

# Active Renewables

## Solar Farm at Knolton Farm, Overton, Wrexham LL13 0LG

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### Flood Consequence Assessment

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29<sup>th</sup> March 2015    V1

This report is based on the instructions given by our client. It is not intended for use by a third party, and no responsibility will be given to any third party.

The consultant has followed accepted procedure in providing the services, but given the residual risk associated with any prediction and the variability which can be experienced in flood conditions, the consultant takes no liability for and gives no warranty against actual flooding of any property (client's or third party) or the consequences of flooding in relation to the performance of the services.

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### Version history

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## 1. Introduction

Active Renewables is proposing to form a Solar Farm to generate approx. 1MW of renewable energy on land 1.5km southwest of Overton, near Wrexham, in North Wales.

This Flood Consequence Assessment (FCA) has been prepared to consider the impact of the solar farm on the hydrology and to show that flood risk is not increased by the development.

It incorporates the results of consultations with the Environment Agency and Welsh Councils following previous solar farm applications, to reduce the risk of surface water drainage leaving the site during construction and during operation.

## 2. Site Location and Setting

The site is located on a single field on land at Knolton Farm, Oswestry Road, Overton, Wrexham, LL13 0LG. It is approximately 1.5km southwest of Overton and 1.2km southeast of Erbistock (Fig 1). The proposed site is situated on land within the site of Knolton Farmhouse Cheese Factory, which is within a predominantly rural area characterised by arable fields with supporting farms, as well as pockets of woodland. The River Dee is approximately 600m north of the site.

The proposed solar farm is irregular in shape and occupies one field. The site can be contained within the dimensions 300m north-south and 140m east-west, excluding the access route.

The Planning Red Line encloses an area of 2.57ha, which includes the off-site access road, so the solar farm site is somewhat less. The general site is at about 75m AOD.



Fig 1 Broader locational context of site (Streetmap, 2015)

North of the site is a steep sided river valley containing a tributary of the River Dee, which flows from south to north into the River Dee valley. The Knolton Farm Cheese Factory is also north of the site.

East of the site lies the Knolton Farmhouse Cheese Factory on generally level land at 75m AOD. Beyond this is the B5069 from St Martin's to Overton Cross, and the land falls very gently away from the site.

South of the site, beyond the B5069 road, is an expanse of fields forming relatively flat open countryside on gently rising. The surrounding fields area mix of arable and grazing. Model Farm lies 500m to the southeast of the site; just southwest of the site is Gwalia Farm surrounded by arable land.

West of the site is the steep wooded valley to the watercourse, a tributary of the Dee. Beyond this is more arable land and small but steep tributary valleys.

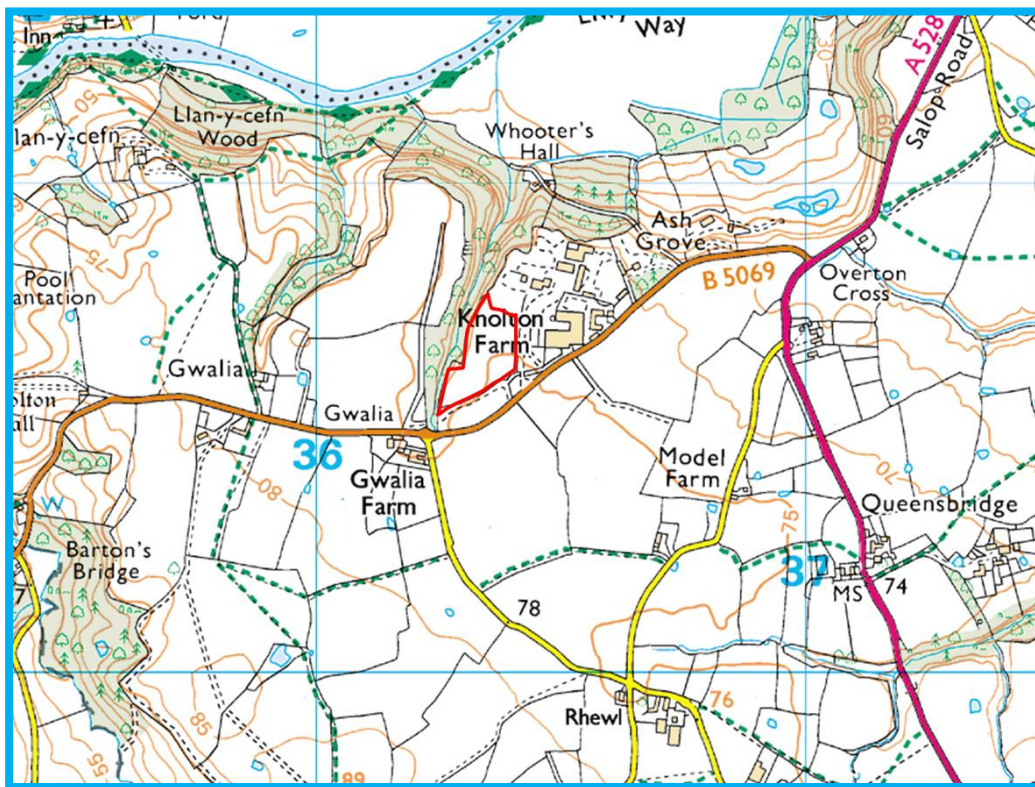


Fig 2 Closer locational context of site. (Streetmap, 2015)

### 3. Existing Development and Ground Conditions

The site is situated within one field, with a gradual fall to the northwest.

A topographical survey has been undertaken on the site. The site has a relatively flat elevation from 73.5m AOD in the northwestern corner to 75.5m AOD in the south, beyond which is a steep bank rising to 76.65m AOD in the southeastern corner. However, the solar farm arrays are generally in an area which has a slope from 74.5m AOD in the north to 75.5m AOD in the south, giving a very shallow gradient of 1 in 130, with a short upward bank along the southern boundary.

The field was previously used for arable purposes (c. 2006), but has also been left fallow and unkempt with bare areas according to historical information. The field has been trafficked by farm machinery, shown by visible tracks. Access to the site is from the southeast, off the B5069. Close to the access is an area of disused ground, which is outside the site.

The north, east and south boundaries are formed by post and wire fences, whereas the western boundary is against the edge of the wooded valley.

There are no features within the site such as buildings or overhead cables.

A shallow ridge (about 400mm high) is identified on the topographical survey, but this is not evident on the satellite images, presumably due to its diminutive height. It is likely to be protection to a utility service.

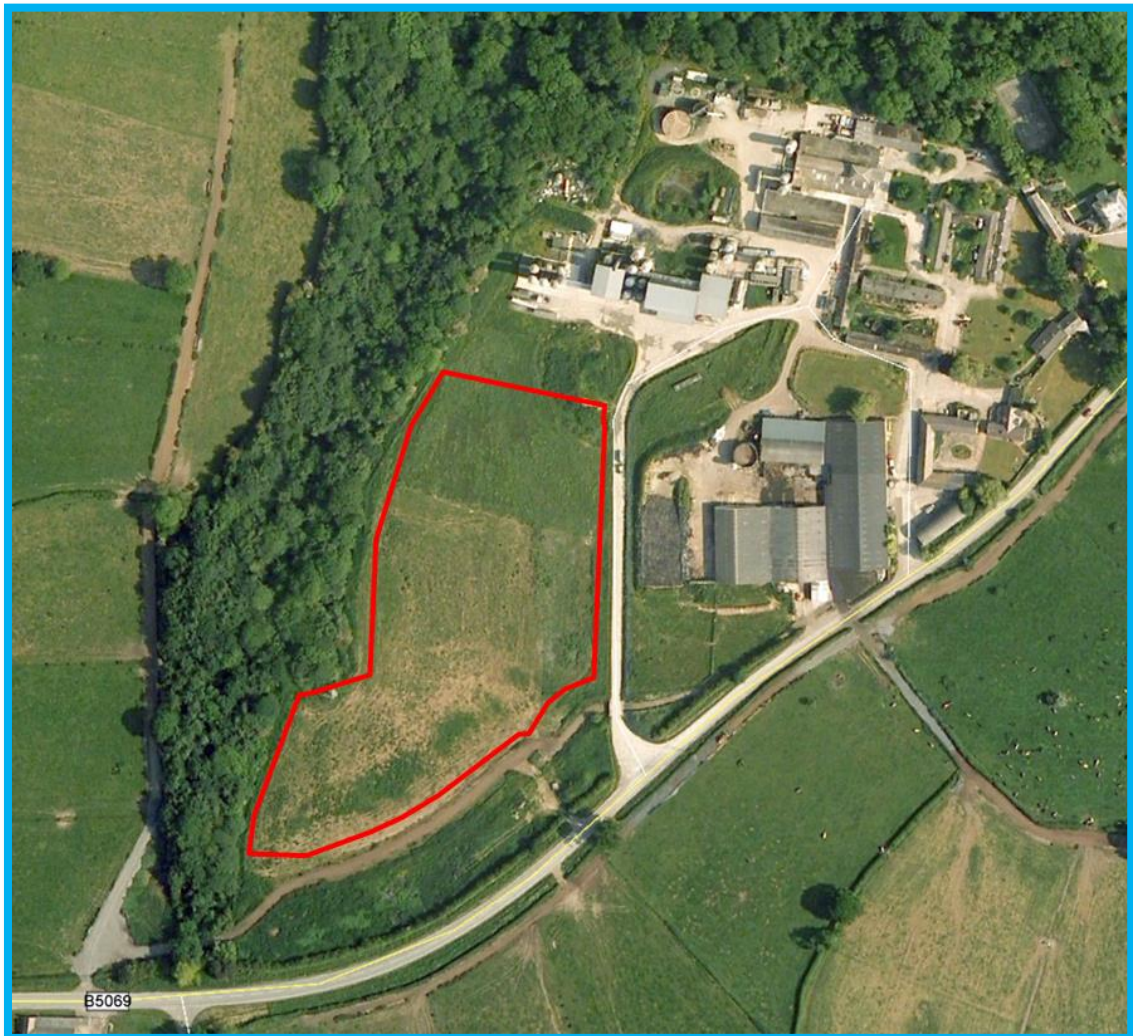


Fig 3 Satellite image of site in red, with cheese farm to the north and east, and wooded value to the west. The site is neglected grassland and bare earth areas. Note that recent development has occurred to the cheese factory north of the site since the date of the image. (Google image by Infoterra Ltd and COWI A/S)

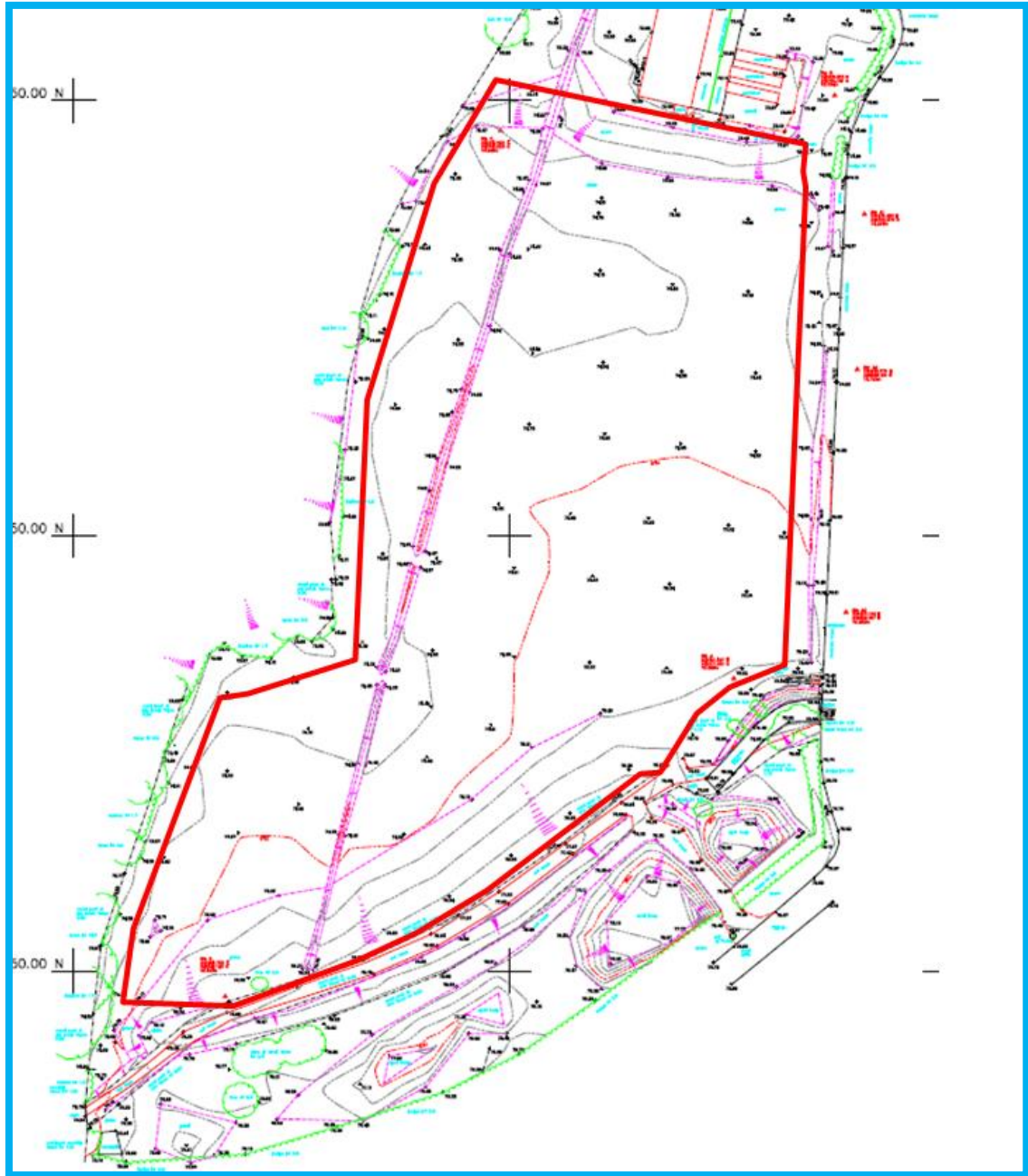


Fig 4 Topographical survey, showing red outline of site fence. Note the shallow contours (at 0.5m vertical intervals, and shallow ridge along spine of site

The Cranfield University Soil Viewer indicates the site has soils with impeded drainage. In addition to this, the BGS Geology Viewer indicates the site is underlain by glacial superficial deposits, typical of the area.

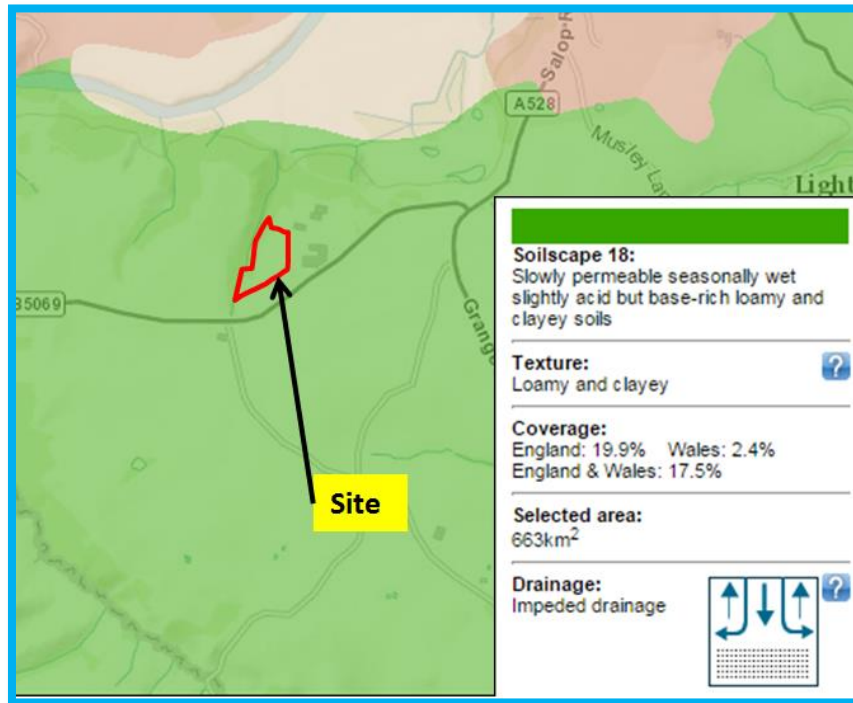


Fig 5 Soils documented beneath the site – slowly permeable seasonally wet loamy clayey soils. (Cranfield University, 2015).

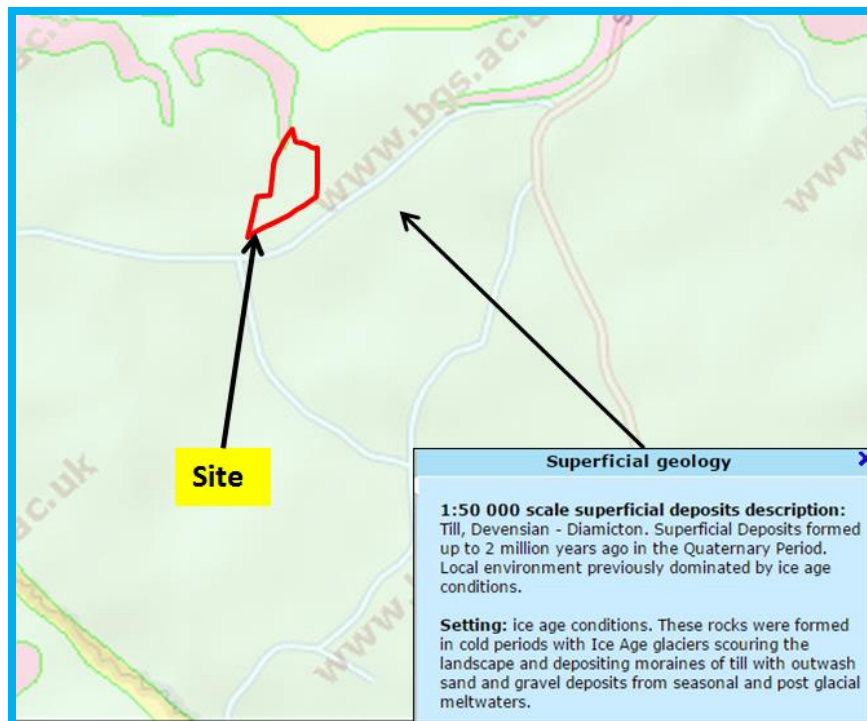


Fig 6 Superficial geology beneath the site, showing glacial deposits. (BGS, 2015)

#### 4. Proposed Development

The proposed development comprises pressed steel post mounted solar panel arrays positioned in an east-west alignment to collect the sunshine

The arrays are approximately 2.5m in height, with the lower edge approx. 800mm above ground, which varies with local undulations in the ground surface. The solar arrays contain 20mm gaps at 1m centres along the array, and 1 or 3 gaps up the slope, which are fundamental for thermal movement. These gaps allow rainwater to disperse through the arrays and avoid concentrated flows on the ground.



Fig 7 Plan of proposed solar farm. Arrays are indicated in black and perimeter fence in blue. Note the utility ridge is avoided (in grey) running north-south through the site. Also note creation of new hedge with trees to the east.

There will be an inverter station and associated units located in cabins on concrete bases at the north of the site, and cables will be installed in backfilled trenches.

The cabin plinths will have a perimeter French drain approx. 300mm deep and 300mm wide to encourage infiltration of runoff from the slab into the soil.

Deer fencing with a large open mesh will be installed around the solar farm. The fence will contain a large mesh to allow localised movement of surface water and invertebrates, small mammals etc to move freely. The fence will not cross any watercourses.



Fig 8 Typical deer fence illustrating open mesh.

The fence will be located to provide maintenance of the perimeter boundaries, including the proposed hedge to the east of the site, along the cheese factory access track, as shown on the layout above. This space also allows surveillance of the fence. The arrays are also set inside the fence to provide a protection buffer for the arrays and for maintenance of the space and surveillance.

The field on which the solar arrays are located will be prepared and seeded to encourage vegetation with native grasses and restored where construction has caused damage. The area within the fence will become a haven for invertebrates, reptiles, amphibians, small mammals and birds.

The area will be strimmed about 2-5 times per year (depending on weather conditions) to prevent tall plants shading the panels. Any bare areas of earth will be prepared, seeded and protected to encourage growth. Sheep will be grazed seasonally at low density to manage the grass.

Vehicular access will be gained from the Cheese Factory along a very short access road at the north of the site, extended up to the inverters to allow for servicing vehicles. The track will be formed in permeable material, and the track will tend to green over due to low usage, thus maintaining permeability and providing a varied habitat.

## 5. Existing Hydrology and Flood Risk

The site is located in Flood Zone A, at little or no risk of flooding according to the TAN 15 DAM (Development Advice Map) Flood Risk Map.

The site is located to the south of the River Dee floodplain, at a higher elevation than the Dee. The site also has 'dry' access.

Flooding along the River Dee to the north of the site would occur after prolonged rainfall, which would begin to cause the river to rise, and is within a large natural floodplain some 45m below the level of the site (ie at below 30m AOD).

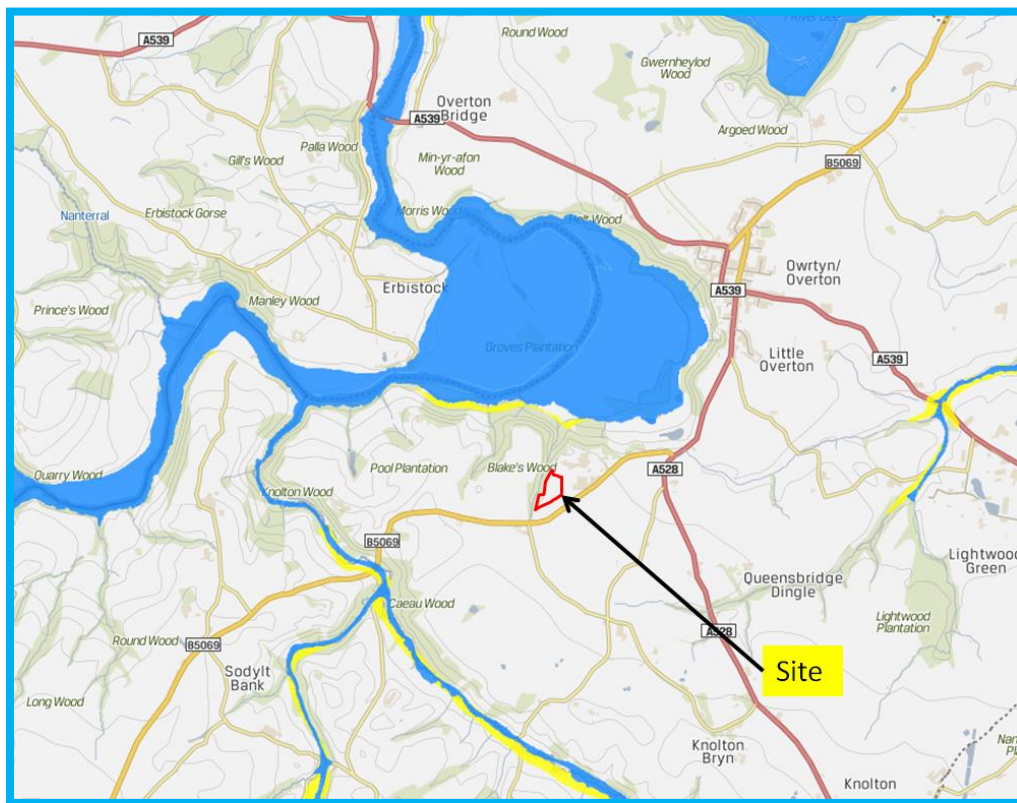


Fig 8 Site located in relation to the River Dee floodplain – in Flood Zone A. (Development Advice Map, Wales, 2015)

The site is generally very flat, with a gradient in the region of 1 in 100; runoff from the panels, dispersed by the thermal gaps, will therefore infiltrate or pond locally; the gradient is too shallow to cause streaming.

The site is not at risk from localised ditches, watercourse or uphill surface water flows, or surface water runoff, as can be seen from the Environment Agency's Surface Water Flooding Map below.



Fig 9 Risk from Flooding from Surface Water map (Environment Agency, 2015)

As the site will become species rich grass, the soil properties will improve due to the species rich grassland, silt runoff associated with bare areas etc will be avoided. Trafficking through the field will be eliminated, except occasionally for inspections.

In addition, the water quality infiltrating into the soil will not contain pesticides and fertilizer associated with farming, thus bring improvements to groundwater quality. Any runoff will tend to soak into the ground where it falls with the flat terrain.

## 6. Policy

Flood Policy relates to the protection of people and property. The Welsh Government has produced Technical Advice Note 15 (TAN 15), which gives guidance on flood risk and steers development away from areas at risk of flooding.

The development is within Natural Resources Wales Zone A. In this context, according to TAN 15, justification tests are not applicable and there is no need to consider flood risk further.

The downstream area is a wooded valley leading into a small stream, which leads to the River Dee in an area with a large natural floodplain. The site location would not be considered as sensitive in flood risk terms.

This development is durable and resilient, and can withstand being in all weathers. The supporting structure and cabling is all resilient to water. No pollution will be caused. The site will be routinely inspected to monitor the solar farm and undertake essential maintenance. It is unlikely that people will visit the site during intense storms because

the conditions would not be conducive to servicing – the solar farm can be operated remotely.

The deer fence has a large grid to allow movement of localised surface water and smaller mammals to pass through.

The farming activities will cease on the fields (apart from light seasonal grazing by sheep), thus removing animal waste and silt etc from the water arriving in the receiving waters or groundwater.

The species rich grassland, improving soil quality and reduced trafficking (ie bare earth at gateways) will bring real benefits by improving runoff quality, reducing the rate of runoff and reducing the frequency of runoff.

The proposal therefore complies with the objectives of TAN 15 because it will reduce the rate of runoff and improve water quality due to the improved spoil conditions.

## 7. Surface Water Drainage

The site will be prepared and seeded to allow a mixture of grasses to flourish. Within the boundary fence, tall plants will be strimmed 2-5 times per year to avoid shading over the solar panels. The solar farm area would therefore be categorised as species-rich grassland, providing a high level of natural surface water attenuation and better than with current farming practices. Bare areas will be treated, protected and seeded. No specific drainage channels or pathways will be introduced.

Runoff from the panels will be distributed over the surface due to the 20mm thermal gaps between the panels. The Agency has confirmed that solar farms do not increase the rate of runoff from sites.



Fig 10 Typical solar array showing 20mm thermal gaps between panels to disperse runoff.

The research work by Richard Smith, the Environment Agency's Senior Land Quality Officer has shown that farming activities increase compaction of the soil and the rate of runoff consequently increases considerably, increasing the risk of downstream flooding, and pollution from silt borne and contaminated water.

This work is described clearly on the Environment Agency's website at <http://www.environment-agency.gov.uk/news/134494.aspx>. The design life of the Solar Farm is circa 25 years allowing the grassland to establish and achieve the virtues described in Richard Smith's reports, after proper preparation.

The solar farm will contribute to the virtues encouraged by the Wrexham Biodiversity Action Plan. It would assist and reinforce the targets of 'maintaining the current number of important hedgerows in Wrexham County Borough' and increase habitats to encourage biodiversity.

The internal tracks will be permeable and designed to allow excess runoff to flow over the edge and into the long grass, to naturally infiltrate.

The solar farm will allow the soil structure to improve due to lack of compaction by heavy farm machinery and intense grazing. The soil structure provides biodiversity and improved absorption of rainfall – the rate of runoff is more a function of the soil than the underlying geology, as confirmed by the EA's Senior Land Quality Advisor.

The proposal will therefore reduce the rate of runoff, especially when compared with seasonal harvesting times before vegetation has established, the pesticides and fertilizers will be eliminated, and the rate of runoff from the site and frequency of runoff will be reduced considerably. More surface water will infiltrate, and the reduced rate of runoff will continue to follow existing pathways. The proposal therefore brings betterment to the overall hydrology of the area and reduces the risk of downstream flooding.

## **8. Construction Process**

To minimise damage to the soil structure within the solar farm site, the contractor should allow appropriate weather conditions to prevail, and use appropriate machinery for the circumstances.

Machinery used within the solar farm should have low earth pressure tyres or tracks, such as is typical with farm machinery, to minimise compaction of the ground.

A delivery sequence by vehicles should be devised which minimises repeated journeys over the pasture to reduce rutting and damage to the pasture and soil structure.

On completion of the works the pasture should be restored using light farming machines and prepared appropriately for seeding to encourage early growth, restoration of the soil structure and natural creation of species rich grassland.

## 9. Conclusions and Recommendations

The change in use of these fields from arable to solar farm achieves the following:

- Introduces a major source of renewable energy to the community
- The solar farm, an electricity generation facility, is within Flood Zone A
- The access to the site is within Flood Zone A
- The proposed use is acceptable when referring to TAN15.
- The proposed fence and structures will not adversely affect surface water characteristics due to the large grid deer fence
- There is no risk to visitors from flooding or excessive surface water or flood flows
- The equipment and associated infrastructure is durable, robust, and resilient to wet weather and will not cause pollution
- The farming practices associated with arable farming, such as the application of pesticides and fertilizers, and the potential for silt runoff in the autumn, will be eliminated, thus improving the quality of water entering the environment
- The creation of a species rich grass meadow comprising long grass with native species will bring major improvements in infiltration and evapotranspiration
- The resulting ecology will be a haven for a range of invertebrates, reptiles, amphibians, small mammals and birds and contribute to the targets of the Wrexham Biodiversity Action Plan
- The improvement in the soil structure through the changed ecology will therefore be very beneficial to the hydrology
- Permeable tracks will green over through low use and remain permeable
- French drains around cabin bases will reduce and infiltrate their runoff into the soil
- The heavy machinery associated with farming will be eliminated, and only light vehicles will be used for maintenance after completion, thus preventing further compaction of the soil

In conclusion, the proposed change of use will provide a real contribution to soil improvement and biodiversity and will improve infiltration quality, bringing significant overall benefits to the environment and renewable energy. The site will be safe and durable and the solar farm site is not at risk of flooding nor of causing worse flooding elsewhere, but bringing betterment, and therefore is appropriate in terms of TAN15 related to flooding.