Calleva Community Energy

Flood Risk Assessment and Surface Water Management Plan

Enborne Parish Solar Initiative, Enborne, Berkshire, RG20 0PR

Report LL051
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Summary

This document is a Flood Risk Assessment and Surface Water Management Plan for a solar farm, located at Enborne, near Newbury, Berkshire. The site has recently had an agricultural use. Surface water flood risk at the site is shown to be "low" on published mapping but experience suggests that it is greater than this, the site was visited on 20th July 2021. This assessment includes outline plans for surface water management using attenuation. In the text below, reference to documentation is provided by hyperlinks, which are shown as footnotes for clarity. The main findings are as follows:

1. A solar energy development has been proposed at Enborne, south west of Newbury, covering an area of some 3.6 ha. The site has historically been used by local poor people to collect firewood but more recently has had an agricultural use.

2. Land and buildings used for agriculture are classified as "Less Vulnerable", under NPPF guidelines. As an "electricity generating power station", the solar farm would be classified as "Essential Infrastructure".

3. The site is located on a south-facing slope, on land between about 113 mAOD on the site's northern margin to below 104 mAOD on its southern boundary, where is River Enborne is some 10 m lower.

4. The Flood Map for Planning shows the site to be in fluvial flood zone 1, beyond the limits of 1:1,000-year fluvial flooding. An area at the west of the site is designated as flood zone 2 but that designation appears to be anomalous and incorrect.

5. Surface water flood extent mapping shows most of the site to have a very low risk of flooding. A single flood flow path down the slope is categorised as having a low risk but anecdotal evidence suggests that flooding along this route is fairly common.

6. This flood flow path carries surface water into the Spring Gardens housing estate. There is a possibility that flooding from this source could become more common in future and action is required to mitigate that risk.

7. An adjacent stream, that flows near the site's eastern border, is evidently spring-fed. Alluvial gravels to the north overlie the London Clay and a spring was recorded near the contact. There has been flooding downstream but the site was not affected.

8. It is not known whether the flood flow path that affects the site and Spring Gardens is spring-fed. It crosses the site along a broad, shallow valley before passing through the woodland fringe and into Spring Gardens.

9. Crossing the ditch aligned north to south within the woodland fringe, an east to west ditch is evidently very old and may be part of an earlier drainage system. It was broken at the other ditch, so any flow would be diverted south, to Spring Gardens.

10. Solar farms have a design life of about 25 to 40 years. Guidance on climate change suggests that peak rainfall would increase by 10% to 20% over that period.

11. Regional soil mapping shows the soil to be "slowly permeable", with loamy and clayey texture. Geological mapping shows the area to be underlain by London Clay.

12. It is very unlikely that surface water could be managed using infiltration alone and a surface water management plan has been designed, based on runoff attenuation.

13. There already is space for an attenuation pond in the south of the site and it is suggested that a wetland is created and the attenuation layer is built on top. Outflow from the pond would be directed along the existing ditches but at attenuated rates.

14. In addition to reducing flood risk at Spring Gardens, the proposed system would help to improve water quality, increase biodiversity locally and could, subject to agreement and appropriate security arrangements, provide a valuable local amenity.

15. The parameters of the proposed attenuation system will need to be calculated, once the impermeable areas and other pertinent details have been fully agreed.

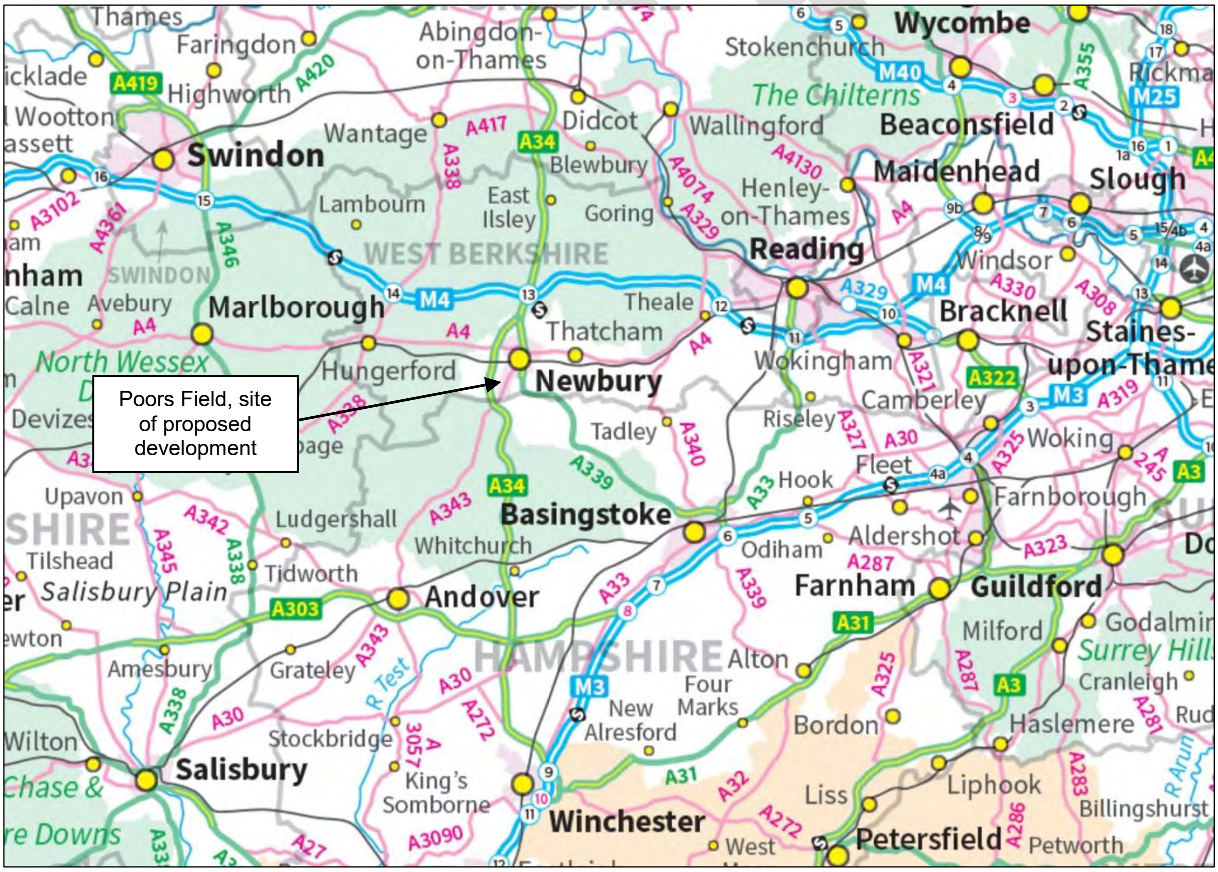
16. In summary, flood risk at the site is low and “Essential Infrastructure” is considered to be appropriate in any flood zone, subject to an acceptable FRA. Once they have been calculated, it will be possible to keep outflow below Greenfield runoff rates using an attenuation system with the recommended outline design. This development will then be able to fully comply with the flood risk provisions of the NPPF.

1. Development site and Location

A solar energy development has been proposed at Poors Field, Enborne, about 5 km south west of Newbury (Figure 1). Covering an area of about 8 ha, of which the Application area (the red line boundary) covers 3.61 ha, Poors field has historically been used to provide fuel for the poor of the parish of Enborne and is currently used for grazing. The field is owned by the Poors Allotment Charity, whose Trustees are also the Councillors of Enborne Parish Council. As part of their efforts toward energy sustainability, the Councillors / Trustees are proposing to locate solar panels on Poors Field, with the objective of generating electricity and reducing the carbon footprint of the Parish.

The site (Figure 2) has an agricultural use at present (Figure 3), which is classed as less vulnerable. As an “electricity generating power station”, the solar farm would be classified as “Essential Infrastructure”[1]. Solar farms are considered to be appropriate in all flood zones, subject to an acceptable FRA. The location of the site is shown in Table 1.

Figure 1 Location of Poors Field Farm within West Berkshire



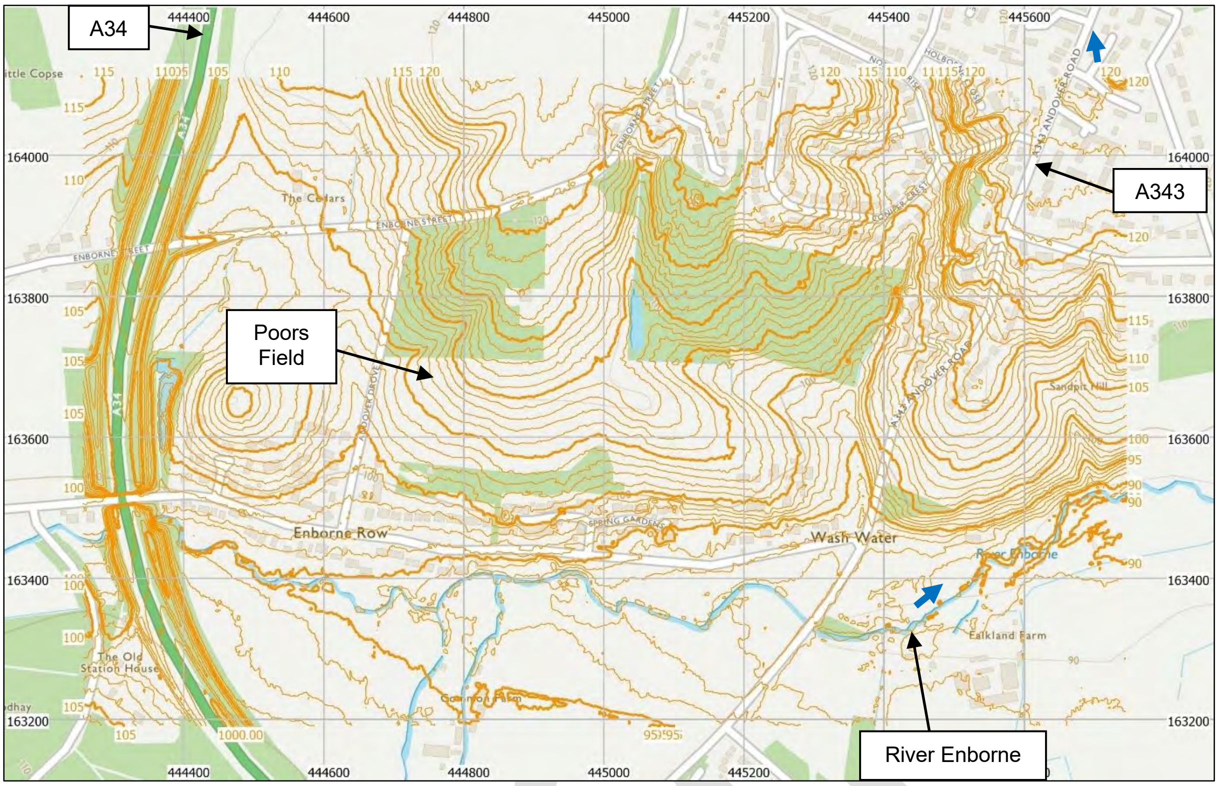
Source: https://maps.the-hug.net/

Table 1 Approximate location of the proposed solar farm

OS X (Eastings)	444933
OS Y (Northings)	163636
Nearest Post Code	RG20 0PR
Lat (WGS84)	51.37004
Long (WGS84)	W-1.35590
Nat Grid Ref	SU 44933 63638

[1] https://www.gov.uk/guidance/flood-risk-and-coastal-change#Table-2-Flood-Risk-Vulnerability-Classification

Figure 2 Location of Poors Field, in relation to the surrounding area



Source: https://osmaps.ordnancesurvey.co.uk/51.37004,-1.35590,16

Figure 3 Air photo of the site and surrounding area

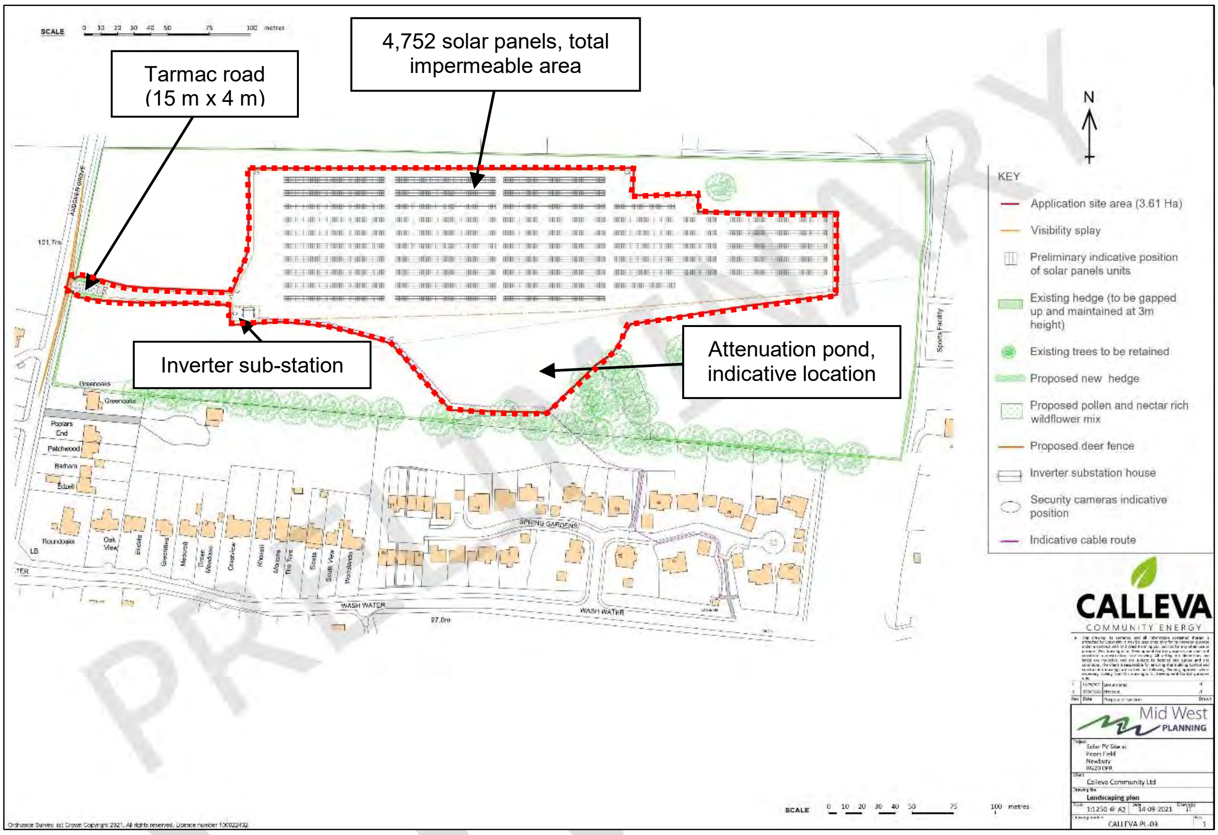
Source: Satellite Pro (UK)[2]

[2] https://satellites.pro/UK_map#51.371647,-1.355576,16

2. Development proposals

The layout of the site and its key features are shown in Figure 4. The proposed development includes 4,752 solar panels, mounted as 42 static arrays. A short tarmac road is proposed inside the site entrance, to facilitate the import of heavy equipment. Solar arrays are regarded as having a design life in the order of 25 to 40 years[3].

Figure 4 Plan of the proposed development, showing its main components



[3] https://www.nrel.gov/analysis/tech-footprint.html

3. Climate Change

The Environment Agency and NPPF require a consideration of the impacts of climate change on flood risk, for any proposed development. In February 2016, the Environment Agency updated the climate change allowances required in Flood Risk Assessments and surface water management calculations. This advice updates previous climate change allowances to support the NPPF (DCLG, 2012). The Environment Agency (2016) state:

> "Making an allowance for climate change in your flood risk assessment will help to minimise vulnerability and provide resilience to flooding and coastal change in the future. The climate change allowances are predictions of anticipated change for:
> - peak river flow by river basin district;
> - peak rainfall intensity;
> - sea level rise;
> - offshore wind speed and extreme wave height".

For rainfall, Table 2 shows the anticipated changes in small catchments, recommending a progressive increase, reaching 10% for the "central" and 20% for the 'upper end' allowance by 2069. These allowances would appear to be appropriate for this development, in view of the design life of photovoltaics, of 25 to 40 years.

Table 2 Peak rainfall intensity allowance in small and urban catchments

Allowance Category	Total potential change anticipated		
Applies across all of England	2015 to 2039	2040 to 2069	2070 to 2115
Upper end	10%	20%	40%
Central	5%	10%	20%

Source: Environment Agency (2016)[4]

The allowance category reflects the proportion of possible scenarios that fall below an allowance level. The central allowance is based on the 50th percentile and the upper end allowance is based on the 90th percentile. This means that for a development such as this, with a design life of 25 to 40 years, there is considered to be a 50% chance that climate change will increase peak rainfall by no more than 10% and a 90% chance that it will be increased by no more than 20%. With reference to the peak rainfall intensity allowance, the Environment Agency advise that:

> "*For flood risk assessments and strategic flood risk assessments, assess both the central and upper end allowances to understand the range of impact*". and
>
> "*Design your drainage system to make sure there is no increase in the rate of runoff discharged from the site for the upper end allowance*".

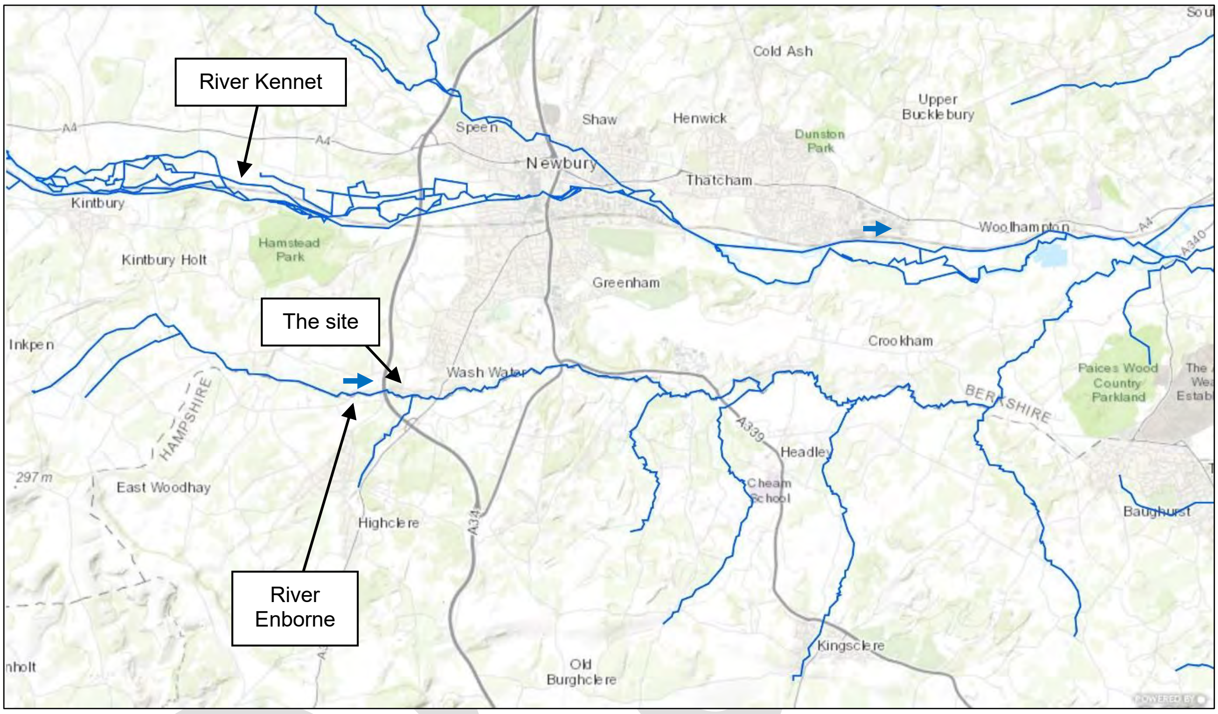
In view of the 25 to 40-year design life of this development, the surface water management plan is designed to manage a 10% allowance for climate change but tested against a 20% allowance, to confirm how well this "upper end" increment would be managed and ensure no increase in the rate of runoff discharged from the site under these conditions.

[4] https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#table-2

4. Existing Topography and Drainage

The WWF Rivers Map (Figure 5) shows the River Enborne is a tributary of the River Kennet, which it joins upstream of Reading, on the right-hand side of Figure 5. The River Enborne catchment to the site covers about 25 km^2, draining an area to the west.

Figure 5 Map showing the regional drainage



Source: https://www.wwf.org.uk/uk-rivers-map

Topographic mapping is laid over Ordnance Survey mapping in Figure 6 and Figure 7. The contours in Figure 6 have been drawn from LiDAR digital terrain model (DTM) data, which is also used to colour the surface in the layer shaded map in Figure 7. Digital surface model (DSM) data has been used in Figure 7 to show locations where surface features such as buildings and vegetation are significantly above bounding land. Any DSM data point that is more than 0.5 m above a bounding point is shown with a black dot. In this way, the outlines of buildings are shown as rectangles and hedgerows along road and field margins show up as lines of dots, marking these features.

These maps show the area to be descending from higher land at about 113 mAOD on the site's northern margin to below 104 mAOD on its southern boundary. South of the site, the River Enborne flows from west to east, descending from about 95 mAOD at the A34 to below 90 mAOD, east of the A343, Newbury Road. This circa 10 m height difference makes it very unlikely that the site would be affected by River Enborne flooding. The movement of surface water within the site is guided by subtle changes in the surface, which are discussed in detail in Section 6.

Figure 6 Contour map of the site and surrounds, derived from LiDAR DTM data, contour interval 1.0 m

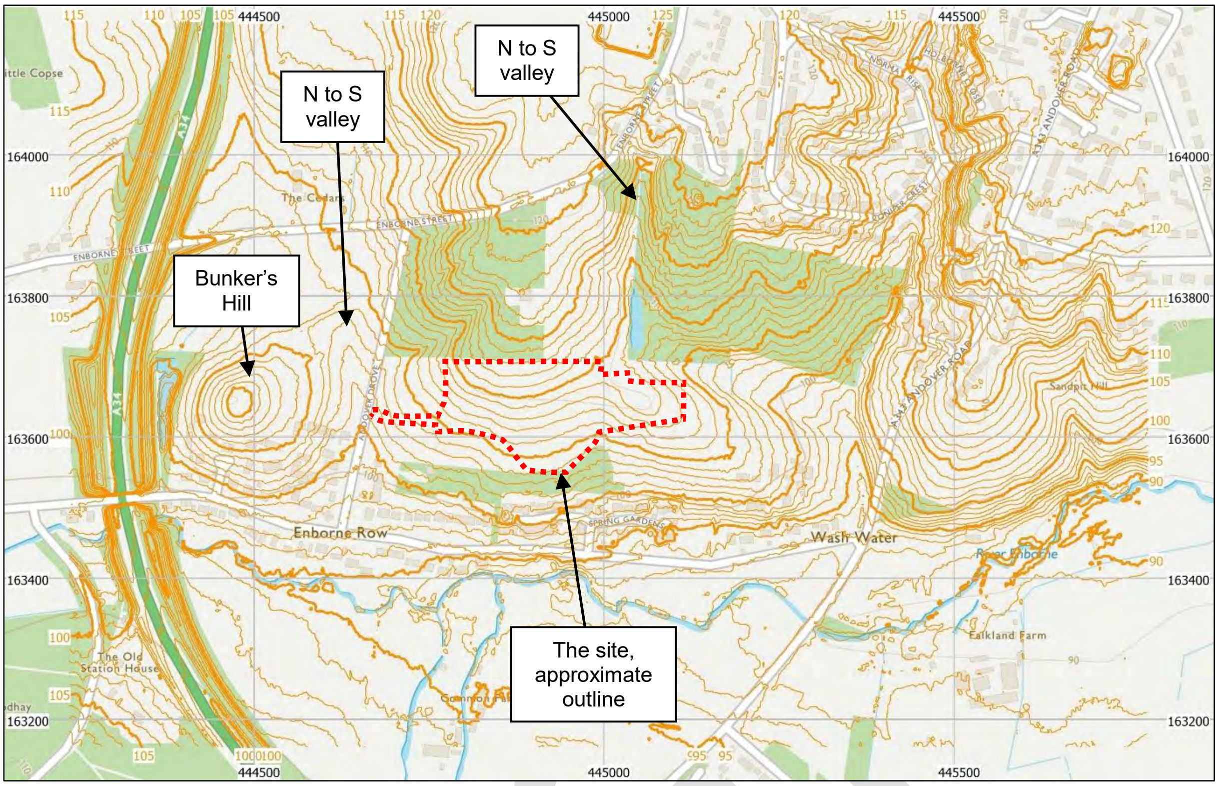
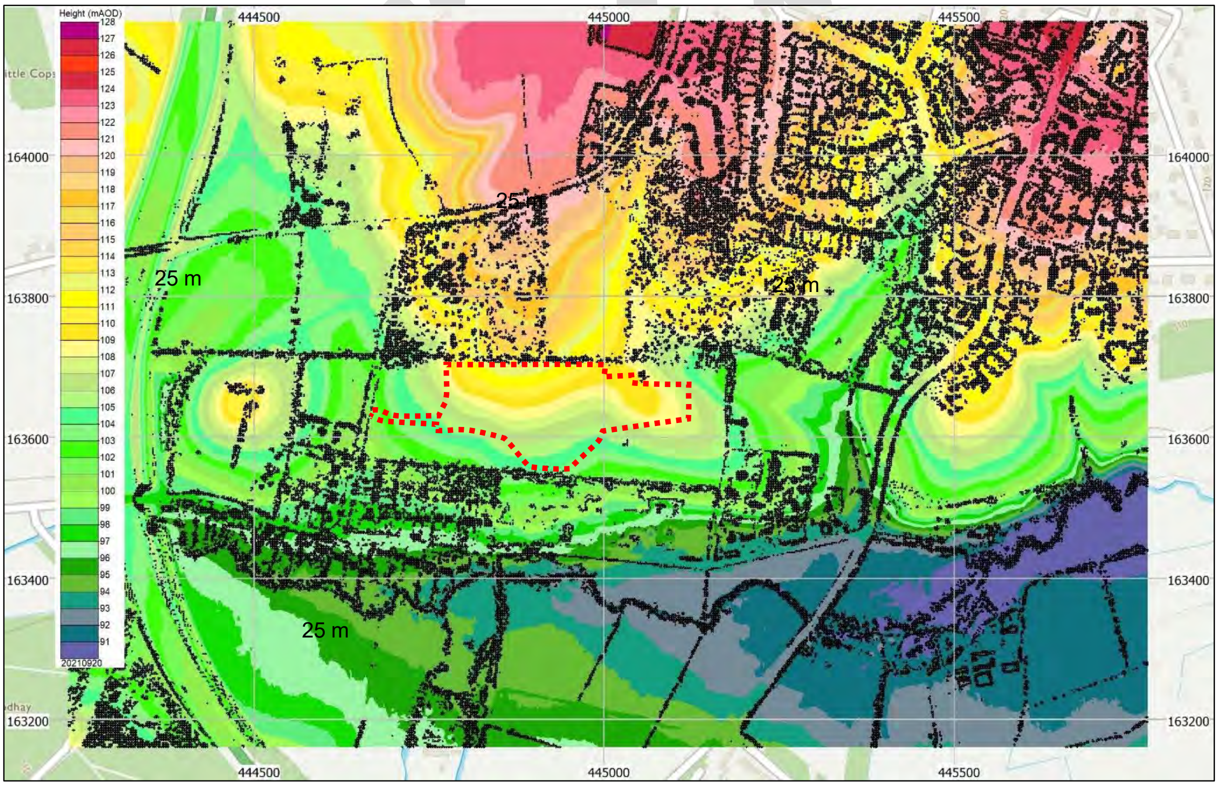


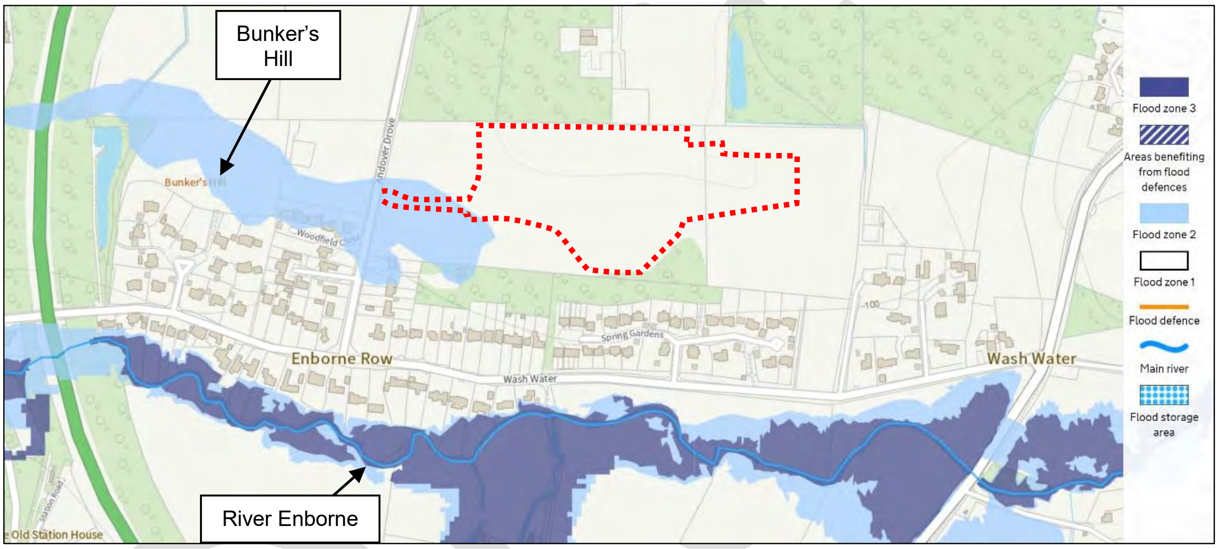
Figure 7 Layer shaded map of the area shown in Figure 6



5. Flood Risk

There is no record of fluvial flooding at the site. The Flood Map for Planning (Figure 8) shows flood risk from rivers to be concentrated along the River Enborne. The site is mainly shown as being located in Flood Zone 1, beyond the limits of 1:1,000-year flooding from rivers and the sea. There is however an area designated as flood zone 2 to the west of the site and across the site entrance. This area of flood zone 2 does not correspond with any marked stream or low land and comparison with the contour map (Figure 7) shows that it crosses an isolated hill marked as "Bunker's Hill" on Figure 8. Contour mapping shows a valley to the west of Andover Drove, which would convey flow southward and away from the site. It is unclear why this area of flood zone 2 has been marked on the Flood Map for Planning but it is not believed to be any threat to the site.

Figure 8 Flood map for Planning shows fluvial flood risk in the region around the site



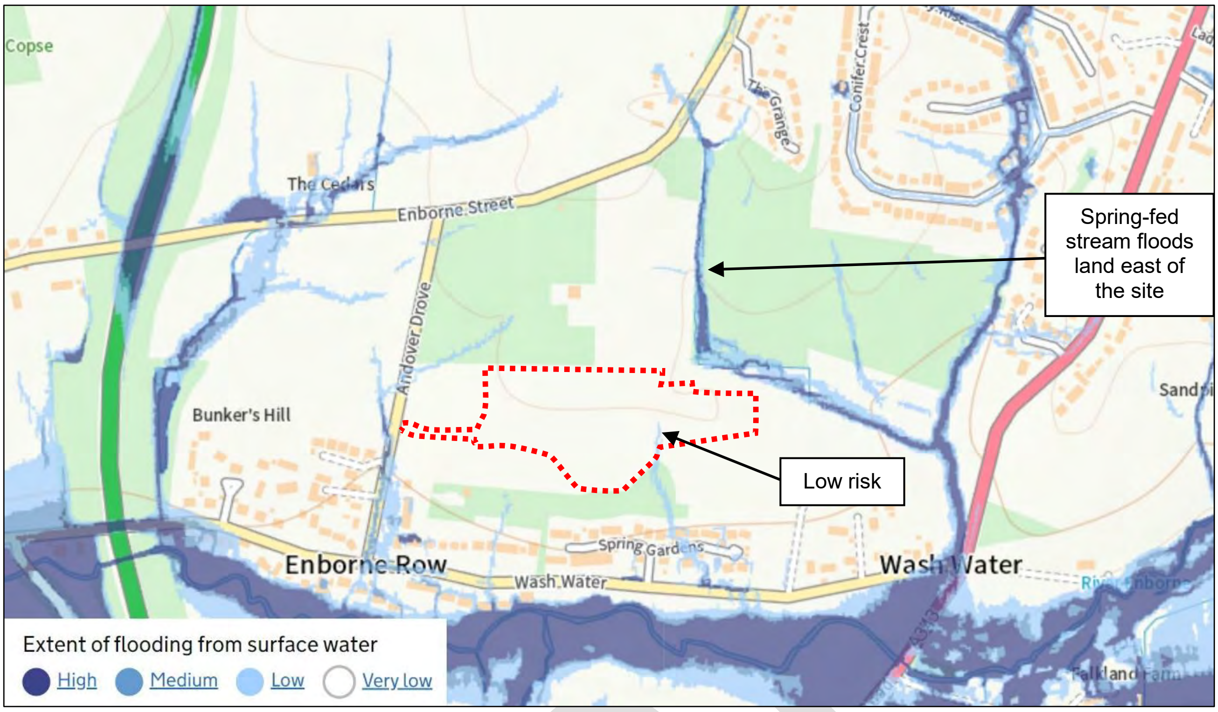
Source: https://flood-map-for-planning.service.gov.uk/confirm-location?easting=444941&northing=163507&placeOrPostcode=RG20%200PR

The flood zone around Bunker's Hill is not shown on the map of surface water flood extent (Figure 9), which picks up low land, including that along stream channels. This map uses a three-point scale of "high", "medium" and "low" flood risk, in which "high" indicates high probability, the most likely to occur, rather than high intensity, the most serious. It can be seen from Figure 9 that a risk of surface water flooding has been identified within the valley feature to the west of Andover Drove, which joins this road to the south of the site entrance. This provides evidence that the entrance to the site is not at significant flood risk.

The site itself is uncoloured in Figure 9, indicating a very low risk of surface water flooding. One area of the site is coloured in light blue, indicating a low risk of flooding. As explained on the website: "*Low risk means that each year this area has a chance of flooding of between 0.1% and 1%*". That risk is similar to that experienced in fluvial flood zone 2, indicating areas affected by flooding between the 100-year and the 1,000-year return periods. The southward extension of this area of low flood risk passes through the woodland to the south of the site and on down to Washwater, the road to the south.

Notwithstanding the indicated rarity of such an event, it has occurred in relatively recent time. The photograph in Figure 10 was taken in May 2016 by Enborne Parish Councillor John Leeson, who stated in an email dated 3rd June 2021: "*Such water flow events are quite frequent after any heavy rainfall*". Such flooding is evidently not a rare event, with 0.1% to 1% annual exceedance probability (AEP), as suggested by Figure 9.

Figure 9 Surface water flood extent map, showing the site to be at very low risk of surface water flooding



Source: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map

Figure 10 Surface water flooding in Spring Gardens, 11th May 2016

Source: Photo supplied by Councillor John Leeson

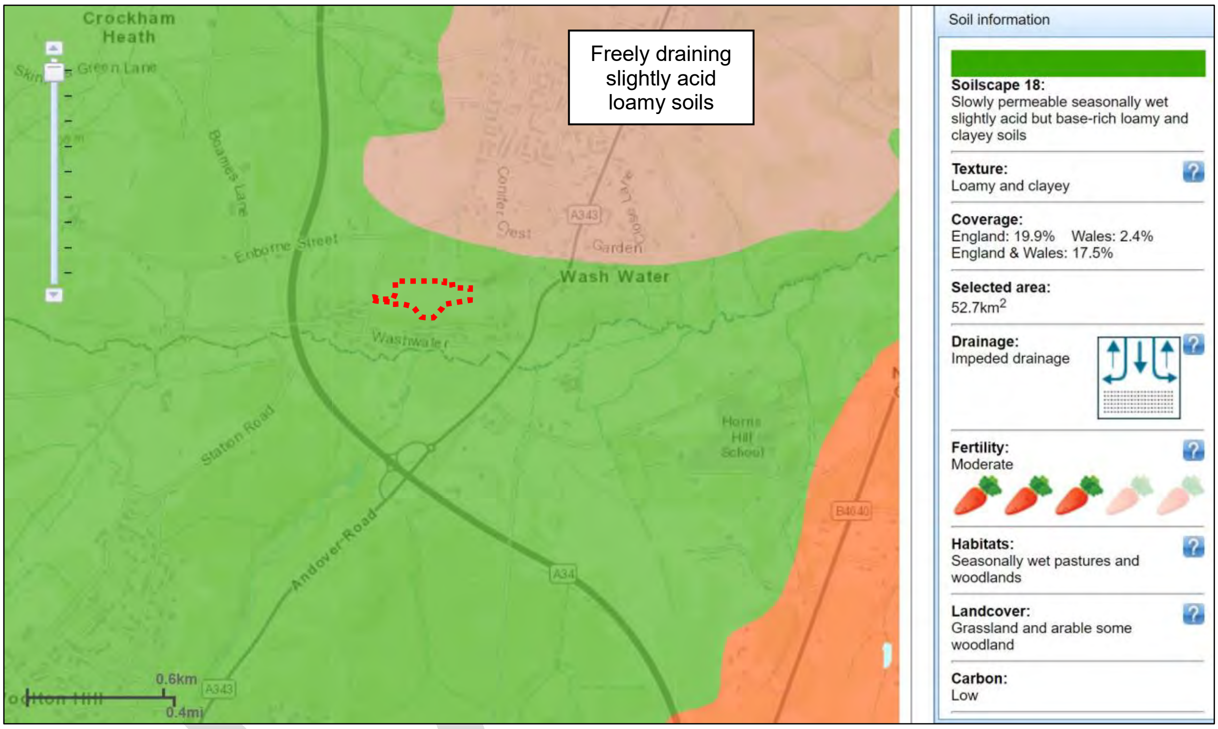
The event shown in Figure 10 involves surface water, which appears to have crossed at least part of the site and the belt of woodland to the south. It is a requirement of the NPPF that flood risk elsewhere in not made any worse and, if possible, reduced by any development. With this in mind, the cause and mechanism of flooding were investigated and are described and possible mitigation is considered in the next Section.

6. Surface water management

6.1 Surface Characteristics

Regional soil mapping (Figure 11) shows the soil to be “slowly permeable”, with a loamy and clayey texture. Geological mapping (Figure 12) shows that the lithologies underlying the site are fine grained deposits from the Palaeogene Period of the Early Tertiary, known as the London Clay Formation. Formed approximately 48 to 56 million years ago, when local environments were dominated by deep seas. These are expected to weather to form the heavy, slowly permeable soils mapped in Figure 11.

Figure 11 Soil map of the site and surrounding area

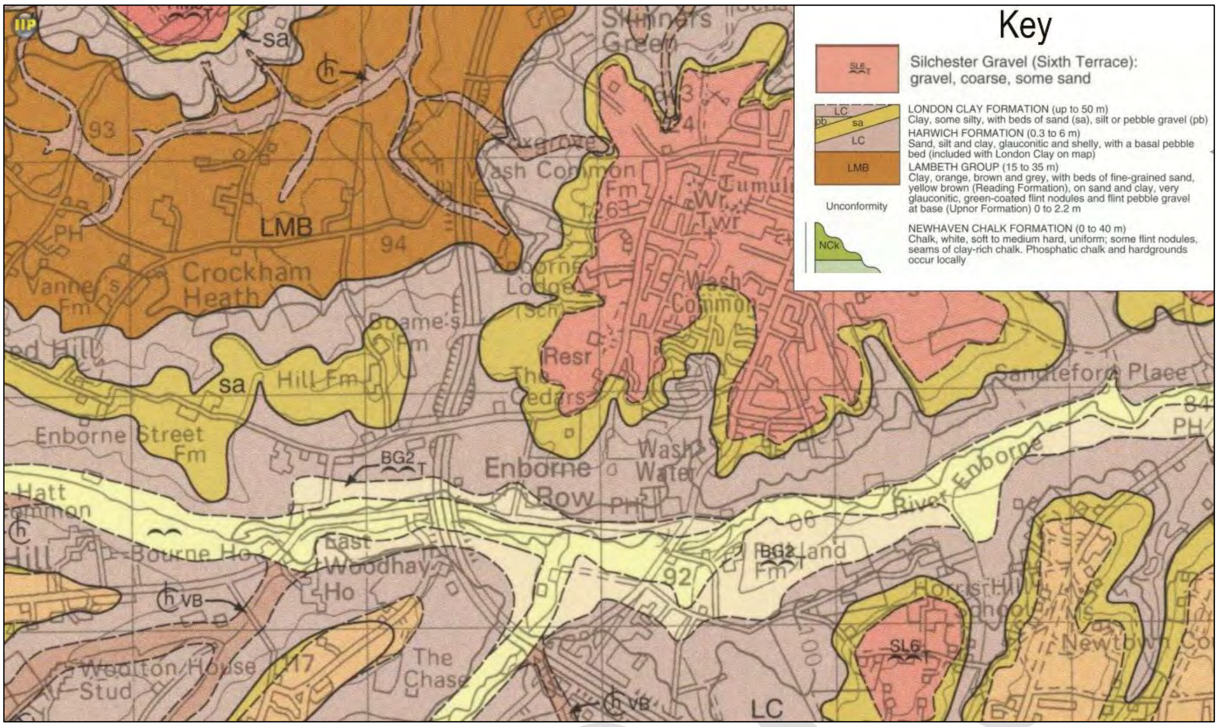


Source: http://www.landis.org.uk/soilscapes/

It can be seen from Figure 12 that the London Clay is found associated with similar marine deposits, the Harwich Formation and the Lambeth Group, which contain coarser members, in which some sand, silt and shell fragments are described. To the north of the site, the Palaeogene sequence is overlain by the Silchester Gravel, coarse gravels with some sand. This is described in the Key as the “Sixth Terrace” and on the original map as “River terrace deposits of the Kennet and proto-Kennet”. In the context of this assessment, this deposit is important mainly due to its ability to hold water.

Underlying the sediments described above is the Cretaceous chalk, the upper members of which are shown on the Key. The chalk does not outcrop on Figure 12 but is exposed to the west, where it forms large areas of the surface of the Wiltshire Downs. It can be seen from the key in Figure 12 that the Palaeogene sequence rests unconformably over the uppermost member of the Cretaceous chalk. This is important because it indicates a break in deposition, a period of possible erosion, during which fragments of chalk or their flint inclusions could be re-worked and incorporated within subsequent deposits.

Figure 12 Regional Bedrock Geology



Source: British Geological Survey, 1:50,000 mapping[5]

6.2 Site Drainage Arrangements

Existing surface water drainage arrangements at the site reflect the very small variations in level across the surface of Poors Field. Topographic mapping with a 1.0 m contour interval has been superimposed over the site plan in Figure 13, showing a gentle valley, aligned almost north to south and marked on Figure 13 by a dashed arrow.

Figure 13 Existing attenuation arrangements along the western site boundary, outflow towards the north

5 https://largeimages.bgs.ac.uk/iip/mapsportal.html?id=1001762

Viewed across Poors Field from the north, this swell is barely perceptible (Figure 14), with no channel along its length. Having crossed the field and woodland below, the drainage path enters Spring Gardens along a footpath, at the southern end of the arrow in Figure 13. Despite having little or no value as a footpath, this is covered in tarmac (Figure 15) and would convey flow rapidly from the north. Having entered Spring Gardens, the road sloped down to the left and runoff can be expected to follow that route. As shown by the event of 11th May 2016 (Figure 10), that is exactly what happens.

Figure 14 View across Poors Field, looking along drainage line from the north

Figure 15 Tarmac-covered footpath, where the drainage path would be deflected left, through Spring Gardens

Stepping back from the footpath into the woodland, a channel is small but well defined (Figure 16). Little or no water was seen within it and an abundance of twigs and leaf litter suggest that flow has been intermittent and rare. Walking northward through the woodland, a ditch was found near the fence marking the southern margin of Poors Field.

Figure 16 A small channel leaves the woodland and meets the northern end of the footpath

Aligned approximately east to west, at right angles to this southward aligned channel, the confluence of these two ditch / channel features is shown in Figure 17. The margins of the east-west ditch are evidently old, supporting mature trees. There is a break in its southern margin and it was not clear whether it was formed naturally, through overtopping or whether a section had been deliberately removed, to facilitate southward flow.

Figure 17 Outflow from the east-west aligned ditch turns towards the south

6.3 Surface Water Flooding Mechanism

In order to better understand the local mechanism of surface water flooding, the underlying geology was examined. In particular, the observation that there appears to be a material difference between the water retention characteristics of the upper part of the field and its lower slopes. Walking across the lower levels after winter rains was described by a local witness as "wet and squidgy", while the upper slopes appeared much firmer and dryer.

During an examination of the soil near the top of the field, several stones were seen on the surface. This can result from a number of causes, several of which are anthropogenic, such as building of roads or other structures in the past. A trial pit dug near the north of the site turned up several more stones (Figure 18). Some of these are rounded while others are angular and include at least one flint. In addition, the intervening soil was coarser than a clay and appeared to be of silt or fine sand, being slightly gritty when rubbed between the fingers.

Figure 18 Near-surface soil excavated from a shallow pit, near the northern site boundary

It had been suggested this could be part of the overlying Silchester Gravels (Figure 12), which could have been poorly located at this (1:50,000) scale of mapping. In order to better understand the sequence in this area, the British Geological Survey (BGS) were contacted for further advice. On their “Contact us” page[6], BGS helpfully offer further advice:

> “*If you can’t find what you are looking for, BGS Enquiries are the main point of contact and will be happy to help with your request. We will spend up to 30 minutes free of charge on an enquiry and for any request that will take longer than 30 minutes to answer, we will prepare a quote to cover the cost of providing a more detailed scientific response*”.

BGS were duly contacted by email on 21st July 2021 and responded on 23rd July, with very complete and helpful advice. For completeness, this dialogue is included as Appendix A of this report. Having examined 1:10,000 scale geological mapping the respondent, BGS Enquiry Service Manager, Rachel Cartwright MSc MCLIP was able to confirm that the Silchester Gravel member appears to have been correctly mapped and that its southern contact was some 180 m north of the site boundary. Rachel Cartwright also noted that “Spring Gardens” may have been named because of the presence of springs locally and provided further detail as follows:

> “*We have one spring mapped upgradient of the site, at 445050, 164011 (this doesn’t mean that no others are present). This spring is at the head of a stream which flows close to the boundary of your site. To the east of the site there are multiple springs arising from the London Clay, suggesting that the same could happen at this site*”.

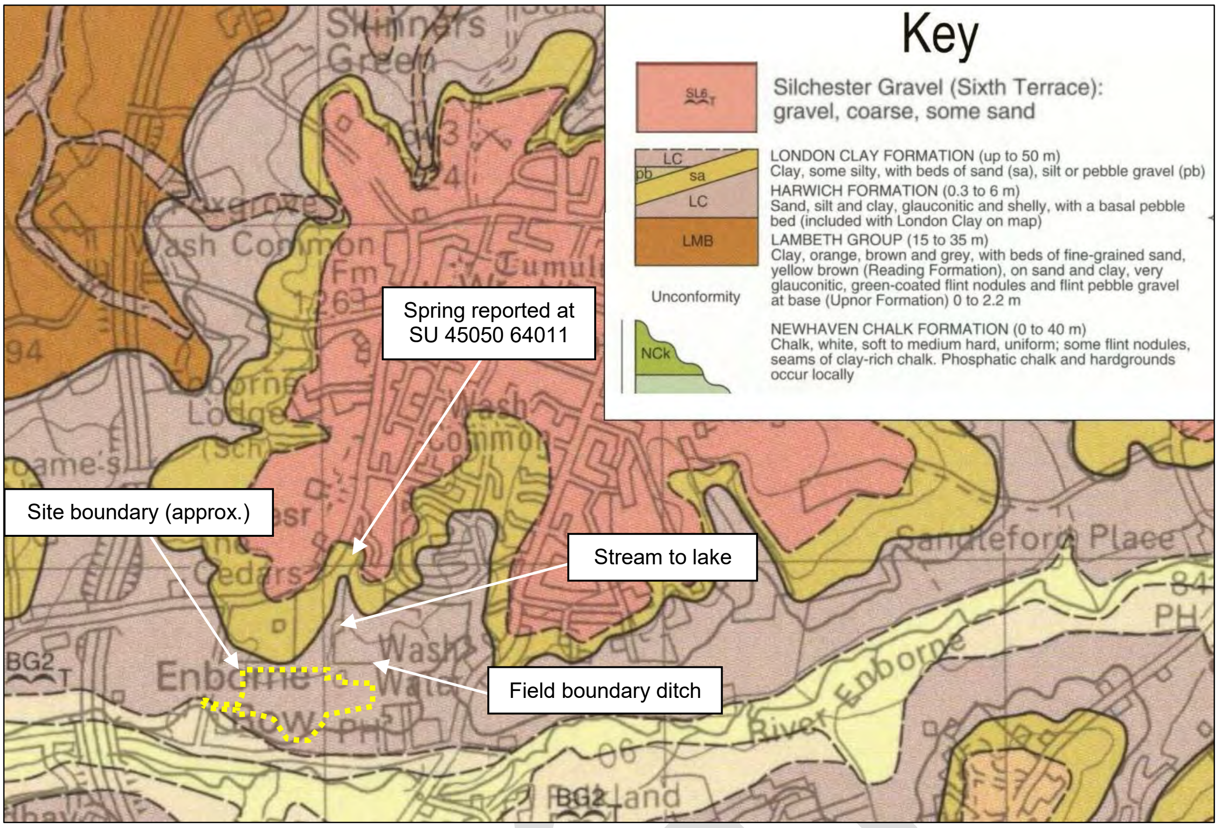
Since 1:10,000 scale geological mapping adds no further detail and was shown on the BGS website to be out of stock, 1:10,000 scale geological mapping is used again in Figure 19 to illustrate the additional information provided by BGS. The spring at the head of a stream flowing close to the site boundary is shown in Figure 6 to be located within a north to south trending valley. It can also be located on OS mapping (Figure 20) and is shown on the WWF Rivers map (Figure 21), using a dashed blue line. This indicates that it does not convey water all year round. It may only flow when water stored in the Silchester Gravel aquifer reaches a sufficient level.

The relationship between this spring-fed stream and surface water flood risk can be seen on the surface water flood extent map (Figure 9), where this stream is labelled. It is clear from this map that this particular stream is diverted well to the east of the site. The stream can be seen in Figure 9, following field boundaries and cutting the corners between them. It is clear that this stream will not affect the site but the process of springs flowing from the contact between London Clay and the overlying gravels is unlikely to be unique to this one location.

Looking at the anecdotal properties of Poors Field, the “squishy” lower slopes and the firmer hillside above them may reflect the slightly different properties of the two London Clay facies mapped in this area. The Harwich Formation is up to 6 m thick, described as “Sand, silt and clay … with a basal pebble bed”. Its lower contact is shown on Figure 19 to extend to the site’s northern boundary and it is possible that the improved drainage provided by its coarser texture may explain the firm surface of the upper slopes, with the more “squishy” feel of the lower slopes resulting from the higher proportion of fines within the underlying London Clay. Whether or not the runoff through the site is spring-fed has not been answered by this analysis, the fact remains that it could be.

[6] https://www.bgs.ac.uk/about-bgs/contact-us/#:~:text=If%20you%20can't%20find,to%20help%20with%20your%20request.

Figure 19 Local geological map, annotated with features believed to be relevant to surface water flooding



Source: https://www.wwf.org.uk/uk-rivers-map

Figure 20 Location of the spring described by BGS as flowing southward, close to the site boundary

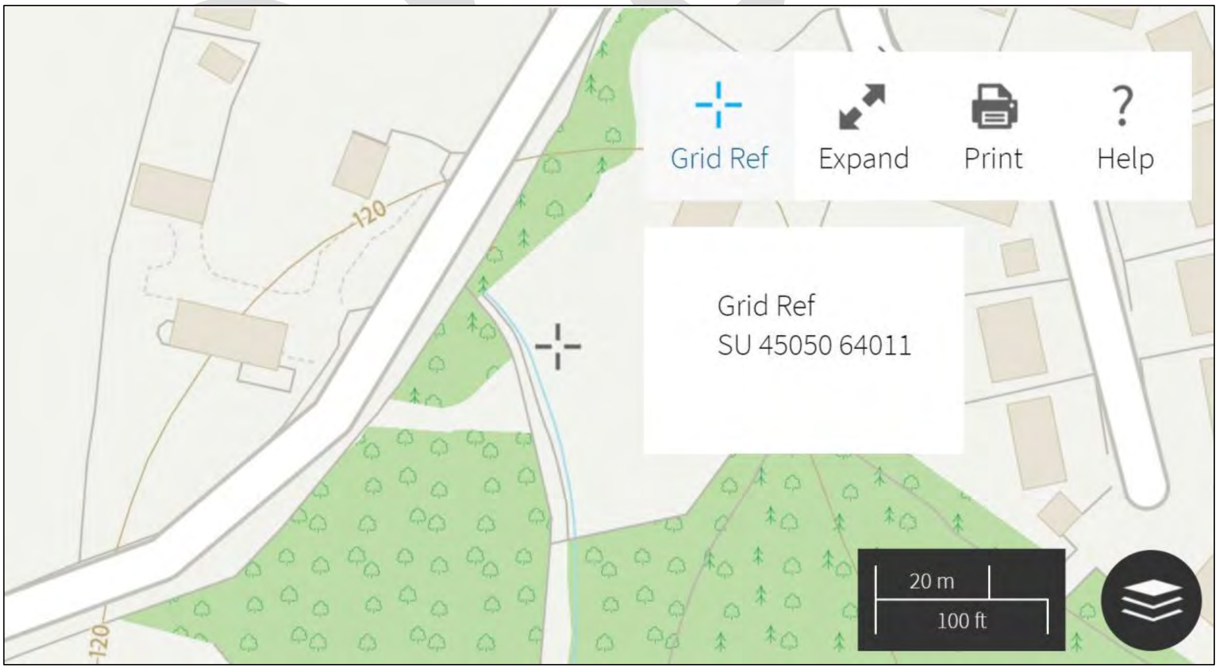
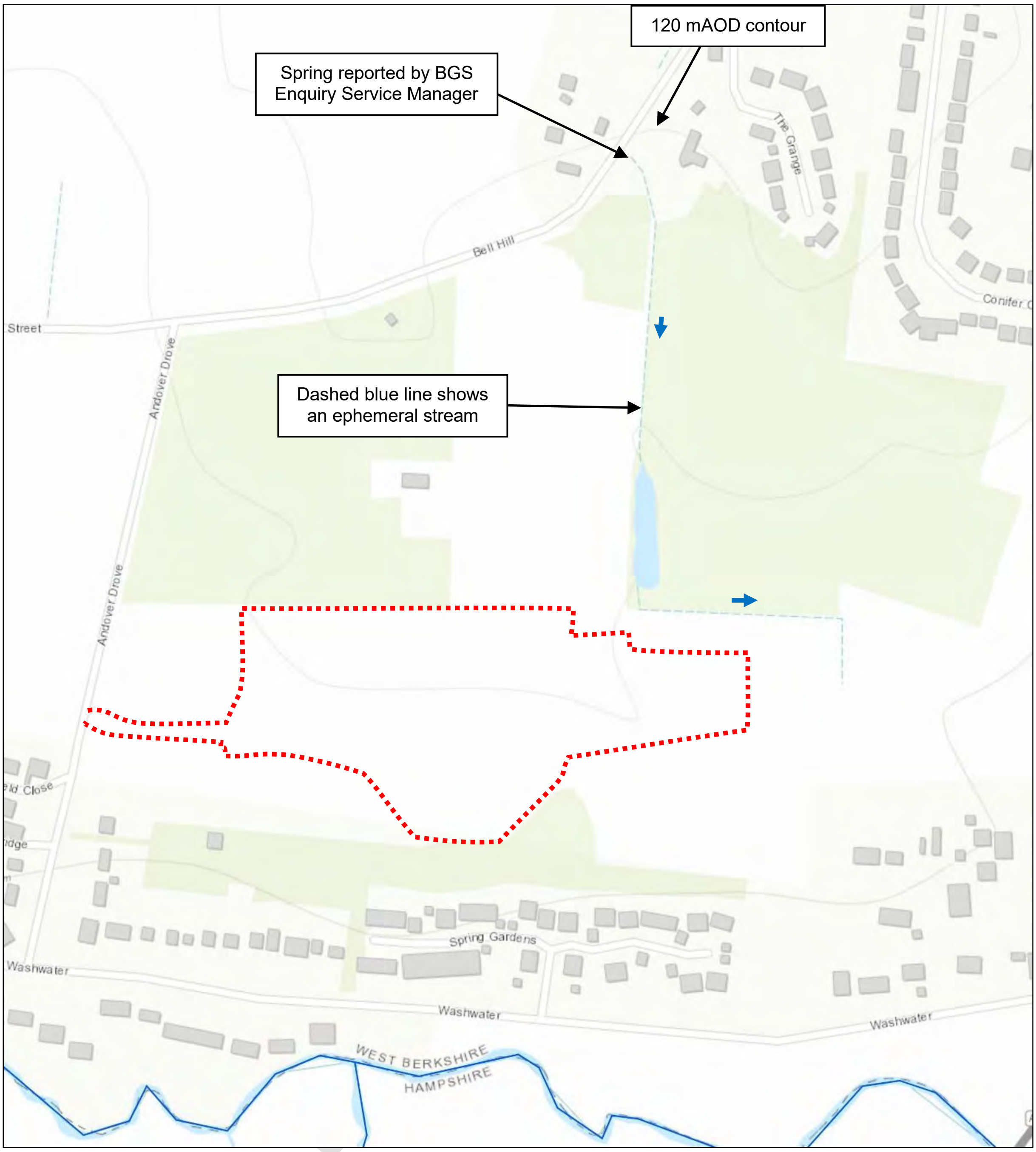


Figure 21 WWF Rivers Map, covering the site and associated southward flowing streams



6.4 Runoff Mitigation

Evidence from soil and geological mapping shows that soil in this area has low permeability. Solar panels and other elements proposed on the site are impermeable and runoff rates could increase locally. It is a requirement of the National Planning Policy Framework (NPPF) that no development should increase flood risk elsewhere. Since a flood risk has been identified in Spring Gardens, measures should be put in place to ensure that this is made no worse by the solar farm and if possible, that it is reduced. Ideally, this would be achieved by infiltration into the surface but in view of the low permeability in this area, soakaways or other, similar means of managing runoff are unlikely to be entirely effective.

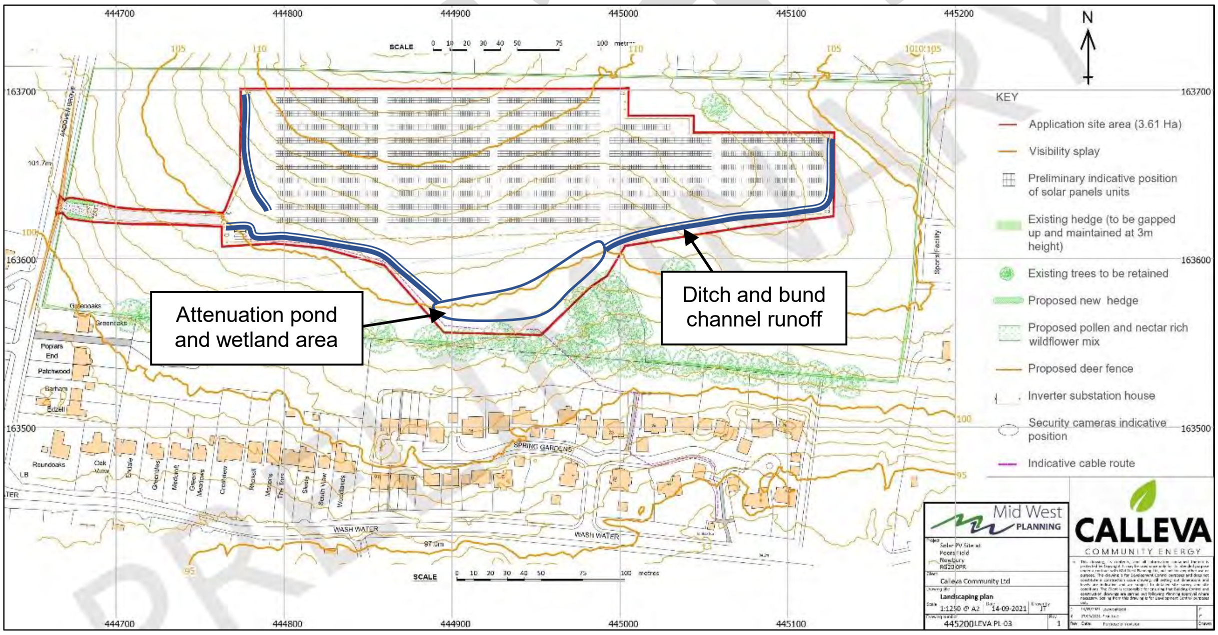
There remains the possibility of managing runoff in other ways and the most common, under these ground conditions, is runoff attenuation. This involves creating a basin below the level of the impermeable surfaces. During any rainstorm, runoff would be directed into this, which would become an attenuation pond. In the absence of adequate infiltration, the pond would fill. Within the wall of the pond, generally at its base, an outflow would direct water leaving the pond through a flow control device.

This is important because a sudden increase in flow following a rainstorm could increase flood risk downstream. The flow control device ensures that outflow from the pond is no more rapid than would occur naturally. Rapid runoff after a rainstorm would be spread over a longer time period, removing flow peaks and making outflow more like runoff from a fully rural or “Greenfield” catchment. NPPF rules require that peak outflow from the pond is below Greenfield rates at all return periods, once allowance has been made for climate change.

6.5 Outline Location and Design

The site needs to drain to lower land, as it currently does. The map in Figure 22 locates the pond and associated wetland between about 104 mAOD and 105 mAOD, on the northern margin of the woodland shown in Figure 23. Note that the pond shape takes advantage of the land between contours, which drops 1 m across a north-south distance of 20 m to 25 m. Earth taken out of the bed would need to be emplaced on the pond’s southern rim, which would need to be built up to the required depth.

Figure 22 Indicative location of the wetland, attenuation pond and associated structures, not to scale

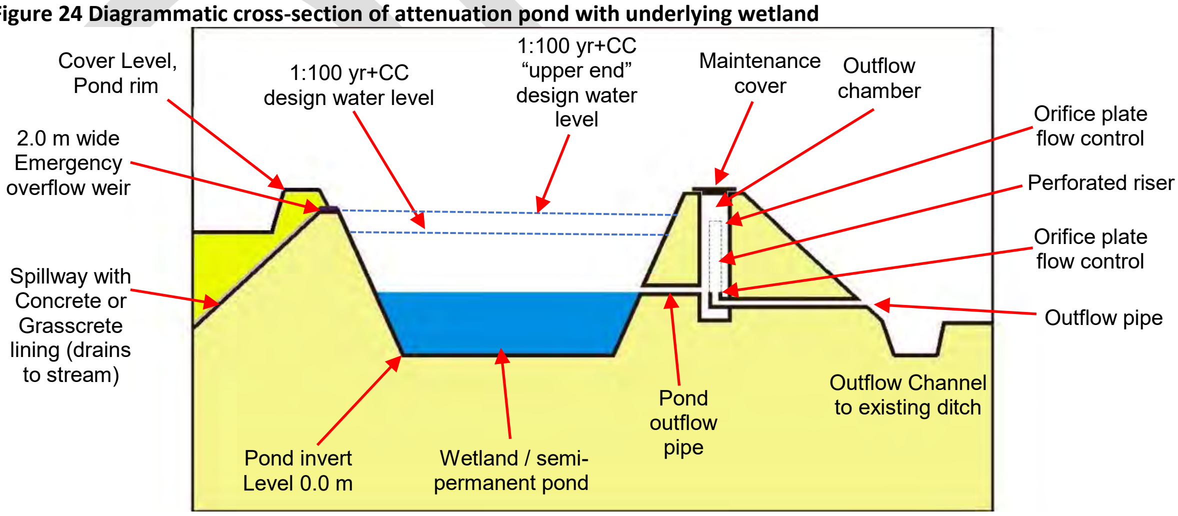


The diagram in Figure 24 shows how an attenuation pond can work in tandem with a wetland or permanent / semi-permanent pond. The surface of the blue layer in the pond represents the resting water level, the level attained after the pond has spilled through the flow control and filtration devices located within the outflow chamber. Just like water draining from a bath, which is slowed by the relatively small plug hole, the orifice is calibrated to slow outflow down to Greenfield runoff rates. The grid across the plug hole that catches your soap is replaced by a more sophisticated filter to catch leaves that fall in and plastic bags that may blow in. There is an ongoing maintenance requirement to keep the system clear of detritus and whoever is charged with maintaining the solar farm would pick up this job, as well.

The blue water below the attenuation layer represents a wetland, with vegetation planted around it. With no exit below the level of the outflow chamber on the right of Figure 24, water would either infiltrate into the underlying London Clay or to be lost in evapotranspiration. This water is replaced by runoff down Poors Field to its north, via a series of ditches and bunds (Figure 22) which intercept it and direct it towards the attenuation pond / wetland area.

Figure 23 Land at the base of the slope, Poors Field, with indicative outline of the attenuation pond shown in white

Figure 24 Diagrammatic cross-section of attenuation pond with underlying wetland



Runoff entering the attenuation layer above the wetland, would be held temporarily within the structure, before being released at an attenuated rate, at or below the Greenfield runoff rate. Runoff down the field has previously been directed along the route shown in Figure 13 and this continues to be the recommended route out. In the absence of an alternative route out of the area, the existing route should continue to be used. Outflow would be minimised first through the wetland, which would initially accept runoff and then through the need to outflow at Greenfield rates.

7. Sustainable Drainage Opportunities and Benefits

Under the heading "What are SuDS?", Page 6 of the SuDS Manual explains:

> "*Sustainable drainage systems (SuDS) are designed to maximise the opportunities and benefits we can secure from surface water management. There are four main categories of benefits that can be achieved by SuDS: water quantity, water quality, amenity and biodiversity. These are referred to as the four pillars of SuDS design*".

The reason for ensuring that SuDS methods are used, is to ensure that the principles of sustainable drainage are incorporated into this proposal, making the four pillars of SuDS design an important consideration.

The permanent pond, shaded in blue in Figure 24, should perhaps be described as a semi-permanent pond, as it is likely to dry up, to some extent in the heat of summer. Given that this entire structure would be located on top of London Clay, it is likely that at least some of the inflow would be retained between rainstorms for most of the year. The pond would allow the development of aquatic plant communities around its edges and within the water column. These in turn provide benefits to animal and bird populations locally.

a) Surface water runoff:

As explained above, runoff from impermeable surfaces is very much more rapid than from most natural surfaces. Flood risk from developments which add a significant impermeable area therefore need to be properly managed. The first choice would be to infiltrate runoff into the surface but as explained in Section 6.1, the soil locally is "slowly permeable", with a loamy and clayey texture and geological mapping shows the area to be underlain by London Clay. The effect of attenuation, using a pond whose characteristics are designed to outflow below Greenfield rates would achieve this requirement.

b) Water quality:

It is assumed that all runoff from the solar panels is essentially rainwater, with perhaps a little dust and small particles carried there by air currents. Under these circumstances, there is a limit to the water quality benefits which could accrue through SuDS practice. It is possible however that travelling overland to the attenuation pond would allow water to pick up some pollutants. By allowing plants and other organisms to flourish in and around the pond, there would be opportunity for adsorption of pollutants by aquatic vegetation and further biological activity.

c) Amenity:

No specific provision is made within this assessment, since the free use of this area by the public has security implications. One aspect of amenity would be to bring wildlife into nearby gardens, as plant communities become established and birds, amphibians and other animals start to make use of the new habitats provided by the pond. Although no arrangements have been made, if the security fence is arranges so as to exclude this pond area, it may be possible to make this area accessible to the public for walking dogs and taking picnics.

d) Biodiversity:

Although the structure that has been recommended to facilitate attenuation is described in this report as a “pond”, it is only likely to retain a significant volume of water if it is allowed to rest on top of a basin without a permanent outflow. This is why it is recommended that part or all of the attenuation pond area should be dug below the pond outflow. In order to create a semi-permanent water body that is best able to achieve the four pillars of SuDS design, it is recommended that the area around the pond is landscaped and planted with appropriate plant species, in order to achieve the twin goals of enhancing water quality and biodiversity. These aspect of the pond design go beyond the hydrological perspective and the help of ecologists and leisure planners should perhaps be sought.

8. Surface water management credentials

This surface water management plan was written by Chris Nugent of Lidar-Logic. Chris has a degree in the Environmental Sciences and has worked since 1981 in areas of hydrology and fluvial geomorphology, specialising in flood risk assessment and surface water management in 2007. Since then, working for Hydro-Logic Services (HLS), he has written and/or managed well over 500 assessments of flood risk across the UK, most of which included a surface water management component. Chris left HLS to form Lidar-Logic in August 2018, in order to benefit from the detailed mapping that he produces, from LiDAR digital elevation data. The current work was prepared for submission to Planning between July and September 2021.

Appendix A Dialogue with British Geological Survey, July 2021

Email of 21/07/2021
Subject: Enborne Solar Initiative, RG20 0PR

Dear Team

We have been asked to produce a Flood Risk Assessment for the proposed solar panels located in **Error! Reference source not found.**. It is clear from the surface water flood risk mapping (**Error! Reference source not found.**) that there already is a risk of water draining down the hill into Spring Gardens and enquiries locally confirmed this.

While on site yesterday, one of the Parish Councillors, who previously worked as a petroleum geologist, produced the published, online mapping that I have included as Ref. He offered the view that the Silchester Gravel Member extends further to the south than is indicated on this mapping, suggesting that it may act as an aquifer and affect flood risk to the south. Having found several stones on the surface, of gravel to pebble grade, we dug a shallow trial pit and found several more within the surface layers, which have presumably been ploughed in recent times.

I note the text at the base of Ref, telling me that "To purchase detailed geological reports for this area, try our GeoReports service". Looking on your "Contact Us" page, I was delighted to read under the heading "Contact BGS Enquiries" that:

> "*If you can't find what you are looking for, BGS Enquiries are the main point of contact and will be happy to help with your request. We will spend up to 30 minutes free of charge on an enquiry and for any request that will take longer than 30 minutes to answer, we will prepare a quote to cover the cost of providing a more detailed scientific response*".

I consider his to be a very generous offer. My original intent was simply to purchase the detailed mapping in order to better determine the mapped limits of the Silchester Gravel Member and whether we may be looking at a sandy member of the underlying London Clay Formation. Ideally, I would need not just detailed mapping but an indication of permeability, such as soil infiltration rates. I note that your excellent database of borehole records (Ref) includes one log, from 1905, which penetrated 180 ft, down to the underlying chalk. Several near-surface members of the London Clay include the words "sand" and "pebbles" in their description but the Silchester Gravel Member is not present at this location. Boreholes located where the Silchester Gravel Member is mapped are marked as "Confidential or Restricted".

Do you have detailed mapping covering this location and does it include any reference to permeability? If we need to purchase any additional report or supplementary information, I would be grateful for your further advice on content and cost.

Best wishes

Chris Nugent
Lidar-Logic

Note: Several Figures were included as part of this enquiry, some of which are reproduced elsewhere in this assessment. A response was received from Rachel Cartwright, Enquiry Service Manager with BGS only two days later:

From: enquiries [mailto:enquiries@bgs.ac.uk]
Sent: 23 July 2021 15:04
To: chris@lidar-logic.co.uk
Subject: RE: Enborne Solar Initiative, RG20 0PR (Our ref: IDA 281630)

Dear Chris

Thank you for your enquiry. There is a 1:10,000 scale geological map available that you could purchase (SU46SE) but one of the hydrogeologists has had a look at the site and says that the boundaries of the superficial deposits and bedrock are no different on the 1:10K map compared to the 50K map so you may not want to purchase it. We only map superficial deposits where they are more than 1 m thick so thin superficial deposits may be present adjacent to a mapped deposit. However in this case the southern edge of the Silchester Gravel is c.180 metres away and over 5 m higher elevation, so seems unlikely it extends to your site. The 1:10k geology map doesn't contain any information on permeability.

Confidential boreholes can be requested via our online shop https://shop.bgs.ac.uk/Shop/Department/GeoRecords and our GeoRecords team will see if it's possible to release them. This is a charged service.

Our hydrogeologist explained that it's often worth noting is that "Spring Gardens" may have been named this because of the presence of springs. We have one spring mapped upgradient of the site, at 445050, 164011 (this doesn't mean that no others are present). This spring is at the head of a stream which flows close to the boundary of your site. To the east of the site there are multiple springs arising from the London Clay, suggesting that the same could happen at his site.

We have a permeability dataset https://www.bgs.ac.uk/datasets/permeability/ that is supplied under a licence agreement. The user guide that can be downloaded from this page will give you more information on it. For small sites of just a few square kilometres this data is usually available the most reasonably through one of our data resellers and there are links to them on this page https://www.bgs.ac.uk/information-hub/licensing/#resellers. Where we supply it in a format for use in a GIS they may be able to offer alternative formats.

Permeability is not the same as soil infiltration rates. The data gives a range e.g. "very low to low" permeability for uppermost mapped deposit (with values for superficial and bedrock). We don't have soil infiltration data.

If you would like a geologist to research the site this is available through GeoReports as you have already discovered. The report you would need is an area assessment with additional hydrogeology (non-abstraction) module https://shop.bgs.ac.uk/Shop/Product/GRC_C004. There is an example report on this page containing examples of each of the modules available that you could view to see if it would meet your needs. We are assuming that what you want to know is the depth to groundwater but we weren't sure if it was groundwater or surface water you were concerned about. If you want more guidance as to whether the report would meet your needs please let us know because surface water isn't considered in the report.

I hope this is helpful.

Kind regards
Rachel

Rachel Cartwright MSc MCLIP
Enquiry Service Manager

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w www.bgs.ac.uk

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