Hydro-Logic Services

Ed Jessamine
Novus Solar
Nelson House
2, Hamilton Terrace
Leamington Spa CV34 6QB

Ref: K0463

19th March 2014

Dear Ed,

FLOOD RISK ASSESSMENT: PHOTOVOLTAIC ARRAY, LOWER NEWTON FARM

This letter constitutes a Flood Risk Assessment, for development of a *circa* 11 mw photovoltaic array at Lower Newton Farm, Draycott Rd, Tean, Stoke-On-Trent, ST10 4JN. This assessment is based on the proforma for undertaking an FRA that is included as Appendix B of the FRA Practice Guide (DCLG, 2009). The main findings are summarised in this covering letter.

The site of proposed development, within the curtilage of Lower Newton Farm, is currently in agricultural use. On Environment Agency flood zone mapping, a small part of the site is shown to lie within Flood Zone 3, suggesting that this area would be affected by the 1:100 year flood on the River Blithe. Topographic information suggests that flooding could reach up to 2 m depth at the peak of the 1:100 year event. As your proposals are for an alternative energy development, the Sequential Test is not relevant. Your plans would pass the Exception Test, since flood risk on site would be very small and downstream flood risk would not be increased. We believe that the development confers wider sustainability benefits to the community that outweigh flood risk.

Flood risk at the site would be small, since the equipment is able to survive brief periods of inundation and people would not be required to access the site during flooding. The downstream effect of the development would be small because there are no significant flood flow paths in this area and the equipment would lead to a negligible loss of floodplain storage. In order to prevent the large impermeable area of the solar panels from increasing flood risk downstream, it is recommended that a series of swales are created across the site to detain runoff and give it an opportunity to infiltrate into the soil. Conservative assumptions were used to calculate the dimensions of such swales, which would be able to manage the 1:100 year rain storm, with an allowance for climate change. If conditions are less severe than assumed in this analysis, then downstream flood risk could be reduced by the development.

In summary, the risk of flooding on site is small and surface water runoff can be managed to ensure that the development does not increase flood risk elsewhere. If the recommendations within this report are implemented, the proposed development can be made to comply with the flood risk requirements of the NPPF.

Yours sincerely,

Chris Nugent

Chris Nugent
Senior Hydrologist

PRO-FORMA FOR UNDERTAKING A FLOOD RISK ASSESSMENT (APPENDIX B OF PRACTICE GUIDE (DCLG, 2009))

1 Development description and location

1a. What type of development is proposed and where will it be located?

- A location plan at an appropriate scale should be provided with the FRA, or cross referenced to the main application when it is submitted.

It is proposed that an 11 mw photovoltaic array should be established at Lower Newton Farm, Draycott Rd, Tean, Stoke-On-Trent, ST10 4JN, as located in Figure 1. The site currently has an agriculture use, as shown by the air photo (Figure 2). The site lies to the north east of the River Blithe and a main line railway and to the south west of the A50 trunk road.

Figure 1 Proposed location of the solar farm

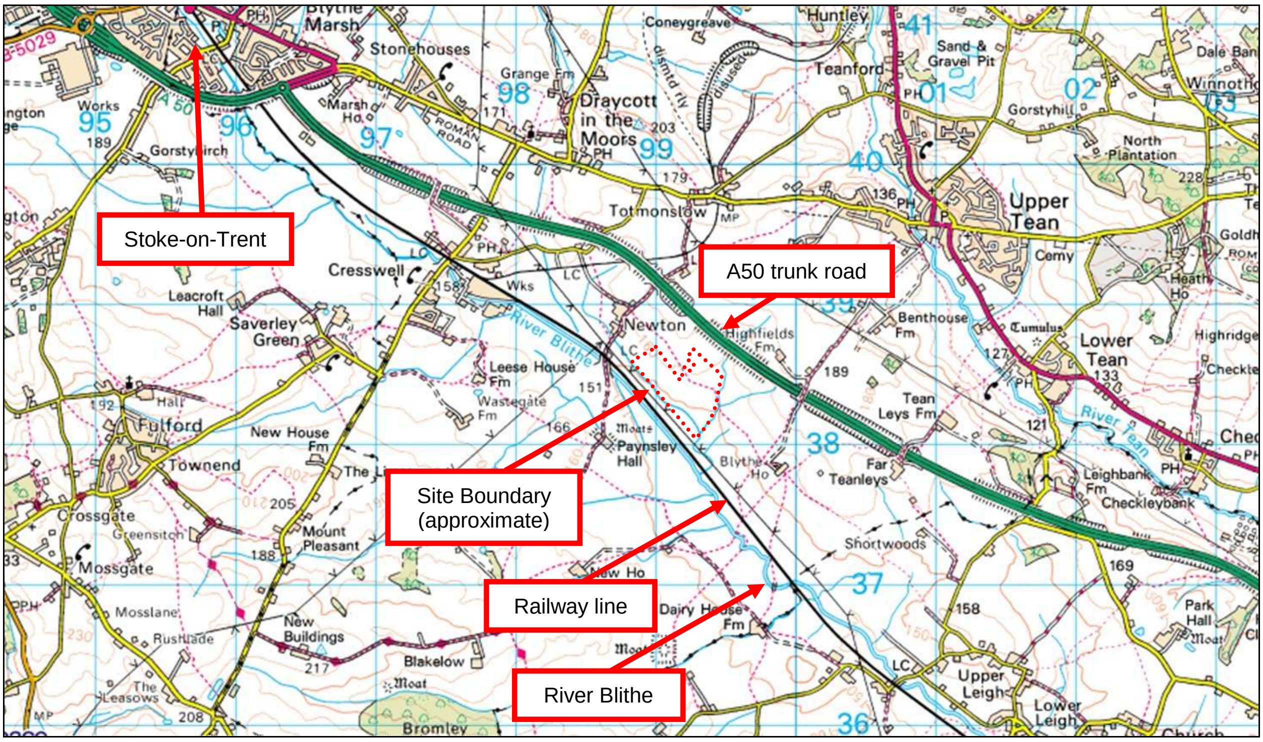

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Figure 2 Air photo showing the location of the proposed solar farm

1b. What is its vulnerability classification?

- Vulnerability classifications are provided in Table D.2, Annex D of PPS25

In terms of the National Planning Policy Framework (NPPF, DCLG, 2012a and 2012b), electricity generating power stations are classified as "Essential Infrastructure".

1c. Is the proposed development consistent with the Local Development Documents?

- Where the site is allocated in an existing LDD the allocation should be referred to. Your Local Planning Authority planning officer should be able to provide site-specific guidance on this issue.

Staffordshire's Corporate Climate Change Strategy (Staffordshire County Council, 2013)[1] strongly encourages the use of solar power, listing numerous case studies describing the use of the technology around the county and offering cash incentives to householders willing to adopt it. This development is consistent with the County's wish to develop low-carbon renewable energy resources.

1d. Please provide evidence that the Sequential Test or Exception Test has been applied in the selection of this site for this development type?

- Evidence is required that the Sequential Test has been used in allocating the proposed land use proposed for the site and that reference has been made to the relevant Strategic Flood Risk Assessment (SFRA) in selecting development type and design (See paragraphs 16-20 and Annex D of PPS25). Your Local Planning Authority planning officer should be able to provide site-specific guidance on this issue.
- Where use of the Exception Test is required, evidence should be provided that all three elements of this test have been passed (see paragraphs 20 and Annex D of PPS25). Your Local Planning Authority planning officer should be able to provide site-specific guidance on this issue.

[1] https://www.staffordshire.gov.uk/environment/climatechange/Green-Shoots-Final-Version2.pdf (accessed 13th March 2014)

The Sequential Test is not relevant to this development. Referring specifically to Renewable Energy, DCLG (2009, Section 4.39, p.93) advises that LPAs should not use a sequential approach in the consideration of such proposals, although the Exception Test still applies.

The Exception Test requires that:

1) *The development provides wider sustainability benefits to the community that outweigh flood risk and*
2) *The development should be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, should reduce flood risk overall*

This document will demonstrate that flood risk to people on site would be very small and that flood risk would not be increased elsewhere and may be reduced, as a result of this development.

1e. *[Particularly relevant to minor developments (alterations & extensions) & changes of use]* Will your proposal increase overall the number of occupants and/or users of the building/land; or the nature or times of occupation or use, such that it may affect the degree of flood risk to these people?

There are no people currently living at the site and no additional people are proposed, so the number of people would not be increased by the development.

2. Definition of the flood hazard

2a. What sources of flooding could affect the site? (see Annex C PPS25).

- This may include hazards such as the sea, reservoirs or canals, which are remote from the site itself, but which have the potential to affect flood risk (see Chapter 3 of the Practice Guide).

The closest watercourse is the River Blithe, which flows near the site, to the south west of a railway line. There is also a north bank tributary of the River Blithe, whose course forms the eastern margin of the site (Figure 1, Figure 2). Flood risk to the site from all sources is summarised in Table 1, which shows that fluvial flooding from the River Blithe is the only significant flood risk at the site.

Table 1 Sources of flooding which could affect the site

Key sources of flooding	***Possibility at Site***
Fluvial (Rivers)	*Part of the site within River Blithe flood zone*
Tidal	*N/A*
Groundwater	*None recorded in this area*
Sewers	*No sewers in this area*
Surface water	*None shown on Environment Agency surface water map*
Infrastructure failure	*N/A*

Based on DCLG (2009)

2b. For each identified source, describe how flooding would occur, with reference to any historic records wherever these are available.

- An appraisal of each identified source, the mechanisms that could lead to a flood occurring and the pathways that flood water would take to, and across, the site.
- Inundation plans, and textural commentary, for historic flood events showing any information available on the mechanisms responsible for flooding, the depth to which the site was inundated, the velocity of the flood water, the routes taken by the flood water and the rate at which flooding occurred.

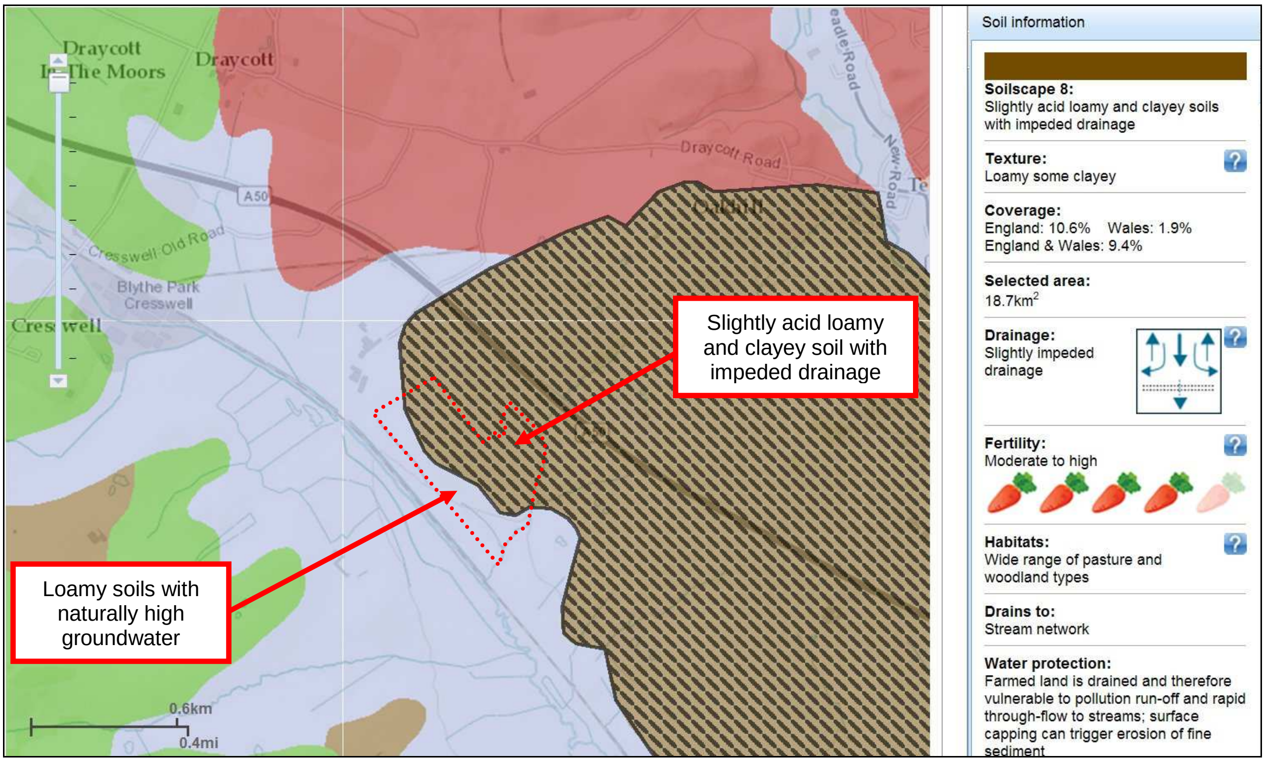
There is no record of flooding at this site. As summarised in the table above, the only source of flooding that could affect the site is from the River Blithe. In order to do so, floodwater would need to cross over or under the railway line shown in Figure 1. There are culverts beneath the railway and bridges over the major tributaries but this discontinuous barrier means that under flood conditions, the site would lie within a backwater and unlikely to carry significant flood flow paths or experience rapid flow velocities.

2c. What are the existing surface water drainage arrangements for the site?

- Details of any existing surface water management measures already in place, such as sewers and drains and their capacity.

There is no formal drainage on the site itself, where water is managed by infiltration into the underlying soils or runoff across its surface. The soil map in Figure 3 shows that the north eastern part of the site is underlain by "Slightly acid loamy and clayey soil with impeded drainage". To the south west of this, soils are described as "Loamy soils with naturally high groundwater". This second soil type bounds the River Blithe and other streams, where it is characterised by numerous surface drainage lines.

Figure 3 Soil types at the site



Source: http://www.landis.org.uk/soilscapes/

The soil evidence suggests that the site drainage is relatively poor, with much of the runoff being conveyed as surface flow towards the open channels in the south west of the site. Another view of the catchment is provided by the Flood Estimation Handbook (FEH). A catchment which includes the site is shown in Figure 4 and its characteristics are listed in Table 2, in which percentage runoff (SPRHOST) is shown to have a value of about 33 percent. This figure is intermediate for the UK, suggesting a broadly average infiltration rate for this site as a whole.

Figure 4 Catchment covering the site and bounding land

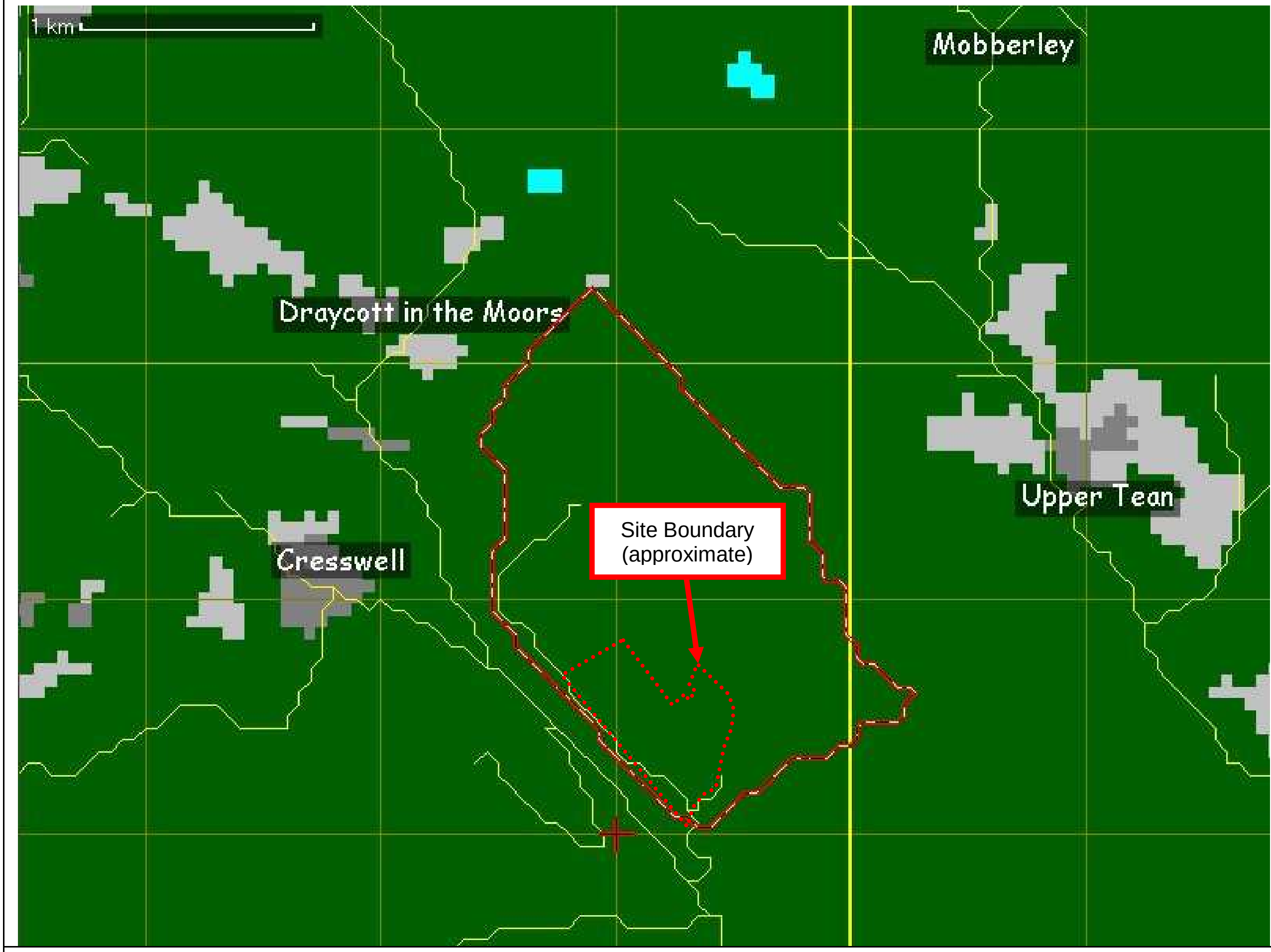


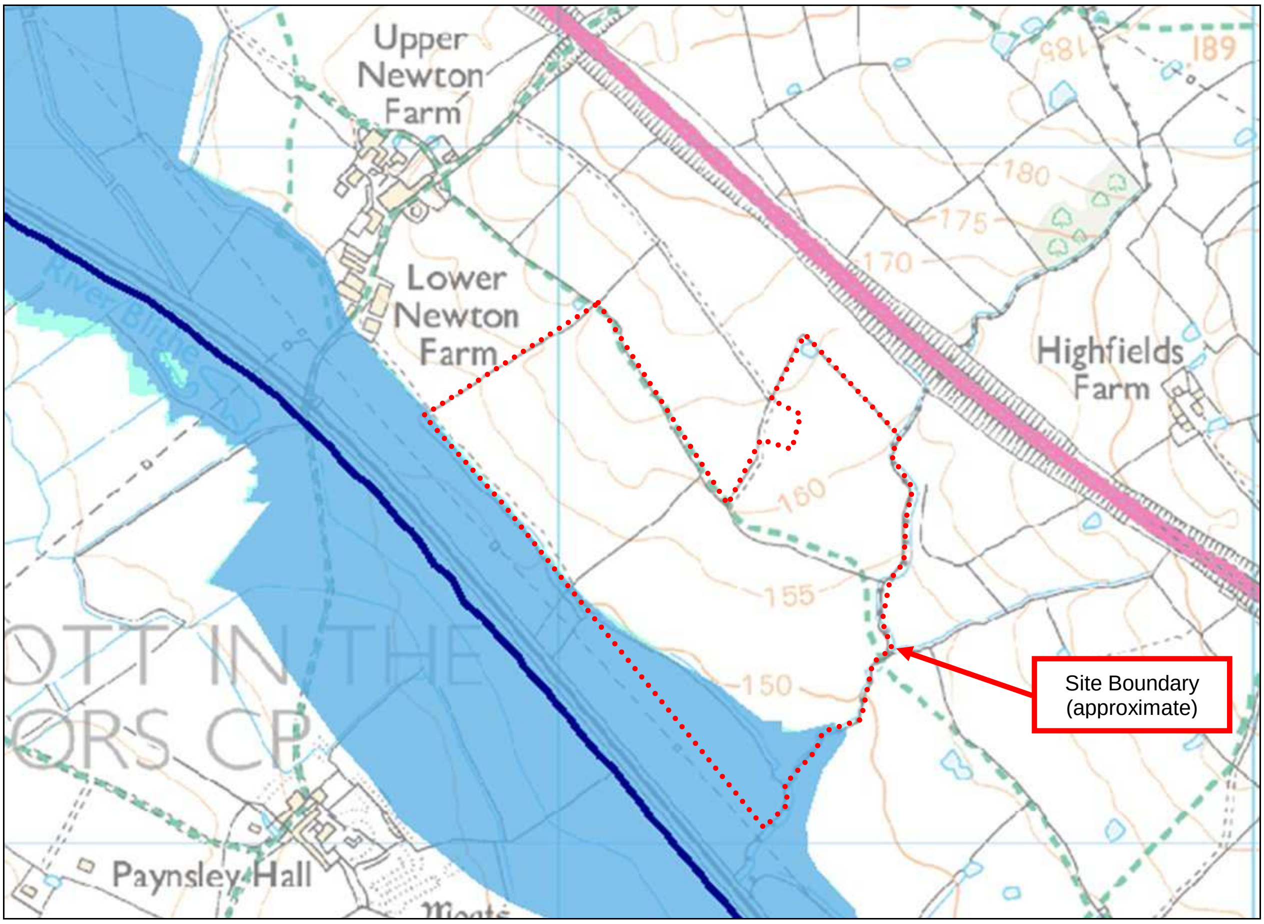
Table 2 Selected catchment characteristics

	Location:	Crymych
	NGR:	SJ 99350 38050
AREA	Catchment area (km^2)	2.29
BFIHOST	Base flow index	0.575
DPLBAR	Mean drainage path length (km)	1.68
DPSBAR	Mean drainage path slope	39.7
FARL	Index of lakes	1
FPLOC	Avg dist of FP to outlet	0.737
LDP	Longest drainage path (km)	3.23
PROPWET	Proportion of time soil is wet	0.44
RMED-1H	Median 1 hour rainfall (mm)	10.8
RMED-1D	Median 1 day rainfall (mm)	32.9
RMED-2D	Median 2 day rainfall (mm)	39.7
SAAR	Average annual rainfall (mm)	850
SAAR4170	Ditto for 1941-1970 (mm)	825
SPRHOST	Percentage runoff	32.97
URBEXT2000	Urban extent 2000	0

Source: FEH CD-ROM v3 (Centre for Ecology and Hydrology, 2009)

3. Probability
3a Which flood zone is the site within? • The flood zones are defined in Table D.1 of Annex D PPS25.
The site is within Flood Zone 1 and Flood Zone 3, as shown on the Environment Agency flood zone map below, indicating a greater than 1% annual probability of flooding from fluvial sources in an area within the south of the site.

Figure 5 Environment Agency Flood Zone map



Source: http://maps.environment-agency.gov.uk/wiyby/wiybyController?value=ST10+4JN&lang=_e&ep=map&topic=floodmap&layerGroups=default&scale=9&textonly=off&submit.x=29&submit.y=18 (accessed 14th March 2014)

3b If there is a Strategic Flood Risk Assessment covering this site, what does it show? • The planning authority can advise on the existence and status of the SFRA.
The only Strategic Flood Risk Assessment covering the site is by Staffordshire County Council and Stoke-on-Trent City Council (2010). This document was prepared in particular to assist in the management of waste material and does not address flood risk from the River Blithe.

3c What is the probability of the site flooding taking account of the contents of the SFRA and of any further site-specific assessment?

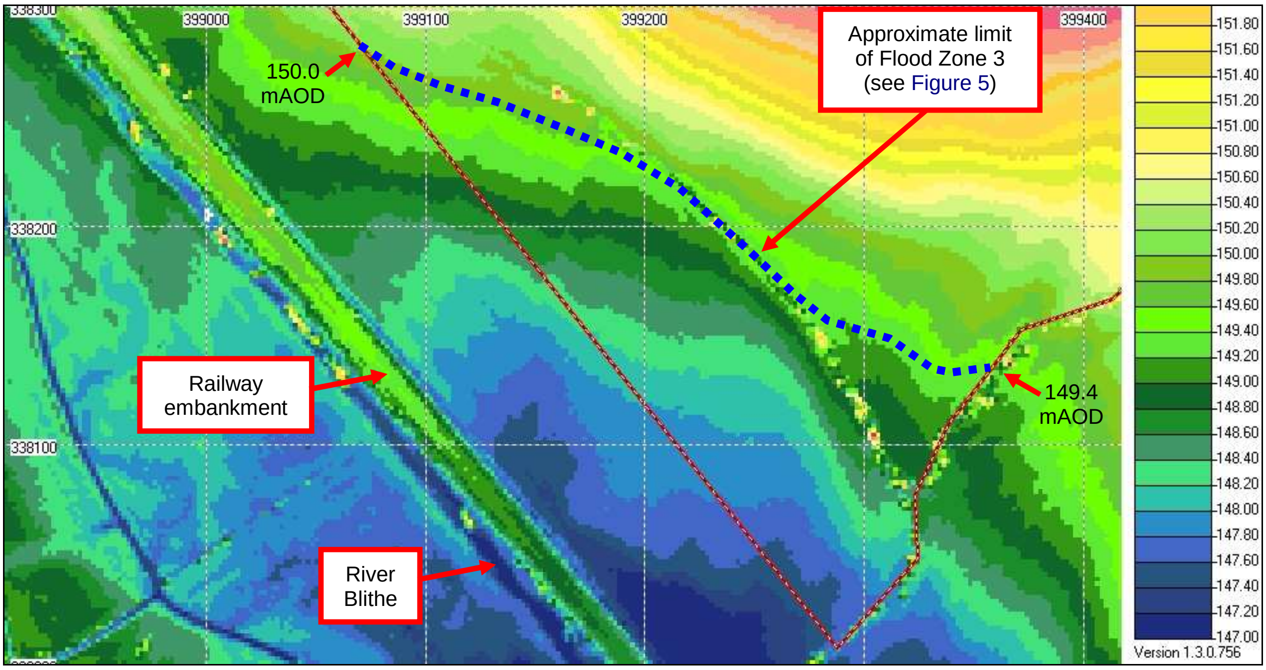
This may need to include

- a description of how any existing flood risk management measures affect the probability of a flood occurring at the site FRA Pro-forma
- supporting evidence and calculations for the derivation of flood levels for events with a range of annual probability
- inundation plans of, and cross sections through, the existing site showing flood extents and levels associated with events with a range of annual probability
- a plan and description of any structures which may influence the probability of a flood occurring at the site. This may include bridges, pipes/ducts crossing a watercourse, culverts, screens, embankments or walls, overgrown or collapsing channels and their likelihood to choke with debris.
- details of any modelling studies completed to define the exiting degree of flood risk (Ref Chapter 3 of the Practice Guide)

The Environment Agency flood zone map in Figure 5 shows the southern part of the site to be within Flood Zone 3, subject to the 1:100 year flood on the River Blithe. The approximate limit of Flood Zone 3 has been copied from Figure 5, on to the topographic map in Figure 6. This is a digital surface model (DSM), based on LiDAR data. The DSM shows all features of the land surface, including hedgerows and buildings.

This map confirms that the limits of 1:100 year flooding drop from about 150.0 mAOD near the upstream limit of this flood zone within the site, to about 149.4 mAOD at its downstream limit, as indicated on Figure 6. Since the lowest point on site is between 147.4 mAOD and 147.6 mAOD, flooding to 149.4 mAOD would result in up to 2 m depth of floodwater. These assumptions are based entirely on the Environment Agency flood zone map, which is based on their generalised model in this area. Detailed hydraulic modelling would be required to refine that assessment.

Figure 6 Topographic map of the southern part of the site



3d What are the existing rates and volumes of run-off generated by the site?

- This should generally be accompanied by calculations of run-off rates and volumes from the existing site for a range of annual probability events (see Chapter 4 of the Practice Guide).

The soil map (Figure 3) shows that the site is divided between "Slightly acid loamy and clayey soil with impeded drainage", which occupies about two thirds of the area and "Loamy soils with naturally high groundwater". Runoff estimation for small catchments based on the Marshall and Bayliss (1994) methodology uses five soil types, whose characteristics vary from permeable to impermeable, designated S1 to S5.

For this analysis, the slightly acid loamy and clayey soil with impeded drainage has been designated as S3 or S4, while the naturally high groundwater of the other soil type causes it to be assigned to S5. In order to estimate the rate of runoff using Marshall and Bayliss (1994), the catchment is divided equally between S3, S4 and S5. Since the Marshall and Bayliss method is only strictly valid on catchments of at least 0.5 km^2, that area has been used in the analysis to produce the results shown in Table 3.

Table 3 Estimate of greenfield and urban runoff from the site

Return period (years)	Peak rate of runoff (l/s/ha)	
	Rural	Urban
QBAR	5.326	7.786
2	4.767	7.282
5	6.539	9.686
10	7.929	11.447
20	9.448	13.135
25	9.973	13.680
50	11.703	15.097
100	13.688	17.067
200	16.085	19.485
250	16.884	20.279
500	19.280	22.602
1000	22.156	25.426

Methodology based on Marshall D.C.W. & Bayliss A.C., 1994. Flood estimation for small catchments, IH Report No. 124, Institute of Hydrology, Wallingford and Hall, Hockin & Ellis

The "Rural" column represents an estimate of greenfield runoff, with the "Urban" column showing the effect of 25% of the site area being under impermeable surfaces (see Section 5).

4. Climate change

How is flood risk at the site likely to be affected by climate change?

- Annex B of PPS25 and Chapters 3 and 6 of the Practice Guide provide guidance on how to assess the impacts of climate change.

The general impacts of climate change on flood behaviour in England and Wales remain unclear. The FEH (Institute of Hydrology, 1999) describes a review of flood peak data to investigate possible trends. The analyses do not show that climate change has affected UK flood behaviour, but neither do they prove that it has not affected it. The NPPF requires a consideration of the impacts of climate change on the flood risk for any proposed development. The suggested mechanism for this is to allow for increases in peak flows of 20% to 2115 and peak rainfall of 30% over the same period.

The design life of this project is 15 years and over that period, relatively minor change is expected at the site. It is recommended that when sizing infiltration structures, the peak rainfall should be increased by 10%, as an allowance for climate change.

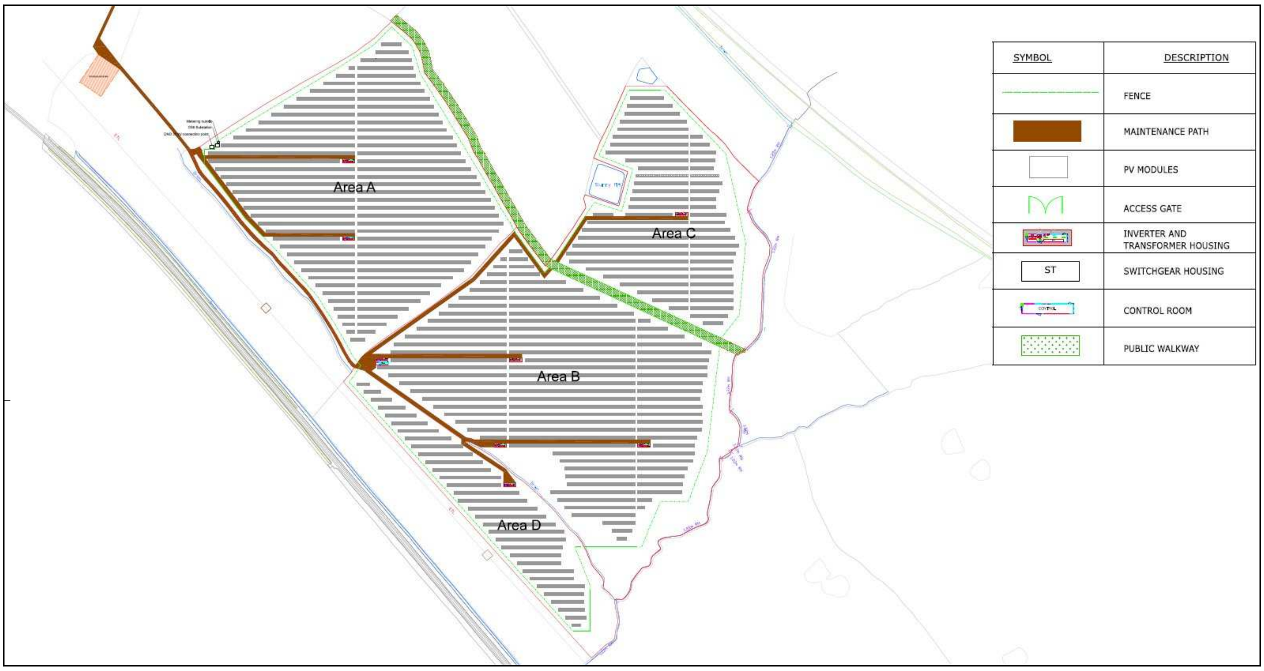
5. Detailed development proposals

Where appropriate, are you able to demonstrate how land uses most sensitive to flood damage have been placed in areas within the site that are at least risk of flooding, including providing details of the development layout?

- Reference should be made to Table D.2 of PPS25.
- Chapter 4 of the Practice Guide provide guidance on how the sequential approach can be used to inform the lay-out of new development sites.

The site has been divided into four areas, marked A to D on Figure 7. The areas that would be occupied by solar panels is summarised in Table 4, which shows that they are expected to cover some 70,926 m^2, about 7.1 ha. This compares with a fenced area of 22.6 ha, showing that the solar farm would result in the area of impermeable surface being increased to some 31% of the fenced area. This calculation neglects the fact that the full 22.6 ha of the underlying field is still available for infiltration, since runoff from each solar panel would be free to infiltrate beneath the panel or adjacent panels. The 7.1 ha area of solar panels is therefore additional to the 22.6 ha of the underlying field and occupies some 24% of the total area.

Figure 7 Site plan

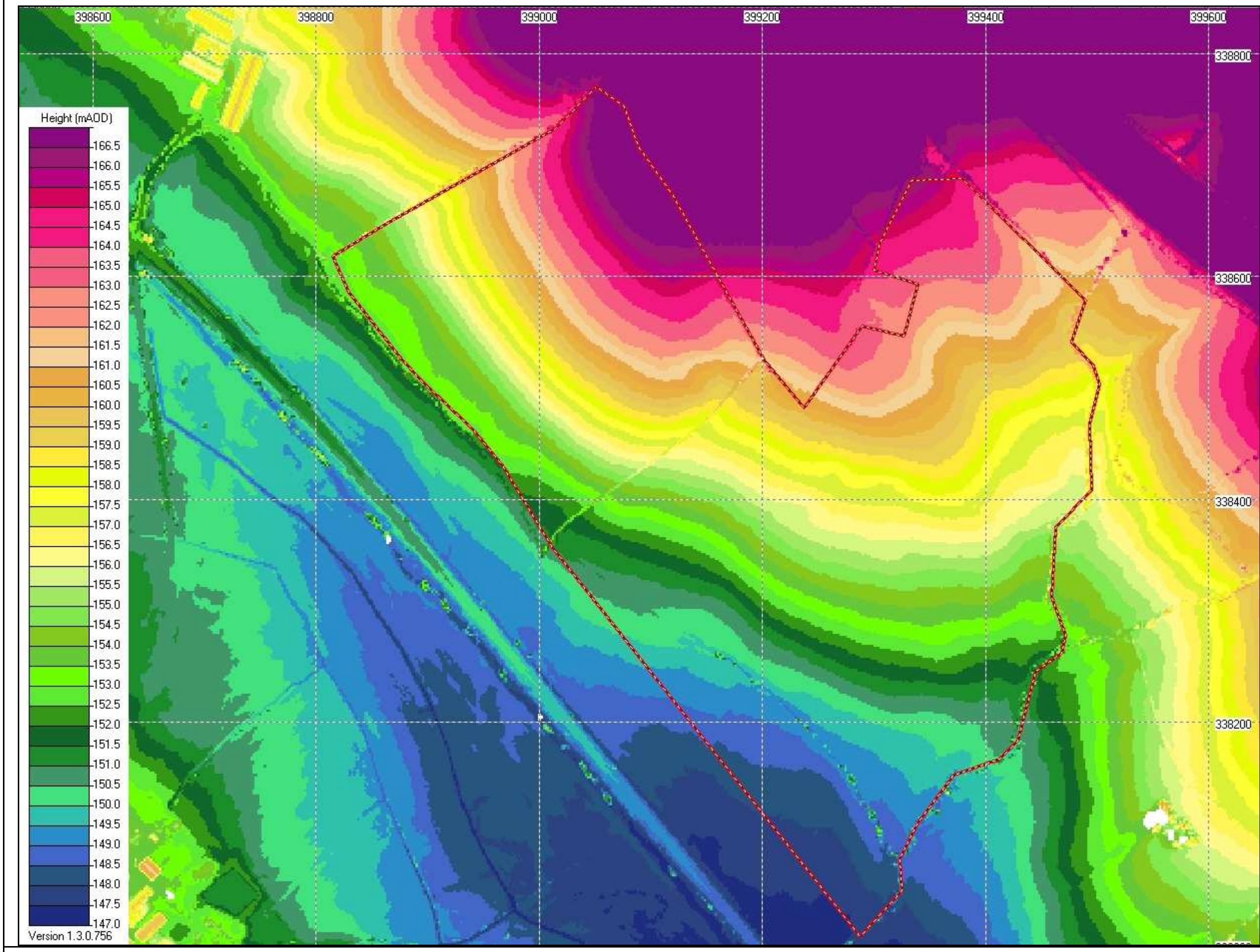


The underlying topography is shown in the LiDAR map (Figure 8). The fields slope down towards the south, with much of the western area sloping to the southwest and some areas in the east sloping down in a south easterly direction. The steepest slope on site is about 0.143 or 1:7, although slopes over most of the site are much less steep. Area D, the lowest part of the site, also has the gentlest topography.

Table 4 Areas occupied by solar panels

Location	Area of panels (m^2)
Area A	25,560
Area B	27,048
Area C	12,024
Area D	6,294
Total =	**70,926**

Figure 8 Topographic map of the site and surrounds at 0.5 m vertical interval



6. Flood risk management measures

How will the site be protected from flooding, including the potential impacts of climate change, over the development's lifetime?

- This should show that the flood risk management hierarchy has been followed and that flood defences are a necessary solution. This should include details of any proposed flood defences, access/egress arrangements, site drainage systems (including what consideration has been given to the use of sustainable drainage systems) and how these will be accessed, inspected, operated and maintained over the lifetime of the development. This may need to include details of any modelling work undertaken in order to derive design flood levels for the development, taking into account the presence of any new infrastructure proposed.

As described in Section 1b, electricity generating power stations are classified as "Essential Infrastructure" under the NPPF. Although the NPPF allows that developments that fall within this vulnerability class may be located within flood zones, DCLG (2009, Section 4.85, p.103), this Section states as follows:

"The Exception Test would then need to be passed with evidence provided that the need for the development outweighs the flood risk; that they would remain operational and safe at times of flood and would not increase flood risk, and would not impede water flows. The development must satisfy these tests in order to be permitted".

The equipment used in the solar panels is able to resist periodic inundation, so should not suffer any long term effect through being flooded and those panels above flood waters would continue to supply power. It was shown in Section 2b that the site is separated from the River Blithe by a main line railway and that although floodwaters would reach the site, this would be a backwater effect and no significant flood flow paths would cross the site. For these reasons, the operation of the solar farm would be barely affected or not affected by flooding. The design at the base of the solar collectors (Figure 9) ensures that they would occupy very little floodplain storage volume.

Figure 9 Solar panels of the type proposed at Lower Newton Farm

Note: This picture is indicative, it is likely that double panels would be used at this site.

There would be no need for people to approach the solar panels during times of flooding, since any necessary maintenance can be delayed until after flood waters had receded. There is therefore no risk to people on site and very little or no change in the downstream flood risk (see below). Since flood risk is very small, the benefits of the development may be considered to outweigh flood risk. Solar farms provide an ideal land use for sites such as this.

7. Off site impacts

7a How will you ensure that your proposed development and the measures to protect your site from flooding will not increase flood risk elsewhere?

This should be over the lifetime of the development taking climate change into account. The assessment may need to include:

- Details of the design basis for any mitigation measures (for example trash screens, compensatory flood storage works and measures to improve flood conveyance). A description of how the design quality of these measures will be assured and of how the access, operation, inspection and maintenance issues will be managed over the lifetime of the development.
- Evidence that the mitigation measures will work, generally in the form of a hydrological and hydraulic modelling report.
- An assessment of the potential impact of the development on the river, estuary or sea environment and fluvial/coastal geomorphology. A description of how any impacts will be mitigated and of the likely longer-term sustainability of the proposals.

The proposed development would not increase flood risk downstream for a number of reasons:

1) *Floodplain storage would not be affected significantly because of the relatively small volume of material required to support the solar panels. The cross-section of each pole shown in Figure 9 is about 100 mm, about the size of a small tree. The volume of floodplain storage that would be lost is negligible.*
2) *Flood flow paths would not be affected since the River Blithe flows the other side of the railway embankment and the site is in a backwater, as described in Section 6.*
3) *It is recommended that the rate of runoff from the site is mitigated using swales.*

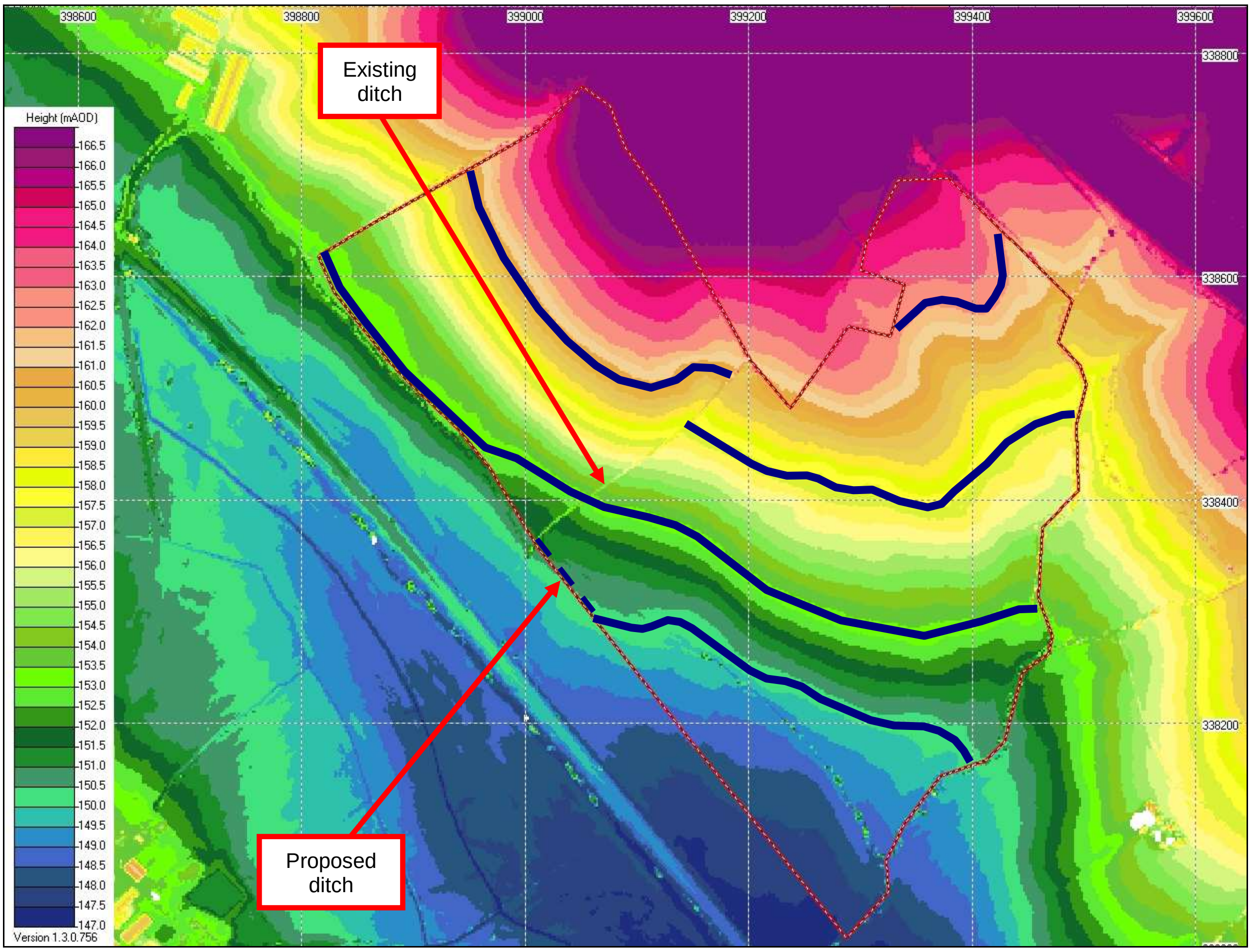
It is recommended that runoff mitigation is put in place at the site, to ensure that the increased rate of runoff from the solar panels does not increase flood risk downstream. It is recommended that broad swales are aligned along the contours, in order to intercept any runoff across the surface of the fields. A possible arrangement is suggested in Figure 10. The precise location of the swales would depend on site issues, such as the locations of roads and other features of the development, so the arrangement suggested in Figure 10 should be regarded as indicative.

It is envisaged that these swales would form broad basins, circa 10 m wide. This width would promote infiltration across a broad wetted perimeter and ensure that the swales would not need to be very deep. As well as promoting infiltration more efficiently, broad shallow swales need not disrupt the arrangement of solar panels, which can be located over swales and bounding areas with equal ease.

The infiltration coefficient of the underlying soil is not known, so a conservative value has been selected. CIRIA (2007) give infiltration rates for loam in the range 0.1 m/hr to 0.001 m/hr and in order to be conservative, the slowest value has been used. Calculations of the depth of the swales were undertaken using the assumptions shown below, which could later be refined by infiltration testing on site.

1) *Swales to be laid parallel with the contours, with a 10 m width*
2) *Total swale length shown in Figure 10 is 2,000 m*
3) *With an impermeable area of 70,926 m^2 (Table 4), each metre of swale serves an average of 36 m^2 of impermeable catchment*
4) *Design rainfall totals derived from FEH (Centre for Ecology and Hydrology, 2009)*
5) *A runoff coefficient of 50% is assumed, a little over the SRPHOST of 33% (Table 2)*
6) *Infiltration rate in the swales is taken as 0.001 m/hr*
7) *A factor of safety of 1.5 is used, as recommended by CIRIA (2007, p.4-31)*
8) *Peak rainfall at the site will increase by 10%, due to climate change over the 15 year design life of the project.*

Figure 10 Suggested location for swales to intercept runoff



Swales shown by solid blue lines

It is recommended that the swales should be grassed over, forming a continuous grass cover with the rest of the area under solar panels, as illustrated in Figure 9. In this way if any one swale is overtopped, surface flow down slope would be intercepted by the swale below it. The lower most swale in Figure 10 is located between 150 mAOD and 150.5 mAOD, beyond the limits of flooding shown on the Environment Agency Flood Zone Map (Figure 5).

The calculation below is designed to dimension unit length (ie. one metre) of swale. The calculation is performed Hydro-Logic Services' infiltration tool, which is based around the methodology recommended in CIRIA156. This tool assumes a rectilinear cross-section, as may be found in soakaways. In practise, swales are more likely to have a curved base, typical of a basin. As a result, the calculated depth should be regarded as the average depth of the swales.

The results (Figure 11) show that under the conservative assumptions listed above, the critical storm duration is between 24 hours and 96 hours, when the swale would fill to a depth of 0.17 m. If the swales are constructed as basins, with curved upward-facing surfaces, this average depth implies that the maximum depth, between the deepest point and the outer lip should be in the order of 0.34 m. These dimensions are based on conservative assumptions and if conditions are less severe than assumed, the system of swales shown in Figure 10 is likely to reduce runoff and so reduce flood risk downstream.

Figure 11 Calculated swale depth

Basin Infiltration calculations:
K0463 Lower Newton Farm

HydroLogic

Catchment and Soakaway

Observed Infiltration	q	0.001	m/h
Factor of Safety	F	1.5	
Porosity	n	1	
Area of Catchment	Ad	36	m^2
Runoff Coefficient		0.5	
Area of Infiltration System	Ab	10	m^2
Perimeter	P	2	m
Climate Change Factor		1.1	

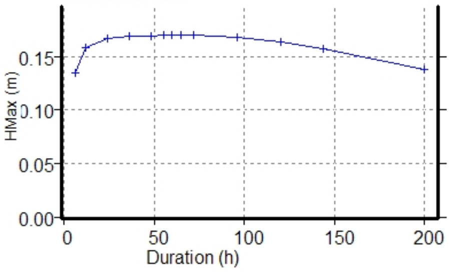
Calculated

Effective infiltration coeff	qe	0.00067	m/h
For 3D systems	b	0.00013	/h
Hmax for Critical duration	Hmax	0.17	m
Empty time (full to half full)	t	124.88	h

Critical duration

Duration	Rainfall	Intensity	Hmax
(h)	(mm)	(m/h)	(m)
6	70.2	0.01287	0.13
12	84.0	0.0077	0.16
24	92.4	0.00424	0.17
36	97.7	0.00299	0.17
48	101.6	0.00233	0.17
55	104.6	0.00209	0.17
60	106.6	0.00195	0.17
65	108.5	0.00184	0.17
72	110.9	0.00169	0.17
96	117.9	0.00135	0.17
120	123.7	0.00113	0.16
144	128.7	0.00098	0.16
200	138.1	0.00076	0.14

Hmax / Duration



Report Details

Report created by:	chrisn
Report created on:	19 Mar 2014 09:39am
Report produced by:	HL Groundwater Tools
Version number:	1.1.0.59

Notes
* Method in accordance with Ciria Report 156: Infiltration Drainage Section 4.4.2
* Based around 1 m length of swale

Q:\PROJECTS\K_hydrology\K0463_Lower_Newton_Farm\Lower_Newton_Infiltration_36m.csv

The analysis undertaken in Figure 11 is for the loamy and clayey soil, which occupies the major part of the site (Figure 3). Soils nearer the River Blithe are described in Figure 3 as "Loamy soils with naturally high groundwater". It can be seen from Figure 6 that the slope over these soils is less steep and it is assumed that the naturally high groundwater will ensure that the proposed solar panels would make little difference to runoff. During times of flooding, the water table is likely to be at or near the surface. Under these circumstances and depending on slope, runoff would be high whether or not the solar panels were in place. Conversely, swales are unlikely to facilitate infiltration.

For these reasons, it is believed that there would be little benefit to siting swales within this gently sloping land on the 1:100 year floodplain and these features are not recommended below the lowest swale, at about 150.0 mAOD.

7b How will you prevent run-off from the completed development causing an impact elsewhere?

- Evidence should be provided that drainage of the site will not result in an increase in the peak rate or in the volumes of run-off generated by the site prior to the development proceeding.

See above, Section 7a.

8. Residual risks

8a What flood-related risks will remain after you have implemented the measures to protect the site from flooding?

- Designing for event exceedence on site drainage systems is covered in Chapter 5 of the Practice Guide. Guidance on other residual risks is provided in Chapter 7.

Residual risks include the possibility that heavy rainfall could cause individual swales to overtop and result in a breach of the outer lip. It is recommended therefore that the swales are inspected and maintained on a regular schedule, at least annually and after heavy rains.

8b How, and by whom, will these risks be managed over the lifetime of the development? • Reference should be made to flood warning and evacuation procedures, where appropriate, and to likely above ground flow routes should sewers or other conveyance systems become blocked or overloaded. This may need to include a description of the potential economic, social and environmental consequences of a flood event occurring which exceeds the design standard of the flood risk management infrastructure proposed and of how the design has sought to minimize these – including an appraisal of health and safety issues.
Maintenance of the infiltration systems should be borne by the site owners.

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