FLOOD RISK ASSESSMENT

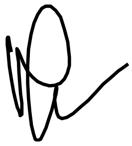
In support of a planning application for the installation of standalone solar PV modules and associated infrastructure on land at Heywood Grange, Tickhill Lane, Dilhorne, Staffordshire.

January 2015

Prepared By

aardvark
environment matters

Project Quality Control Sheet

ORIGINAL	Author	Checked by	Approved by
Signature			
Date	22/01/2015	22/01/2015	22/01/2015
Company	Aardvark EM Ltd	Aardvark EM Ltd	Aardvark EM Ltd

Location: **Heywood Grange, Tickhill Lane, Dilhorne, Staffs, ST10 2PL**

Grid Reference: **396046, 344411**

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1 Executive Summary

Aardvark EM Ltd has been instructed by Elgar Middleton Ltd to prepare a Flood Risk Assessment (FRA) in support of a planning application for the development of a solar photovoltaic (PV) installation on agricultural fields located at Heywood Grange, Dilhorne, Staffordshire.

This report considers the topography of the site and local area, and the proximity of the site to the watercouse in the context of fluvial flooding. The report also considers the site in relation to surface water flooding, ground water flooding and establishes the surface water drainage strategy for the site.

The report:

- Determines the flood risk vulnerability for proposed use and flood zone classification of the site;
- Identifies the risk of all possible sources of flooding;
- Describes the existing site and drainage;
- Determines the overall site area and impermeable/permeable areas; and
- Identifies a mitigation drainage strategy for the anticipated increase in surface water runoff.

2 Development Description and Location

2.1 Site Location

The site is located on land at Heywood Grange, Tickhill Lane, Dilhorne Staffordshire with a grid reference of 396046, 344411. The site extends to approximately 13.72ha and is shown edged red on the Location Plan in Figure 1 below.

The site is located approximately 8.5km south east of Stoke-on-Trent, 3km north of Blythe Bridge and 4.5km north west of Cheadle. It is accessed via a farm track leading off from Tickhill Lane.

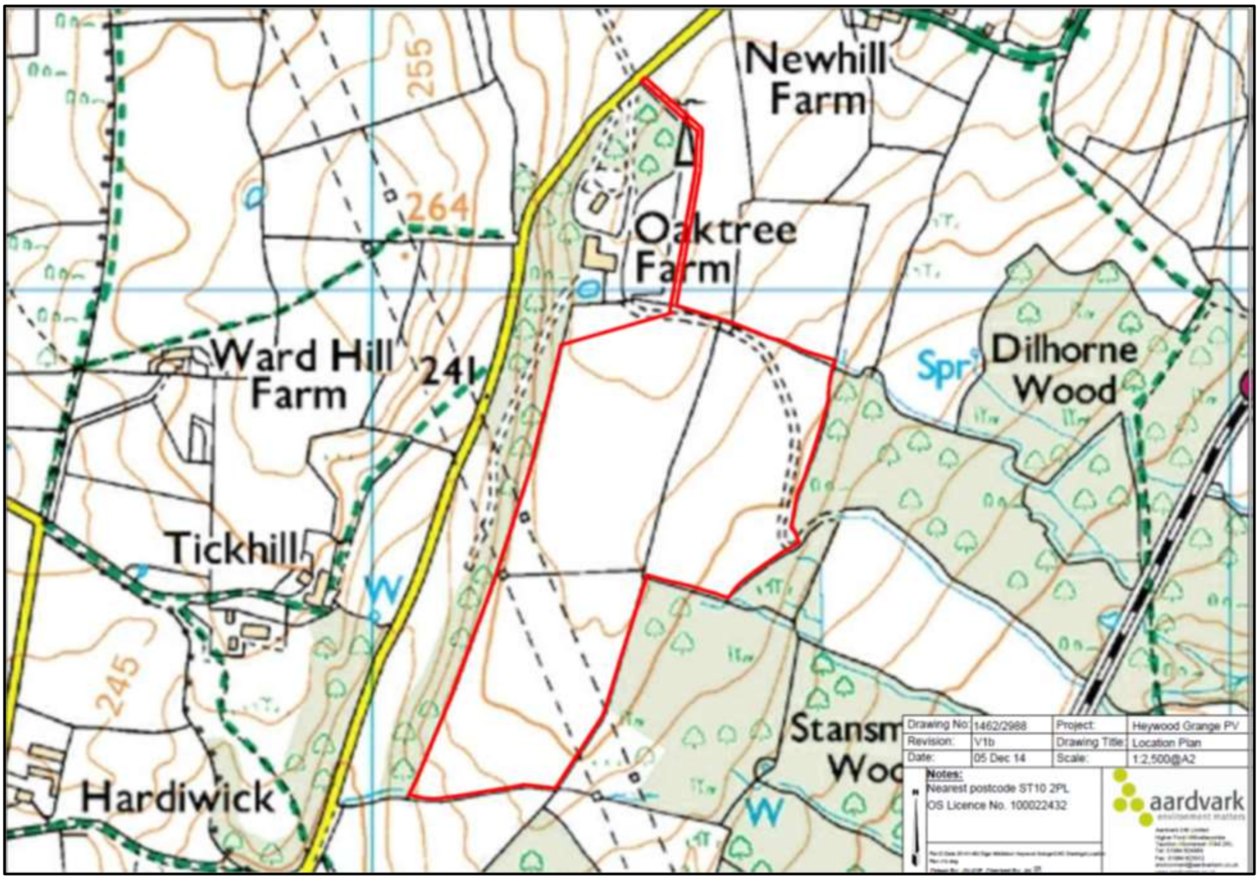


Figure 1: Location Plan

2.2 Site Description

The site comprises agricultural land totalling 13.72ha as shown in the proposed site plan. The site borders both Dilhorne Wood and Stansmore Wood to the east.

A general view across the site is shown in Plate 1. The field boundaries, which will be retained by the proposed development in order to maintain natural screening, comprise mature hedgerows and trees.

The topography of the site is slightly undulating with gentle slopes towards the south. Elevation across the site ranges from approximately 239m AOD to 263m AOD.

2.3 Site Proposal

The proposed development is for the erection of 32,188 solar PV modules, with associated infrastructure for export of renewable energy to the National Grid. There will be 8 inverter / transformer buildings, as well as 1 private substation building, 1 DNO substation and 1 storage container.

The scheme has been specifically designed to maximise the amount of electrical hours of production per hectare. The design layout takes into account topography, orientation, appropriate hedgerow buffer zones and mitigation planting. The proposal is set out in further detail within the proposed development plan submitted alongside this application.

The proposal will consist of the following items and materials;

- 32,188 Solar PV panels, each panel will measure approximately 1670mm x 1015mm with a depth of 35mm;
- The panels will be attached to a fixed aluminium or steel mounting frame, at approximately 20 degrees. The panels will be elevated at approximately 1244mm above the ground and have a rear high no higher than 2900mm;
- The mounting frames can either be screwed or driven into the ground causing minimal impact to the ground surface and are fully removable after the operation period;
- The PV panels will be connected by cabling to a central inverter required to connect the array to the national grid. The central inverter will be 6060mm long x 2902mm high by 2440mm wide;
- It is estimated that 8 inverter / transformer buildings are required to convert the direct current (DC) electricity generated by the panels, into alternating current (AC) in order to feed into the grid. These would sit at strategic positions alongside the areas within the development area and measure 6040mm long x 2800mm high 2438mm wide;
- A storage container is required to store spare equipment, it will be a standard shipping container measuring 6058mm long by 2591mm high by 2438mm wide;
- A security system is required to prevent unauthorised access into the PV array, and to protect the PV array. This will consist of a fence, approximately 2m high, installed within the site boundary and pole mounted security cameras installed around the fence perimeter. The security cameras will employ infra-red technology and no site lighting will be required
- The Distribution Network Operator will install a substation on site measuring 4790mm long by 3548mm high by 5350mm wide.

3 Flood Risk

3.1 Flood Data

The initial phase in identifying whether a site is potentially at risk of flooding is to consult the Environment Agency's (EA) flood zone maps, available on the EA's website. However, these are (often) based on coarse scale modelling and provide only an initial indication of the flood risk to a site.

The Flood Zones divide the floodplain into three categories of flood risk, and do not take flood defences into account. Flood Zones are defined as:

- Flood Zone 1 – very low to low risk, with annual probability of flooding from rivers and the sea of less than 0.1% (< 1 in 1,000)
- Flood Zone 2 – low to medium risk, with annual probability of flooding of 0.1 to 1.0% (1 in 1,000 to 1 in 100) from rivers and 0.1 to 0.5% from the sea (1 in 1,000 to 1 in 200)
- Flood Zone 3a – high risk of flooding with an annual probability of flooding of 1.0% or greater from rivers (>1 in 100), and 0.5% or greater from the sea (> 1 in 200)
- Flood Zone 3b – functional floodplain, land which would flood with annual probability of 5% or greater (≥1 in 20).

The site is entirely situated in Flood Zone 1 which means it has a very low probability of flooding, less than 1 in 1000 (0.1%).

The Environment Agency indicative flood map is shown below.

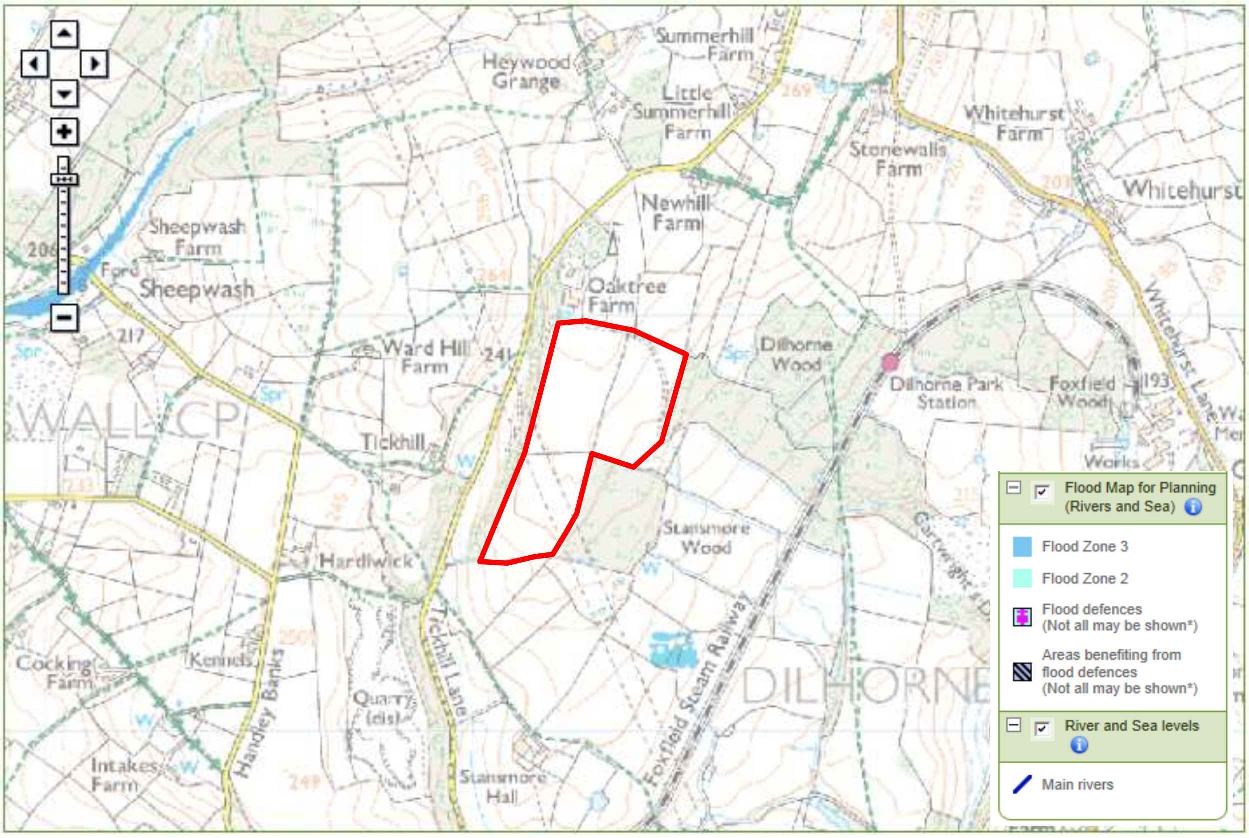


Figure 2: EA Flood Zone Map

3.2 Vulnerability Classification

The National Planning Policy Framework (NPPF) was produced in March 2012, and sets out the Government's planning policies for England and how these are expected to be applied. Section 10 relates to "Meeting the challenge of climate change, flooding and coastal change" with specific policies being taken from Planning Policy Statement 25. This guidance defines zones and procedures for carrying out assessments, allowing for a risk based approach that considers the probability of an event, and the consequences, depending on the vulnerability of the user.

The National Planning Policy Guidance (NPPG) came into effect March 2014 and provides technical guidance for site specific flood risks assessments (FRAs).

NPPG Table 2 confirms the 'Flood Risk Vulnerability Classification' of a site, depending upon the proposed use. This classification is subsequently applied to NPPG Table 3 to determine whether:

a) The proposed development is suitable for the flood zone in which it is located, and

b) Whether an Exception Test is required for the proposed development.

Discussion with the EA has confirmed that they consider solar PV to be 'Less Vulnerable', which is compatible development within Flood Zone 1.

3.3 Sources of Flooding

3.3.1 Fluvial (River) Flooding

The site lies within Flood Zone 1 and is therefore at low risk of fluvial flooding. There are a number of springs in the surrounding area which all run away from the site. There are no recognised drains or watercourses within the boundary of the site.

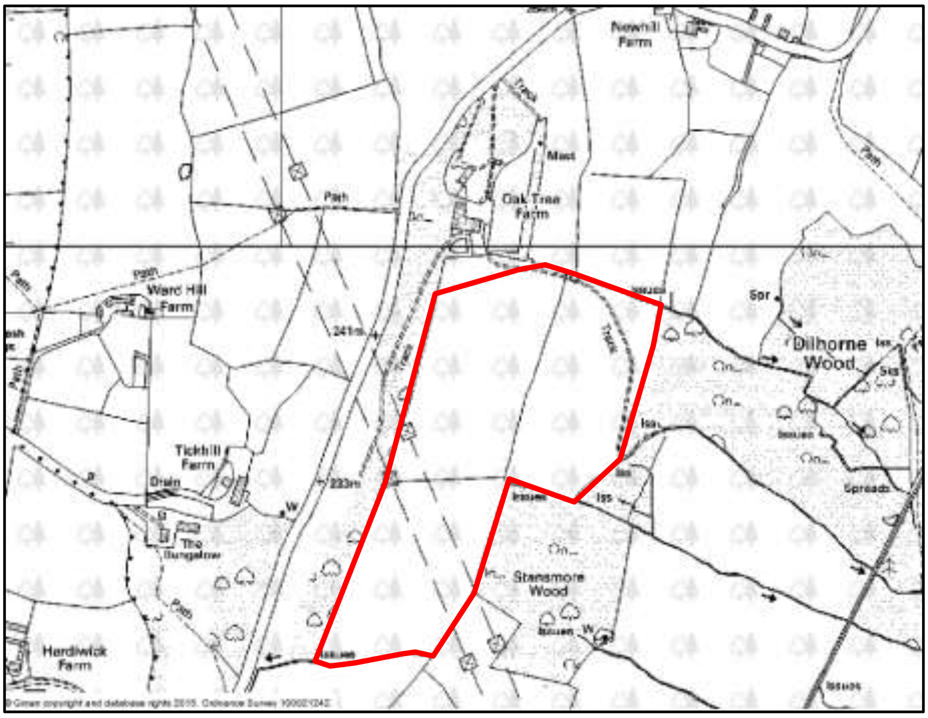


Figure 3: Network of drains and watercourses surrounding the site

3.3.2 Tidal

According to the EA's indicative flood maps the site is not located in an area at risk of tidal flooding.

3.3.3 Overland Sheet Flow

The site is relatively flat sitting on a small ridge above the surrounding area. The site slopes gently towards the south from 260m AOD at the northern boundary to 245m AOD at the southern boundary.

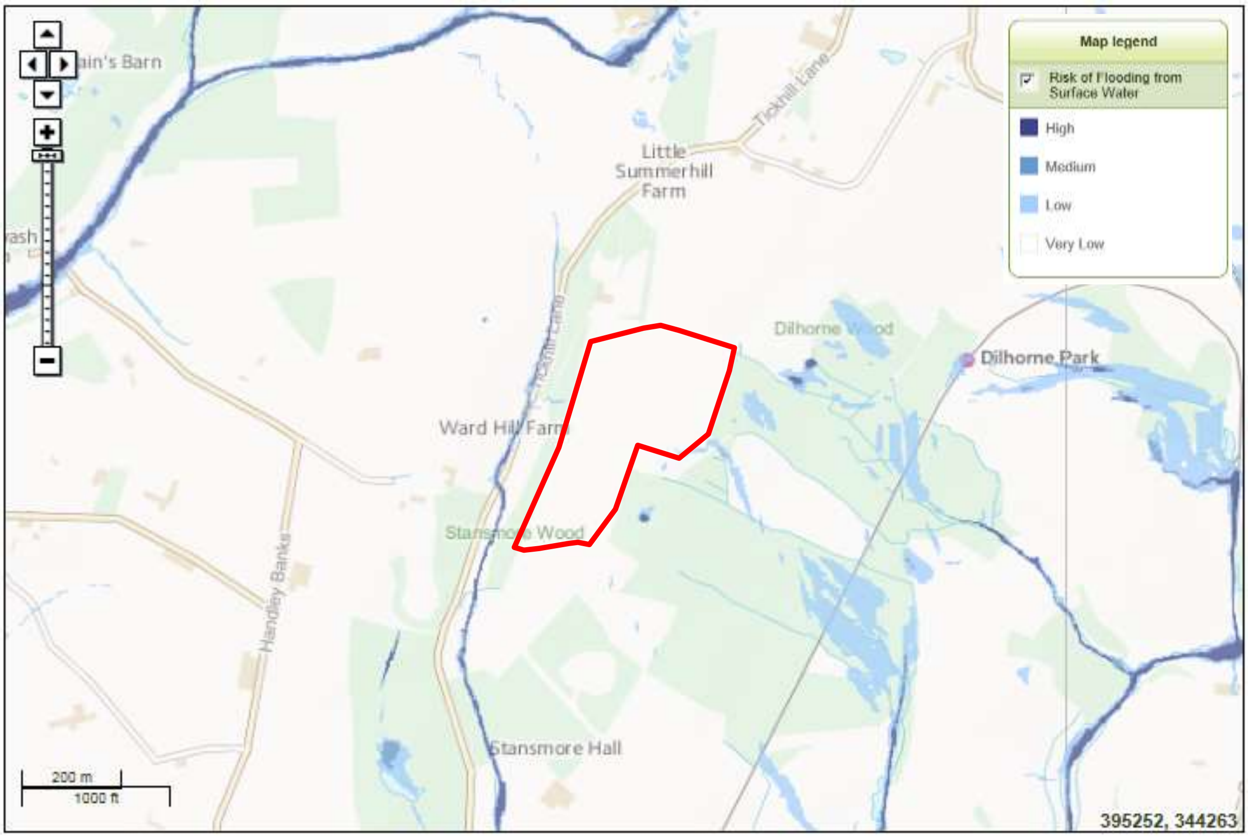


Figure 4: EA Surface Water Flood Map

The Environment Agency flood map for surface water shows a very small section of the site (on the eastern boundary) within a low risk area of surface water flooding.

3.3.4 Flooding as a Result of the Development

The proposed development has the potential to introduce impermeable area around the site where the land was previously permeable. This could have the potential to increase the runoff rates across the site which could increase the flood risk to adjacent sites.

From the development layout it can be seen that the proposed solar array infrastructure only introduces a small area of impermeable surfaces through the foundations of the solar panel modules, inverters and the substation. All access and maintenance roads are proposed to be constructed from permeable material and will therefore not contribute to increased run-off rates from the site.

3.3.5 Groundwater Source Protection Zone

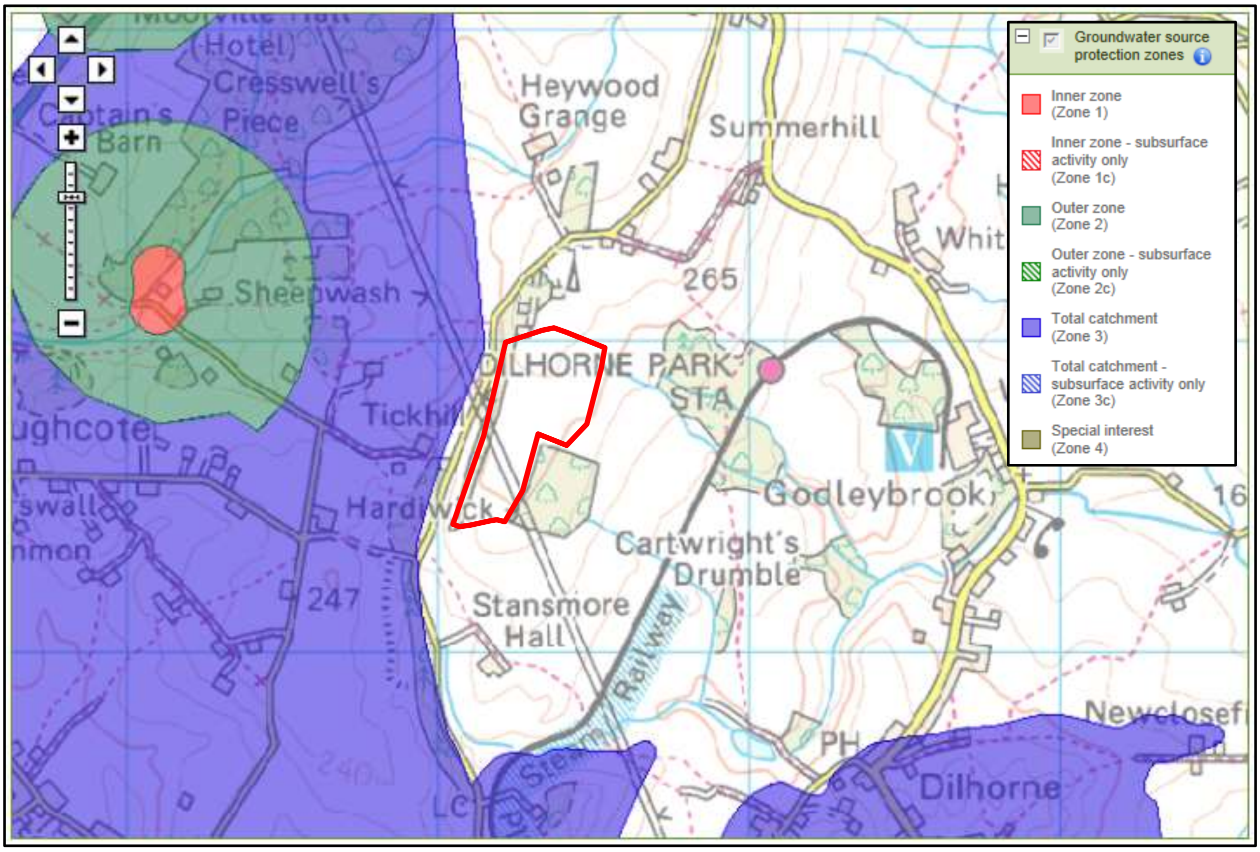


Figure 5: EA Groundwater Source Protection Zone Map

The site does not lie within a Groundwater Source Protection Zone.

3.3.6 Aquifer

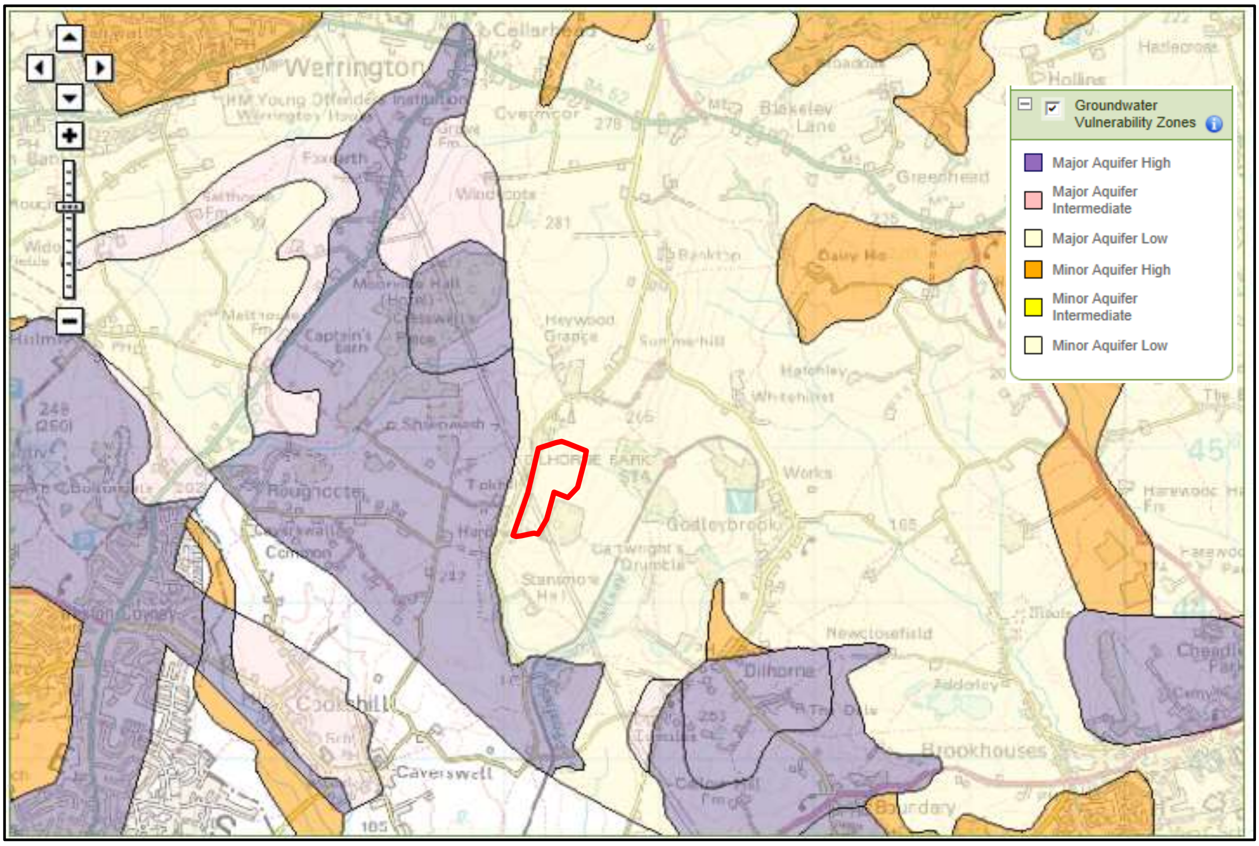


Figure 6: Aquifer Designation Map

The site lies within a minor aquifer with soils of low leaching potential.

4 Surface Water Drainage Strategy

The proposed development has the potential to introduce impermeable area around the site where the land was previously permeable. This could have the potential to increase runoff rates across the site which could increase flood risk to adjacent sites.

Inspection of the development layout shows that the proposed solar array infrastructure only introduces a small area of impermeable surfaces through the foundations of the solar panels modules, transformers and the central substation. It is anticipated that rain falling on each solar panel table will run off panels and flow / infiltrate in the sheltered rain showdown area underneath the down slope modules.

The impermeable area totals approximately 333.93m^2, which is only around 0.2% of the total site area. To ensure the risk of flooding within the site and surrounding areas is not increased due to the development, a drainage strategy has been put in place to deal with the additional run-off.

In terms of surface water runoff, the development will not increase the impermeable area on the site, as the size of the inverter houses are considered to be negligible in the context of the site. Although the solar panels will divert the downward path of falling rain, being raised off the ground on frames, they will not reduce the permeable area of the field in which they are sited. Any rain that does fall onto the site will, as now, be removed from the site via combination of run –off and infiltration.

The main surface water management issues associated with ground mounted solar panels are:

1. Potential of soil compaction below the panel modules
2. Increased surface runoff rate from the panel modules causing rilling / gullying, localised ponding in the field and increased runoff and soil creep.

4.1 Percolation Testing

In view of the relatively small areas of impermeable surface being introduced across the site, there will be a negligible impact in the runoff rates resulting from the development. Therefore percolation testing has not been conducted.

In addition during the design of Sustainable Urban Drainage Systems (SuDS) across the site it has been assumed that the primary function of the SuDS will be the interception, storage and redistribution of the runoff from the site with infiltration into the system a secondary benefit.

4.2 Surface Water Drainage

The impermeable areas across the site have been calculated as 333.93m^2, which is 0.2% of the total development area. As the impermeable areas across the site are small, no formal drainage is required. Therefore a pragmatic approach has been taken to promote infiltration and create storage across the site. This involves the installation of swale features running parallel to the site contours within downstream areas of the site. These features will intercept flows, create storage, attenuate runoff and promote infiltration across the site.

The development will create an increase in impermeable area of 333.93m^2 with the greenfield runoff rate being calculated at 7.2 l/s. To ensure there is no increase in run off across the site 22.01m^3 of storage will need to be provided for a 6 hour duration 1 in 100 year rainfall event. Storage will be in the form of swales. For more details on calculations please see Appendix 1.

It is proposed to install swales of 0.15m base width and 0.15m depth with side slopes of 1 in 4 at the down edges of the slope, with the total length of swales required being approximately 196m in length, providing a total volume of 22.05m^3.

Appendix 2 shows a detailed cross section of the proposed swale design.

Provided the swale structures outlined above are installed prior to commencement of other construction works on site, then surface water run-off during construction can also be adequately managed by the use of these swale structures.

4.3 Maintenance Requirements

Maintenance of the drainage network is essential to ensure optimal performance of the drainage elements. As such maintenance requirements for the drainage system will include but not be limited to:

- Inspection and cleaning of the swales to ensure that capacity and infiltration rates are maintained

The drainage system will remain in private ownership; the site operator would therefore be responsible for the maintenance of the drainage features within the site. The developer of the site should make this responsibility clear to the site operator by providing a maintenance plan for the development.

4.4 Decommissioning

During decommissioning of the site the swales will be left in place to ensure that any run-off from the decommissioning phase can be suitably managed.

5 Conclusion

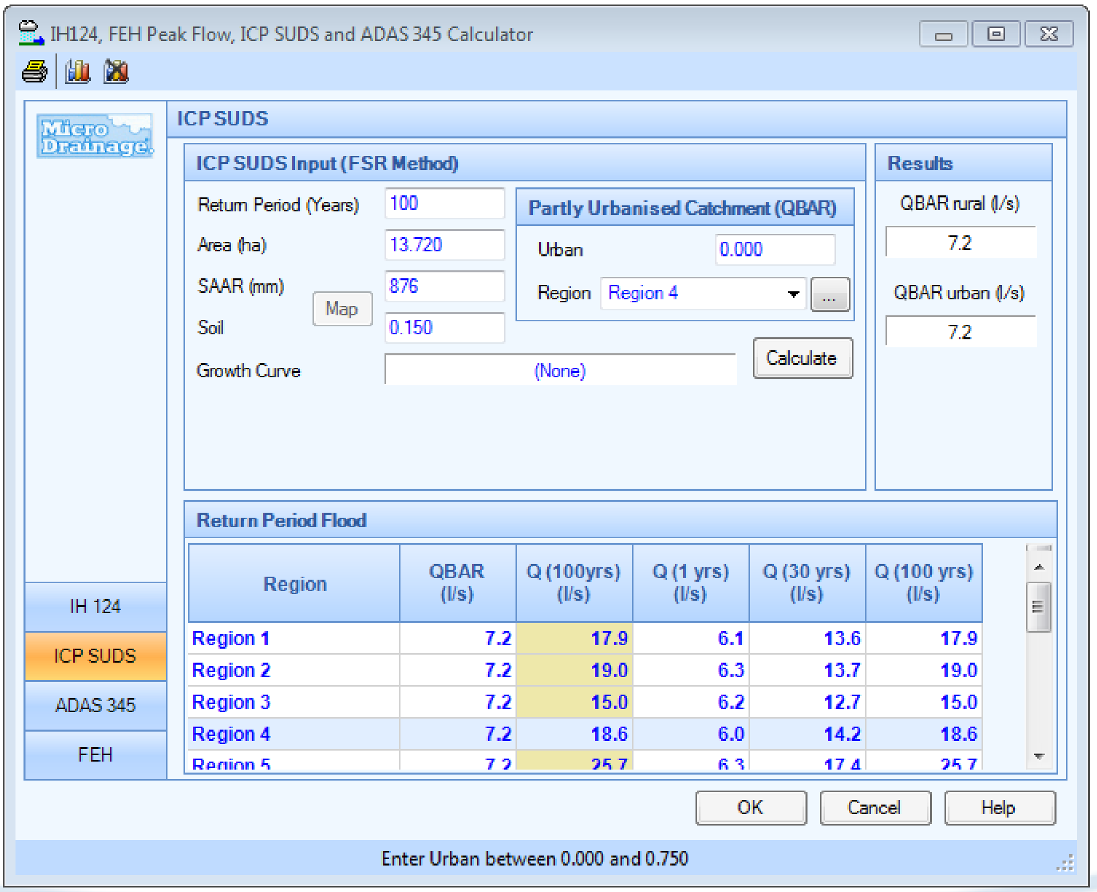
The report has investigated the mechanisms for flooding at the proposed Heywood Grange solar PV site and identified that the site is not at direct risk of flooding from rivers or sea. Reference to the EA maps show that the site is located in Flood Zone 1 (less than 1 in 1000 annual probability of flooding), and all uses of land are appropriate in this development.

The report has investigated the impact that the proposed development will have on runoff rates from the site. It has been shown that the impermeable area introduced across the site is very small relative to the size of the site and as such will have limited impact upon the runoff rates from the site. A swale system has been proposed to allow the interception and infiltration of the flow from these areas.

As such there will be no impact on the nearby watercourses and neighbouring sites as a result of the proposed development. In addition the pragmatic approach to the design of the swales will provide an improved storage and interception capacity and will reduce any risks to adjacent sites from run-off, when compared to the predevelopment situation.

6 Appendices

6.1 Surface Water Drainage Calculations



Region	QBAR (l/s)	Q (100yrs) (l/s)	Q (1 yrs) (l/s)	Q (30 yrs) (l/s)	Q (100 yrs) (l/s)
Region 1	7.2	17.9	6.1	13.6	17.9
Region 2	7.2	19.0	6.3	13.7	19.0
Region 3	7.2	15.0	6.2	12.7	15.0
Region 4	7.2	18.6	6.0	14.2	18.6
Region 5	7.2	25.7	6.3	17.4	25.7

Volume of Runoff Calculations

Client:	Elgar Middleton
Engineer:	NJ/JS
Location	Heywood Grange
Grid Reference:	396046, 344411

Site Information

Pre-development total area	137,200	m2
Pre-development permeable area	137,200	m2
Pre development impermeable area	0	m2
Post-development total area	137,200	m2
Post development permeable area	136,866	m2
Post-development impermeable area	333.93	m2
impermeable area as % of total area	0.2	%

Rainfall Event Information

Return period	100	year
Whole area greenfield run-off rate (see attached MicroDrainage calcs)	7.2	l/s
Duration of rainfall event	6	hours
Depth of Rainfall (calculated using Wallingford Procedure including 20% increase for climate change	65.8992	mm

RUNOFF CALCULATION

Pre-development permeable area runoff	155520	litres
Pre-development impermeable area runoff	0	litres
Total pre-development runoff	**155.52**	m3
Post development permeable area runoff	155520	litres
Post development impermeable area runoff	22005.49	litres
Total post development runoff (without mitigation)	**177.53**	m3
Difference in runoff	22.01	m3

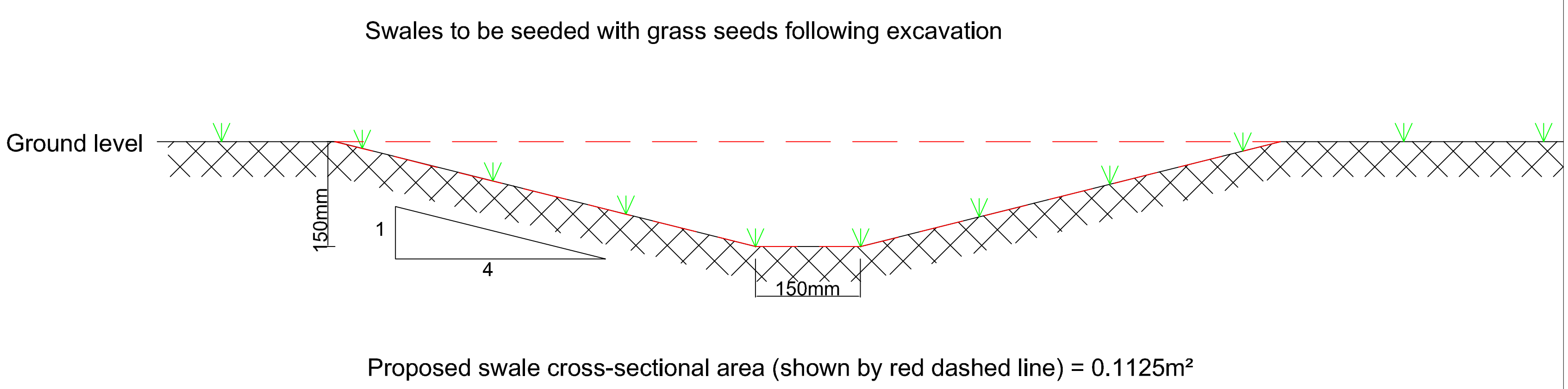
Volume of Runoff Calculations

Client:	Elgar Middleton
Engineer	NJ/JS
Location	Heywood Grange
Grid Ref	396046, 344411

Impermeable Area

<u>Piles</u>		
no.of modules		32188
no.of groundscrews		16094
groundscrew diamater		0.1
groundscrew area		0.01
Total Area		160.94
<u>Transformer</u>		
Total no	8	
Length	6.04	
Width	2.44	
Total surface Area		117.80416
<u>Sub-Station</u>		
Total No.	1	
Length (m)	4.79	
Width (m)	5.35	
Total Surface Area (m)		25.6265
<u>Switchgear</u>		
Total No.	1	
Length	6.06	
Width	2.44	
Total Area		14.7864
<u>Storage Container</u>		
Total No	1	
Length	6.058	
Width	2.438	
Surface Area		14.769404
Total Impermeable Area		**333.926464**

6.2 Swale Cross Sectional Drawing



Drawing No:	1462-2313	Project:	Heywood Grange Solar PV
Revision:	V1	Drawing Title:	Indicative swale cross-section
Date:	21 Jan 15	Scale:	1:10 @ A4

N

Key:

- Existing and new grass to be reseeded
- Cross-sectional area of proposed swale

File:\\AARDVARK-3\Nick E\Data 2014\1462 Elgar Middleton Heywood Grange\CAD Drawings\Swale drawing.dwg

Drawn By: JS Checked By: JH

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