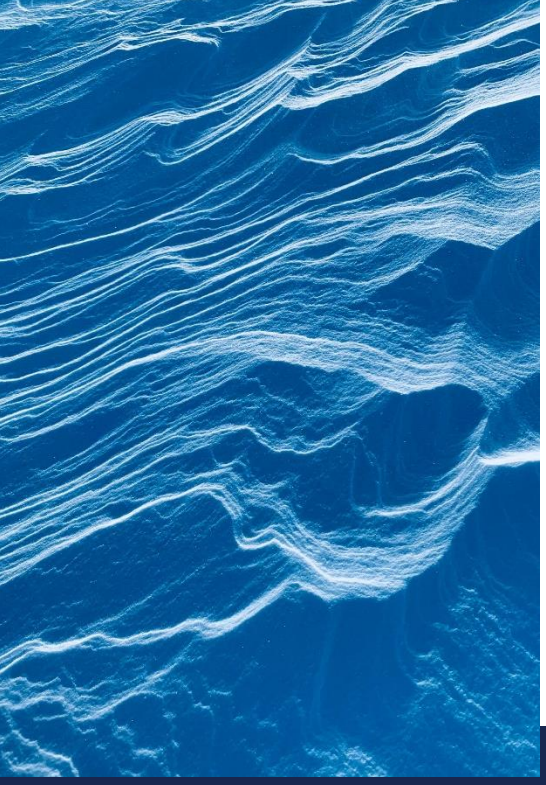


aegaea

Flood risk, water and environment

Flood Risk Assessment and Surface Water Drainage Strategy

AEG02105_BB12_Burnley_07

Site Address: Crow Wood Hotel

Holme Road

Burnley

BB12 0RT

UK Experts in Flood Modelling, Flood Risk Assessments, and Surface Water Drainage Strategies

aegaea

Flood risk, water and environment

Document Issue Record

Project: Flood Risk Assessment and Surface Water Drainage Strategy

Prepared for: Kirkwells Ltd

Reference: AEG02105_BB12_Burnley_07

Site Location: Crow Wood Hotel, Holme Road, Burnley, BB12 0RT

Consultant		Date	Signature
Author	Ahmed Alwaal	11/04/2023	
Document Check	Oliver Harvey	17/04/2023	
Authorisation	Nick Darling-Drewett	17/04/2023	

Please Note:

aegaea

Flood risk, water and environment

Table of Contents

aegaea

Flood risk, water and environment

Summary

Development Description	Existing	Proposed
Development Type	A greenfield site	Creation of a solar farm
EA Vulnerability Classification	N/A	Essential Infrastructure
Ground Level	LiDAR data shows that the ground elevations of the development site vary between approximately 100.82m AOD and 106.16m AOD.	No change
Surface Water Drainage	N/A[1]	Recommended to provide swales/ infiltration trenches parallel to the rows of panels to provide attenuation and promote some infiltration compared to existing. Given nature of solar panels being raised above existing soft landscaping, runoff rates should not increase post-development. But the swales/ trenches are proposed to provide a betterment over the existing situation.
Site Size	Approx. 1.5 ha	No change
Risk to Development	**Summary**	**Comment**
EA Flood Zone	Flood Zone 1	
Flood Source	N/A	Site considered to be at low risk from all sources
SFRA Available	Burnley Council Level 1 Strategic Flood Risk Assessment (Burnley Council, 2017)	
Management Measures	**Summary**	**Comment**
Development level above extreme flood levels	Yes	Site considered to be at low risk from all sources

Safe Access/Egress Route	N/A[1]	Site considered to be at low risk from all sources. It is expected that site will be unmanned, and thus safe access/ egress not considered significant.
Flood Resilient Design	N/A[1]	Site considered to be at low risk from all sources.
Site Drainage Plan	N/A[1]	Recommended to provide swales/ infiltration trenches parallel to the rows of panels to provide attenuation and promote some infiltration compared to existing.
Flood Warning & Evacuation Plan	N/A[1]	It is expected that site will be unmanned, and thus safe access/ egress not considered significant.
Offsite Impacts	**Summary**	**Comment**
Displacement of floodwater	Negligible	Solar panels will be raised above external ground levels on frames, which should not result in significant displacement of flood water.
Increase in surface run-off generation	N/A[1]	N/A[2]
Impact on hydraulic performance of channels	Negligible	Nearest watercourse approximately 133m from site

[1] not required for this assessment.

[2] data not available.

1. Introduction

1.1. Aegaea were commissioned by Kirkwells Ltd to undertake a Flood Risk Assessment (FRA) and Surface Water Drainage Strategy (SWDS) to facilitate a planning application for the proposed development. This FRA has been prepared in accordance with the requirements set out in the National Planning Policy Framework (NPPF) and the associated Planning Practice Guidance.

1.2. The FRA and SWDS are intended to support a full planning application and as such the level of detail included is commensurate and subject to the nature of the proposals.

Site Overview

1.3. The site of the proposed development is land to the rear of Crow Wood Hotel, Holme Road, Burnley, BB12 0RT (Figure 1).

Figure 1: Site Location (Base map and data from OpenStreetMap and OpenStreetMap Foundation (CC-BY-SA). © https://www.openstreetmap.org and contributors)

1.4. The existing site is a greenfield site, and it forms part of the overall land ownership of the Crow Wood complex.

1.5. The proposed development is for the construction of a solar farm. It comprises a ground mounted solar farm together with associated equipment and infrastructure. It is anticipated that the delivered capacity of the solar farm would be around 1.121MW. The solar farm will consist of Photovoltaic (PV) arrays based on simple metal framework, pile driven into the ground, site boundary fencing, and associated access tracks connecting the site to the access road.

1.6. In the absence of a topographical survey, Environment Agency Light Detection and Ranging (LiDAR) data Digital Terrain Model (1m resolution) has been used to review the topography of the site. Analysis of the 1m LiDAR data shows that the ground elevation of the site varies between approximately 100.82m AOD and 106.16m AOD. Analysis of the topographic levels indicates that the site generally slopes towards the northeast (Figure 2).

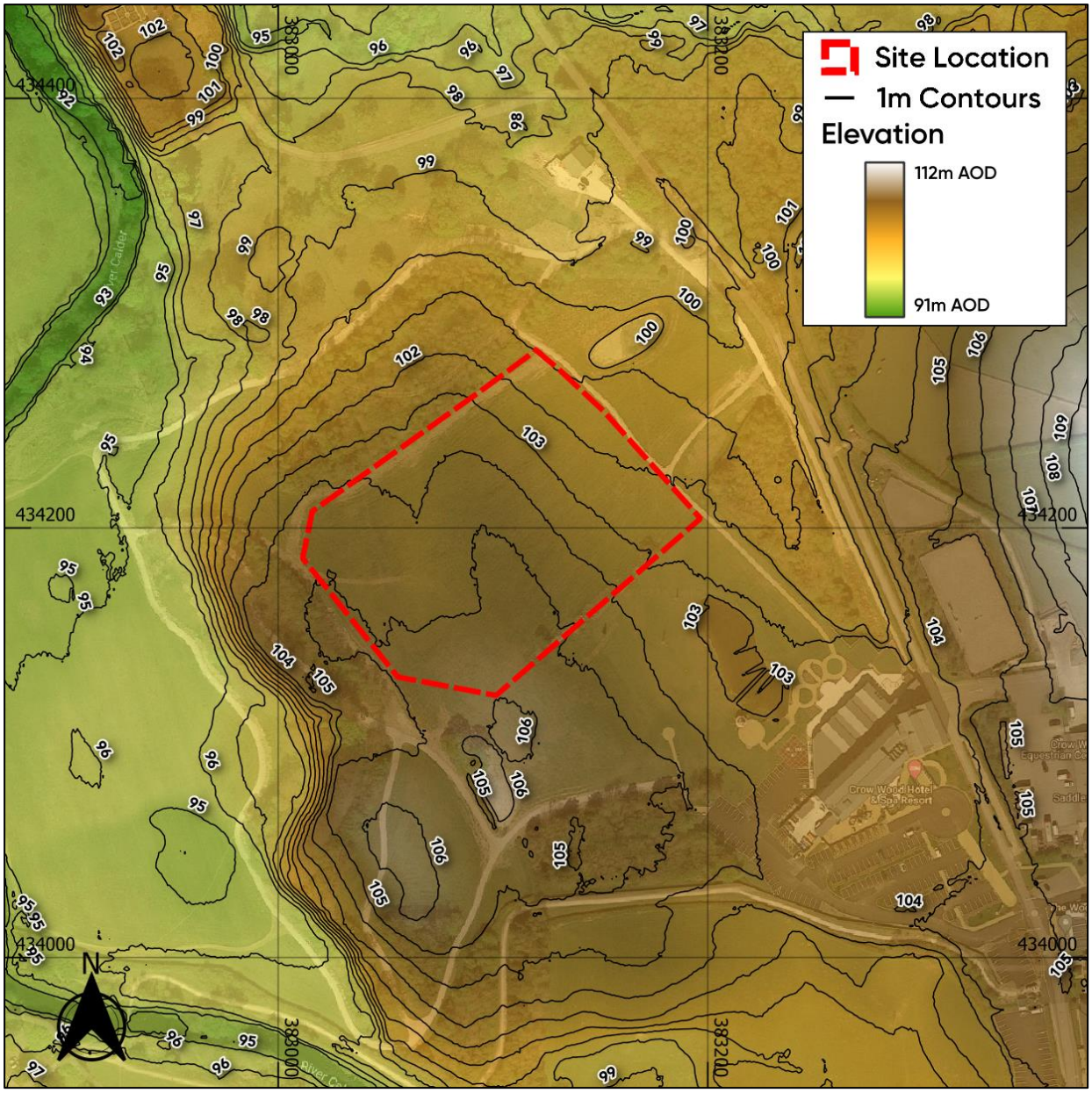


Figure 2: Site Topography (© Environment Agency, Base map, and data from OpenStreetMap and OpenStreetMap Foundation (CC-BY-SA) © https://www.openstreetmap.org and contributors).

1.7. Burnley Council is the Local Planning Authority (LPA) for the site, and Lancashire County Council is the designated Lead Local Flood Authority (LLFA). The site sits within the Environment Agency's Cumbria and Lancashire region.

Planning Policy and Guidance

1.8. UK government planning guidance states[1] that an FRA is required for developments which are:

- *in flood zone 2 or 3 including minor development and change of use*
- *more than 1 hectare (ha) in flood zone 1*
- *less than 1 ha in flood zone 1, including a change of use in development type to a more vulnerable class (for example from commercial to residential), where they could be affected by sources of flooding other than rivers and the sea (for example surface water drains, reservoirs)*
- *in an area within flood zone 1 which has critical drainage problems as notified by the Environment Agency*

1.9. The site has an area greater than 1 hectare within Flood Zone 1, therefore the NPPF states that an FRA is required. Therefore, the NPPF states that an FRA is required.

1.10. The objective of this FRA is to demonstrate that the proposals are acceptable in terms of flood risk. This report summarises the findings of the study and specifically addresses the following issues in the context of the current legislative regime:

- Fluvial/ tidal flood risk
- Surface water flood risk
- Risk of flooding from other sources

[1] **https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications#when-you-need-an-assessment**

2. Planning Policy

2.1. Inappropriate development in a flood risk area could pose significant risk in terms of personal safety and damage to property for the occupiers of the development or for people elsewhere. The approach taken in the assessment of flood risk at the planning stage is set out in national, regional, and local planning policy and associated guidance. This section summarises the key policies and guidance relevant to the proposed development.

National Planning Policy Framework (NPPF)

2.2. The National Planning Policy Framework[2] (NPPF) (DLUHC, 2021) which includes UK Government policy on development and flood risk states:

> *"159. Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere.*
>
> *167. When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:*
>
> *a) 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;*
>
> *b) the development is appropriately flood resistant and resilient such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment;*
>
> *c) it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;*

[2] https://www.gov.uk/guidance/national-planning-policy-framework, **last updated July 2021**

d) *any residual risk can be safely managed; and*

e) *safe access and escape routes are included where appropriate, as part of an agreed emergency plan.*

169. Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:

a) *take account of advice from the lead local flood authority;*

b) *have appropriate proposed minimum operational standards;*

c) *have maintenance arrangements in place to ensure an acceptable standard o operation for the lifetime of the development; and*

d) *where possible, provide multifunctional benefits.*

2.3. Footnote 55 of the NPPF 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; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use."

2.4. Flood Zones in England are defined as follows:

Table 1: Flood Zone Definitions

Flood Zone	Definition
Zone 1 Low Probability	Land having less than 1 in 1,000 annual probability of river or sea flooding (all land outside Zones 2 and 3).
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding.
Zone 3a High Probability	Land 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.
Zone 3b The Functional Floodplain	This zone comprises land where water from rivers or the sea has to flow or be stored in times of flood. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. Functional floodplain will normally comprise: land having a 3.3% or greater annual probability of flooding, with any existing flood risk management infrastructure operating effectively; or land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as 0.1% annual probability of flooding). Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map)

2.5. An FRA should be appropriate to the scale, nature, and location of the development. It should identify and assess the risk from all sources of flooding to and from the development and demonstrate how any flood risks will be managed over the lifetime of the development.

2.6. An assessment of hydrological impacts should be undertaken, including to surface water runoff and impacts to drainage networks in order to demonstrate how flood risk to others will be managed following development and taking climate change into account.

Local Plan

2.7. The Local Plan (adopted: July 2018) prepared by the Local Planning Authority, Burnley Council, sets out the policies for development in the local area.

2.8. Policies CC4 and CC5 of Burnley Council Local Plan concern development and flood risk, and Surface Water Management and Sustainable Drainage System (SuDS) are replicated below.

Policy CC4: Development and Flood Risk

1) *The Council will seek to ensure that new development does not result in increased flood risk from any source or other drainage problems, either on the development site or elsewhere.*

2) *No development should take place within 8m of the top of the bank of a watercourse either culverted or open, unless this approach is supported by the Environment Agency or Lead Local Flood Authority. Proposals involving the creation of new culverts (unless essential to the provision of access) will not be permitted.*

3) *Culverts should be opened up where possible to improve drainage and flood flows.*

Sequential Test

4) *New development on sites not allocated for the use proposed in this Plan, or which do not comprise minor development or changes or use, should be located within Flood Zone 1 unless the Sequential Test as set out in the NPPF and NPPG has been satisfied.*

Exception Test

5) *Development in Flood Zones 2, 3a or 3b on allocated or unallocated sites will only be acceptable where it is of a compatible type as set out in the NPPG (Tables 2 and 3), satisfies the Exception Test set out in the NPPF and NPPG and meets criteria 6b ii) to vi) below.*

Site Specific Flood Risk Assessments

6) *Development proposals on allocated or unallocated sites:*

a) *of 1 hectare or greater in Flood Zone 1, or in an area within Flood Zone 1 which has critical drainage problems or includes an ordinary watercourse; or*

b) *in Flood Zones 2, 3a or 3b;*

should be supported by a site-specific Flood Risk Assessment taking account of the Council's Strategic Flood Risk Assessment (or the most up to date flood risk information available) along with any evidence from the Lead Local Flood Authority (Lancashire County Council), and the Environment Agency to establish whether the proposed development:

i. *is likely to be affected by current or future flooding from any source, taking into account the increased risk associated with climate change;*

ii. *will increase flood risk elsewhere or interfere with flood flows;*

iii. *can provide appropriate mitigation measures to deal with potential risks and effects;*

iv. *would be likely to preclude the future implementation of necessary flood risk measures, including the improvement of flood defences;*

v. *can reasonably maintain access and egress at times of flood; and*

vi. *can be accommodated within the capacity of the water supply, drainage and sewerage networks.*

7) *Where flood defences exist that protect development sites, any site-specific Flood Risk Assessment required should also assess the risk overtopping of defences in extreme events and possible breach analysis evidence.*

8) *Where mitigation is required to make any identified impacts acceptable, these will be secured through conditions and/or legal agreement, including where necessary through planning contributions.*

Policy CC5: Surface Water Management and Sustainable Drainage Systems (SuDS)

1) *In order to assist in minimising surface water run-off from sites:*

a) *Existing green infrastructure should be retained and integrated and where possible enhanced in line with Policy SP6; and*

b) *The use of permeable materials should be maximised.*

2) *Surface water should be managed at source and not transferred and discharged. The following order of priority for any water discharge should be adopted:*

a) *A permeable soakaway or some other form of infiltration system*

b) *An attenuated discharge to a watercourse*

c) *An attenuated discharge to surface water sewer*

d) *An attenuated discharge to combined sewer (this should be considered the last resort)*

3) *In respect of major developments, SuDS will be required and surface water discharges from developed sites should be restricted to QBar rates (mean annual greenfield peak flow). A drainage strategy should be submitted detailing the following:*

a) *The types of SuDS and/or measures;*

b) *Hydraulic design details/calculations;*

c) *Pollution prevention and water quality treatment measures together with details of pollutant removal capacity as set out in the current CIRIA SuDS Manual C753 or equivalent and updated local or national design guidance; and*

d) *The proposed management and maintenance regime for the lifetime of the development.*

Sequential and Exception Tests

2.9. The Sequential and Exception Tests are applied in specific cases defined by UK Government policy. Their purpose is to drive development to areas of low flood risk and to support developments which improve flood risk for developments in areas at risk of flooding.

2.10. Under the NPPF all new planning applications should undergo a Sequential Test unless a minor household development or a change of use application in accordance with paragraph 168 and footnotes 55 and 56. This test should be implemented by local planning authorities with a view to location particularly vulnerable new developments outside of the flood plain

Sequential Test

2.11. The proposals for development are located in Flood Zone 1 and based on the analysis in Section 4, the site is considered to be at low risk of flooding from all reviewed sources. As such, the site is already considered sequentially located and should not be subject to the Sequential Test.

Exception Test

2.12. The Exception Test is applied to sites based on the Flood Zone and the nature of the development. As the proposed development is for a solar farm, it would be classed as 'Essential Infrastructure' in line with government development use classes. Table 2 of the PPG *Flood Risk and Coastal Change* states the Exception Test is not required for 'Essential Infrastructure' development located in Flood Zone 1.

Summary

2.13. This flood risk assessment has been prepared with due consideration to the above local and national policy.

3. Consultation and Review

Documents and Online Mapping

3.1. Local Governments and Lead Local Flood Authorities provide documents which contain data and policies on flood risk and new development in their areas. These documents are introduced and briefly summarised below. For the purposes of this FRA, these documents have been reviewed for relevant information and any relevant data is discussed within the appropriate sub heading of this report.

3.2. The following sources of information have been reviewed for this assessment:

- Flood Map for Planning on the Environment Agency website *https://flood-map-for-planning.service.gov.uk/*
- Long Term Flood Risk Information on the Environment Agency website *https://www.gov.uk/check-long-term-flood-risk*
- National Planning Policy Framework (NPPF) (Department for Levelling Up, Housing and Communities, 2021)
- Planning Practice Guidance - Flood Risk and Coastal Change (Department for Levelling Up, Housing and Communities, 2022)
- Geoindex Onshore (British Geological Survey, 2022)
- Local Plan (Burnley Council, 2018)[3]
- Lancashire County Council Preliminary Flood Risk Assessment (Lancashire County Council, 2011)[4]
- Burnley Council Level 1 Strategic Flood Risk Assessment (Burnley Council, 2017)[5]

3 https://burnley.gov.uk/planning/planning-policies/burnleys-local-plan/
4 https://webarchive.nationalarchives.gov.uk/ukgwa/20140328094439/http://www.environment-agency.gov.uk/research/planning/135532.aspx#10
5 https://burnley.gov.uk/wp-content/uploads/2022/02/SFRA-Level-1-Report-March-2017-FINAL.pdf

- Lancashire County Council Local Flood Risk Management Strategy (Lancashire County Council, 2021-2027)[6]

Preliminary Flood Risk Assessment (PFRA)

3.3. The PFRA, published in 2011, is a high-level appraisal of flood risk across Lead Local Flood Authority Lancashire County Council. The flood risk from all sources, including fluvial, surface water, groundwater and surcharged sewers is evaluated. It is the basis upon which the Local Flood Risk Management Strategy is produced.

3.4. The PFRA summarises historical flood incidents in Lancashire County Council. The site is not recorded as having been affected by any flood event.

Strategic Flood Risk Assessment (SFRA)

3.5. The SFRA, published in 2017, provides the evidence base for the Local Planning Authority Burnley Council Local Plan and guidance for consideration when determining planning applications. The SFRA seeks to place new development into areas of lower flood risk taking into account current flood risk, future flood risk, and the effect a proposed development would have on the risk of flooding.

3.6. The SFRA mapping provided by Burnley Council has been used throughout production of this report as a source of information, particularly pertaining to historical flood incidents.

Local Flood Risk Management Strategy (LFRMS)

3.7. The Local Flood Risk Management Strategy (2021-2027) sets out roles and responsibilities for flood risk management, assesses the risk of flooding in the area, where funding can be found to manage flood risk, and the policies, objectives and actions of the Lead Local Flood Authority. The Lancashire County Council LFRMS is used within this report to identify any flood management infrastructure and historical incidences of flooding.

6 https://www.lancashire.gov.uk/media/928565/lancashire-flood-risk-management-strategy-2021-2027-final-v2.pdf

4. Sources of Flood Risk

Fluvial

4.1. Flooding from watercourses arises when flows exceed the capacity of the channel, or where a restrictive structure is encountered, resulting in water overtopping the banks into the floodplain.

Main Rivers and Ordinary Watercourses

4.2. The River Calder - confluence with Brun to Pendle Water is a Main River located approximately 133m northwest of the site, at its closest proximity. There are no other watercourses in the vicinity of the site.

4.3. The 'Leeds and Liverpool' Canal is located approximately 941m south of the site.

EA Flood Map for Planning

4.4. The EA Flood Map for Planning shows the site is located within Flood Zone 1 (low risk). Flood Zone 1 denotes a risk of flooding from fluvial sources less than 0.1% annually (Figure 3).

Figure 3: EA Flood Map for Planning (Base map and data from OpenStreetMap and OpenStreetMap Foundation (CC-BY-SA). © https://www.openstreetmap.org and contributors). Contains public sector information licensed under the Open Government Licence v3.0.)

4.5. However, the site is close to an area in Flood Zone 2 and 3 which is located to the west of the site. The risk of flooding in this area is from the River Calder.

Historical Fluvial Flooding

4.6. There is no record of historical fluvial flooding on site based on the EA's Recorded Flood Outlines dataset. However, there are records of historical fluvial flooding approximately 537m to the northwest of the site (Figure 4).

Figure 4: EA Historic Flood Mapping (Base map and data from OpenStreetMap and OpenStreetMap Foundation (CC-BY-SA). © https://www.openstreetmap.org and contributors). Contains public sector information licensed under the Open Government Licence v3.0.

Fluvial Flood Risk Summary

4.7. Based on the EA Flood Map for Planning, the site is considered to be at low risk from fluvial flooding.

Tidal

4.8. Tidal flooding occurs when a high tide and high winds combine to elevate sea levels. An area behind coastal flood defences can still flood if waves overtop the defences or break through them. Tidal flooding can also occur a long way from the coast by raising river levels. Water may overtop the riverbank or river defences when tide levels are high.

4.9. The site is a significant distance from any tidal source and above the anticipated extreme tidal levels, even when considering the impacts of climate change.

4.10. The risk of flooding from tidal sources is considered low.

Canals

4.11. The Canal and River Trust (CRT) generally maintains canal levels using reservoirs, feeders, and boreholes and manages water levels by transferring it within the canal system.

4.12. The site is approximately 941m from the Leeds and Liverpool Canal. As a controlled water body, the Canal itself does not pose a direct flood risk.

4.13. Water in a canal is typically maintained at predetermined levels by control weirs. When rainfall or other water enters the canal, the water level rises and flows out over the weir. If the level continues rising it will reach the level of the storm weirs. Control weirs and storm weirs are normally designed to take the water that legally enters the canal under normal conditions. However, it is possible for unexpected water to enter the canal or for the weirs to become obstructed. In such instances the increased water levels could result in water overtopping the towpath and flowing onto the surrounding land.

4.14. Flooding can occur where a canal is impounded above surrounding ground levels and the retaining structure fails.

4.15. Water levels within the canal will be maintained as described above, therefore flood risk from this source to the site is considered low.

Pluvial

4.16. Pluvial flooding can occur during prolonged or intense storm events when the infiltration potential of soils, or the capacity of drainage infrastructure is overwhelmed leading to the accumulation of surface water and the generation of overland flow routes.

4.17. Annual surface water flood risk is labelled by the EA as:

- 'High Risk'; >3.3% AEP (annual probability greater than 1 in 30).
- 'Medium Risk'; 1.1% to 3.3% AEP (annual probability between 1 in 100 and 1 in 30).
- 'Low Risk'; 0.1% to 1% AEP (annual probability between 1 in 1000 and 1 in 100).
- 'Very Low Risk'; <0.1% AEP (annual probability less than 1 in 1000).

4.18. Examination of the EA's surface water flood risk (RoFSW) mapping shows that approximately 95% of the site is at very low risk of flooding from surface water. However, there is a very small part to the southwest corner of the site is located within an area of low risk (Figure 5).

Figure 5: RoFSW - Extent (Base map and data from OpenStreetMap and OpenStreetMap Foundation (CC-BY-SA). © https://www.openstreetmap.org and contributors, EA RoFSW: © Environment Agency copyright and/or database right 2015. All rights reserved.)

4.19. The Risk of Flooding from Surface Water (RoFSW) dataset provided by Defra have been used to determine the pluvial flood risk to the site on a closer scale.

1 in 100 (1% AEP) event - Medium Risk and 1 in 1000 (0.1% AEP) event - Low Risk event

4.20. Analysis of the EA Surface Water Depth map for the modelled 'medium' risk event (equivalent to the 1 in 100 year event - 1% AEP) and 'low' risk event (equivalent to the 1 in 1000 year event - 0.1% AEP) in Figures 6 and 7 show that the majority of the site remains unaffected by flooding. However, there is a small, localised area to the southwest corner of the site which could experience flood depths up to 300mm. However, this is considered to be below the lower edge of the panels and thus the panels themselves would not be expected to be affected in these modelled events.

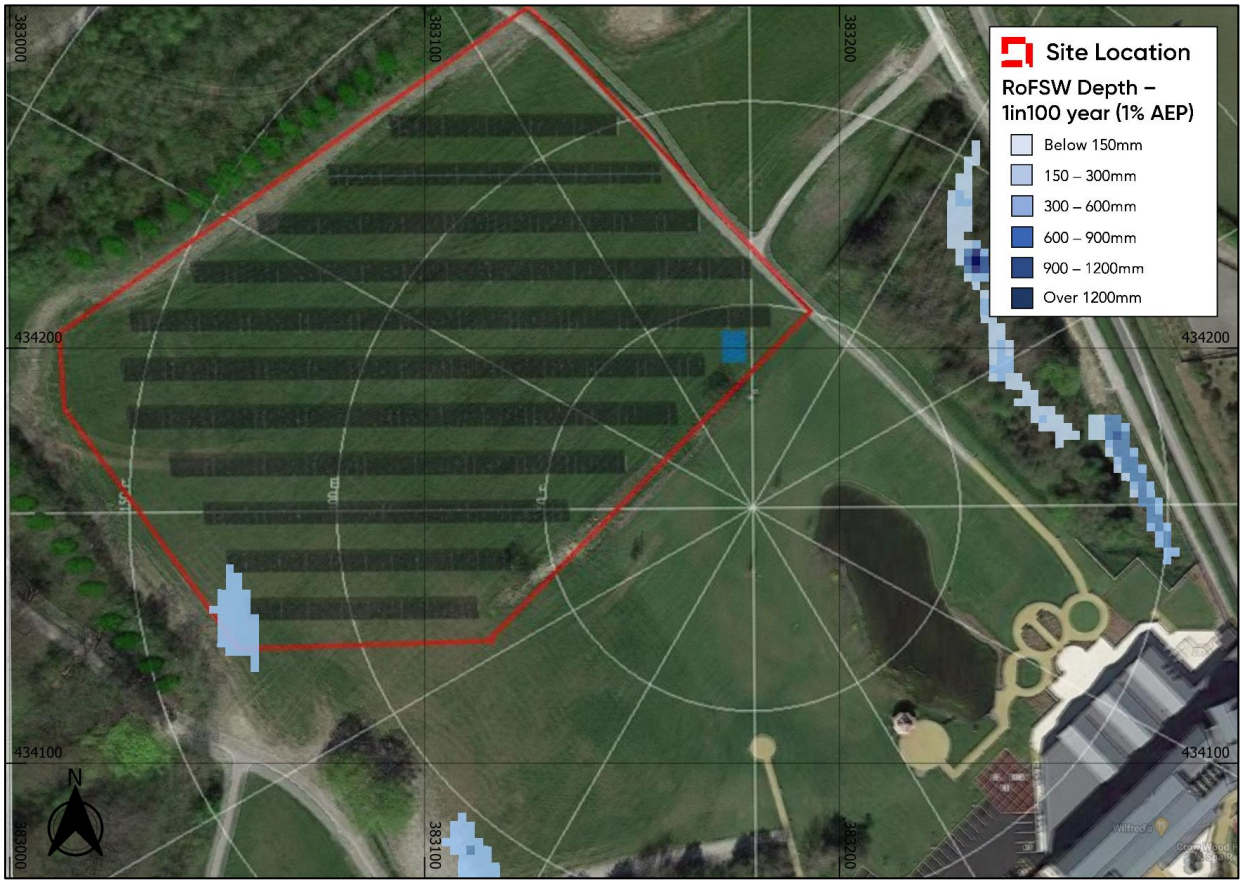


Figure 6: RoFSW, 1in100 Year Depths (Base map and data from OpenStreetMap and OpenStreetMap Foundation (CC-BY-SA). © https://www.openstreetmap.org and contributors, EA RoFSW: © Environment Agency copyright and/or database right 2015. All rights reserved.)

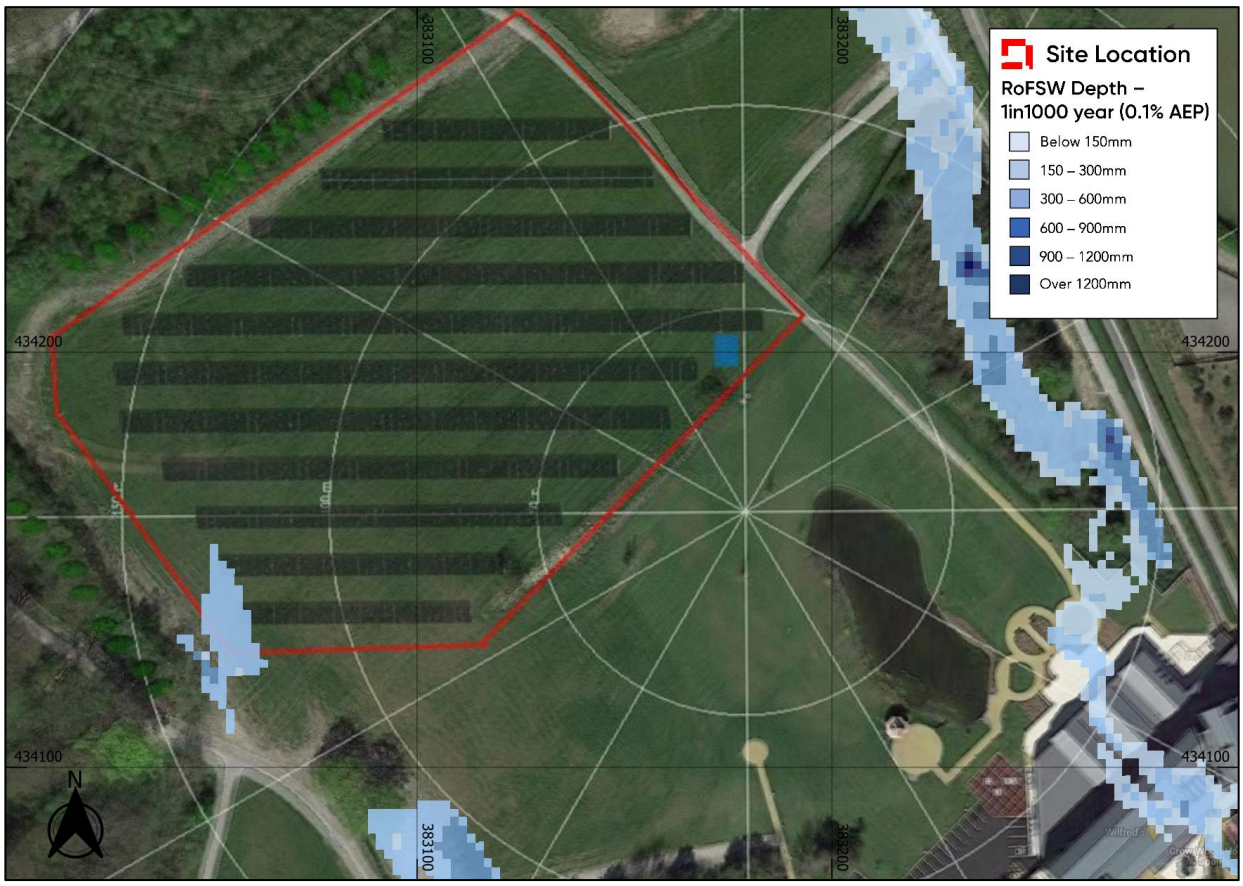


Figure 7: RoFSW, 1in1000 Year Depths (Base map and data from OpenStreetMap and OpenStreetMap Foundation (CC-BY-SA). © https://www.openstreetmap.org and contributors, EA RoFSW: © Environment Agency copyright and/or database right 2015. All rights reserved.)

Pluvial Flood Risk Summary

4.21. Based on the EA's RoFSW mapping, the proposed development is considered to be at low risk from pluvial flooding.

Reservoirs

4.22. Flooding can occur from large waterbodies or reservoirs if they are impounded above the surrounding ground levels or are used to retain floodwater. Although unlikely, reservoirs and large waterbodies could overtop or breach leading to rapid inundation of the downstream floodplain.

4.23. According to the EA's Flood Risk from Reservoirs mapping the site is outside flood extents in the event of reservoir flooding (Figure 8).

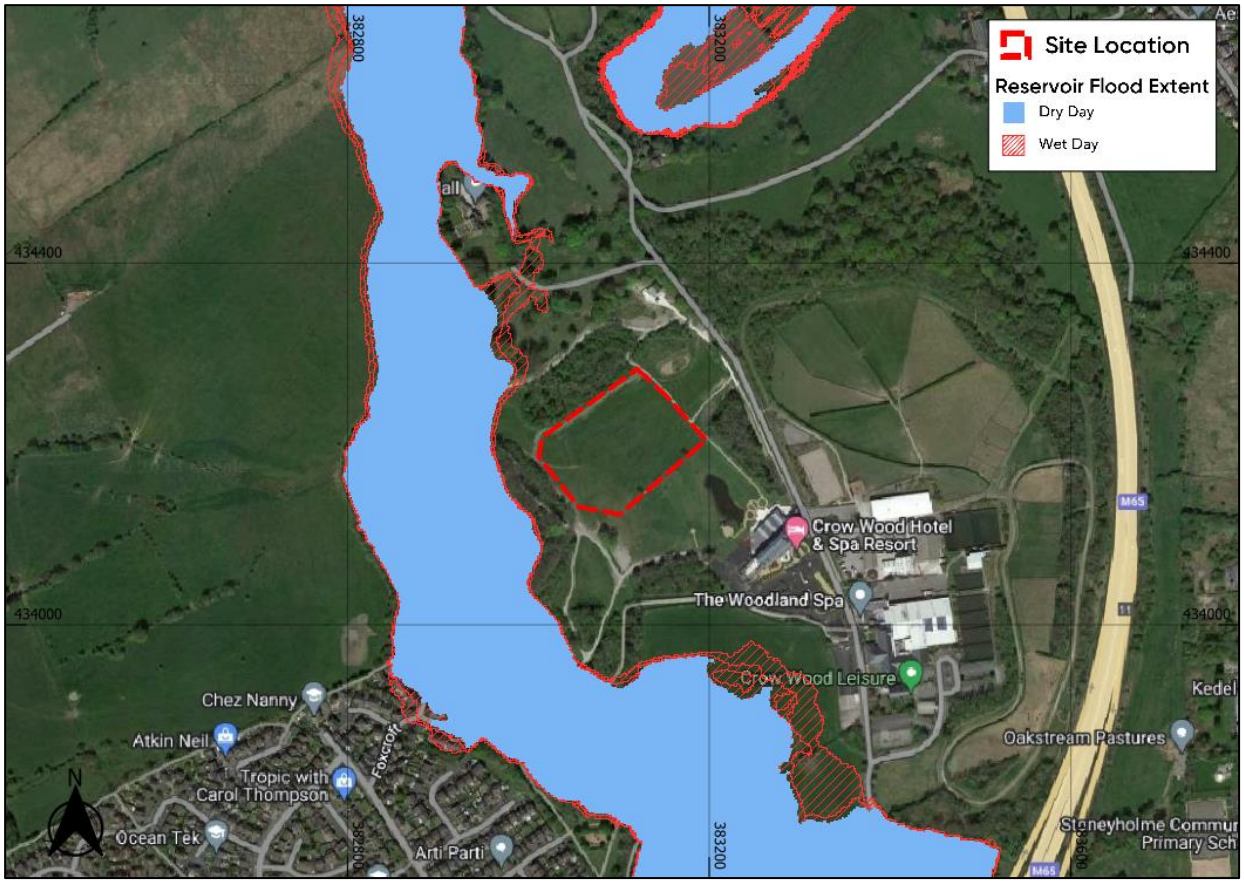


Figure 8: EA Reservoir Flood Risk Mapping. Base map and data from OpenStreetMap and OpenStreetMap Foundation (CC-BY-SA). © https://www.openstreetmap.org and contributors. © Environment Agency copyright and/or database right 2015. All rights reserved).

Groundwater

4.24. Groundwater flooding occurs in areas where underlying geology is permeable, and water can rise within the strata sufficiently to breach the surface.

4.25. The British Geological Survey's (BGS) mapping shows superficial deposits of Till, Devensian - Diamicton underlying the site. The bedrock underlying the site is Pennine Lower Coal Measures Formation - Mudstone, Siltstone and Sandstone.

4.26. Historic BGS online borehole records were reviewed and the nearest borehole (Ref: SD83SW51) is approximately 162m southwest of the site. No groundwater strikes were recorded within the borehole.

4.27. The PFRA presents the EA's Areas Susceptible to Groundwater Flooding mapping. The map shows that the site is not at risk of flooding from groundwater (Figure 9).

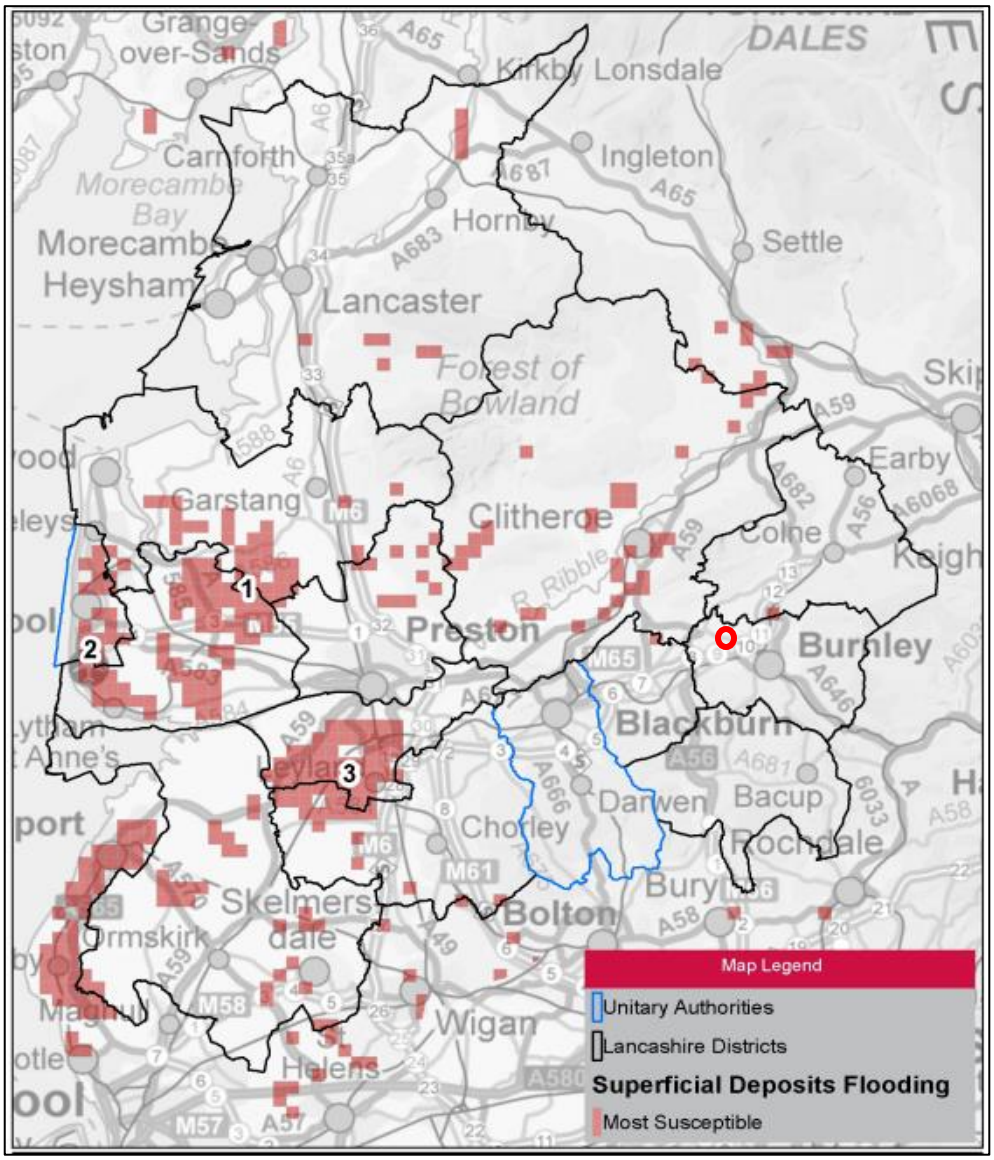


Figure 9: PFRA Areas Susceptible to Groundwater Flooding - Source: Preliminary Flood Risk Assessment (Lancashire Council, 2011). Site approx. location in red circle

4.28. The risk from groundwater to the development is considered to be low.

Sewers

4.29. Foul or surface water sewers can be a cause of flooding if the drainage network becomes overwhelmed, either by blockage or due to local development beyond the designed capabilities of the drainage system.

4.30. The site is greenfield and is not expected to contain significant sewer infrastructure to pose a risk to the site.

4.31. The PFRA provides mapping of artificial infrastructure flood incident records kept by the local authority, which is understood to include sewers. No artificial infrastructure flooding incidents have been recorded in the vicinity of the site (Figure 10).

4.32. Local policy documentation does not identify the site as being in a Critical Drainage Area.

4.33. The development is therefore considered to be at low risk of flooding from sewers.

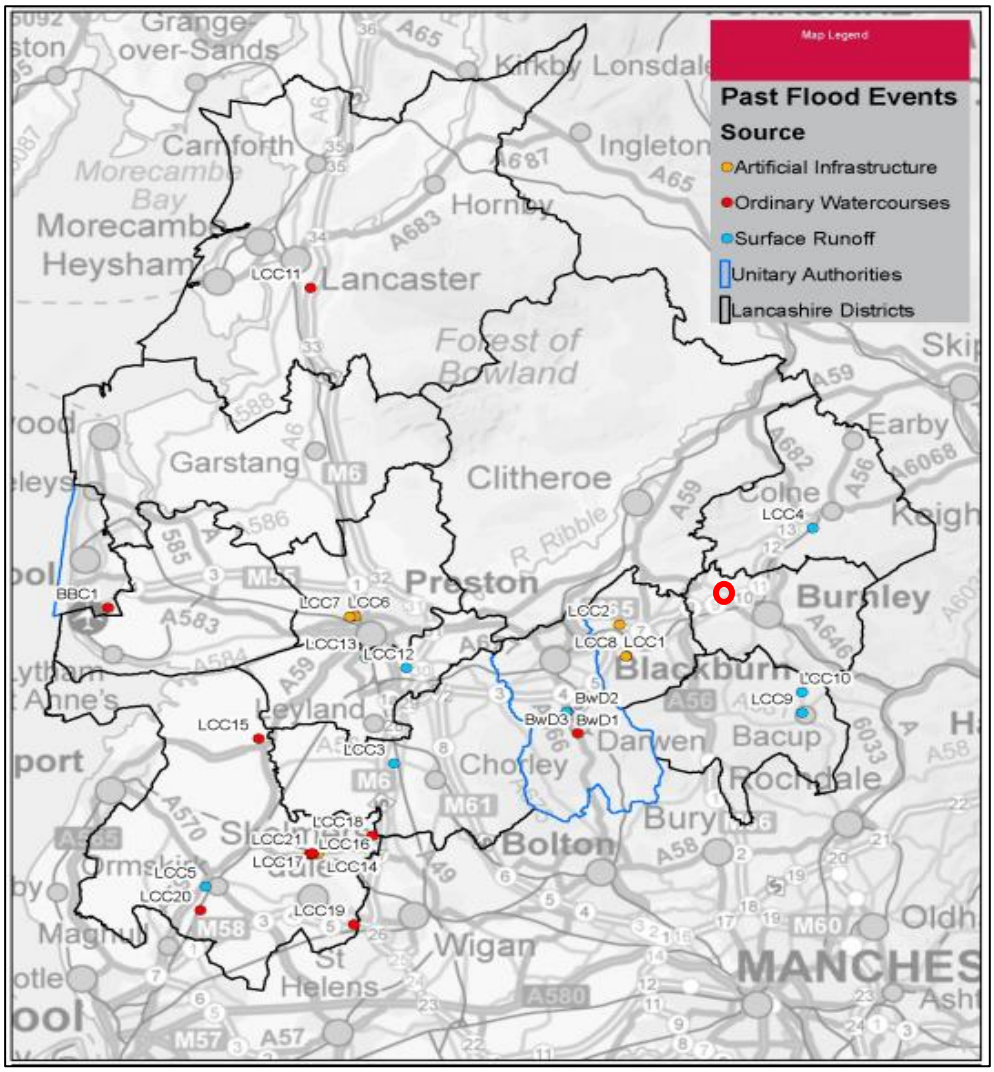


Figure 10: PFRA - Summary Map of Past Floods – Source: Preliminary Flood Risk Assessment (Lancashire Council, 2011). Site approx. location in red circle

5. Flood Risk Mitigation

Fluvial, Pluvial and Other Sources

5.1. It is noted that southwest corner of the site could experience flood depth below 300mm in the modelled 1% AEP and 0.1% AEP pluvial events. However, it is understood that the solar panel will be raised approximately 650mm above ground level, therefore, they are above the 300mm flood depth.

5.2. Flood risk from Fluvial, Pluvial and other reviewed sources is considered to be low, therefore mitigation is not required.

Increase to Flood Risk Elsewhere

5.3. The panels will be raised 650mm above ground levels and thus above modelled pluvial 1:1000 year flood depths. Furthermore, the proposed GRP Cabin is to be located outside the modelled 1:1000 year extent.

EA Flood Warning Service

5.4. As a further precaution and risk reduction, the owner of the site should sign up the EA flood Alert service for River Calder in east Lancashire. This service allows site owners to register an address, which is at risk of flooding, along with contact details so that in the event of a flood being forecast, the site owner will be sent an alert directly to their chosen method of contact.

5.5. Flood warnings/alerts can be enforced at any time of the day or night. Signing up for this service provides site owners some notice before a flood event. The amount of time afforded before a flood occurs depends on the site specific location (e.g. proximity to the source of flooding, topography of the surrounding area) and the flood mechanism (e.g. bank over topping versus a breach event). Flood alerts and warnings provide site managers with time to take necessary action, e.g. communication of the risk of flooding to occupants/employees etc, evacuation of occupants offsite or to a safe level, removal of valuable items out of reach of flooding and the mounting of site specific flood defences.

6. Surface Water Drainage Strategy

Surrounding Water Environment & Existing Drainage

6.1. The nearest watercourse is the River Calder - confluence with Brun to Pendle Water, a Main River located approximately 133m northwest of the site. There are no other watercourses in the vicinity of the site.

6.2. The British Geological Survey's (BGS) mapping shows superficial deposits of Till, Devensian - Diamicton underlying the site. The bedrock underlying the site is Pennine Lower Coal Measures Formation - Mudstone, Siltstone and Sandstone.

6.3. The existing site is greenfield and there is no known formal drainage serving the site.

6.4. No infiltration testing has been carried out at the time of writing this report.

Surface Water Drainage Strategy

6.5. In accordance with the SuDS management train approach, the use of various SuDS measures to reduce and control surface water flows have been considered in detail for the development. This does not constitute a detailed drainage design but does demonstrate that a viable solution for managing surface water runoff from the development in a sustainable manner is available.

6.6. The management of surface water has been considered in respect to the SuDS hierarchy below, as detailed in the CIRIA C753 "The SuDS Manual" (section 3.2.3).

Table 2: SuDS Drainage Hierarchy

SUDS DRAINAGE HIERARCHY				
			Suitability	**Comment**
	1.	**Store rainwater for later use**	x	Rainwater harvesting is not formally proposed due to the nature of the development.
	2.	**Use infiltration techniques, such as porous surfaces in non-clay areas**	✓	The British Geological Survey's (BGS) mapping shows superficial deposits of Till, Devensian - Diamicton underlying the site. The bedrock underlying the site is Pennine Lower Coal Measures Formation - Mudstone, Siltstone and Sandstone. Given the nature of solar farm, it is proposed to promote infiltration using infiltration trenches along the panels.
	3.	**Attenuate rainwater in ponds or open water features for gradual release**	x	Open SuDS features promoting infiltration should be considered prior to considered below ground sealed features. Filter drains are proposed on site as the primary form of attenuation within the development to manage runoff from the impermeable areas. They should also be proposed at the toe of the PV panels. These features will also provide amenity, biodiversity and water quality benefits. It is proposed that these features remain unlined to allow passive infiltration to occur, reducing the total volume prior to discharge to the wider water environment.
	4.	**Attenuate rainwater by storing in tanks or sealed water features for gradual release**	x	Open SuDS features promoting infiltration should be considered prior to considered below ground sealed features.
	5.	**Discharge rainwater direct to a watercourse**	x	A preferable solution is available for the site and therefore this option has been discounted.
	6.	**Discharge rainwater to a surface water sewer/drain**	x	A preferable solution is available for the site and therefore this option has been discounted.
	7.	**Discharge rainwater to Combined Sewer**	x	A preferable solution is available for the site and therefore this option has been discounted.

6.7. The document *'bre Planning guidance for the development of large-scale ground mounted solar PV systems'*[7] states:

> *As* ***solar PV panels will drain to the existing ground, the impact will not in general be significant*** *and therefore this should not be an onerous requirement.*
>
> *Where access tracks need to be provided, permeable tracks should be used, and localised SUDS, such as swales and infiltration trenches, should be used to control any run-off where recommended.*
>
> *Given the temporary nature of solar PV farms, sites should be configured or selected to avoid the need to impact on existing drainage systems and watercourses.*

6.8. As such, it is not proposed to provide formal runoff capture and attenuation for the solar panel areas. It is recommended that to promote infiltration where feasible, shallow swales and grassland are to be installed/ planted underneath and between the rows of panels. These features would intercept and distribute flows, offer attenuation and storage, and promote infiltration across the site. This is considered to be a pragmatic approach to manage surface water across the site and promote infiltration.

6.9. With regards to the GRP Electrical Unit, the unit is raised on concrete plinth above the existing soft landscaping and therefore, any runoff would be expected to infiltrate into the soft landscaping as per the exiting situation.

6.10. It is also expected that the access tracks will be formed of unbound gravel or similar permeable surfacing and thus it is not proposed to manage runoff from these areas. If an impermeable surfacing is required for the access tracks, runoff should be directed via overland flow to infiltration trenches running parallel with the tracks, to capture and infiltrate runoff from these tracks.

[7] **https://files.bregroup.com/solar/KN5524_Planning_Guidance_reduced.pdf**

7. Conclusions

7.1. This FRA and SWDS has been undertaken with reference to the requirements of NPPF and Planning Practice Guidance with respect to the development at Crow Wood Hotel, Holme Road, Burnley, BB12 0RT. It has been written to support a planning application and has been prepared with due consideration to the nature of the proposed development to provide the appropriate level of detail.

7.2. An assessment of the risk of flooding from all sources has been undertaken and is summarised in the table below:

Source of Flooding	Flood Risk Summary
Fluvial Pluvial	The EA Flood Map for Planning shows the site is located within Flood Zone 1 (low risk. Examination of the EA's surface water flood risk (RoFSW) mapping shows that approximately 5% of the site is at risk of flooding in 'Low' surface water flood events. Most of the site is shown to be at low risk of flooding with safe access/egress to/from the site available. It is understood that the solar panel will be raised approximately 650mm above ground level. Therefore, mitigation measures are not required.
Tidal Reservoirs Groundwater Sewers Canals	The site is considered to be at low risk from other sources.

7.3. The FRA and SWDS supports the planning application and demonstrates that there is an acceptable level of flood risk to the site. The proposed development does not increase flood risk off site or to the wider area.

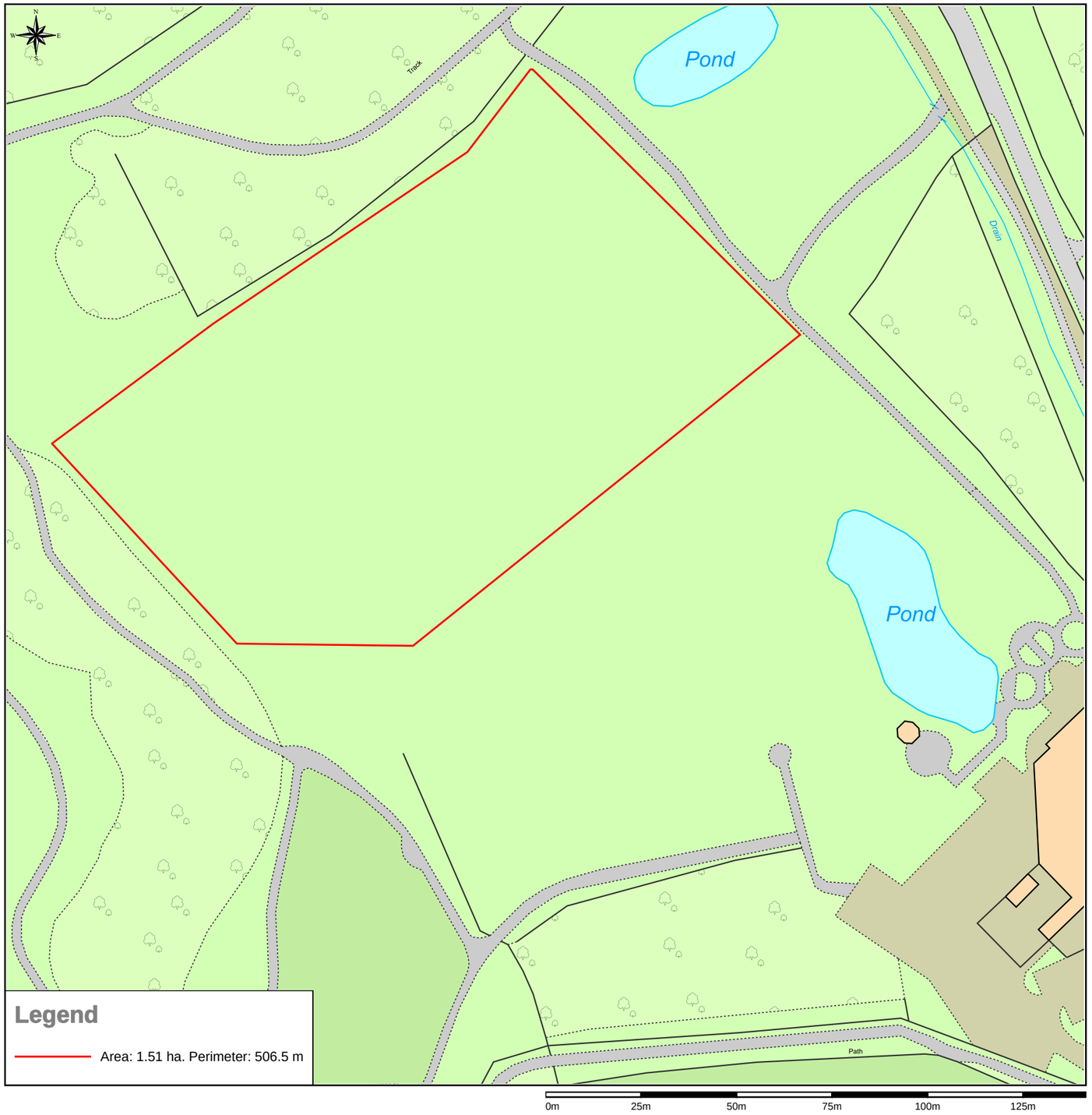
7.4. In accordance with the document '*bre Planning guidance for the development of large scale ground mounted solar PV systems'*, it is recommended that to promote infiltration where feasible, shallow swales and grassland are to be installed/ planted underneath and between the

rows of panels. These features would intercept and distribute flows, offer attenuation and storage, and promote infiltration across the site. This is considered to be a pragmatic approach to manage surface water across the site and promote infiltration.

7.5. This FRA and SWDS should be submitted as part of the planning application to satisfy the requirements under NPPF.

Appendix A - Development Proposals

Location Plan Solar Array

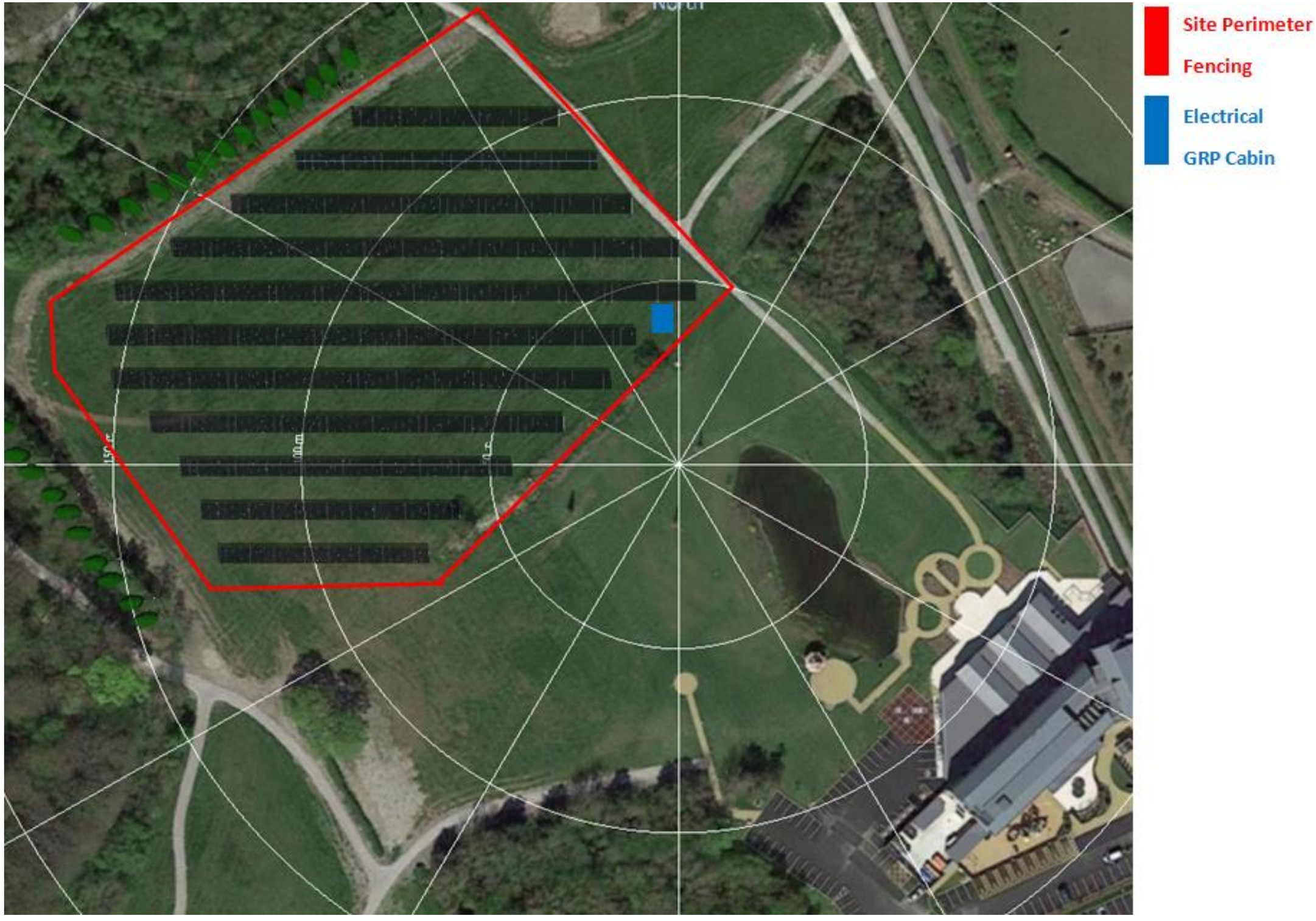


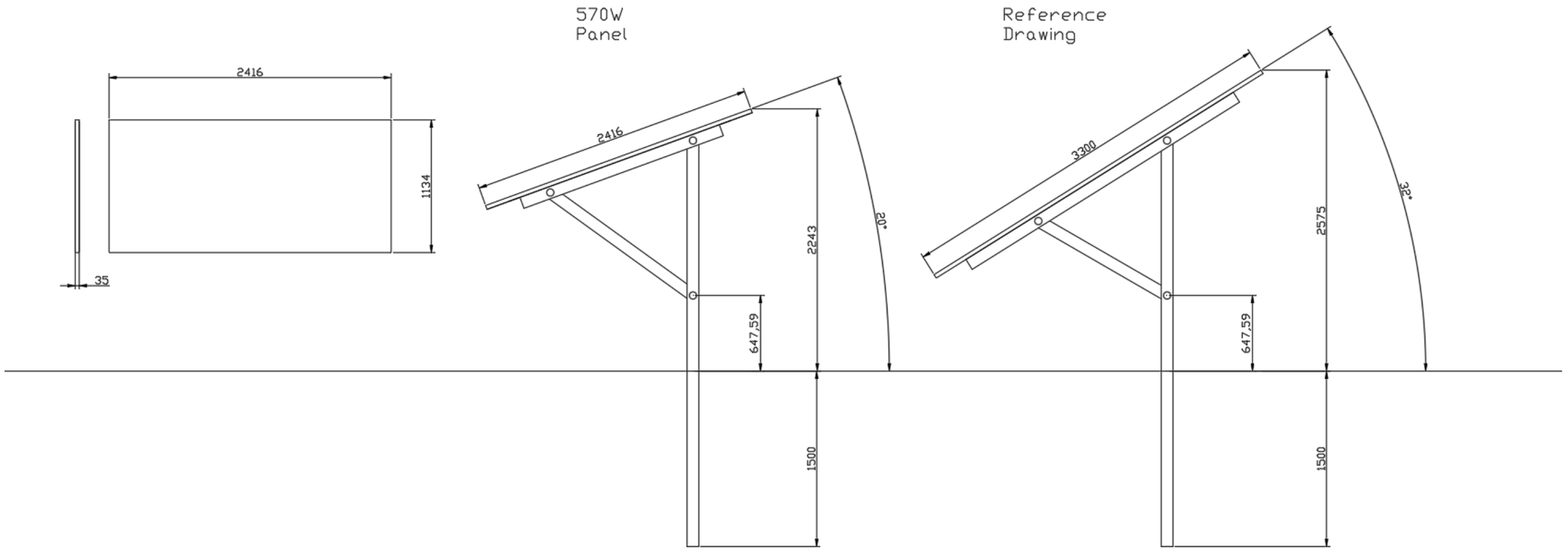
Crow Wood, Holme Road, Burnley

Location Plan

Scale: 1:1250, paper size: A3

Prepared by: Claire Bradley, 30-01-2023


Site Perimeter
Fencing
Electrical
GRP Cabin


570W
Panel
Reference
Drawing
2416
1134
35
2416
2243
20°
647,59
1500
3300
2575
32°
647,59
1500