



Flood Risk Assessment and Drainage Strategy

Radcliffe BESS

08/04/2025



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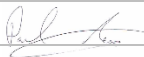
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1. EXECUTIVE SUMMARY

- 1.1. This Flood Risk Assessment and Drainage Strategy has been carried out for the Proposed Development consisting of a Battery Energy Storage System (BESS) facility on land to the east of Shore Top Farm, Kearsley Road, Radcliffe, Greater Manchester, England, M26 1FA.
- 1.2. The Environment Agency (EA) Mapping shows that the Proposed Development is located outside the areas at risk of fluvial flooding and **wholly** located within Flood Zone 1.
- 1.3. The proposed type of development is classed as 'Essential Infrastructure' and therefore development in Flood Zone 1 is deemed appropriate.
- 1.4. In addition to fluvial and coastal flood risk, the EA also provide surface water flood risk mapping. The EA surface water flood risk maps, aerial maps and site visit photos, were studied to determine the risk of surface water flooding on the site. This indicated that there were no areas at risk of pluvial flooding.
- 1.5. It has been demonstrated that the impact of the Proposed Development on surface water runoff is minimal due to the small amount of impermeable infrastructure (3.9% of the overall Application Site Area) proposed for the Application Site. However, drainage in the form of SuDS has been proposed so the operational site discharges surface water at the greenfield run off rate (QBar).
- 1.6. The soil classification within the Application Site is Class 4 which has a Standard Percentage Runoff (SPR) of 0.47 and will likely provide poor infiltration opportunities. Infiltration testing will be conducted post consent to confirm whether infiltration drainage is suitable. This will inform the detailed drainage design which will also be undertaken post consent and should dealt with by means of a suitably worded condition.
- 1.7. The drainage strategy will consist of an infiltration drain connecting to an attenuation structure (likely to be a detention basin or SuDS Pond) to the northwest outside the main battery storage compound. The attenuation structure will be designed to hold a volume of 41.0m³ (subject to detailed design and infiltration testing) with the detailed design of the structure being submitted to the Council for review prior to the construction period. As the transformers will hold a volume of oil, this feature will be bunded and the drainage from here will lead to a Class 1 full retention separator.
- 1.8. The site has been designed using infiltration only, due to xxx Alternatively, a discharge point into the local drains is available to the northwest of the Application Site. A limiting discharge rate of 2l/s is recommended; however, this will be agreed with the Council post consent when the detailed drainage design is being undertaken.
- 1.9. The SuDS features will be implemented during the early construction phase of the Proposed Development and will be planted with vegetation to protect against soil erosion. They will be maintained throughout the lifespan of the Proposed Development, generally in accordance with the recommendations in the appropriate guidance.

- 1.10. This FRA and DS demonstrates that the Proposed Development will **not increase flood risk** away from the Application Site during the construction, operation and decommissioning phases. The Proposed Development is therefore considered to be acceptable in planning policy terms.

2. INTRODUCTION

BACKGROUND

2.1. Neo Environmental Ltd has been appointed by Taiyo Power & Storage Ltd (the “Applicant”) to undertake a Flood Risk Assessment (“FRA”) and Drainage Strategy (“DS”) for a Battery Energy Storage System (BESS) facility (the “Proposed Development”) on land to the east of Shore Top Farm, Kearsley Road, Radcliffe, Greater Manchester, England, M26 1FA.

PROPOSED DEVELOPMENT DESCRIPTION

2.2. The Proposed Development will consist of the construction of battery containers, DNO substation, customer substation, storage, access tracks and auxiliary transformers, CCTVs, water tanks, transformers, inverters, fencing, gates and all ancillary infrastructure and associated works.

SITE DESCRIPTION

2.3. The Application Site is located c. 1.5km to the southwest of Radcliffe. Centred at approximate Grid Reference SD 77501 05984, the Application Site covers a total area of c. 1.39 hectares. Comprising of one field, the Proposed Development will be accessed via existing roads from Wood Street during construction and Kearsley Road during ongoing operations.

SCOPE OF REPORT

2.4. The aim of this assessment is to identify the baseline geological and hydrological conditions of the site and surrounding area; to assess the potential impacts of the Proposed Development during the construction, operation and decommissioning phases; to identify the risk of flooding at the proposed Application Site; and to recommend mitigation measures where appropriate.

2.5. This Flood Risk Assessment has been prepared in accordance with National Planning Policy Framework, December 2024 and amended February 2025, Planning Practice Guidance, last updated 12th December 2024 and the Places for Everyone Joint Development Plan Document (PFE), adopted, 21 March 2024.

2.6. This report is supported by the following figures and appendices:

- Appendix A Figures:

- Figure 1: Watercourses and Photo Locations
- Figure 2: Topographical Survey
- Figure 3: Planning Flood Map
- Figure 4: Outline SuDS Design
- Figure 5: Site Layout
- Appendix B: Photo Appendix
- Appendix C: Flow Output

STATEMENT OF AUTHORITY:

2.7. This Flood Risk Assessment (FRA) and Drainage Strategy (DS) has been produced by Jessica Ho, Michael McGhee and Tom Saddington of Neo Environmental. Having completed a civil engineering degree in 2012, Michael has worked on over 1GW of renewable development flood risk and drainage impact assessments across the UK and Ireland whilst working towards becoming a Chartered Engineer. Michael has over 10 years of environmental consultancy experience, mainly producing technical assessments for energy projects. Tom has an undergraduate degree in Bioengineering and graduated with an MSc in Environmental and Energy Engineering in January 2020. He has been working on various technical assessments including flood risk assessment reports for numerous renewable developments in Ireland and the UK. Jessica has an undergraduate degree in Environmental Science and graduated with an MSc in Environmental Engineering in September 2022.

3. LEGISLATION

3.1. A review of relevant legislation has been conducted to ensure the Proposed Development complies with the following:

- EU Directive on the Assessment and Management of Flood Risks [2007/60/EC]¹ implemented in England via the Flood and Water Management Act 2010² and the Flood Risk Regulations 2009³;
- The Water Framework Directive [2000/60/EC]⁴ as implemented in England via the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017⁵;
- The Groundwater Directive (GWD) (2006/118/EC)⁶ as implemented by the Groundwater (Water Framework Directive) (England) Direction 2016 and Environmental Permitting (England and Wales) Regulations 2016.
- National Planning Policy Framework, December 2024⁷, last updated February 2025

¹ European Parliament (2007). Directive 2007/60/EC of the European Parliament and of the Council establishing a framework for the assessment and management of flood risks. Available at <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32007L0060>

² UK Government (2010). Flood Water a Management Act 2010. Available at <https://www.legislation.gov.uk/ukpga/2010/29/contents>

³ UK Government (2009). The Flood Risk Regulations 2009. Available at <http://www.legislation.gov.uk/uksi/2009/3042/contents>

⁴ European Parliament (2000). Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy ("The Water Framework Directive"). Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32000L0060>.

⁵ UK Government (2017). The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017. Available at <http://www.legislation.gov.uk/uksi/2017/407/contents/made>

⁶ European Parliament (2006). Directive 2006/118/EC of the European Parliament and of the Council establishing a framework for the protection of groundwater against pollution and deterioration ("The Water Framework Directive"). Available at <https://www.eea.europa.eu/policy-documents/groundwater-directive-gwd-2006-118-ec>

⁷ UK Government, National Planning Policy Framework, 2024, Available at https://assets.publishing.service.gov.uk/media/67aafe8f3b41f783cca46251/NPPF_December_2024.pdf

- Planning Policy Guidance, last updated 14th February 2024 – Flood Risk and Coastal Change⁸

REVIEW OF LOCAL PLANNING POLICY

Emerging Local Plan

- 3.2. Bury Council is currently consulting on the draft Bury Local Plan⁹. The Draft Bury Local Plan presents an extensive list of policies regarding development management within the District. Of these policies, only Policy 42 is considered relevant to this assessment.
- 3.3. The emerging Bury Local Plan will replace the current Bury Urban Development Plan (UDP) that was adopted by the Council in 1997. The Bury UDP contains a number of saved policies, however, none of the saved policies are relevant to this assessment.

The Places for Everyone Plan

- 3.4. The Places for Everyone Joint Development Plan Document (PfE) was adopted, 21 March 2024 which presents an extensive list of policies regarding development management within the District. Of these policies, only Policy JP-S4 is considered relevant to this assessment.
- 3.5. Policy JP-S4: Flood Risk and the Water Environment)

Table 3-1: Plan Flood Management Policies/Objectives (key points summarised)

Planning Policy/Objective	Comment
<i>“Policy JP-S4: Flood Risk and the Water Environment</i> <i>“An integrated catchment-based approach will be taken to protect the quantity and quality of water bodies with reference to the North West River Basin Management Plan and managing flood risk, by:</i>	The Flood Risk Assessment will consider the impacts of overall Flood-Risk due to the Proposed Development.

⁸ UK Government, Planning Policy Guidance – Flood Risk and Coastal Change, 2024, Available at Planning Policy Guidance – Flood Risk and Coastal Change.

⁹ Bury Council. Bury Local Plan. <https://www.bury.gov.uk/planning-building-control/policy-and-projects/planning-policy/bury-local-plan>

1. <i>Returning rivers to a more natural state, where practicable;</i> 2. <i>Working with natural processes and adopting a natural flood management approach to slow the speed of water drainage and intercept water pollutants;</i> 3. <i>Locating and designing development so as to minimise the impacts of current and future flood risk, including retrofitting or relocating existing developments, infrastructure and places to increase resilience to flooding;</i> 4. <i>Expecting developments to manage surface water runoff through sustainable drainage systems and as close to source as possible. Development should achieve greenfield run-off rates unless it is demonstrated to be impracticable. District local plans should consider setting more detailed surface water drainage policies to reflect local circumstances, including alternative surface water discharge rates, such as in areas with critical drainage issues;</i> 5. <i>Ensuring that sustainable drainage systems:</i> i. <i>Are designed to provide multifunctional benefits wherever possible, including for water quality, nature conservation and recreation;</i> ii. <i>Avoid adverse impacts on water quality and any possibility of discharging hazardous substances to ground;</i> iii. <i>Are delivered in a holistic and integrated manner, including on larger sites split into different phases; and</i> iv. <i>Are managed and maintained appropriately to ensure their proper functioning over the lifetime of the development.</i> 6. <i>Securing the remediation of contaminated land and the careful design of developments to minimise the potential for urban diffuse pollution to affect the water environment; and</i>	The Drainage Strategy will ensure SuDS are implemented and in line with national standards. The Strategic Flood Risk Assessments and other related flood defence plans and strategies will be considered in the Flood Risk Assessment and Drainage Strategy.
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<i>7. As a minimum, residential development should meet the mandatory water efficiency standard of 125 litres/person/day as set out in Building Regulations. District local plans may and should consider setting a tighter water efficiency standard of 110 litres/person/day where there is a clear local need with reference to national guidance on housing optional technical standards.”</i>	
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Strategic Flood Risk Assessment

3.6. Bury jointly prepared a Strategic Flood Risk Assessment¹⁰ with other Greater Manchester planning authorities. The assessment is based upon historic flood records, hydraulic modelling data and the EA's Planning Flood Map. The assessment outlines the fluvial and pluvial flood zones; however, these refer to the Environment Agency mapping and therefore that will be used in this report to delineate the flood zones.

¹⁰ Chichester Council. Strategic Flood Risk Assessment December 2022. Available at: https://www.chichester.gov.uk/media/37621/Level-1-SFRA-Report-Final-Dec-22/pdf/JBA-CDC_Level_1_SFRA_Report_-_Final_-_Dec_22.pdf?m=1673966198490

4. METHODOLOGY

4.1. Flood planning policy and guidance for England is contained within the National Planning Policy Framework, December 2024 (last updated February 2025) and, in relation to flood risk, it states:

“A site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving:

- *sites of 1 hectare or more;*
- *land which has been identified by the Environment Agency as having critical drainage problems;*
- *land identified in a strategic flood risk assessment as being at increased flood risk in future;*
- *land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use”*

4.2. As this Proposed Development is over 1 hectare in size then a site-specific FRA is necessary. The objectives of a site-specific FRA are to establish:

- whether a proposed development is likely to be affected by current or future flooding from any source;
- whether it will increase flood risk elsewhere;
- whether the measures proposed to deal with these effects and risks are appropriate;
- the evidence for the local planning authority to apply (if necessary) the Sequential Test, and;
- whether the development will be safe and pass the Exception Test, if applicable.

4.3. The Guidelines provide five vulnerability categories, based on the type of proposed development, which are detailed as follows:

- **Essential Infrastructure**
 - Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk.
 - Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and

primary substations; and water treatment works that need to remain operational in times of flood.

- Wind turbines.
- Solar Farms.

- **Highly Vulnerable**

- Police and ambulance stations; fire stations and command centres; telecommunications installations required to be operational during flooding.
- Emergency dispersal points.
- Basement dwellings.
- Caravans, mobile homes and park homes intended for permanent residential use.
- Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as 'Essential Infrastructure').

- **More Vulnerable**

- Hospitals
- Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels.
- Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels.
- Non-residential uses for health services, nurseries and educational establishments.
- Landfill* and sites used for waste management facilities for hazardous waste.
- Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.

- **Less Vulnerable**

- Police, ambulance and fire stations which are not required to be operational during flooding.
- Buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution; non-residential institutions not included in the 'more vulnerable' class; and assembly and leisure.
- Land and buildings used for agriculture and forestry.
- Waste treatment (except landfill* and hazardous waste facilities).
- Minerals working and processing (except for sand and gravel working).
- Water treatment works which do not need to remain operational during times of flood.
- Sewage treatment works, if adequate measures to control pollution and manage sewage during flooding events are in place.
- **Water Compatible Development**
 - Flood control infrastructure.
 - Water transmission infrastructure and pumping stations.
 - Sewage transmission infrastructure and pumping stations.
 - Sand and gravel working.
 - Docks, marinas and wharves.
 - Navigation facilities.
 - Ministry of Defence defence installations.
 - Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location.
 - Water-based recreation (excluding sleeping accommodation).
 - Lifeguard and coastguard stations.
 - Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms.

- Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

Table 4-1: Flood Risk Vulnerability Classification

Flood Zone	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Zone 1	Appropriate	Appropriate	Appropriate	Appropriate	Appropriate
Zone 2	Appropriate	Exception Test Required	Appropriate	Appropriate	Appropriate
Zone 3a	Exception Test Required ^x	Not Appropriate	Exception Test Required	Appropriate	Appropriate
Zone 3b	Exception Test Required *	Not Appropriate	Not Appropriate	Not Appropriate	Appropriate*
^x In Flood Zone 3a essential infrastructure should be designed and constructed to remain operational and safe in times of flood.					
[*] In Flood Zone 3b (functional floodplain) essential infrastructure that has to be there and has passed the Exception Test, and water-compatible uses, should be designed and constructed to: • remain operational and safe for users in times of flood; • result in no net loss of floodplain storage; • not impede water flows and not increase flood risk elsewhere.					

- 4.4. The sequential test compares the Proposed Development site with other available sites, with the aim to develop on areas of land which are at a lower risk of flooding.
- 4.5. Where Proposed Development requires an Exception Test, this must be undertaken to determine if the development can be justified. The application of the exception test should be informed by a site-specific FRA.
- 4.6. Development should only be allowed in areas at risk of flooding where, in the light of the site-specific FRA (and the sequential and exception tests, as applicable), it can be demonstrated that:
- within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;
 - the development is appropriately flood resistant and resilient;

- it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;
- any residual risk can be safely managed; and
- safe access and escape routes are included where appropriate, as part of an agreed emergency plan.

4.7. Site specific FRA's should also provide surface water management arrangements at the site using sustainable drainage systems wherever appropriate, to ensure there is no increase in flood risk to others off-site.

5. BASELINE CONDITIONS

5.1. This section presents the information gathered on the existing topographical, geological, hydrological and hydrogeological conditions of the Application Site and its immediate surroundings.

TOPOGRAPHY

5.2. A topographical survey was undertaken at the Application Site (**Figure 2: Appendix A**). The lowest point within the Application Site of 80.72m AOD is located on the northern boundary of the Application Site. The highest point at 90.64m AOD is located on the southeastern boundary of the Application Site. The fields generally slope towards the north and west.

GEOLOGY & SOIL

5.3. The geological conditions of the Application Site were identified utilising the British Geological Society (“BGS”) Spatial Resources online geological mapping¹¹ system. It is underlain by Newton Heath Sandstone - Sandstone. Newton Heath Sandstone – Sandstone formed between 315.2 and 309.5 million years ago during the Carboniferous period. This is overlain by Till, Devensian – Diamicton and Glaciofluvial Deposits, Devensian - Sand and gravel. Sedimentary superficial deposit formed between 116 and 11.8 thousand years ago during the Quaternary period. Glaciofluvial Deposits, Devensian - Sand and gravel formed between 116 and 11.8 thousand years ago during the Quaternary period.

5.4. There are several borehole records within the vicinity of the Application Site which indicate that clay is found at least 0.5m below the surface

Soil

5.5. Different soil types have different capabilities of soaking up water, the efficiency of which is dependent upon the structure and infiltration capacity. The Soilsclapes¹² map has been utilised to obtain soil data. It classes the soil at the site as ‘*Slowly permeable seasonally wet acid loamy and clayey soils*’.

¹¹ BGS Geology of Britain Map., Available at <http://mapapps.bgs.ac.uk/geologyofbritain/home.html>

¹² Cranfield Soil and Agrifood Institute, Soilsclapes website. Available at <http://www.landis.org.uk/soilsclapes/>

- 5.6. According to the Wallingford Procedure ‘Winter Rain Acceptance Potential’ (WRAP) map¹³, the soil classification for the site is Class 4. This soil class has a Standard Percentage Runoff (SPR) of 0.47 and will likely provide poor infiltration opportunities. Infiltration testing will be conducted post consent to confirm whether infiltration drainage is suitable. This will inform the detailed drainage design which will also be undertaken post consent and should dealt with by means of a suitably worded condition.

HYDROLOGY

- 5.7. According to the Environment Agency Catchment Data Explorer¹⁴, the Application Site lies within Irwell Management Catchment. Within this, the site lies within the Croal Irwell Operational Catchment.

Local River Network

- 5.8. The Application Site is within the catchment of the River Irwell, which is located approximately 0.26km to the north and has an overall classification of “Moderate” under the Water Framework Directive.
- 5.9. The River Irwell flows in a western direction before converging with the Manchester Canal approximately 9.97km southeast of the Application Site. The Manchester Canal merges with the River Mersey 19.44km southwest of the Application site which flows in a western direction before discharging into the Irish Sea 47.13km southwest of the Application Site.

Internal Watercourses

- 5.10. All the surface water within the Application Site will flow towards the River Irwell (Roch to Croal) which lies to the north of the Application Site.

FLOOD ZONE CLASSIFICATION

- 5.11. The Environment Agency (EA) Planning Flood Map¹⁵ shows that all of the Application Site is located within Flood Zone 1 which is an area described as low xxxof flooding in **Table 1: Flood Zones** of the

¹³ UK Sustainable Drainage and Guidance Tools. Greenfield Runoff Estimation for the Sites. Available at: <https://www.uksuds.com/tools/members/greenfield-runoff-rate-estimation-members>

¹⁴ Environment Agency, Catchment Data Explorer, Available at <https://environment.data.gov.uk/catchment-planning>

¹⁵ Environment Agency Planning Flood Map. Available at: <https://flood-map-for-planning.service.gov.uk/>

“Planning Practice Guidance to the National Planning Policy Framework”, which follows the southern boundary of the developable area of the Application Site.

- 5.12. Flood Zone 1 is categorised as being the lowest flood risk and comprises land assessed as having a 1 in 1000 or lower annual probability of river or sea flooding, see **Figure 3: Appendix A**.

HISTORIC FLOODING

- 5.13. The Environment Agency historic flood map¹⁶ is a GIS layer showing the maximum extent of individual Recorded Flood Outlines from the river, the sea and groundwater springs that meet a set criterion. It shows areas of land that have previously been subject to flooding in England. The map shows that no part of the Application Site has been included within this historic flood extent with no areas shown to historically flood within proximity to the Application Site.
- 5.14. A review of the Strategic Flood Risk Assessments covering the area has identified that there are no specific records of flooding within the vicinity of the Application Site.

HYDROGEOLOGY

- 5.15. The Application Site is not located within a Source Protection Zone (SPZ).

Groundwater Vulnerability

- 5.16. Groundwater Vulnerability refers to the intrinsic geological and hydrogeological characteristics that determine the ease at which groundwater may be contaminated by human activities. The more vulnerable the groundwater is, the more easily it can be contaminated by surface water.
- 5.17. According to the Environment Agency Groundwater Vulnerability Maps, the groundwater vulnerability across the Application Site is considered to be ‘Medium – Low’.
- 5.18. Potential contamination from a development such as a BESS is limited and almost completely associated with the construction stage. The Construction Environmental Management Plan (CEMP) will provide mitigations to ensure any potential risks of groundwater contamination will be mitigated where possible.

¹⁶ Environment Agency, Historic Flood Outlines, Available at <https://www.data.gov.uk/dataset/76292bec-7d8b-43e8-9c98-02734fd89c81/historic-flood-map>

6. FLOOD RISK ASSESSMENT

SEQUENTIAL TEST

6.1. The Sequential Test ensures that a sequential approach is followed to steer new development to areas with the lowest probability of flooding. The flood zones as refined in the Strategic Flood Risk Assessment for the area provide the basis for applying the Test. The aim is to steer new development to Flood Zone 1 (areas with a low probability of river or sea flooding). Where there are no reasonably available sites in Flood Zone 1, local planning authorities in their decision making should take into account the flood risk vulnerability of land uses and consider reasonably available sites in Flood Zone 2 (areas with a medium probability of river or sea flooding), applying the Exception Test if required. Only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in Flood Zone 3 (areas with a high probability of river or sea flooding) be considered, taking into account the flood risk vulnerability of land uses and applying the Exception Test if required.

Fluvial and Coastal Flood Risk

- 6.2. The EA Mapping shows that the Proposed Development is located outside the areas at risk of fluvial flooding and **wholly** located within Flood Zone 1.
- 6.3. The proposed type of development is classed as 'Essential Infrastructure' and therefore development in Flood Zone 1 is deemed appropriate (**See Table 4-1 above**).
- 6.4. The Sequential Test and Exception Test are not required in this instance.

Pluvial Flood Risk

- 6.5. In addition to fluvial and coastal flood risk, the EA also provide surface water flood maps¹⁷. This shows the areas at risk of surface water flooding within the Application Site.
- 6.6. This indicated that there were no areas at risk of pluvial flooding.

Groundwater Flood Risk

- 6.7. Groundwater flooding is a "hidden" risk that is often difficult to distinguish from other types of flooding. For example, rising groundwater often forms in low-lying areas which are also susceptible to the accumulation of surface water.

¹⁷ EA Surface water flood maps: <https://check-long-term-flood-risk.service.gov.uk/map>

- 6.8. Local groundwater levels often respond to water levels within nearby watercourses and pond in those same areas that are at risk of pluvial flooding, due to the low-lying nature of those areas. Therefore, it can be assumed that groundwater flood levels are likely to be the same as those for pluvial flooding and below the lowest part of the proposed development.
- 6.9. Based on the above, the risk of flooding from groundwater to the Proposed Development is **low**.

SITE ACCESS POINTS

- 6.10. The temporary construction access point into the site will be from Wood Street. All surface waters should be directed into the site, with no surface water flows from the Proposed Development directed towards the public highway.

7. DRAINAGE STRATEGY

INTRODUCTION

- 7.1. There is a requirement in the NPPG for proposals to incorporate surface water drainage measures that have a neutral or beneficial effect on the risk of flooding both on and off the Application Site.
- 7.2. Surface water arising from a developed site should, as far as is practicable, be managed to mimic the surface water flows arising from the site prior to the Proposed Development, while reducing the flood risk at the site itself and elsewhere.

METHODOLOGY

Catchment Characteristics

- 7.3. Catchment characteristics were obtained from the Flood Studies Report¹⁸. Catchment sizes were measured using ArcGIS and catchment boundaries were produced based on the site-specific topographical survey.

Greenfield Runoff and Stormwater Storage

- 7.4. Greenfield runoff rates and stormwater storage requirements have been obtained using the following tools:
- HR Wallingford UK Sustainable Drainage Greenfield Runoff Estimation Tool (using IH124¹⁹ methodology due to the small-scale nature of the catchment).
 - Flow – Causeway Drainage design software (using IH124 methodology due to the small-scale nature of the catchment).
 - The areas of permeable and impermeable surfaces have been estimated and are based upon the Proposed Development layout (**Figure 5: Appendix A** for the layout of the Proposed Development).

¹⁸ Institute of Hydrology, Flood Studies Report (1975)

¹⁹ Institute of Hydrology (1994). *Flood estimation for small catchments. Report No IH124*, Wallingford.

Greenfield Runoff rates

7.5. The IH24 methodology is used for calculating the Greenfield runoff rates. This is recommended by the Institute of Hydrology for catchments below 200ha.

7.6. The IH124 equation estimates Qbar with the following equation:

$$Qbar - rural = 0.00108 \times (0.01 \times AREA)^{0.89} \times SAAR^{1.17} \times SPR^{2.17}, m^3/s$$

where:

- Qbar-rural is the mean annual flood flow from a rural catchment (approximately 2-3-year return period).
- AREA is the area of the catchment in ha.
- SAAR is the standard average annual rainfall for the period 1961 to 1990, available from the Flood Studies Report
- SPR is Standard Percentage Runoff coefficient for the SOIL category.

Calculating storage estimates

7.7. The storage estimates are calculated using the inputs below:

- Return Period
- Climate Change
- Impermeable Area
- Peak Discharge

7.8. The return period and climate change are combined with the Flood Studies Report (FSR) parameters and storm durations to generate the rainfall used. The result from these calculations is the attenuation storage required for the Application Site as a result of the additional runoff generated by the Proposed Development.

Site and Project Descriptions

7.9. The majority of the compound will be made up of crushed aggregate which will be compacted to create a surface, however, it will still have permeable properties and rainwater will soak into the ground beneath at the same rate that it presently does.

- 7.10. The grid compounds are mostly permeable land, however there are a number of infrastructure parts which will require small foundations. To cater for this within the drainage calculations, a betterment figure of 20% has been included.
- 7.11. Similarly, any rainwater falling onto the permeable access tracks will soak into the ground beneath at the same rate that it presently does.
- 7.12. The extent of impermeable area created as a result of the Proposed Development is summarised in **Table 7-1**.

Table 7-1: Extent of less permeable areas created by the Proposed Development

Building	BESS (m ²)
13 x Battery Containers (6.1m(L) x 2.6m(W))	206.2
1 x Storage (6.1m(L) x 2.6m(W))	15.9
1 x Customer Substation (6.1m(L) x 2.6m(W))	15.9
1 x DNO (3.9m (L) x 3.3m (W))	12.9
2 x Transformers/Inverters (abnormal shape = 68.5m ²)	137.0
1 x Water Tank (abnormal shape)	99.2
Total Impermeable Area (m ²)	487.1
Site Area (m ²)	12,407.03

- 7.13. In its current greenfield state, the Application Site is considered to be 100% undeveloped. As a result of the Proposed Development, the extent of impermeable hardstanding introduced will be approximately 487.1m² or 3.9% of the total site area.

EXISTING DRAINAGE ARRANGEMENTS

Existing Runoff Rates

7.14. The existing runoff rates and hydrological characteristics of the Proposed Development are detailed in **Table 7-2** below (there are no hardstanding areas on the site at present).

Table 7-2: Pre-Development Greenfield runoff rates.

Site Make Up	Green Field
Greenfield Method	IH124
Positively Drained Area (ha)	0.049
SAAR (mm)	1025
Soil Index	4
Standard Percentage Runoff	0.47
Region	10
	Runoff rate (l/s)
QBar	0.4
1 year	0.3
1 in 30 year	0.5
1 in 100 year	0.6

7.15. The limiting discharge will be taken as the QBar rate seen in **Table 7-2**.

Post Development Runoff Rate

7.16. The surface water runoff rate resulting from the Proposed Development has been based on the areas of hardstanding introduced, which will have a lower permeability than the existing greenfield composition.

7.17. Surface water runoff was derived using the Modified Rational Method as outlined within the methodology.

- 7.18. Using this approach, the runoff rate for the 1-in-100-year, 360-minute storm event, inclusive of the 40% climate change allowance would be a combined **18m³**, across the site areas, if left unmanaged.

PROPOSED DRAINAGE ARRANGEMENTS

- 7.19. The SuDS Manual²⁰ is the current best practice guidance on the use of SuDS. It promotes the use of a hierarchical approach to managing runoff. This approach is outlined below:

- Prevention - Preventing runoff by reducing impermeable areas.
- Source Control - Effective control of runoff at or very near its source.
- Site Control - Planned management of water in a local area or site.
- Regional Control - Designing a system that can efficiently manage the runoff from a site, or several sites.

- 7.20. The use of SuDS is generally accepted to have greater benefits than conventional drainage systems and these include²¹:

- Managing runoff volumes and flow rates from hard surfaces, reducing the impact of urbanisation on flooding;
- Providing opportunities for using runoff where it falls;
- Protecting or enhancing water quality (reducing pollution from runoff);
- Protecting natural flow regimes in watercourses;
- SuDs are sympathetic to the environment and the needs of the local community;
- Providing an attractive habitat for wildlife in urban watercourses;
- Providing opportunities for evapotranspiration from vegetation and surface water; and
- Encouraging natural groundwater/aquifer recharge (where appropriate).

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

21 Susdrain. Sustainable drainage. Accessed <http://www.susdrain.org/delivering-suds/using-suds/background/sustainable-drainage.html>

- 7.21. The surface water drainage strategy for the Proposed Development seeks to provide a sustainable and integrated surface water management scheme for the whole Application Site and aims to ensure no increase in downstream flood risk by managing discharges from the Proposed Development to the local water environment in a controlled manner.
- 7.22. To comply with current policies, guidance and best practice, the volume and quality of surface water runoff discharged off-site from the Proposed Development at this Application Site will need to be controlled using SuDS.
- 7.23. In compliance with the above, the drainage strategy has been developed to meet the following key principles;
- Mimic existing (greenfield) drainage arrangements as far as possible;
 - Avoid increases in the greenfield rate, volume and frequency of offsite discharge;
 - Avoid significant deterioration in water quality of discharges and no detrimental impact in downstream water quality;
 - Achieve the above criteria for all storms up to and including the 100-year event; and,
 - Incorporate an allowance for climate change (40%).

Indicative Surface Water Storage Requirements

- 7.24. Indicative storm water storage volumes have been estimated using Causeway's Drainage Design Flow software. The storage calculations include up to the critical storm 100-year return period event (including a 40% allowance for climate change) and the design limits discharge rates back to greenfield runoff rates. The results are enclosed in **Appendix C**. These are estimated from the new surfaces added to the Proposed Development.
- Attenuation storage limits the rate of surface runoff discharge from the Proposed Development to match the pre-development greenfield runoff rates; and,
 - All storage calculations have been given a climate change allowance factor of 40% that has been added to the rain depths.
 - All storage calculations have been given a betterment factor of 20%.

Table 7-3: Storage Estimates

Storage Estimates	
Return Period (years)	100 years
Climate Change (%)	40
Impermeable Area (ha)	0.049
Peak Discharge (l/s)	0.4
Total storage Requirement (m ³)	41

Proposed Drainage Strategy

- 7.25. The drainage strategy will consist of an infiltration drain connecting to an attenuation structure (likely to be a detention basin or SuDS Pond) to the northwest outside the main battery storage compound (see **Figure 3: Appendix A**). The attenuation structure will be designed to hold a volume of 41.0m³ (subject to detailed design and infiltration testing) with the detailed design of the structure being submitted to the Council for review prior to the construction period. As the transformers will hold a volume of oil, this feature will be bunded and the drainage from here will lead to a Class 1 full retention separator.
- 7.26. The SuDS features will be implemented during the early construction phase of the Proposed Development and will be planted with vegetation to protect against soil erosion. They will be maintained throughout the lifespan of the Proposed Development, generally in accordance with the recommendations in the appropriate guidance.
- 7.27. The site has been designed using infiltration only, due to xxxx. Alternatively, there is an available discharge point into the local drains to the northwest of the Application Site. A limiting discharge rate of 2l/s is recommended; however, this will be agreed with the Council post consent when the detailed drainage design is being undertaken.

DESIGNING FOR EXCEEDANCE EVENTS

- 7.28. Overland flow routes will not be altered by the construction of the Proposed Development as it is not proposed to significantly vary ground levels. The outline drainage has been designed so that flooding will not occur for up to and including the 1-in-100-year storm event (including 40% climate change consideration).

- 7.29. Should an exceedance of this 1 in 100-year critical storm event occur, surface water will flow the same way as at present, into the surrounding field drains. There are no sensitive receptors between the Application Site and the existing watercourses.

LONG TERM MAINTENANCE OF SuDS

- 7.30. The long-term management and maintenance of the proposed SuDS will be the responsibility of the site owner and/or operators. These responsibilities include:
- Periodic cutting or grazing of vegetation;
 - Observation of infiltration performance; and
 - Maintain the structural integrity of the attenuation structure and cleaning out any rubbish accumulation.

8. SUMMARY & CONCLUSIONS

- 8.1. This Flood Risk Assessment and Drainage Strategy has been carried out for the Proposed Development consisting of a Battery Energy Storage System (BESS) on land to the east of Shore Top Farm, Kearsley Road, Radcliffe, Greater Manchester, England, M26 1FA.
- 8.2. The Environment Agency (EA) Mapping shows that the Proposed Development is located outside the areas at risk of fluvial flooding and **wholly** located within Flood Zone 1.
- 8.3. The proposed type of development is classed as 'Essential Infrastructure' and therefore development in Flood Zone 1 is deemed appropriate.
- 8.4. In addition to fluvial and coastal flood risk, the EA also provide surface water flood map. Where the EA map demonstrates areas of surface water risk, as well as aerial maps and site visit photos, were studied to determine if there will be surface water flooding. This indicated that there were no areas at risk of pluvial flooding.
- 8.5. It has been demonstrated that the impact of the Proposed Development on surface water runoff is minimal due to the small amount of impermeable infrastructure (3.9 of the overall Application Site Area) proposed for the Application Site. However, drainage in the form of SuDS has been proposed so the operational site discharges surface water at the greenfield run off rate (QBar).
- 8.6. The soil class within the Application Site is Class 4 which has a Standard Percentage Runoff (SPR) of 0.47 and will likely provide poor infiltration opportunities. Infiltration testing will be conducted post consent to confirm whether infiltration drainage is suitable. This will inform the detailed drainage design which will also be undertaken post consent and should dealt with by means of a suitably worded condition.
- 8.7. The drainage strategy will consist of an infiltration drain connecting to an attenuation structure (likely to be a detention basin or SuDS Pond) to the northwest outside the main battery storage compound. The attenuation structure will be designed to hold a volume of 41.0m³ (subject to detailed design and infiltration testing) with the detailed design of the structure being submitted to the Council for review prior to the construction period. As the transformers will hold a volume of oil, this feature will be bunded and the drainage from here will lead to a Class 1 full retention separator.
- 8.8. The site has been designed using infiltration only, however, should this not be found suitable then the discharge point will be into the local drains to the northwest of the Application Site. A limiting discharge rate of 2l/s is recommended; however, this will be agreed with the Council post consent when the detailed drainage design is being undertaken.
- 8.9. The SuDS features will be implemented during the early construction phase of the Proposed Development and will be planted with vegetation to protect against soil erosion. They will be maintained throughout the lifespan of the Proposed Development, generally in accordance with the recommendations in the appropriate guidance.

- 8.10. This FRA and DS demonstrates that the Proposed Development will **not increase flood risk** away from the Application Site during the construction, operation and decommissioning phases. The Proposed Development is therefore considered to be acceptable in planning policy terms.

9. APPENDICES

APPENDIX A FIGURES:

- Figure 1: Watercourses and Photo locations
- Figure 2: Topographical Survey
- Figure 3: Planning Flood Map
- Figure 4: Outline SuDS Design
- Figure 5: Site Layout

APPENDIX B: PHOTO APPENDIX

APPENDIX C: FLOW OUTPUT