



Technical Appendix 4: Flood Risk and Drainage Scheme

Allington Lane Solar Farm

08/12/2023



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EXECUTIVE SUMMARY

- 4.1. This Flood Risk and Drainage Scheme (FRA-DS) has been carried out for the Proposed Development consisting of a c.35MWMW solar farm and associated infrastructure on lands at Allington Lane, Eastleigh, Hampshire, England.
- 4.2. The EA Mapping shows that a western section of Field 1 and northern section of Field 3 (See **Figure 24, Field Numbers** within the Planning Drawings) is located within Flood Zone 2 and 3, however only access tracks, panels, fences and CCTV will be located within those areas at risk. Panels can be classed as 'Water Compatible Development' providing they are raised above flood depth levels. Additionally, access tracks, fences and CCTV are classed as 'Water Compatible Development'. Electrical Infrastructure, such as inverters and the substation, is located within Flood Zone 1 only.
- 4.3. Hydraulic modelling was undertaken for the River Itchen and its tributaries in 2019 by JBA Consulting, who were commissioned by the Environment Agency (EA). This data was provided by the EA to help inform the flood depths within the Application Site. The areas shown to be at risk of flooding within the Application Site reach worst case flood depths of 0.4m in a 1 in 1000 year storm event. Therefore, as the panels will be pile driven and lifted above ground level by a minimum height of 0.8m there will be a sufficient freeboard between the panel and the flood water. As mentioned above, by having the panels located above the flood depths, they can be classified as 'Water Compatible Development. Along with access tracks, fences and CCTV.
- 4.4. In addition to fluvial and coastal flood risk, the EA also provide surface water flood maps. This indicated that there were some areas at risk of pluvial flooding, with a depth of up to 0.5m. However, only solar panels, fences, access tracks and CCTV will be located in these areas at risk of pluvial flooding. The panels will be pile driven and lifted above ground level by a minimum height of 0.8m and therefore any ponding will occur well beneath the lowest part of the panels. The maximum ponding depth is likely to be approximately 0.6m due to the topography of the area where the panels are located within the surface water flood zone.
- 4.5. The soil class within the Application Site is 2 and 4, these have a Standard Percentage Run-off (SPR) of 0.3 and 0.47 which suggests that they provide good and poor opportunity for infiltration, respectively. 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.
- 4.6. It has been demonstrated that the Proposed Development's impact on surface water runoff is minimal due to the small amount of impermeable infrastructure proposed (588.8m²). The QBar discharge rate of 0.3l/s (Solar) and <0.1l/s (other) was used to predict the extent of attenuation storage required to maintain greenfield run off rates which resulted in a requirement of 68m³ of storage.

Proposed Drainage Strategy

- 4.7. It is proposed to construct multiple filter drains / soakaways within the Application Site. The location of the soakaways have been chosen on the downward slope, before the surface water reaches the Hatch Green Brook or the Moorgreen brook. The intent is to capture any overland flow in the SuDS device, prior to releasing into the watercourses outlined above at greenfield run off rates.
- 4.8. The proposed filter drains / soakaways will have an overall length of approximately 854m, with a base width of 0.5m, a 1m design depth and a 0.15m freeboard. It will be filled with crushed rock with a void ratio of 20% and will provide a total storage volume of approximately 87.9m³
- 4.9. As the other infrastructure is concentrated within the southern section of Field 2, the majority of the soakaways have been placed within this area to ensure maximum surface water run-off is captured.
- 4.10. In total, proposed drainage strategy will provide a storage volume of 87.9m³. This is greater than the volume of additional runoff generated as a result of the impermeable buildings (68.0m³). It is therefore considered that this not only adequately mitigates the increase in flow rates as a result of the minor increase in impermeable area but provides significant improvement.
- 4.11. The SuDS features will be implemented during the construction phase of the Proposed Development and the swales 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.
- 4.12. Additional drainage measures to be implemented on-site include the following:
- Solar Panels: Current grass cover is to be retained or reinstated adjacent to and under panels in order to maximise bio-retention;
 - Access Tracks: Access tracks are to be unpaved and constructed from local stone. Swales or similar shall be utilised to collect runoff from access tracks, where required, however these will be designed at the detailed design stage. Where swales are utilised, check dams formed from gravels and other excavated material shall be placed in the swale at frequent intervals; and,
 - Inverter Substations, Spare Part Containers, etc: Filter strips will surround the concrete bases of the ancillary buildings to capture any runoff from the roofs. This will be discharged to a percolation area or into the sites drainage network where it is close enough. Should surface water accumulate around any of these locations then a simple soakaway can be constructed to allow water soak into the underlying subsoils.

- 4.13. 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.

INTRODUCTION

Background

- 4.14. Neo Environmental Ltd has been appointed by Locogen Ltd (the “Applicant”) to undertake a Flood Risk Assessment (“FRA”) and Drainage Scheme (“DS”) for a proposed solar farm (the “Proposed Development”) on lands at Allington Lane, Eastleigh, Hampshire, England (the “Application Site”).

Development Description

- 4.15. The Proposed Development will consist of the construction of PV panels mounted on metal frames, new access tracks, underground cabling, perimeter fencing with CCTV cameras and access gates, a temporary construction compound and all ancillary grid infrastructure and associated works.

Site Description

- 4.16. The Application Site lies at an elevation of approximately 7-17m AOD and covers a total area of c. 37 hectares. It is centred at approximate UK National Grid Reference (NGR) E 447754 N 116809 and the nearest town of Eastleigh is located c.0.74km northwest of the Proposed Development, with the city of Southampton located approximately 2km to the south, at its closest point. The Application Site is situated in a rural setting, surrounded by villages and settlements within the nearby area. The villages of Horton Heath, Fair Oak, Bishopstoke, and West End are situated c. 0.54km east, c.0.68km north, c.1.43km northwest, c.1.3km south, respectively.
- 4.17. The Application Site comprises of seven fields of agricultural land which is split into two sections, southwest and northeast, by a railway line situated c.10m from the Proposed Development boundary. The fields are bound by a mixture of mature trees, hedgerows and post-and-wire fencing, with woodland to the adjacent south-west and south-east. .
- 4.18. The Proposed Development is located 1.25km north of the M27 motorway and other A and B roads such as the B3354, B3037, and the A335 which are situated c. 1.24km south, c.0.92 east, c.1.3km north, and c.1.89km northwest, respectively. Local roads include Hogwood Lane, which is located adjacent to the southern boundary, and Allington Lane which runs north-south through the north-eastern section, . The site will be accessed from Hogwood Lane to the south (‘Route A’) and from Allington Lane (‘Route B’) to the north, as discussed in the accompanying Traffic and Transport Assessment.
- 4.19. The surrounding area includes the River Itchen, which at its nearest point is located c.0.51km northwest, and flows into a small water body located c. 8m south, and the Itchen Valley Country Park, situated c. 0.32km southwest. A series of local industrial units are located on

the southwestern adjacent boundary and Chalcroft Business Park is located 260m southeast of the Proposed Development. Southampton Airport is located c. 1.84km west of the Application Site. The Proposed Development lies northwestern to the adjacent, consented Chalcroft Solar Park (Ref: 12/71539).

Scope of Report

- 4.20. 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.
- 4.21. This Flood Risk Assessment has been prepared in accordance with National Planning Policy Guidelines.
- 4.22. This report is supported by the following figures and appendices:
- Appendix 4A Figures:
 - Figure 4.1: Watercourses with Photo Locations;
 - Figure 4.2: Topographical Survey
 - Figure 4.3: Flood Map for Planning
 - Figure 4.4: Surface Water Flood Map
 - Figure 4.5: Outline Drainage Design
 - Appendix 4B: Photo Appendix
 - Appendix 4C: Flow Output (Solar Farm)
 - Appendix 4D: Flow Output (other)

Statement of Authority

- 4.23. This Flood Risk Assessment (FRA) has been produced by 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.

LEGISLATION

4.24. 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 (NPPF), 2023⁷

Review of Local Plan Policy

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 (2023). National Planning Policy Framework. Available at : <https://www.gov.uk/government/publications/national-planning-policy-framework--2>

Eastleigh Borough Local Plan 2016 - 2036

- 4.25. The Eastleigh Borough Local Plan⁸ was adopted on 25th April 2022 and is the adopted plan at present.

Table 4 - 1: Local Plan Flood Management Policies/Objectives (key points summarised)

Planning Policy/Objective	Comment
Policy DM3 – Adaption to Climate Change <i>“1. All development should be designed to adapt to the predicted climate change impacts for the Borough.</i> <i>a. To reduce the potential impacts of surface water flooding, sustainable drainage systems need to be implemented as part of an integrated SuDS strategy for the site in accordance with policy DM6 (Sustainable surface water management and watercourse management) and as part of the landscape framework for the site including green open space and green roofs where appropriate.”</i>	A Drainage Scheme has been undertaken to ensure the sustainable drainage systems are used.
Policy DM5 – Managing Flood Risk <i>“1. Development will only be permitted within the areas at risk of flooding, now and in the future, as identified on the Environment Agency most recent flood maps and the Council’s Strategic Flood Risk Assessment provided that:</i> <i>a. it meets the sequential and exception test (where required) as outlined in Government guidance;</i> <i>b. a site-specific flood risk assessment demonstrates that the development, including the access, will be safe without increasing flooding elsewhere, and where possible, will reduce flood risk overall;</i> <i>c. the scheme incorporates flood protection, flood resilience and resistance measures appropriate to the character and biodiversity of the area and the specific requirements of the site and where appropriate takes</i>	A Flood Risk Assessment has been undertaken to ensure the Proposed Development remains operational during times of a flood and to ensure flooding does not increase elsewhere as a result of the Proposed Development. SuDS are being implemented as a result of the Drainage Scheme.

⁸ Eastleigh Borough Local Plan 2016 – 2036. Available at <https://www.eastleigh.gov.uk/planning-and-building/planning-policy-and-implementation/local-plan/local-plan-adoption>

<i>advantage of opportunities to utilise natural flood management techniques;</i> <i>d. appropriate flood warning and evacuation plans are in place; and</i> <i>e. new site drainage systems are designed taking account of events which exceed the normal design standard.</i> <i>2. Development should not increase flooding elsewhere.</i> <i>3. Sustainable Drainage Systems (SuDS) must be designed in accordance with policy DM6.”</i>	
Policy DM6 – Sustainable Surface Water Management and Watercourse Management <i>“1. New development (excluding extensions to dwellings and changes of use), will only be permitted if it incorporates Sustainable Drainage Systems (SuDS). Wherever feasible, naturalised filtration should be included within the treatment train as follows:</i> <i>a. On sites of 1 hectare or more, or within 100m of the River Itchen SAC or Solent Maritime SAC, SuDS schemes should include at least three forms of naturalised filtration. On sites within 100m of headwaters and tributaries draining into a SAC, SuDS schemes should include at least three forms of naturalised filtration unless hydrological studies and project-level Habitats Regulations Assessment demonstrate this to be unnecessary to protect the integrity of the SAC and its qualifying features;</i> <i>b. On other sites of between 0.5 hectares and 1 hectare, SuDS schemes should include at least two forms of naturalised filtration; and</i> <i>c. On other sites of less than 0.5 hectares non-naturalised SuDS e.g. permeable paving will be considered where justified.</i> <i>2. In order to reduce flooding and maintain water quality (in accordance with DM8) SuDS schemes should:</i> <i>a. be designed and monitored in accordance with the CIRIA C753 SuDs Manual or equivalent national or local</i>	This policy has been followed during the preparation of the Drainage Scheme.

<i>guidance, noting that all receiving waters in the Borough should be classified as protected waters;</i> <i>b. manage surface water runoff as close to its source as possible;</i> <i>c. ensure that discharge rates are reduced as far as possible and that on greenfield sites these should at least mirror greenfield rates before development;</i> <i>d. be provided as part of any application for outline or full planning permission;</i> <i>e. where discharge is to a wetland or wet woodland habitat, flows off site must mirror the natural hydrological pathways;</i> <i>f. include clear arrangements for their whole life management and maintenance.</i> <i>3. Where a watercourse is present on a development site, it should be retained or restored into a natural state and enhanced where possible. The culverting of any watercourse will not generally be permitted, and development should wherever possible remove any existing culverts and increase onsite flood storage. Development should be laid out to enable maintenance of the watercourse.</i> <i>4. Where development drains into a waterway connected to the Natura 2000 or Ramsar network a site specific Construction Environment Management Plan must be prepared before permission."</i>	
Policy DM7 – Flood Defences, Land Reclamation and Coast Protection <i>"1. Development proposals on the coast of Southampton Water, the River Hamble estuary and in other areas at risk of fluvial or surface water flooding should:</i> <i>a. not give rise to the need for additional flood risk management or coast protection works beyond those proposed in the approved management plans*; and/or</i> <i>b. provide or contribute to the costs of works needed to protect the site as set out in the management plans*; and</i>	This policy has been considered within the Flood Risk Assessment and Drainage Scheme.

<i>c. have regard to watercourse ownership and long-term management.</i> <i>Flood defence and coast protection works will be permitted provided that they accord with the approved management plans*.</i> <i>2. Land reclamation will not be permitted unless it can be demonstrated that it will not:</i> <i>a. impede the movement of craft or otherwise compromise navigational safety on the coast or river; or</i> <i>b. disrupt existing recreational uses or areas where there is existing or proposed public access; or</i> <i>c. adversely affect the nature conservation, landscape or heritage value of the coast or river.</i> <i>*The approved management plans are:</i> <i>• the North Solent Shoreline Management Plan;</i> <i>• the Environment Agency's Catchment Flood Management Plan and;</i> <i>• the Local Flood Risk Management Strategy and the Eastleigh Borough Surface Water Management Plan."</i>	
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Strategic Flood Risk Assessment (SFRA)⁹

- 4.26. Partnership for Urban South Hampshire instructed Atkins to undertake a Level 1 SFRA in 2007. This updated SFRA builds on the 2007 version whilst updating the flood data used to outline the flood extents. The assessments are based upon historic flood records, hydraulic modelling data and the EA's Flood Map for Planning. The assessment outlines the fluvial and pluvial flood zones; however, these refer to the Environment Agency mapping and therefore these will be used in this report to delineate the flood zones.

⁹ Partnership for Urban South Hampshire (2016), Strategic Flood Risk Assessment, Available at <https://www.eastleigh.gov.uk/media/3456/push-flood-risk-assessment-update-2016.pdf>

METHODOLOGY

- 4.27. Flood planning policy and guidance for England is contained within the National Planning Policy Framework 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”*

- 4.28. 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.

- 4.29. 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 - 2: 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.					

- 4.30. The sequential test compares the Application Site with other available sites, with the aim to develop on areas of land which are at a lower risk of flooding.
- 4.31. When applying the sequential test, should the site still be located within Flood Zones 2 and 3 then any flood risk assessment should consider the following:
- What other locations with a lower risk of flooding have you considered for the proposed development?
 - If you have not considered any other locations, what are the reasons for this?
 - Explain why you consider the development cannot reasonably be located within an area with the lowest probability of flooding (flood zone 1); and, if your chosen site is

within flood zone 3, explain why you consider the development cannot reasonably be located in flood zone 2.

- As well as flood risk from rivers or the sea, have you taken account of the risk from any other sources of flooding in selecting the location for the development?

4.32. Where a 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. For the exception test to be passed it should be demonstrated that:

- the development would provide wider sustainability benefits to the community that outweigh the flood risk; and
- the development will be safe for its lifetime, taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

4.33. 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.

4.34. 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. The following questions should be answered in all proposals:

- What are the existing surface water drainage arrangements for the site?
- If known, what (approximately) are the existing rates and volumes of surface water run-off generated by the site?

- What are the proposals for managing and discharging surface water from the site, including any measures for restricting discharge rates? For major developments (eg of 10 or more homes or major commercial developments), and for all developments in areas at risk of flooding, sustainable drainage systems should be used, unless demonstrated to be inappropriate.
- How will you prevent run-off from the completed development causing an impact elsewhere?
- Where applicable, what are the plans for the ongoing operation and/or maintenance of the surface water drainage systems?

BASELINE CONDITIONS

- 4.35. This section presents the information gathered on the existing topographical, geological, hydrological and hydrogeological conditions of the Application Site and its immediate surroundings.
- 4.36. A site walkover survey was also undertaken in order to identify hydrological, geological, flood risk and drainage features within the Application Site. A photographic record of drainage features is contained within **Appendix 4B** and the photo locations can be seen in **Figure 4.1 of Appendix 4A**.

Topography

- 4.37. A topographical survey was undertaken at the Application Site (see **Figure 4.2 Appendix 4A**). The lowest point within the Application Site (9.01m AOD) is on the western boundary of Field 1, whilst the high point (21.79m AOD) is located centrally within Field 7. Generally, there is a slope down in a western direction across the Application Site, with an exception in Field 7 where it slopes east from the high point aforementioned.
- 4.38. **Appendix 4B** shows various pictures of the drains that run along the boundaries and within the Application Site.

Geology & Soil

- 4.39. The geological conditions of the Application Site were identified utilising the British Geological Society ("BGS") Spatial Resources online geological mapping¹⁰ system. This indicated that the Application Site is wholly underlain by Wittering Formation – Sand, Silt and Clay. Wittering Formation formed between 56 and 41.2 million years ago during the Palaeogene period. This is overlain by Alluvium in sections of Field 1, 2 and 3. Alluvium formed between 11.8 thousand years ago and the present during the Quaternary period.
- 4.40. There are numerous borehole records in the area which confirm that clay is found at least 0.5m below ground level.

¹⁰ BGS Geoindex Onshore., Available at https://mapapps2.bgs.ac.uk/geoindex/home.html?_ga=2.106208195.1172329656.1659960824-1947403049.1659960824

Soil

- 4.41. Different soil types have different capabilities of soaking up water, the efficiency of which is dependent upon the structure and infiltration capacity. The Soilsclapes¹¹ map has been utilised to obtain soil data. It classes the soil at the Application Site as *'Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils'*.
- 4.42. According to the Wallingford Procedure 'Winter Rain Acceptance Potential' (WRAP) map¹², the soil classification for the site is Class 2 (SPR of 0.3) in Field 1 - 3. Whilst the soil is Class 4 (SPR of 0.47) in Field 4 - 7.

Hydrology

- 4.43. According to the Environment Agency Catchment Data Explorer¹³, the Application Site lies within the South East Basin District. Within this, the site lies in the Itchen Operational Catchment. The site is within the catchment of the River Itchen.
- 4.44. The Application Site itself contains field drains which empty into the Moorgreen Brook and Hatch Grange Brook before eventually joining the River Itchen, which has an overall classification of "Good" under the Water Framework Directive (WFD).

Local River Network

- 4.45. The Moorgreen Brook is located approximately 0.05km east of Field 7 in the Application Site. This runs in a northern direction before flowing in a western direction to converge with the River Itchen approximately 1.01km northwest of the Application Site.
- 4.46. The Hatch Grange Brook is located approximately 0.05km west of Field 1 in the Application Site. This runs in a northwest direction before converging with the River Itchen approximately 0.5km west of the Application Site.
- 4.47. The River Itchen meets the River Test to form the Southampton Water Estuary, approximately 8.4km southwest of the Application Site, which flows into the Solent and eventually empties into the English Channel.

¹¹ Cranfield Soil and Agrifood Institute, Soilsclapes website. Available at <http://www.landis.org.uk/soilsclapes/>

¹² HR Wallingford. Greenfield Runoff Estimation for the Sites. Available at: <https://www.uksuds.com/tools/greenfield-runoff-rate-estimation>

¹³ Environment Agency, Catchment Data Explorer, Available at <https://environment.data.gov.uk/catchment-planning>

Internal Watercourses

- 4.48. The drains that run through the Application Site between fields will drain all surface water of the Proposed Development to the River Ithcen through the river network outlined above.

Flood Zone Classification

- 4.49. The Environment Agency (EA) Flood Map for Planning¹⁴ shows that most of the Application Site is located within Flood Zone 1. There is however an area of Flood Zone 2 and 3 within the western area of Field 1 and northern areas of Field 2 and 3, an area described as “*high probability*” of flooding in **Table 1: Flood Zones** of the “*Planning Practice Guidance to the National Planning Policy Framework*”, which dissects the two fields of the Application Site.
- 4.50. Flood Zone 3 is categorised as being the highest flood risk and comprises land assessed as having a 1 in 100 or greater annual probability of river flooding or land having a 1 in 200 or greater annual probability of sea flooding, see **Figure 4.3: Appendix 4A**.

Historic Flooding

- 4.51. The Environment Agencies historic flood map¹⁵ is a GIS layer showing the maximum extent of individual recorded flood outlines from rivers, 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 extents.
- 4.52. A review of the Strategic Flood Risk Assessments covering the area has identified that there are no specific records of flooding for the Application Site.

Hydrogeology

- 4.53. The Application Site does not lie within any Source Protection Zones (SPZ).

Groundwater Vulnerability

- 4.54. 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.

¹⁴ Environment Agency Flood Map For Planning. Available at: <https://flood-map-for-planning.service.gov.uk/>

¹⁵ Environment Agency, Historic Flood Outlines, Available at <https://environment.data.gov.uk/DefraDataDownload/?mapService=EA/HistoricFloodMap&Mode=spatial>

- 4.55. According to the Environment Agency Groundwater Vulnerability Maps, the majority of the Application Site is contained within an area of 'Medium' groundwater vulnerability. Sections of Field 4 and 5 lie within an area of 'Low' groundwater vulnerability.

FLOOD RISK ASSESSMENT

Sequential Test

- 4.56. 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, LPA's 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

- 4.57. The EA Mapping (see **Figure 4.3: Appendix 4A**) shows that a western section of Field 1 and northern section of Field 3 is located within Flood Zone 2 and 3, however only access tracks, panels, fences and CCTV will be located within those areas at risk. Panels can be classed as 'Water Compatible Development' providing they are raised above flood depth levels. Additionally, access tracks, fences and CCTV are classed as 'Water Compatible Development'. Electrical Infrastructure, such as inverters and the substation, is located within Flood Zone 1 only.
- 4.58. Hydraulic modelling was undertaken for the River Itchen and its tributaries in 2019 by JBA Consulting, who were commissioned by the Environment Agency (EA). This data was provided by the EA to help inform the flood depths within the Application Site. The areas shown to be at risk of flooding within the Application Site reach worst case flood depths of 0.4m in a 1 in 1000 year storm event. Therefore, as the panels will be pile driven and lifted above ground level by a minimum height of 0.8m there will be a sufficient freeboard between the panel and the flood water. As mentioned above, by having the panels located above the flood depths, they can be classified as 'Water Compatible Development. Along with access tracks, fences and CCTV.
- 4.59. Therefore, according to **Table 4 – 2**, 'Water Compatible Development' is acceptable within Flood Zones 2 and 3. All electrical infrastructure, except as small number of panels which are raised above the flood zone, is located within Flood Zone 1, which according to **Table 4 – 2** is deemed appropriate.

- 4.60. The proposed type of development is classed as 'Essential Infrastructure' and therefore development in Flood Zone 2 and 3 is deemed appropriate as long as there is safe operation during times of flooding, which has been proven to be the case.

Pluvial Flood Risk

- 4.61. In addition to fluvial and coastal flood risk, the EA also provide surface water flood maps¹⁶, see **Figure 4.4: Appendix 4A**. This indicates some small areas of surface water flooding at various points across the Application Site.
- 4.62. **Figure 4.2: Appendix 4A** shows the topographical survey of the Application Site. This indicated that there were some areas at risk of pluvial flooding, with a depth of up to 0.5m. However, only solar panels, fences, access tracks and CCTV will be located in these areas at risk of pluvial flooding. The panels will be pile driven and lifted above ground level by a minimum height of 0.8m and therefore any ponding will occur well beneath the lowest part of the panels. The maximum ponding depth is likely to be approximately 0.6m due to the topography of the area where the panels are located within the surface water flood zone.

Groundwater Flood Risk

- 4.63. 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.
- 4.64. 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 those for pluvial flooding and below the lowest part of the panel.
- 4.65. Based on the above, the risk of flooding from groundwater to the Proposed Development is low.

Access/Egress

- 4.66. The access points into the site will be from Allington Lane and Hogwood Lane. All surface waters should be directed into the site, with no overland flow from the Proposed Development areas reaching the public highway.

¹⁶ EA Check Long Term Flood Risk: <https://check-long-term-flood-risk.service.gov.uk/map>

DRAINAGE SCHEME

Introduction

- 4.67. 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.
- 4.68. 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

- 4.69. Catchment characteristics were obtained from the Flood Studies Report¹⁷. Catchment sizes were measured using ArcGIS and catchment boundaries were produced based on the site-specific topographical survey.

Greenfield Runoff and Stormwater Storage

- 4.70. Greenfield runoff rates and stormwater storage requirements have been obtained using the following tools:
- HR Wallingford UK Sustainable Drainage Greenfield Runoff Estimation Tool (using IH124¹⁸ 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.

¹⁷ Institute of Hydrology, Flood Studies Report (1975)

¹⁸ Institute of Hydrology (1994). *Flood estimation for small catchments. Report No IH124*, Wallingford.

Greenfield Runoff rates

- 4.71. The IH24 methodology is used for calculating the Greenfield runoff rates. This is recommended by the Institute of Hydrology for catchments below 200ha.
- 4.72. 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

- 4.73. The storage estimates are calculated using the inputs below:
- Return Period
 - Climate Change
 - Impermeable Area
 - Peak Discharge
- 4.74. 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

- 4.75. The Proposed Development will have a very limited extent of impermeable ground cover. The area beneath the solar panels will remain as grassland and the post-development site infiltration rate will not change.

- 4.76. Rainwater falling onto each panel will drain freely onto the ground beneath the panels and infiltrate the ground at the same rate as it does in the site's existing greenfield state. Thus, the total surface area of the photovoltaic array is not considered an impermeable area.
- 4.77. Similarly, any rainwater falling onto the permeable access tracks will soak into the ground beneath at the same rate that it presently does.
- 4.78. The extent of impermeable area created as a result of the Proposed Development is summarised in **Table 4-3**.

Table 4 - 3: Extent of less permeable areas created by the Proposed Development

Building	Solar Farm Total Area (m ²)	Other (m ²)
6 x Inverter, Switchgear and Transformer buildings (7.5m(L) x 2.9m(W), 5.25m(L) x 3.75m(W) and 3.75(L) x 2.25(W))	299.3	N/A
2 x Storage Containers (12.0m(L) x 2.5m(W))	60.0	N/A
1 x DNO Substation (8m(L) x 4.2m(W))	33.6	N/A
1 x Customer Substation (12.0m(L) x 4.0m(W))	48.0	N/A
1 x Communication Building (4.0m(L) x 4.0m(W))	16.0	N/A
1 x Storage Building (4.0m(L) x 4.0m(W))	16.0	N/A
4 x PCSK (3.0m(L) x 2.0m(W))	N/A	24.0
2 x Transformer Switchgear Units (5.4m(L) x 2.4m(W))	N/A	25.9
1 x HV Switchgear & Control Room (15.0m(L) x 3.2m(W))	N/A	48.0
1 x Meter Box (3.0m(L) x 3.0m(W))	N/A	9.0
1 x Auxiliary Transformer (3.0m(L) x 3.0m(W))	N/A	9.0

Total Impermeable Area (m ²)	472.9	115.9
Total Impermeable Area (m ²)	588.8	
Site Area (m ²)	370,000.0	

- 4.79. 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 588.8m² or 0.16% of the total site area.
- 4.80. Due to the small size of the inverter substations and equipment containers, and the widespread nature of their locations across the Application Site, it is impractical to connect them into a drainage scheme. Water runoff from these buildings will slowly drain into the underlying geology through infiltration and the impact of this will be **Negligible**. Should surface water accumulate around any of these locations, a simple soakaway can be constructed to allow water soak into the underlying subsoils.

Existing Drainage Arrangements

Existing Runoff Rates

- 4.81. The existing runoff rates and hydrological characteristics of the Proposed Development are detailed in **Table 4-4** below (there are no hardstanding areas on the site at present).

Table 4 - 4: Pre-Development Greenfield runoff rates.

Site Make Up	Solar Farm Green Field	Other Green Field
Greenfield Method	IH124	IH124
Positively Drained Area (ha)	0.05	0.01
Seasonally Adjusted Annual Rate (SAAR) (mm)	800	800
Soil Index	4	2
Standard Percentage Runoff	0.47	0.3
Region	7	7
	Runoff rate (l/s)	Runoff rate (l/s)
QBar	0.3	<0.1
1 year	0.2	<0.1
1 in 30 year	0.6	<0.1
1 in 100 year	0.7	<0.2

- 4.82. The limiting discharge rate will be the QBar greenfield rate, as detailed in **Table 4-4**.

Post Development Runoff Rate

- 4.83. 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.
- 4.84. Surface water runoff was derived using the Modified Rational Method as outlined within the methodology.

- 4.85. 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 **32m³**, across the Proposed Development, if left unmanaged.

Proposed Drainage Arrangements

- 4.86. The SuDS Manual¹⁹ 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.

- 4.87. The use of SuDS is generally accepted to have greater benefits than conventional drainage systems and these include²⁰:

- 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).

- 4.88. 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

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

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

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.

- 4.89. 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.
- 4.90. 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

- 4.91. 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 4C and 4D**. 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.

Table 4 - 5: Storage Estimates

Storage Estimates		
	Solar Farm	Other
Return Period (years)	100 years	100 years
Climate Change (%)	40	40

Impermeable Area (ha)	0.05	0.01
QBar Peak Discharge (l/s)	0.3	0.1
Total storage Requirement (m ³)	41.0	9.0

Proposed Drainage Strategy

- 4.92. It is proposed to construct multiple filter drains / soakaways within the Application Site (**Figure 4.4: Appendix 4A**). The location of the soakaways have been chosen on the downward slope, before the surface water reaches the Hatch Green Brook or the Moorgreen brook. The intent is to capture any overland flow in the SuDS device, prior to releasing into the watercourses outlined above at greenfield run off rates.
- 4.93. The proposed filter drains / soakaways will have an overall length of approximately 879m, with a base width of 0.5m, a 1m design depth and a 0.15m freeboard. It will be filled with crushed rock with a void ratio of 20% and will provide a total storage volume of approximately 87.9m³
- 4.94. As the other infrastructure is concentrated within the southern section of Field 2, the majority of the soakaways have been placed within this area to ensure maximum surface water run-off is captured.
- 4.95. In total, proposed drainage strategy will provide a storage volume of 87.9m³. This is greater than the volume of additional runoff generated as a result of the impermeable buildings (50.0m³). It is therefore considered that this not only adequately mitigates the increase in flow rates as a result of the minor increase in impermeable area but provides significant improvement.
- 4.96. The SuDS features will be implemented during the construction phase of the Proposed Development and the swales 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.
- 4.97. The proposed discharge points are into various existing field drains and can be viewed on **Figure 4.4: Appendix 4A**.
- 4.98. Additional drainage measures to be implemented on-site include the following:
- Solar Panels: current grass cover is to be retained or reinstated adjacent to and under panels in order to maximise bio-retention;
 - Access Tracks: access tracks are to be unpaved and constructed from local stone. Swales or similar shall be utilised to collect runoff from access tracks, where required, however these will be designed at the detailed design stage. Where swales are utilised,

check dams formed from gravels and other excavated material shall be placed in the swale at frequent intervals; and,

- Inverter Substations, Spare Part Containers, etc: Filter strips will surround the concrete bases of the ancillary buildings to capture any runoff from the roofs. This will be discharged to a percolation area or into the sites drainage network where it is close enough. Should surface water accumulate around any of these locations then a simple soakaway can be constructed to allow water soak into the underlying subsoils.

Designing for Exceedance Events

- 4.99. 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).
- 4.100. 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 and watercourses. There are no sensitive receptors between the Application Site and the field drains.

Long Term Maintenance of SuDS

- 4.101. 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;
 - If poor infiltration is observed then any accumulated silt/litter will be removed and aeration of the soil will be undertaken to improve permeability; and
 - Maintain the structural integrity of the infiltration trenches/ attenuation structure.

Potential for Soil Erosion

- 4.102. The key to avoiding increased runoff and the transport of soil into watercourses is to maintain soil permeability and vegetative cover. Permeable land surfaces underneath and between panels should be able to absorb rainfall as long as they are not compacted and there is some vegetation to bind the soil surface.
- 4.103. Soil compaction will be limited during construction and operation of the solar farm. During construction, only light machinery will be required to install the solar arrays. Any Heavy Goods

Vehicles (HGVs) delivering components will be restricted to site access tracks and the temporary construction compounds.

- 4.104. To alleviate the effects of any limited compaction during the construction process any affected areas will be harrowed prior to being reseeded.
- 4.105. The risks of runoff and soil erosion are lowest on land with a gradual gradient with cohesive soils and are highest on dry, sandy and steeply sloping soil surfaces. Furthermore, the slope aspect of the land can also have an effect on runoff rates and soil erosion. The aspect of static solar panels in England will mostly always be south-facing and, therefore, north or south facing slopes will result in runoff flowing in a parallel direction to that of the runoff from the panels; thereby remaining relatively diffuse and unlikely to result in concentrated flows that could cause soil erosion, apart from where very steep slopes occur.
- 4.106. With regard to the Proposed Development, most of the fields of the Application Site are relatively flat with only a gentle gradient. The orientation of the solar panels could concentrate surface water flow in some areas of the Application Site and increase the risk of soil erosion. However, due to the low gradient across these fields, the likelihood of increased overland flow or soil erosion occurring is considered to be **Low**. The addition of the soakaways on the downstream boundary of the fields with the steeper gradients will reduce the risk of soil erosion on these fields and reduce any risk of water quality issues on any downstream watercourses or agricultural land.

SUMMARY & CONCLUSIONS

- 4.107. The FRA and DIA requirements are set out by the National Planning Policy Framework and Planning Policy Guidance.
- 4.108. The Guidance aims to avoid inappropriate development in flood zones and instead direct it to areas of low risk by adopting a sequential approach.
- 4.109. The EA Mapping shows that a western section of Field 1 and northern section of Field 3 is located within Flood Zone 2 and 3, however only access tracks, panels, fences and CCTV will be located within those areas at risk. Panels can be classed as 'Water Compatible Development' providing they are raised above flood depth levels. Additionally, access tracks, fences and CCTV are classed as 'Water Compatible Development'. Electrical Infrastructure, such as inverters and the substation, is located within Flood Zone 1 only.

- 4.110. Hydraulic modelling was undertaken for the River Itchen and its tributaries in 2019 by JBA Consulting, who were commissioned by the Environment Agency (EA). This data was provided by the EA to help inform the flood depths within the Application Site. The areas shown to be at risk of flooding within the Application Site reach worst case flood depths of 0.4m in a 1 in 1000 year storm event. Therefore, as the panels will be pile driven and lifted above ground

level by a minimum height of 0.8m there will be a sufficient freeboard between the panel and the flood water. As mentioned above, by having the panels located above the flood depths, they can be classified as 'Water Compatible Development. Along with access tracks, fences and CCTV.

- 4.111. In addition to fluvial and coastal flood risk, the EA also provide surface water flood maps. This indicated that there were some areas at risk of pluvial flooding, with a depth of up to 0.5m. However, only solar panels, fences, access tracks and CCTV will be located in these areas at risk of pluvial flooding. The panels will be pile driven and lifted above ground level by a minimum height of 0.8m and therefore any ponding will occur well beneath the lowest part of the panels. The maximum ponding depth is likely to be approximately 0.6m due to the topography of the area where the panels are located within the surface water flood zone.
- 4.112. The soil class within the Application Site is 2 and 4, these have a Standard Percentage Run-off (SPR) of 0.3 and 0.47 which suggests that they provide good and poor opportunity for infiltration, respectively. 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.
- 4.113. It has been demonstrated that the Proposed Development's impact on surface water runoff is minimal due to the small amount of impermeable infrastructure proposed (588.8 m²). The QBar discharge rate of 0.3l/s (Solar) and <0.1l/s (other) was used to predict the extent of attenuation storage required to maintain greenfield run off rates which resulted in a requirement of 50m³ of storage.

Proposed Drainage Strategy

- 4.114. It is proposed to construct multiple filter drains / soakaways within the Application Site. The location of the soakaways have been chosen on the downward slope, before the surface water reaches the Hatch Green Brook or the Moorgreen brook. The intent is to capture any overland flow in the SuDS device, prior to releasing into the watercourses outlined above at greenfield run off rates.
- 4.115. The proposed filter drains / soakaways will have an overall length of approximately 854m, with a base width of 0.5m, a 1m design depth and a 0.15m freeboard. It will be filled with crushed rock with a void ratio of 20% and will provide a total storage volume of approximately 87.9m³
- 4.116. As the other infrastructure is concentrated within the southern section of Field 2, the majority of the soakaways have been placed within this area to ensure maximum surface water run-off is captured.
- 4.117. In total, proposed drainage strategy will provide a storage volume of 87.9m³. This is greater than the volume of additional runoff generated as a result of the impermeable buildings

(50.0m³). It is therefore considered that this not only adequately mitigates the increase in flow rates as a result of the minor increase in impermeable area but provides significant improvement.

- 4.118. The SuDS features will be implemented during the construction phase of the Proposed Development and the swales 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.
- 4.119. Additional drainage measures to be implemented on-site include the following:
- Solar Panels: Current grass cover is to be retained or reinstated adjacent to and under panels in order to maximise bio-retention;
 - Access Tracks: Access tracks are to be unpaved and constructed from local stone. Swales or similar shall be utilised to collect runoff from access tracks, where required, however these will be designed at the detailed design stage. Where swales are utilised, check dams formed from gravels and other excavated material shall be placed in the swale at frequent intervals; and,
 - Inverter Substations, Spare Part Containers, etc: Filter strips will surround the concrete bases of the ancillary buildings to capture any runoff from the roofs. This will be discharged to a percolation area or into the sites drainage network where it is close enough. Should surface water accumulate around any of these locations then a simple soakaway can be constructed to allow water soak into the underlying subsoils.
- 4.120. 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.

APPENDICES

Appendix 4A Figures:

- Figure 4.1: Watercourses with Photo Locations;
- Figure 4.2: Topographical Survey
- Figure 4.3: Flood Map for Planning
- Figure 4.4: Surface Water Flood Map
- Figure 4.5: Outline Drainage Design

Appendix 4B: Photo Appendix

Appendix 4C: Flow Output (Solar Farm)

Appendix 4D: Flow Output (other)



Appendix 4B: Hydrology Photos



Photo 1 – Low point in Field 2 where flood zone is displayed



Photo 2 – Culvert under drain crossing



Photo 3 – Depression in ground within Field 2 where surface water may accumulate



Photo 4 – Large surface water pond on northern boundary of Field 4



Photo 5 – Overgrown vegetation with depression near to the centre of Field 6



Photo 6 – Field 7 slopes down towards the Moorgreen brook on the eastern boundary



Photo 7 – Low point on southeast boundary of Field 7



Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	30	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Simulation Settings

Rainfall Methodology	FSR	Drain Down Time (mins)	240
FSR Region	England and Wales	Additional Storage (m³/ha)	0.0
M5-60 (mm)	20.000	Check Discharge Rate(s)	✓
Ratio-R	0.400	1 year (l/s)	0.2
Summer CV	0.750	30 year (l/s)	0.6
Winter CV	0.840	100 year (l/s)	0.7
Analysis Speed	Normal	Check Discharge Volume	✓
Skip Steady State	x	100 year +40% 360 minute (m³)	23

Storm Durations

15 | 30 | 60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	0	0	0
100	40	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.95
Greenfield Method	IH124	Growth Factor 100 year	2.48
Positively Drained Area (ha)	0.050	Betterment (%)	0
SAAR (mm)	800	QBar	0.3
Soil Index	4	Q 1 year (l/s)	0.2
SPR	0.47	Q 30 year (l/s)	0.6
Region	7	Q 100 year (l/s)	0.7
Growth Factor 1 year	0.85		

Pre-development Discharge Volume

Site Makeup	Greenfield	Return Period (years)	100
Greenfield Method	FSR/FEH	Climate Change (%)	40
Positively Drained Area (ha)	0.050	Storm Duration (mins)	360
Soil Index	4	Betterment (%)	0
SPR	0.47	PR	0.525
CWI	120.000	Runoff Volume (m³)	23

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	30	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Simulation Settings

Rainfall Methodology	FSR	Drain Down Time (mins)	240
FSR Region	England and Wales	Additional Storage (m³/ha)	0.0
M5-60 (mm)	20.000	Check Discharge Rate(s)	✓
Ratio-R	0.400	1 year (l/s)	0.1
Summer CV	0.750	30 year (l/s)	0.1
Winter CV	0.840	100 year (l/s)	0.2
Analysis Speed	Normal	Check Discharge Volume	✓
Skip Steady State	x	100 year +40% 360 minute (m³)	9

Storm Durations

15 | 30 | 60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440

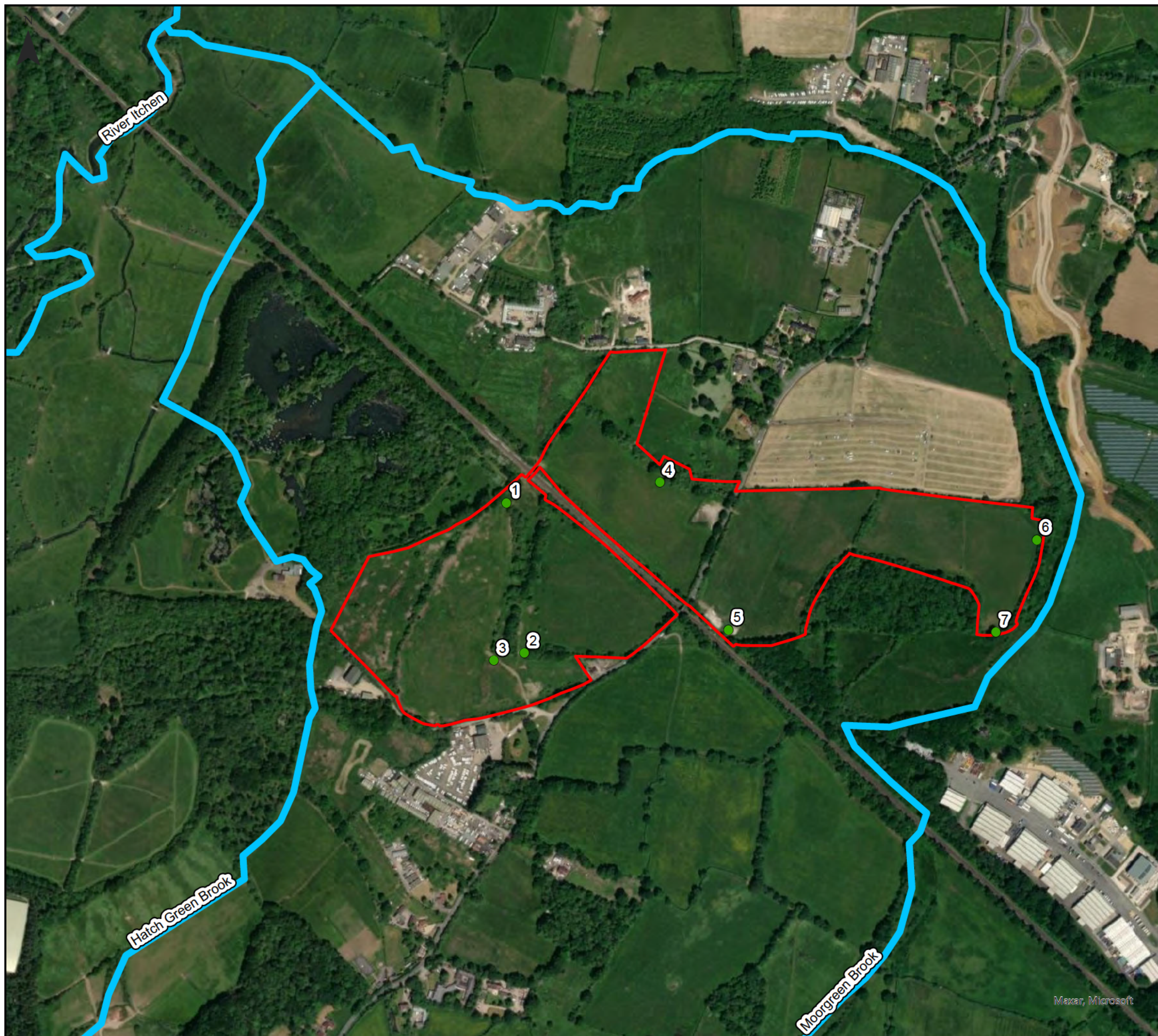
Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	0	0	0
100	40	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.95
Greenfield Method	IH124	Growth Factor 100 year	2.48
Positively Drained Area (ha)	0.030	Betterment (%)	0
SAAR (mm)	800	QBar	0.1
Soil Index	2	Q 1 year (l/s)	0.1
SPR	0.30	Q 30 year (l/s)	0.1
Region	7	Q 100 year (l/s)	0.2
Growth Factor 1 year	0.85		

Pre-development Discharge Volume

Site Makeup	Greenfield	Return Period (years)	100
Greenfield Method	FSR/FEH	Climate Change (%)	40
Positively Drained Area (ha)	0.030	Storm Duration (mins)	360
Soil Index	2	Betterment (%)	0
SPR	0.30	PR	0.355
CWI	120.000	Runoff Volume (m³)	9

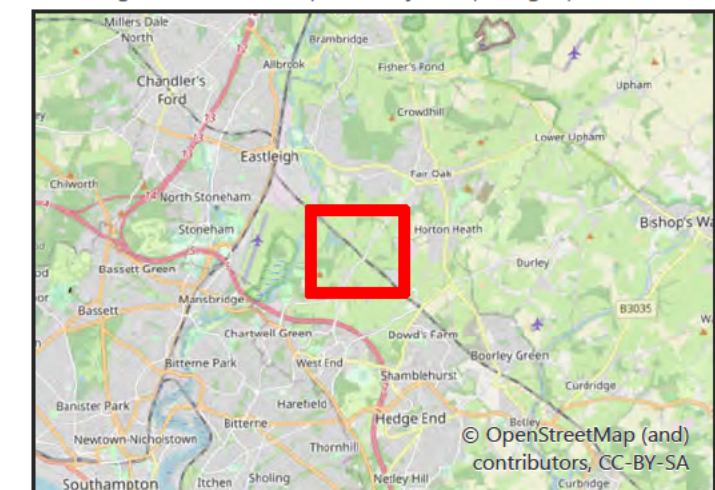


Allington Solar Farm
Watercourses and
Photo Locations
Figure 4.1

Key

- Development Boundary
- Photo Locations
- Watercourses

Neo Office Address:
Wright Business Centre, 1 Lonmay Road, Glasgow, G33 4EL



Date: 22/11/2023
Drawn By: Tom Saddington
Scale (A3): 1:7,000
Drawing No: NEO01041/012/A



Flood Map for Planning (Rivers and Sea) Centred on Grid Ref: 447893, 116817

Created 30 May 2023



1: 10,000

0 Metres 250



Flood Map for Planning (Rivers & Sea)

- Defences
- Flood Storage Areas
- Flood Zone 3
- Flood Zone 2

Flood Map Areas (assuming no defences)

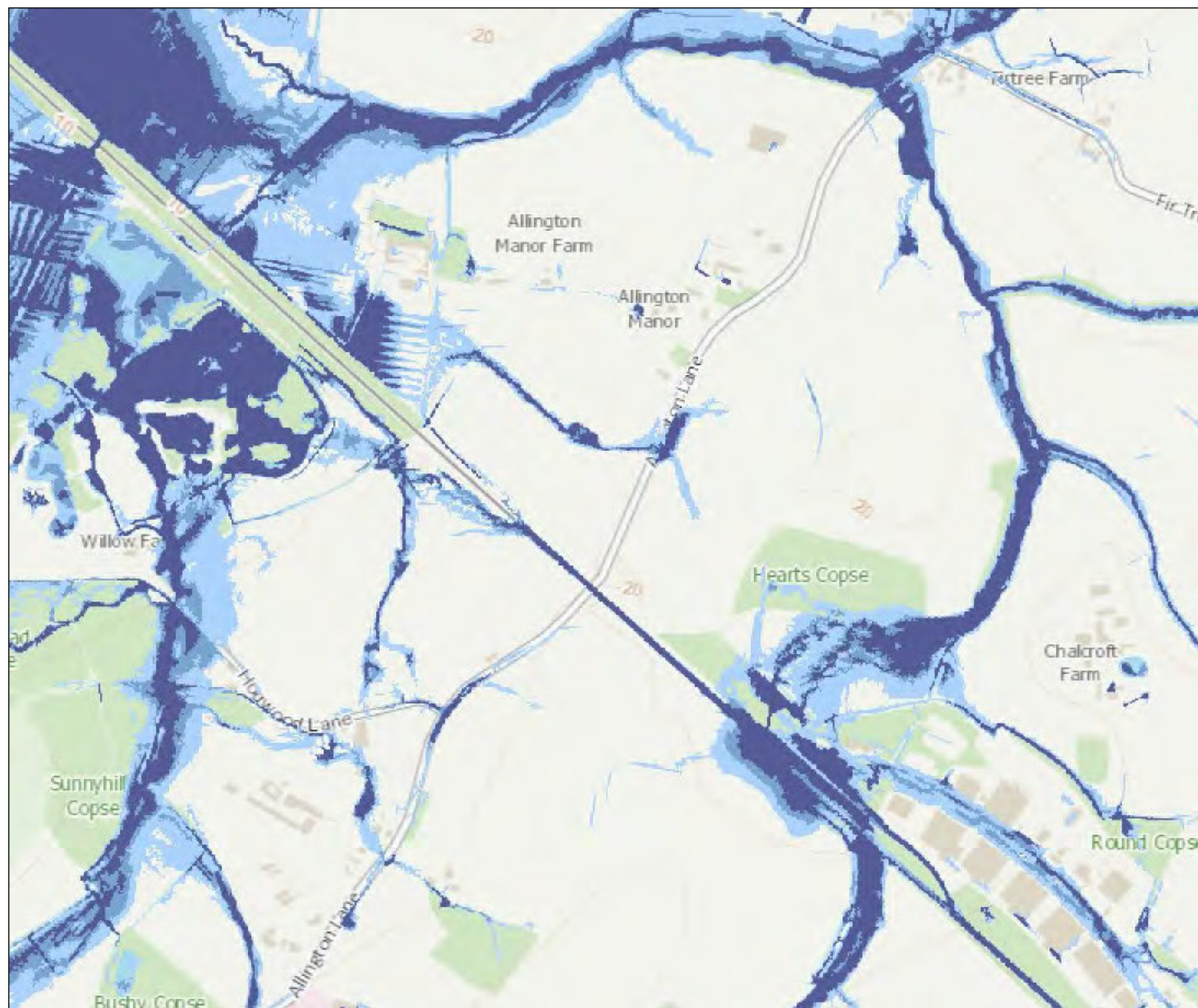
Flood Zone 3 shows the area that could be affected by flooding:

- from the sea with a 1 in 200 or greater chance of happening each year
- or from a river with a 1 in 100 or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to a 1 in 1000 chance of occurring each year.

Risk of flooding from Surface Water Centred on Grid Ref: 447893, 116817

Created 30 May 2023



1: 10,000

0 Metres 250



Likelihood of flooding from Surface Water

- High ($\geq 3.3\%$)
- Medium (3.3% - 1%)
- Low (1% - 0.1%)
- Very Low
- Flood Extent 1 in 30
- Flood Extent 1 in 100
- Flood Extent 1 in 1000

Likelihood of flooding from Surface Water

- High:** Greater than or equal to 3.3% (1 in 30) chance in any given year
- Medium:** Less than 3.3% (1 in 30) but greater than or equal to 1% (1 in 100) chance in any given year
- Low:** Less than 1% (1 in 100) but greater than or equal to 0.1% (1 in 1,000) chance in any given year
- Very Low:** Less than 0.1% (1 in 1,000) chance in any given year

This information is shown on the Risk of Flooding from Surface Water map on GOV.UK.

1m Depth Soakaway

1m Depth Soakaway

Key

- Development Boundary
- Security Fence
- Access Track
- Inverters
- Construction Compound
- Panels
- Soakaways

Drawn By: James Greenan
Address: Wright Business Centre
1 Lonmay Road
Glasgow
G33 4EL

Ver.	Date	Comments

A 23/11/2023

neo
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Project:	Allington Solar Farm
Client:	Locogen
Drawing:	Outline SuDs Design
Project No.:	NEO01041
Drawing No.:	NEO01041_0131_A Figure 4.5
Drawn:	JM
Checked:	MM
Approved:	PN
Scale:	1: 2000 @ A1
Revision:	
Date:	23 November 2023
	A

