As Shown	28/07/2022	A3
Produced By	**Drawn By**	**Approved By**
LC	LC	HF

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