JT Energy Storage, Land to the east of Dalzell Street near Woodend, CA24 3LF

Flood Risk Assessment and Drainage Strategy

For JT Energy Storage Ltd (Windel Energy)

KRS.0536.014.R.001.B

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Egremont BESS	
Project	Flood Risk Assessment and Drainage Strategy
Client	JT Energy Storage Ltd (Windel Energy)
Status	Final
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CONTENTS

TABLES & FIGURES

EXECUTIVE SUMMARY

The Site would be expected to remain dry in all but the most extreme conditions. The consequences of flooding are acceptable, and the development would be in accordance with the requirements of the National Planning Policy Framework (NPPF).

The Proposed Development would be operated with minimal risk from flooding, would not increase flood risk elsewhere and is compliant with the requirements of the NPPF. The Proposed Development will considerably reduce the flood risk posed to the Site and to off-site locations due to the adoption of a Sustainable Drainage Systems (SuDS) Strategy.

The Proposed Development should not therefore be precluded on the grounds of flood risk or drainage.

1.0 INTRODUCTION

1.1 Background

This Flood Risk Assessment and Drainage Strategy (FRA) has been prepared by KRS Enviro at the request of JT Energy Storage Ltd (Windel Energy) to support a planning application for the proposed Battery Energy Storage System (BESS) and associated infrastructure, landscaping and buried grid cable route ("the Proposed Development") on land to the east of Dalzell Street near Woodend, CA24 3LF ("the Site").

This FRA has been carried out in accordance with guidance contained in the National Planning Policy Framework (NPPF)[1], associated Planning Practice Guidance on flood risk and coastal change[2] (PPG) and the PPG 'Site-specific flood risk assessment checklist'. This FRA identifies and assesses the risks of all forms of flooding to and from the development and demonstrates how these flood risks will be managed so that the development remains safe throughout its lifetime, taking climate change into account.

It is recognised that developments which are designed without regard to flood risk may endanger lives, damage property, cause disruption to the wider community, damage the environment, be difficult to insure and require additional expenditure on remedial works. The development design should be such that future users will not have difficulty obtaining insurance or mortgage finance, or in selling all or part of the development, as a result of flood risk issues.

1.2 National Planning Policy Framework (NPPF)

One of the key aims of the NPPF is to ensure that flood risk is taken into account at all stages of the planning process; to avoid inappropriate development in areas at risk of flooding and to direct development away from areas of highest risk.

It advises that where new development is exceptionally necessary in areas of higher risk, this should be safe, without increasing flood risk elsewhere, and where possible, reduce flood risk overall. A risk-based approach is adopted at stages of the planning process, applying a source pathway receptor model to planning and flood risk. To demonstrate this, an FRA is required and should include:

- whether a Proposed Development is likely to be affected by current or future flooding from all sources;
- whether it will increase flood risk elsewhere;
- whether the measures proposed to deal with these effects and risks are appropriate;
- if necessary, provide the evidence to the Local Planning Authority (LPA) that the Sequential Test can be applied; and

[1] Ministry for Housing, Communities and Local Government (2024) National Planning Policy Framework: https://assets.publishing.service.gov.uk/media/67aafe8f3b41f783cca46251/NPPF_December_2024.pdf
[2] Communities and Local Government (2022) Planning Practice Guidance - Flood Risk and Coastal Change: https://www.gov.uk/guidance/flood-risk-and-coastal-change

- whether the development will be safe and pass part c) of the Exception Test if this is appropriate.

The report findings are based upon professional judgement and are summarised below with detailed recommendations provided at the end of the report. The report includes rainfall data from the Flood Estimation Handbook (FEH) and hydrogeological information from the British Geological Survey (BGS). The assessment will summarise and refer to these datasets in the text.

1.3 Report Structure

This FRA has the following report structure:

- Section 2 describes the location, its existing use and the Proposed Development;
- Section 3 outlines the flood risk posed to the existing use and Proposed Development;
- Section 4 details the proposed surface water drainage for the Site and assesses the potential impacts of the Proposed Development on surface water drainage;
- Section 5 details the sequential approach; and
- Section 6 presents a summary and conclusion.

2.0 LOCATION & DEVELOPMENT DESCRIPTION

2.1 Site Location

The Site is located on land to the east of Dalzell Street near Woodend, CA24 3LF (see Figure 1). The National Grid Reference (NGR) of the approximate centre of the Site is 300842, 513769. The larger settlements of Egremont, Cleator Moor and Whitehaven are all located within a 5km radius of the Site. The Lake District National Park boundary lies approximately 2.70km to the north-east. The Site is wholly located within the administrative boundary of Cumberland Council.

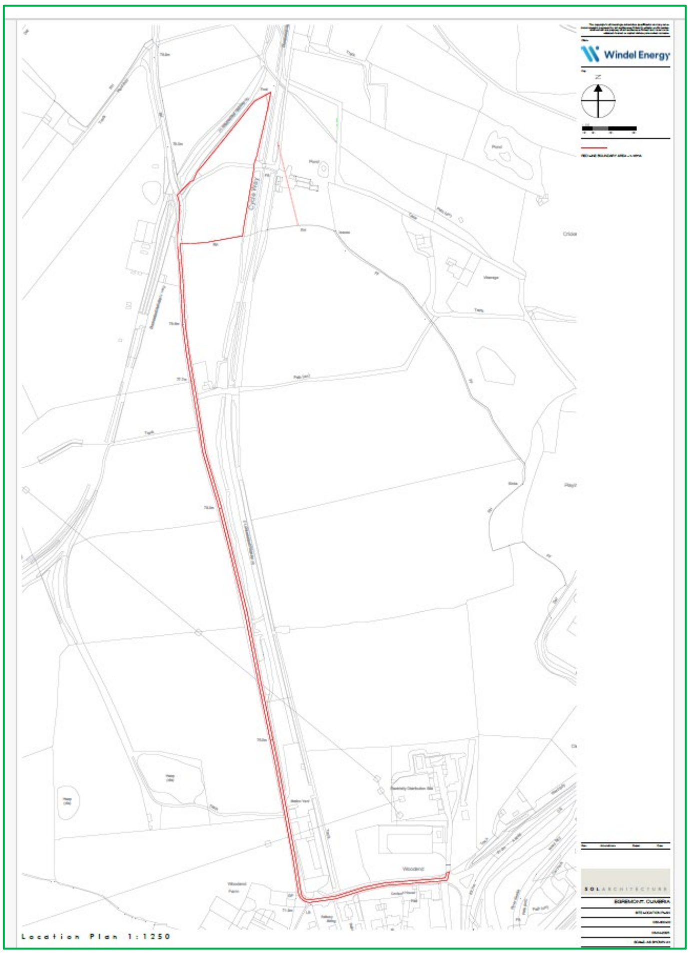


Figure 1 - Site Location

2.2 Existing Development

The Site comprises pasture land, which has most recently been used for the grazing of livestock. The Site is split across two fields, separated by an access track. The Site boundaries are demarcated by hedgerow and scattered trees.

2.3 Proposed Development

The Proposed Development is for a Battery Energy Storage System (BESS) and associated infrastructure, landscaping and buried grid cable route (see Appendix 1) and comprises the following key components along with associated ancillary infrastructure and equipment:

- 16 no. battery storage containers providing a total capacity of 30MW. Each BESS unit typically resembles a storage container, measuring 6.10m in length, 2.50m width and 2.90m in height.
- 8 no. inverter stations, measuring 6.10m in length, 2.50m in width and 2.90m in height
- Spare parts container, measuring 12.20m in length, 2.50m in width and 2.60m in height
- 2 Substations (note: the substations are positioned back to back, read as a single unit):
- Client substation: 7.50m length, 3.50m width and 3.30m in height
- DNO substation: 7.50m in length, 5.350m in width and 3.30m in height
- Access track comprised of crushed stone
- Fencing – 3m high palisade fence
- CCTV cameras
- Water tank: 10.45m depth and 3.90m in height
- Aux transformer: 4.70m in length, 3.80m in width and 2.40m in height
- Landscaping and biodiversity enhancements

The Site boundary including the underground cable route to the point of connection at Woodend substation measures 1.18 hectares) ha. The proposed cable route will follow Dalzell Street southwards to the point of connection at Woodend substation.

The Site area, excluding the cable route, wherein the Proposed Development will be located will be approximately 0.58ha. The Site area for the triangular field to the northern portion of the Site to be used for BNG purposes is 0.32ha.

Further details with regard to the Proposed Development can be found in the accompanying Planning, Design and Access Statement submitted with the planning application.

2.4 Ground Levels

A Topographical Survey has recently been undertaken (see Appendix 2). The Site falls from west to east with a maximum ground level of 76.47 metres Above Ordnance Datum (mAOD) to the western boundary and a minimum ground level of 70.58mAOD to the eastern boundary.

2.5 Catchment Hydrology/Drainage

There is a drainage ditch which runs along the southern boundary of the Site which ultimately discharges into the River Keekle. The River Keekle is located approximately 400m to the east of the Site and is a tributary of the River Ehen which is located approximately 812m to the southeast of the Site.

2.6 Ground Conditions

The British Geological Survey (BGS) map shows that the bedrock deposits consist of the Eskett Limestone Formation - limestone. Sedimentary bedrock formed between 343 and 328 million years ago during the Carboniferous period. The superficial deposits consist of Till, devensian - diamicton. Sedimentary superficial deposit formed between 116 and 11.80 thousand years ago during the Quaternary period.

Information from the National Soil Resources Institute details the Site area as being situated on slowly permeable seasonally wet acid loamy and clayey soils with impeded drainage.

2.7 Source Protection Zone

The Site is not located within a Source Protection Zone (SPZ). SPZ's have been defined by the Environment Agency around major public water supplies with the intent to show the risk of contamination from any activities that might cause pollution in the area. Three zones are defined: SPZ 1 is the Inner Zone (highest risk); SPZ 2 is the Outer Zone (average risk); and SPZ 3 is the Total Catchment (least risk).

2.8 Contaminated Land

KRS Enviro are not aware of any historical industrial land use and there is no information to suggest the potential for contamination within the Site boundary from past land uses.

3.0 FLOOD RISK

3.1 Sources of Flooding

All sources of flooding have been considered, these are; fluvial (river) flooding, tidal (coastal) flooding, groundwater flooding, surface water (pluvial) flooding, sewer flooding and flooding from artificial drainage systems/infrastructure failure.

3.2 Climate Change

Projections of future climate change, in the UK, indicate more frequent, short-duration, high intensity rainfall and more frequent periods of long duration rainfall. Guidance included within the NPPF recommends that the effects of climate change are incorporated into FRA's. Recommended precautionary sensitivity ranges for peak rainfall intensities and peak river flows are outlined in the flood risk assessments: climate change allowances guidance[3]. The Proposed Development is a temporary development of 40 years. As per Environment Agency guidance, the anticipated lifetime of the development is deemed to be 75 years.

Table 1 shows peak river flow allowances by river catchment. The flood risk assessments: climate change allowances guidance recommends that the central allowances are used. Therefore, the design flood event for the Site is the 1 in 100 year (+30%) event.

Table 1 - Peak River Flow Allowances

Catchment	Allowance Category	2020s	2050s	2080s
South West Lakes Management Catchment	Upper	+22%	+38%	+63%
	Higher	+14%	+23%	+39%
	Central	+12%	+17%	+30%

3.3 Environment Agency Flood Zones

A review of the Environment Agency's Flood Zones indicates that the Site is located within Flood Zone 1 and therefore has a 'low probability' of flooding as shown in Figure 2, with less than a 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).

The Flood Zones are the current best information on the extent of the extremes of flooding from rivers or the sea that would occur without the presence of flood defences, because these

[3] https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#high-allowances

can be breached, overtopped and may not be in existence for the lifetime of the development. They show the worst-case scenario.

The Environment Agency Flood Zones and acceptable development types are explained in Table 2. Table 2 shows that all development types are generally acceptable in Flood Zone 1.

Figure 2 - Environment Agency Flood Zones

Table 2 - Environment Agency Flood Zones and Appropriate Land Use

Flood Zone	Probability	Explanation	Appropriate Land Use
Zone 1	Low	Less than a 1 in 1000 annual probability of river or sea flooding in any year (<0.1%)	All development types generally acceptable
Zone 2	Medium	Between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% 0.1%) in any year	Most development type are generally acceptable
Zone 3a	High	A 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year	Some development types not acceptable
Zone 3b	'Functional Floodplain'	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	Some development types not acceptable

		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)	

3.4 Flood Vulnerability

In the PPG, appropriate uses have been identified for the Flood Zones. Applying the Flood Risk Vulnerability Classification in the PPG, the proposed use is classified as 'essential infrastructure'. Table 3 of this report and the PPG states that 'essential infrastructure' uses are appropriate within Flood Zone 1 after the completion of a satisfactory FRA.

Table 3 - Flood Risk Vulnerability and Flood Zone 'Compatibility'

Flood Risk Vulnerability Classification	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	✓	Exception test required	✓	✓
Zone 3a	Exception test required	✓	×	Exception test required	✓
Zone 3b 'Functional Floodplain'	Exception test required	✓	×	×	×

Key: *✓ : Development is appropriate, × : Development should not be permitted.*

3.5 Historic Flooding

Environment Agency data shows that the Site has not historically flooded. There are no records of anecdotal information of flooding at the Site including within the British Hydrological Society "Chronology of British Hydrological Events". No other historical records of flooding for the Site have been recorded. Therefore, it has been concluded that the Site has not flooded within the recent past.

3.6 Existing and Planned Flood Defence Measures

Environment Agency data confirms that the Site is not protected against flooding by existing flood defence measures.

3.7 Fluvial (River) Flooding

The Site will not be inundated with floodwater for all events up to and including the 1 in 100 year (+30%) and 1 in 1000 year events. The Site will be flood free during the 1 in 100 year (+30%) and 1 in 1000 year events. The Site is not located within the vicinity of fluvial flooding sources and the risk of fluvial flooding is considered to be not significant.

3.8 Tidal (Coastal) Flooding

The Site is not located within the vicinity of tidal flooding sources and the risk of tidal flooding is considered to be **not significant.**

3.9 Groundwater Flooding

Groundwater flooding is defined as the emergence of groundwater at the ground surface or the rising of groundwater into man-made ground under conditions where the normal range of groundwater levels is exceeded.

Groundwater flooding tends to occur sporadically in both location and time. When groundwater flooding does occur, it tends to mostly affect low-lying areas, below surface infrastructure and buildings (for example, tunnels, basements and car parks) underlain by permeable rocks (aquifers). The Environment Agency data shows that flooding from groundwater is unlikely in this area. Site ground conditions suggest a low potential for groundwater flooding. The risk of flooding from groundwater flooding is considered to be **not significant.**

3.10 Surface Water (Pluvial) Flooding

The Site is not situated near to large areas of poor permeability or areas with the geology and/or topography which may result in surface water flooding. The Site surroundings are relatively flat and there are no large catchments that would tend to generate surface water runoff towards the Site. Surface water flow flooding tends to occur sporadically in both location and time such surface water flows would tend to be confined to the streets around the development.

The Environment Agency Surface Water flood map shows that the majority of the Site has a very low risk of flooding with a chance of flooding of 1 in 1000 years (0.1%) during the present day (see Figure 3) and when climate change is taken into account between 2040 and 2060 (see Figure 4). A very small proportion of the Site, on the east of the main BESS Site and a small proportion of the proposed buried grid cable route, has a low to high risk of flooding with a chance of flooding of 1 in 1000 years (0.1%) to less than 1 in 30 years (3.3%) during the present day and when climate change is taken into account between 2040 and 2060. The built development will be located outside of the high risk areas of surface water flooding.

The flood risk from surface water is of a minor nature with low water depths and velocities being experienced. Therefore, the risk of flooding from surface water flooding is considered to be of **low significance.**

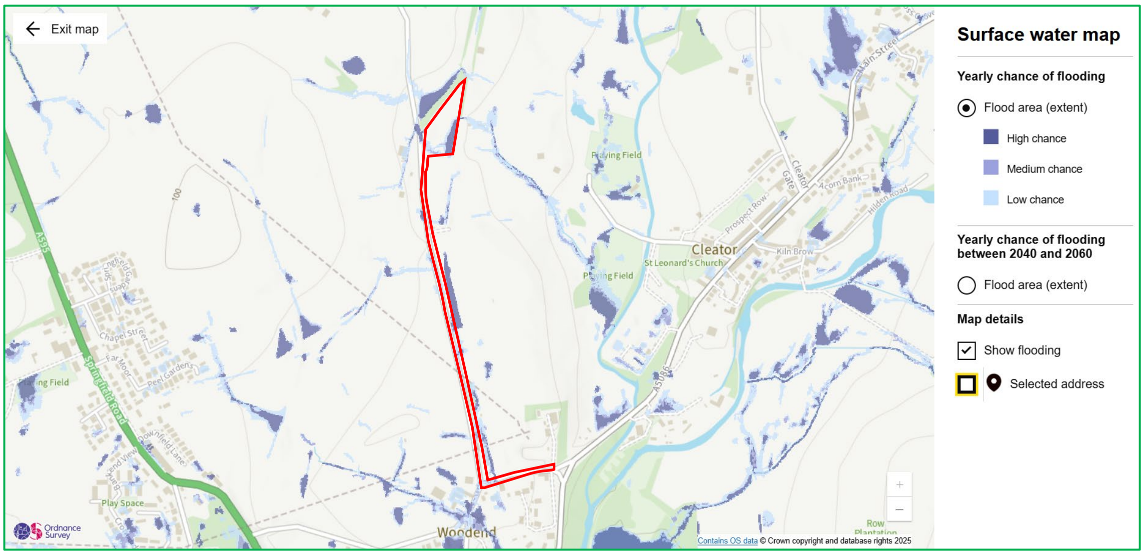


Figure 3 - Environment Agency Surface Water Flood Map: Present Day

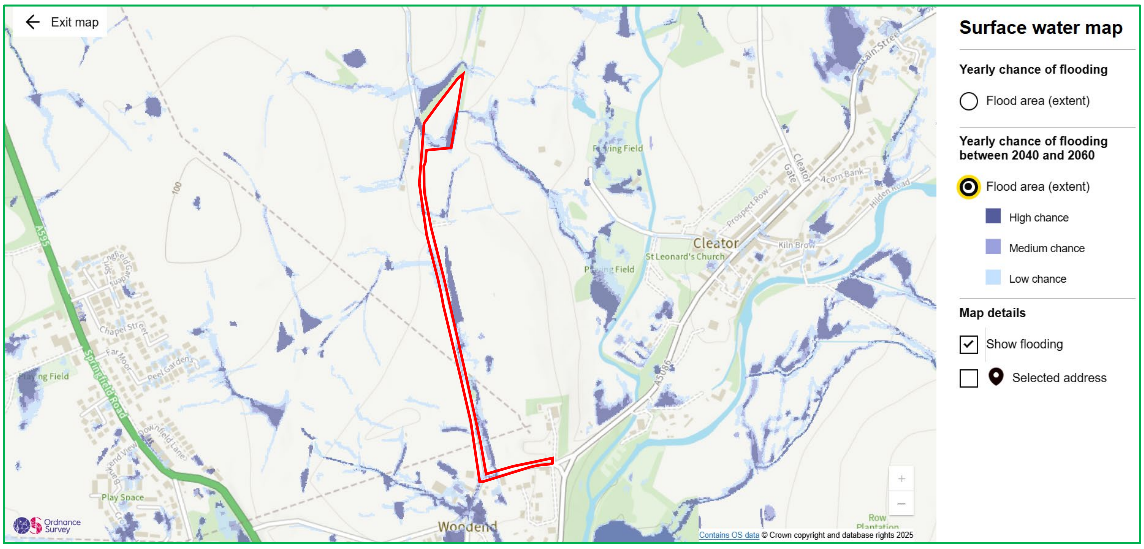


Figure 4 - Environment Agency Surface Water Flood Map: Climate Change Between 2040 and 2060

3.11 Sewer Flooding

Sewer flooding occurs when urban drainage networks become overwhelmed and maximum capacity is reached. This can occur if there is a blockage in the network causing water to back up behind it or if the sheer volume of water draining into the system is too great to be handled. Sewer flooding tends to occur sporadically in both location and time such flood flows would tend to be confined to the streets around the development. Flood flows could also be generated by burst water mains, but these would tend to be of a restricted and much lower volume than weather generated events and so can be discounted for the purposes of this assessment. It is understood that there are no public sewers located within the vicinity of the Site therefore, the risk of flooding from sewer flooding is considered to be **not significant.**

3.12 Flooding from Artificial Drainage Systems/Infrastructure Failure

There are no other nearby artificial water bodies, reservoirs, water channels and artificial drainage systems that could be considered a flood risk to the Site. The Environment Agency Reservoir flood map shows that the Site is not at risk of flooding from reservoir failure (see Figure 5). This map shows the largest area that might be flooded if a reservoir were to fail and release the water it holds. The risk of flooding from artificial drainage systems/infrastructure failure is considered to be **not significant.**

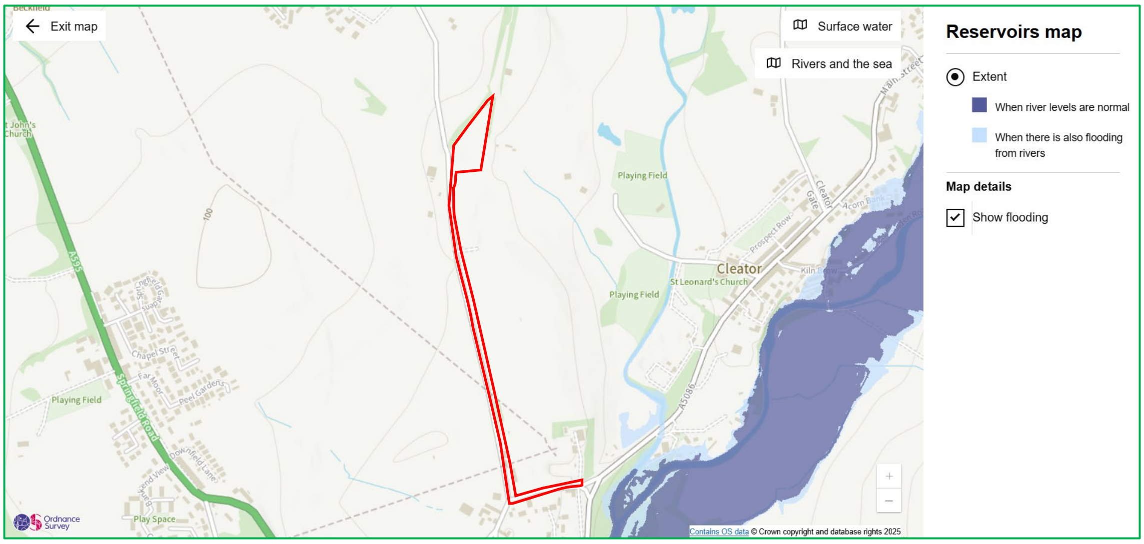


Figure 5 - Environment Agency Reservoir Flood Map

3.13 The Effect of the Development on Flood Risk

The main BESS Site is located within Flood Zone 1 therefore, the Proposed Development will have no impact on flood risk and the overall direction of the movement of water will be maintained within the developed Site and surrounding area. There will no net loss in flood storage capacity. The conveyance routes (flow paths) will not be blocked or obstructed. The topography of the Site will not be altered; therefore, the overland flow routes will not be altered.

3.14 Summary of Site Specific Flood Risk

A summary of the sources of flooding and a review of the risk posed by each source at the Site is shown in Table 4.

The Site is not at risk of flooding from a major source (e.g. fluvial and/or tidal). The Site has a 'low probability' of fluvial/tidal flooding as the Site is located within Flood Zone 1 with less than a 1 in 1000 annual probability of river or sea flooding in any year (<0.1%). A secondary flooding source has been identified which may pose a **low significant** risk to the Site. This is:

- Surface Water Flooding

There will no net loss in flood storage capacity or impact on movement of floodwater across the Site. The overall direction of the movement of water will be maintained within the developed Site and surrounding area. The conveyance routes (flow paths) will not be blocked or obstructed.

The proposed use of the Site is 'essential infrastructure', 'essential infrastructure' uses are appropriate within Flood Zone 1 after the completion of a satisfactory FRA. In conclusion, the flood risk to the Site can be considered to be limited; the Site is situated in Flood Zone 1, with a low or very low annual probability of flooding and from all sources. The Site is unlikely to flood except in very extreme conditions.

Table 4 - Risk Posed by Flooding Sources

Sources of Flooding	Potential Flood Risk	Potential Source	Probability/Significance
Fluvial Flooding	No	None Reported	None
Tidal Flooding	No	None Reported	None
Groundwater Flooding	No	None Reported	None
Surface Water Flooding	Yes	Poor Permeability	Low
Sewer Flooding	No	None Reported	None
Flooding from Artificial Drainage Systems/Infrastructure Failure	No	None Reported	None

4.0 SURFACE WATER DRAINAGE

4.1 Surface Water Management Overview

It is recognised that consideration of flood issues should not be confined to the floodplain. The alteration of natural surface water flow patterns through developments can lead to problems elsewhere in the catchment, particularly flooding downstream. For example, replacing vegetated areas with roofs, roads and other paved areas can increase both the total and the peak flow of surface water runoff from the Site. Changes of land use on previously developed land can also have significant downstream impacts where the existing drainage system may not have sufficient capacity for the additional drainage.

An assessment of the surface water runoff rates has been undertaken, in order to determine the surface water options and attenuation requirements for the Site. The assessment considers the impact of the proposals compared to current conditions. Therefore, the surface water attenuation requirement for the developed Site can be determined and reviewed against existing arrangements.

The requirement for managing surface water runoff from developments depends on the pre-developed nature of the Site. If it is an undeveloped Greenfield site, then the impact of the proposals will need to be mitigated so that the runoff from the Site replicates the natural drainage characteristics of the pre-developed site. The surface water drainage arrangements for any site should be such that the volumes and peak flow rates of surface water leaving a site are no greater than the rates prior to the Proposed Development unless specific off-site arrangements are made and result in the same net effect.

It should be acknowledged that the satisfactory collection, control and discharge of surface water runoff are now a principle planning and design consideration. This is reflected in implemented guidance and the National Sustainable Drainage Systems (SuDS) Standards. It is necessary to demonstrate that the surface water from the proposals can be discharged safety and sustainably.

4.2 Climate Change

Projections of future climate change in the UK indicate more frequent, short-duration, high intensity rainfall and more frequent periods of long duration rainfall. Guidance included within the NPPF (see Section 14) recommends that the effects of climate change are incorporated into FRA's. Recommended precautionary sensitivity ranges for peak rainfall intensities and peak river flows are outlined in the flood risk assessments: climate change allowances guidance[4].

The recommended national precautionary sensitivity range for peak rainfall intensity are summarised in Table 5 for the 1 in 100 year event. The proposals will take into account a 45% increase in rainfall intensity due to climate change for the 1 in 100 year event.

Table 5 - Peak Rainfall Intensity Allowances

Parameter	2050s	2070s
Upper End	+40%	+45%
Central	+25%	+35%

4.3 Opportunities to Discharge Water

Possible receptors for runoff generated onsite have been assessed in line with the prioritisation set out in the Defra non-statutory technical standards for SuDS. There are four possible options to discharge the surface water. The Runoff Destination is (in order of preference):

a) To ground;

b) To surface water body;

c) To road drain or surface water sewer;

d) To combined sewer

It is necessary to identify the most appropriate method of controlling and discharging surface water. The design should seek to improve the local runoff profile by using systems that can either attenuate runoff and reduce peak flow rates or positively impact on the existing surface water runoff.

4.3.1 Discharge to Ground

In determining the future surface runoff from the Site, the potential of using infiltration has been considered. An overview of the general ground conditions may be used to gauge if there is potential for their application.

As detailed previously, information from the National Soil Resources Institute details the Site area as being situated on slowly permeable seasonally wet acid loamy and clayey soils with impeded drainage. Therefore, the ground conditions suggest infiltration would provide inception storage, but disposal of significant volumes of runoff may not be appropriate.

Whilst the permeability and infiltration rate of the Site would be confirmed by a site investigation into the hydrogeology prior to construction, the ground conditions suggest infiltration would not provide a suitable option at the Site for surface water discharge.

[4] https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#high-allowances

4.3.2 Discharge to Surface Water Body

Should infiltration be found to be unsuitable, the next option is discharge to a surface waterbody. There are a number of unnamed watercourses/drainage ditches evident either on, or within the near vicinity of the Site.

There is a drainage ditch located along the southern boundary of the Site which ultimately discharges into the River Keekle. Therefore, it would be possible to discharge surface water runoff from the Site into a watercourse. This is the preferred option for the discharge of surface water runoff from the Site.

4.3.3 Discharge to Road Drain or Surface Water Sewer

There are no public sewers located within the vicinity of the Site therefore, it would not be possible to discharge to the public sewers. However, this option is not required as surface water runoff will be discharged via a watercourse.

4.3.4 Discharge to Combined Sewer

There are no public sewers located within the vicinity of the Site therefore, it would not be possible to discharge to the public sewers. However, this option is not required as surface water runoff will be discharged via a watercourse.

4.3.5 Summary

For the purposes of this assessment the most likely scenario of discharging surface water runoff to a nearby watercourse/drainage ditch with attenuation and a restricted runoff rate is proposed. This option is the preferred option for the discharge of surface water runoff from the Site. The ground conditions suggest infiltration would provide inception storage, but disposal of significant volumes of runoff may not be appropriate.

The various drainage options would be explored further at the detailed design stage and it is suggested that a suitably worded planning condition requiring the detailed drainage proposals to be submitted and approved is included in any permission.

4.4 Surface Water Runoff

Currently the majority of rainfall infiltrates into the soil substrate and/or runoff from the Site. It is proposed that the Site will be surfaced with grass, crushed permeable stone and compacted impermeable stone or similar. The proposed impermeable area will total approximately 1,375m^2 comprised of the control room, switch room, sub-station, battery containers and invertors/transformers. All the plant/machinery will sit on concrete plinths. The access tracks will be constructed of a permeable surface e.g. MOT type 2 crushed stone and the gaps in between battery units etc. will remain as grass or otherwise be a permeable surface.

An estimation of surface water runoff is required to permit effective site surface water management and prevent any increase in flood risk to off-site receptors. In accordance with The SuDS Manual, the Greenfield runoff from the Site has been calculated using the Institute of Hydrology 124 (IoH124) method[5]. Table 6 shows the IoH124 method Greenfield runoff

[5] Institute of Hydrology, Flood Estimation of Small Catchments, June 1994.

rates calculated for the proposed impermeable area of 1,375m^2. The mean annual maximum flow rate from a Greenfield site (QBAR: approximately a 2.30 year return period) has been calculated to be 1.00litres/second (l/s) (see Appendix 3).

Table 6 - IoH124 Method Greenfield Runoff Rates

Rainfall Event	Runoff Rate (I/s)
1	0.90
QBAR (rural)	1.00
30	1.70
100	2.10

The method used for calculating the runoff complies with the NPPF, as well as the new Defra non-statutory technical standards for SuDS, and assumes that the excess runoff associated with the Proposed Development (plus an allowance for future climate change) will need to be managed by the proposed SuDS scheme.

4.5 SuDS Strategy

One of the aims of the NPPF is to provide not only flood risk mitigation but also to maximise additional gains such as improvements in runoff quality and provision of amenity and biodiversity. Systems incorporating these features are often termed SuDS and it is the requirement of NPPF that these are considered as the primary means of collection, control and disposal for storm water as close to source as possible.

The objective of this SuDS Strategy is to ensure that a sustainable drainage solution can be achieved which reduces the peak discharge rate to manage and reduce the flood risk posed by the surface water runoff from the Site. The SuDS Strategy takes into account the following principles:

- No increase in the volume or runoff rate of surface water runoff from the Site.
- No increase in flooding to people or property off-site as a result of the Proposed Development.
- No surface water flooding of the Site.
- The proposals take into account a 45% increase in rainfall intensity due to climate change during the lifetime of the development.

In line with adopting a 'management train' it is recommended that water is managed as close to source as possible. This will reduce the size and cost of infrastructure further downstream and also shares the maintenance burden more equitably. The Outline SuDS Strategy will take the form of:

- Permeable surfaces - crushed stone.
- Filter drains for conveyance.
- Surface water attenuation storage in the form of underground crate system attenuation tank.

- Runoff rates would be restricted to the Greenfield Runoff Rate of 1.00l/s to the drainage ditch to the south east of the Site.

The principle applied in the design of storage is to limit the discharge rate of surface water runoff from the developed site for events of similar frequency of occurrence to the same peak rate of runoff as that which takes place from a Greenfield site prior to development. It would not be practical to include a pond, or lagoon within the Site. It would also not be sustainable to install a green roof on the buildings/structures.

The equipment will sit on concrete rafts, the apron in front of the equipment will be constructed from compacted impermeable surfaces. These areas, where possible, will be constructed to shed water to any adjacent permeable areas. The rest of the Site will be constructed from free draining stone or grass which will allow infiltration of rainfall.

The free draining stone will have a sufficient void ratio of 30% and permeability of granular fill to allow adequate percolation and to control the risk of blockage (examples include coarse aggregate 4-40mm (4/40), 4-20mm (4/20) as defined in BS 753313:2009 or Type 3 sub-base 0-40mm (0/40)). A permeable/open-graded (reduced fines) sub-base layer (i.e. Type 3 with a void ratio of 30%) will be used as a drainage layer below the permeable surfaces which will be sufficiently permeable to allow water to drain through and to store water temporarily. The selected gravel fill and bedding would be clean, free-draining, angular shaped material in the specified size range.

Infiltration capacities of free draining stone are significantly greater than the design rainfall intensities and are not a limiting factor. A minimum value of 2500mm/hr is considered reasonable within The SuDS Manual (see Section 20.5.1 of the SuDS Manual). These are SuDS source control compliant and will as a minimum provide storage for the first 5mm (interception storage). Permeable surfaces, together with their associated substructures, are an efficient means of managing surface water runoff close to its source – intercepting runoff, reducing the volume and frequency of runoff, and providing a treatment medium. These systems encourage biological treatment of flow and extraction of oils and heavy metals from the runoff. Treatment processes that occur within the surface structure and the geotextile layers include:

- Filtration
- Absorption
- Biodegradation
- Sedimentation

It will also assist in reducing the flood profile of the Site by significantly attenuating the runoff from the proposed development within the sub-base material. It is also proposed that an underground crate system attenuation tank will be used to provide the required attenuation storage volume for the impermeable areas consisting of the equipment and roadways within the Site. Additional storage would be provided within the manholes and pipes which will provide betterment over and above the 1 in 100 year (+45%) event.

QBAR has been calculated to be 1.00l/s. Therefore, a value of 1.00l/s has been used as the limiting discharge rate before discharge into the drainage ditch. Appendix 4 shows the volume of storage required for the proposed development estimated within the Microdrainage software for the 1 in 100 year event, with a 45% allowance for climate change (increase in peak rainfall) with 1.00l/s used as the limiting discharge rate before discharge off the Site. The volume of attenuation storage required for these parameters will be $123m^3$.

This SuDS Strategy will reduce peak flows, the volume of runoff, and slow down flows and will provide a suitable SuDS solution for this Site. The adoption of a SuDS Strategy for the Site represents an enhancement from the current conditions as the current surface water runoff from the Site is uncontrolled, untreated, unmanaged and unmitigated. In adopting these principles, it has been demonstrated that a scheme can be developed that does not increase the risk of flooding to adjacent properties and development further downstream.

4.6 Designing for Local Drainage System Failure/Exceedance Events

When considering residual risk, it is necessary to make predictions as to the impacts of a storm event that exceeds the design event, or the impact of a failure of the local drainage system. The SuDS Strategy applies a safe and sustainable approach to discharging rainfall runoff from the Site and this reduces the risk of flooding however, it is not possible to completely remove the risk.

As part of the SuDS Strategy it must be demonstrated that the flooding of property would not occur in the event of local drainage system failure and/or design exceedance. It is not economically viable or sustainable to build a drainage system that can accommodate the most extreme events. Consequently, the capacity of the drainage system may be exceeded on rare occasions, with excess water flowing above ground. However, this is considered unlikely in the immediate future due to the 45% allowance for climate change used in the calculations.

The design of the Proposed Development provides an opportunity to manage this local drainage system failure/exceedance flow and ensure that indiscriminate flooding of property does not occur. There will not be an extensive sewerage network on the Proposed Development and therefore any potential exceedance flooding would be from the sewers and lateral drains connecting the impermeable areas to the storage areas. It is very unlikely that a catastrophic failure would occur. An exceedance or blockage event of the sewers would not affect the proposed structures/equipment because the finished floor level will be raised above surrounding ground levels, ensuring any exceedance flooding would not affect the buildings/structures. Exceedance flows would be contained within the permeable areas within the Site and would flow to the lower ground levels. It is not considered that there is an increased risk to the Site or properties located adjacent to the Site.

Surface water runoff would be directed to the drainage system through filter drains located around the perimeter of the structures and through contouring of the hardstanding areas. When considering the impacts of a storm event that exceeds the design event, there is safety factor, even under the design event conditions. Consequently, if this event were to be exceeded there is additional capacity with the system to accommodate this (i.e. within the manholes, pipes etc.). If this freeboard was to be exceeded the consequences would be similar, if not less than for the local drainage system failure. Consequently, the impact of an exceedance event is not considered to represent any significant flood hazard. The above manages and mitigates the flood risk from surface water runoff to the adjacent premises and site infrastructure from surface water runoff generated by the Proposed Development.

4.7 Intercepting and Collecting Fire Water

Given the nature of the energy storage within the Proposed Development, there is a potential risk of fire which may negatively affect upon the local water environment by mobilising pollution within surface water runoff, ultimately discharging to the nearby watercourses or infiltrating to ground.

The National Fire Chiefs Council (NFCC) guidance states "*as a minimum, it is recommended that hydrant supplies for boundary cooling purpose…..should be capable of delivering no less than 1,900 litres per minute for at least 2 hours*." Therefore, management systems to deal with contaminated water in the event of fire-fighting operations at the Site have been included within the SuDS design. It is proposed that in the event of a fire at the Site, the runoff from the energy storage area will be contained by a brick firewall/earth bund constructed alongside the fencing to the eastern and southern boundaries of the Site and attenuated within the Site prior to being passed forward to discharge from the Site. The natural slope of the Site to the south would be worked into the finished Site levels so that surface waters would run south east and therefore the firewater would be retained by this wall/bund.

In the event of a fire, an automated penstock pollution containment device will be activated to isolate the system drainage. The firewater should then be tested on Site and either treated and released or tankered off-site as necessary. The permeable areas will be lined with an impermeable geotextile.

The various options for fire water containment would be explored further at the detailed design stage and it is suggested that a suitably worded planning condition requiring the proposals to be submitted and approved is included in any permission.

4.8 SuDS and Water Quality

According to the SuDS Standards (see Table 7), the proposed development is a medium hazard (runoff from commercial, industrial uses including car parking spaces and roads).

Table 7 - Level of hazard

Hazard	Source of Hazard
Low	Roof drainage
Medium	Residential, amenity, commercial, industrial uses including car parking spaces and roads
High	Areas used for handling and storage or chemicals and fuels, handling of storage and waste (incl. scrap-yards)

The proposed development has a 'low' pollution hazard level (other roofs and low traffic roads) (see Table 8), as per Table 26.2 of the SuDS Manual.

Table 8 - Pollution Hazard Indices

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Other roofs (typically commercial/industrial roofs)	Low	0.30	0.20	0.05
Individual property driveways, residential car parks, low traffic roads (e.g. cul de sacs, homezones, and general access roads), and non-residential car parking with infrequent change (e.g. schools, offices) i.e. < 300 traffic movements/day	Low	0.50	0.40	0.40

* Indices values range from 0-1.

Conveyance through the permeable areas and the inclusion of filter drains will provide sufficient pollution mitigation. Table 9 shows the indicative SuDS pollution hazard indices as per Tables 26.3 and 26.4 the SuDS Manual. It is therefore considered that adequate water quality treatment can be provided via SuDS components**.** The design of the system will allow any silt and debris from the development an opportunity to settle.

Table 9 - SuDS Mitigation Indices for Discharges to Surface Water

SuDS Component	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Filter Drains	0.40	0.40	0.40
Permeable Areas	0.35*	0.30*	0.35*
Total	**0.75**	**0.70**	**0.75**

* A factor of 0.5 is used to account for the reduced performance of secondary and tertiary components associated with already reduced inflow concentrations

4.9 Surface Water Management During Construction

The below information provides detail on Site drainage during the Construction Phase to include how pollution / silt mitigation measures will be implemented to protect these features during construction. These measures will reduce the potential for vehicle movement on wet ground, which can increase the potential for compaction. In summary, the Pollution Prevention Guidance[6] (PPG) and Government guidance[7] will be referred to and the following methods of surface water management will be put in place during the construction phase to ensure pollution, sediment and erosion control.

[6] Pollution Prevention Guidelines PPG1: Understanding Your Environmental Responsibilities (July 2013).
Pollution Prevention Guidelines PPG6: Working at construction and demolition sites (March 2012).
Pollution Prevention Guidelines PPG7: The safe operation of refuelling facilities (July 2011).
Pollution Prevention Guidelines PPG8: Safe storage and disposal of used oils (February 2004).
Pollution Prevention Guidelines PPG13: Vehicle washing and cleaning (July 2007).
Pollution Prevention Guidelines PPG21: Incident Response Planning (March 2009).
Pollution Prevention Guidelines PPG22: Dealing with spills (April 2011).
[7] https://www.gov.uk/guidance/storing-oil-at-a-home-or-business, May 2015.
https://www.gov.uk/guidance/manage-waste-on-land-guidance-for-land-managers, May 2014.

Excavated Ground and Exposed Ground

To limit the volume of runoff reaching the exposed ground, runoff diversion and interception devices will be placed upstream of exposed ground. To help control sediment in runoff from leaving the Site or entering drainage, silt bunds will be placed downstream of exposed ground to intercept runoff.

Stockpiles

Soil stockpiles will be located away from any Site drainage systems and measures to intercept runoff will be incorporated, such as small perimeter bunds around the base of the stockpiles. Concrete should also be stored to prevent release into drains.

Oils and Hydrocarbons

Simple measures will be taken to prevent oil and hydrocarbons becoming pollutants, such as:

- Maintenance of machinery and plant.
- Drip trays.
- Regular checking of machinery and plant for oil leaks.
- Correct storage facilities.
- Check for signs of wear and tear on tanks.
- Care with specific procedures when refuelling.
- Designated areas for refuelling.
- Emergency spill kit located near refuelling area.
- Regular emptying of bunds.
- Tanks located in secure areas to stop vandalism.

The pollution, sediment and erosion control mitigation measures as detailed above will ensure that the effects on receptors and SuDS components during the construction phase are negligible.

5.0 SEQUENTIAL APPROACH

5.1 Sequential Test

The risk-based Sequential Test in accordance with the NPPF aims to steer new development to areas at the lowest probability of flooding from all sources. NPPF states that developments located within Flood Zones 2 and 3 should apply a risk based sequential test in order to steer the proposed development towards areas classed as having a lower probability of flooding. The NPPF does, however, acknowledge that under certain circumstances it may not be possible to locate the development on land identified as having a lower risk of flooding (Flood Zone 1) but the benefits of the development should be clearly stated.

The Mead/Redrow Judgement[8] provides useful guidance with regards to the Sequential Test and confirms that a failure to satisfy the Sequential Test does not preclude granting planning permission; it is only one consideration in the overall planning balance.

Paragraphs 172 to 174 of the NPPF deals with the Sequential Test and state that:

"All plans should apply a sequential, risk-based approach to the location of development – taking into account all sources of flood risk and the current and future impacts of climate change – so as to avoid, where possible, flood risk to people and property. They should do this, and manage any residual risk, by:

a) applying the sequential test and then, if necessary, the exception test as set out below;

b) safeguarding land from development that is required, or likely to be required, for current or future flood management;

c) using opportunities provided by new development and improvements in green and other infrastructure to reduce the causes and impacts of flooding, (making as much use as possible of natural flood management techniques as part of an integrated approach to flood risk management); and

d) where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking opportunities to relocate development, including housing, to more sustainable locations."

A sequential risk-based approach should also be taken to individual applications in areas known to be at risk now or in future from any form of flooding, by following the steps set out below.

Within this context the aim of the sequential test is to steer new development to areas with the lowest risk of flooding from any source. 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 strategic flood risk assessment will provide the basis for applying this test.

Specifically paragraph 175 of the NPPF states:

"The sequential test should be used in areas known to be at risk now or in the future from any form of flooding, except in situations where a site-specific flood risk assessment demonstrates that no built development within the site boundary, including access or escape routes, land raising or other potentially vulnerable elements, would be located on an area that would be at risk of flooding from any source, now and in the future (having regard to potential changes in flood risk)."

[8] https://assets.publishing.service.gov.uk/media/66012fd165ca2fc1fa7da734/9_Mead_Realisations_Limited_v_Secretary_of_State_for_Levelling_Up__Housing_and_Communities__2024__EWHC_279__Admin_.pdf

Paragraph 34 of the PPG states:

"It is for local planning authorities, taking advice from the Environment Agency as appropriate, to consider the extent to which Sequential Test considerations have been satisfied, taking into account the particular circumstances in any given case."

Paragraph 33 of the PPG is clear that when applying the Sequential Test for individual applications *"…a pragmatic approach on the availability of alternatives should be taken."* A pragmatic approach has been taken within this Sequential Test.

A criteria based approach to Site selection has been undertaken, an important aspect of BESS development is having access to the local distribution network, or 'grid'. If there is insufficient capacity or the distribution network infrastructure is substandard the network will fail.

As part of the grid application process, the distribution network operator (DNO) provides a point of connection on the network or grid where the power from BESS must connect. It is important that these developments are close to the point of connection, due to:

- Excessive costs of the cable and the trenching works;
- Requirement for easements to enable the crossing of third-party land, and necessary works in the highway which may disrupt local communities; and
- Voltage drops and unwanted energy losses resulting from long cable runs which cause further difficulties for the distribution network operators.

The industry-standard approach is to secure sites within 3.50km of a grid connection. Consideration of land closer to the point of connection has been given but discounted as there are significant areas of higher flood risk, proximity to built-up areas and limited availability of landowners willing to lease their land.

The Site proposals remain consistent with the relevant planning policies and are not at odds with the current use of the Site and can only enhance and preserve the employment/power generating base which currently exists. The wider area surrounding the Site is affected by a very similar, and in many cases, higher risk of flooding.

Similar developments on any Site outside a Flood Zone will not offer any advantage vis-a-vis flooding. Consequently, application of the Sequential Test demonstrates that there is no measurable advantage to constructing the Proposed Development elsewhere. The Site needs to be situated at this location to enable a connection to the electricity power network .

The Council's objectives are to sustain and enhance the vitality and viability of the region, and improving the overall quality of life. This is underpinned by the quality of the physical environment, social well-being and economic and environmental improvements. The Council seeks to grant permission for developments that add to the vitality and viability of the region. This Site will help to regenerate the region and will help to deliver these objectives. This Site will help encourage economic impetus.

The Proposed Development can only be delivered where Site conditions are favourable, and a series of criteria are satisfied. These can be summarised as follows:

- The Proposed Development must be located close to a point of connection that has capacity to both export and import the requisite amount of electrical energy. Pressure on the grid results in significant constraints on the availability of sites (UK wide) which can import and export energy from the grid and have sufficient grid connection capacity. In essence, whilst there are a reasonable number of connection points that can export power, the number that can import power is particularly limited.

- The Proposed Development must be located proximate to the point of connection (i.e. cable or existing substation) to minimise transmission losses. As BESSs both export and import energy from / to the grid, transmission losses occur during both the import and export phases, therefore doubling the impact of any losses that occur.
- Finally, the Proposed Development can only be delivered where there is land available for purchase / lease for the development, at reasonable and acceptable commercial terms.

With regard to the above, and other planning considerations, the nearby substation has capacity to accommodate the Proposed Development. Furthermore, the Proposed Development is located on land that is commercially available for development, should planning permission be granted.

No 'reasonably available' alternative sites have been identified within the Site selection process. From the above it is shown that there are overriding sustainability reasons for the development to be granted planning permission. The development proposals should therefore be considered by the LPA to satisfy the Sequential Test as set out in the NPPF.

5.2 Exception Test

Table 3 of this report and the PPG state that 'essential infrastructure' uses within Flood Zone 1 do not require the Exception Test to be passed. The development proposals should therefore be considered by the LPA to satisfy the Exception Test as set out in the NPPF.

6.0 SUMMARY

6.1 Conclusions

In conclusion, the Site would be expected to remain dry in all but the most extreme conditions. The consequences of flooding are acceptable, and the development would be in accordance with the requirements of the NPPF.

The Proposed Development would be operated with minimal risk from flooding, would not increase flood risk elsewhere and is compliant with the requirements of the NPPF. The Proposed Development will considerably reduce the flood risk posed to the Site and to off-Site locations due to the adoption of a SuDS Strategy.

The Proposed Development should not therefore be precluded on the grounds of flood risk or drainage.

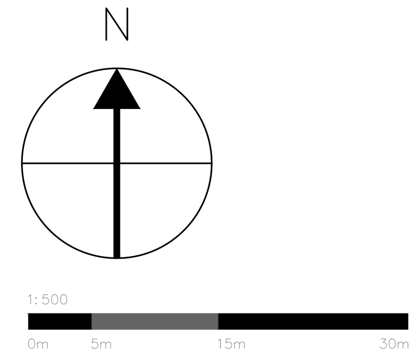
APPENDICES

Layout Plan 1:500

Client

Windel Energy

Key



RED LINE BOUNDARY AREA - 1.18HA

LANDSCAPE BUFFER

PROPOSED ACCESS TRACK

Rev.	Amendment	Drawn	Date
05.	Annotations added	JL	13.05.25
04.	Gate / entrance track updated	JL	01.05.25
03.	Equipment re-position	JL	16.04.25
02.	Equipment re-position	JL	11.04.25
01.	Flood zone / DNO position	JL	10.04.25

SOL ARCHITECTURE

EGREMONT, CUMBRIA

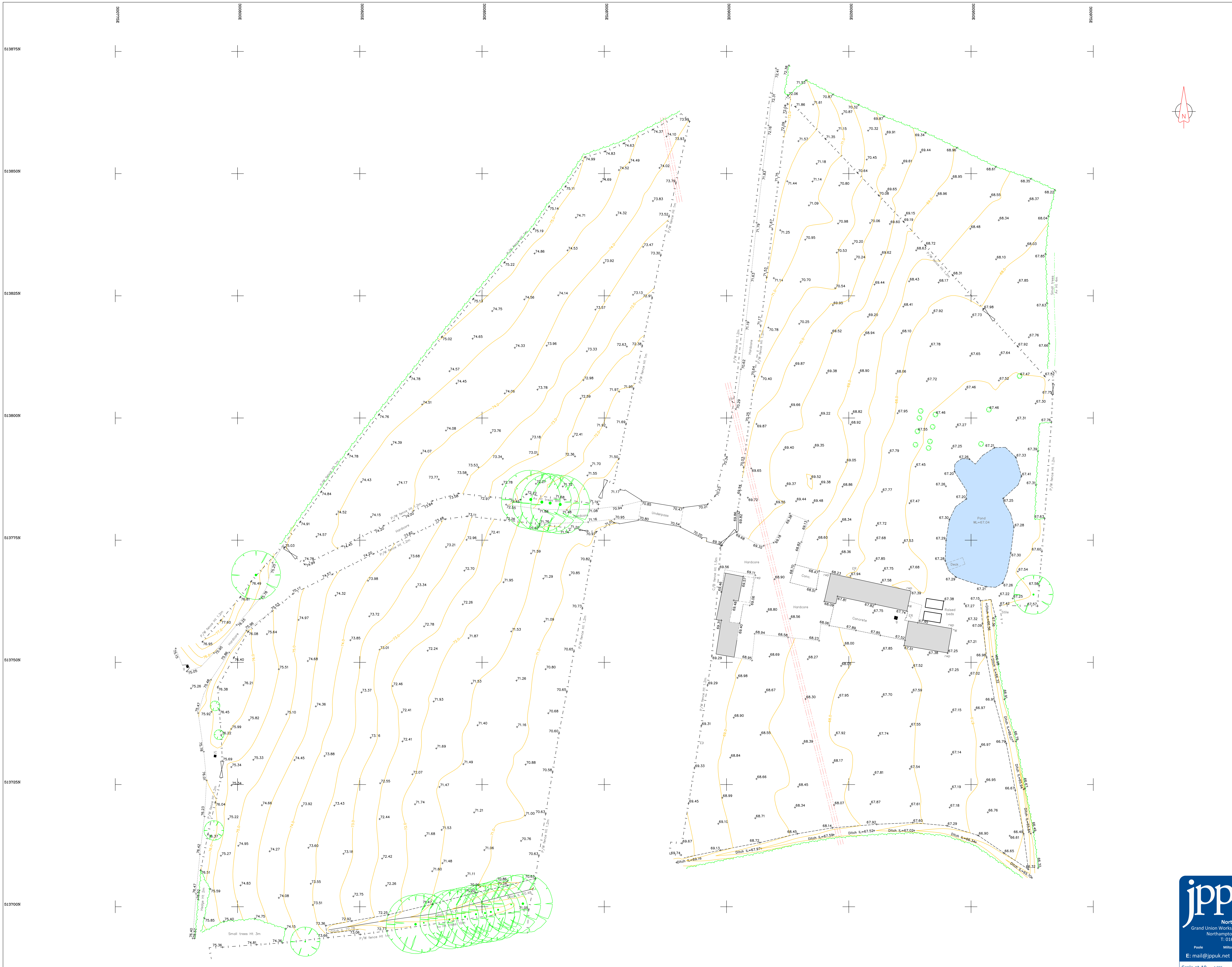
SITE LAYPOUT PLAN

030.301.05

07.04.2025

SCALE: AS SHOWN A1

APPENDIX 1 – Proposed Site Layout



General notes

Grid and levels have been aligned with OS National Grid OSGB36 (15).
All dimensions and levels are in metres unless noted otherwise.

This plan should only be used for its original purpose. JPP accepts no responsibility if supplied to any other party than the original client.

Key

AV	Air Valve	Fl.	Flood Light	P/R	Post & Rail Fence
Bol	Bollard	FW	Foul Water	P/W	Post & Wire Fence
BH	Borehole	g	Gully	RE	Rodding Eye
BL	Bed Level	GV	Gas Valve	RS	Road Sign
BT	BT Cover	Ht.	Height	rwp	Rainwater Pipe
CATV	Cable TV Cover	IC	Inspection Chamber	SV	Stop Valve
C/B	Close Boarded Fence	IL	Invert Level	svp	Soil & Vent Pipe
C/L	Chain Link Fence	I/R	Iron Railing	SW	Surface Water
CL	Cover Level	ko	Kerb Outlet	TL	Traffic Light
Col	Column	LC	Lighting column	TP	Telegraph Pole
El	Elec	LU	Light unit	TW	Top of wall
ER	Earth Rod	MH	Manhole	utl	Unable To Lift
EP	Electricity Pole	Mkr	Marker Post	VP	Vent Pipe
FH	Fire Hydrant	O/H	Overhead	WL	Water Level
FL	Floor Level	PB	Post Box	WM	Water Meter
		Po	Post	wo	Wash Out

Building

Control Station

Tree

Bore Hole

Gate

Bottom of Bank

Top of Bank

Vegetation

Change of surface

Fence

Contours 65.0

OH Telecom

OH Electric

jpp

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Client	Stephenson Halliday
Project	Egremont
Title	Topographical Survey

Scale at A0 1:250	Drawn by JG	Checked by TB	Date 29/1/25
Status	Project ref 29596Y	Drawing no. 01	Revision

APPENDIX 2 – Topographical Survey

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.450
Area (ha)	0.138	Urban	0.000
SAAR (mm)	1066	Region Number	Region 10

Results 1/s

QBAR Rural 1.0
QBAR Urban 1.0

Q100 years 2.1

Q1 year 0.9
Q30 years 1.7
Q100 years 2.1

APPENDIX 3 – IoH124 Method Calculations

APPENDIX 4 – Attenuation Storage Calculations

KRS enviro

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Summary of Results for 100 year Return Period (+45%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	68.534	0.534	0.6	32.8	O K
30 min Summer	68.752	0.752	0.6	46.2	O K
60 min Summer	69.008	1.008	0.7	62.0	O K
120 min Summer	69.297	1.297	0.8	79.7	O K
180 min Summer	69.471	1.471	0.9	90.4	O K
240 min Summer	69.587	1.587	0.9	97.6	O K
360 min Summer	69.729	1.729	0.9	106.3	O K
480 min Summer	69.821	1.821	1.0	112.0	O K
600 min Summer	69.880	1.880	1.0	115.6	O K
720 min Summer	69.918	1.918	1.0	118.0	O K
960 min Summer	69.954	1.954	1.0	120.1	O K
1440 min Summer	69.977	1.977	1.0	121.6	O K
2160 min Summer	69.959	1.959	1.0	120.4	O K
2880 min Summer	69.913	1.913	1.0	117.6	O K
4320 min Summer	69.807	1.807	1.0	111.1	O K
5760 min Summer	69.706	1.706	0.9	104.9	O K
7200 min Summer	69.609	1.609	0.9	98.9	O K
8640 min Summer	69.517	1.517	0.9	93.3	O K
10080 min Summer	69.429	1.429	0.9	87.9	O K
15 min Winter	68.534	0.534	0.6	32.8	O K
30 min Winter	68.752	0.752	0.6	46.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	96.545	0.0	32.9	19
30 min Summer	68.443	0.0	45.7	34
60 min Summer	46.413	0.0	63.9	64
120 min Summer	30.526	0.0	84.0	124
180 min Summer	23.540	0.0	97.0	182
240 min Summer	19.418	0.0	106.4	242
360 min Summer	14.633	0.0	116.4	362
480 min Summer	11.972	0.0	120.2	482
600 min Summer	10.235	0.0	123.2	600
720 min Summer	8.997	0.0	126.2	720
960 min Summer	7.332	0.0	130.6	896
1440 min Summer	5.479	0.0	134.1	1140
2160 min Summer	4.081	0.0	202.6	1532
2880 min Summer	3.305	0.0	218.5	1956
4320 min Summer	2.447	0.0	224.8	2768
5760 min Summer	1.980	0.0	262.3	3624
7200 min Summer	1.680	0.0	278.2	4400
8640 min Summer	1.470	0.0	292.0	5192
10080 min Summer	1.313	0.0	304.3	5960
15 min Winter	96.545	0.0	32.9	19
30 min Winter	68.443	0.0	45.7	33

Summary of Results for 100 year Return Period (+45%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	69.008	1.008	0.7	62.0	O K
120 min Winter	69.299	1.299	0.8	79.9	O K
180 min Winter	69.474	1.474	0.9	90.6	O K
240 min Winter	69.592	1.592	0.9	97.9	O K
360 min Winter	69.736	1.736	0.9	106.8	O K
480 min Winter	69.831	1.831	1.0	112.6	O K
600 min Winter	69.894	1.894	1.0	116.5	O K
720 min Winter	69.936	1.936	1.0	119.1	O K
960 min Winter	69.980	1.980	1.0	121.7	O K
1440 min Winter	69.989	1.989	1.0	122.3	O K
2160 min Winter	69.957	1.957	1.0	120.3	O K
2880 min Winter	69.887	1.887	1.0	116.0	O K
4320 min Winter	69.725	1.725	0.9	106.1	O K
5760 min Winter	69.573	1.573	0.9	96.7	O K
7200 min Winter	69.431	1.431	0.9	88.0	O K
8640 min Winter	69.302	1.302	0.8	80.0	O K
10080 min Winter	69.185	1.185	0.8	72.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	46.413	0.0	63.9	62
120 min Winter	30.526	0.0	84.0	122
180 min Winter	23.540	0.0	97.0	180
240 min Winter	19.418	0.0	106.4	238
360 min Winter	14.633	0.0	116.3	354
480 min Winter	11.972	0.0	120.0	470
600 min Winter	10.235	0.0	123.0	584
720 min Winter	8.997	0.0	126.0	694
960 min Winter	7.332	0.0	130.4	912
1440 min Winter	5.479	0.0	133.7	1156
2160 min Winter	4.081	0.0	202.6	1620
2880 min Winter	3.305	0.0	218.5	2076
4320 min Winter	2.447	0.0	224.7	2984
5760 min Winter	1.980	0.0	262.3	3856
7200 min Winter	1.680	0.0	278.2	4688
8640 min Winter	1.470	0.0	292.0	5528
10080 min Winter	1.313	0.0	304.3	6352

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	1.000
Region	England and Wales	Cv (Winter)	1.000
M5-60 (mm)	16.000	Shortest Storm (mins)	15
Ratio R	0.266	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.138

Time (mins) From:	To:	Area (ha)
0	4	0.138

Model Details

Storage is Online Cover Level (m) 70.000

Tank or Pond Structure

Invert Level (m) 68.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	61.5	2.000	61.5

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0040-1000-2000-1000
Design Head (m)	2.000
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	40
Invert Level (m)	68.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	1.0	Kick-Flo®	0.355	0.5
Flush-Flo™	0.173	0.6	Mean Flow over Head Range	-	0.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.5	1.200	0.8	3.000	1.2	7.000	1.8
0.200	0.6	1.400	0.9	3.500	1.3	7.500	1.8
0.300	0.5	1.600	0.9	4.000	1.4	8.000	1.9
0.400	0.5	1.800	1.0	4.500	1.4	8.500	1.9
0.500	0.5	2.000	1.0	5.000	1.5	9.000	2.0
0.600	0.6	2.200	1.0	5.500	1.6	9.500	2.0
0.800	0.7	2.400	1.1	6.000	1.6		
1.000	0.7	2.600	1.1	6.500	1.7		