Renewable Connections Developments Ltd

2005 – Vicarage Drove, Lincolnshire

Flood Risk Assessment and Drainage Strategy

Final

August 2021

Kaya Consulting Limited
Stanhope House, 12 Stanhope Place
Edinburgh, EH12 5HH, UK
Tel: 0131 466 1458, Web: www.kayaconsulting.co.uk

Kaya Consulting Limited
Stanhope House, 12 Stanhope Place
Edinburgh, EH12 5HH, UK
Tel: 0131 466 1458, Web: www.kayaconsulting.co.uk

Document Information and History

Project:	Solar Farm, Vicarage Drove – FRA and Drainage Strategy
Client:	Renewable Connections Developments Ltd
Kaya Consulting Job Number:	KC2005
Filename:	2005 - Vicarage Drove, FRA+DS, August 2021
Project Director:	Callum Anderson
Author	Lee Ruddick

This document has been issued and amended as follows:

Version	Date	Description	Created by:	Verified by:	Approved by:
V1.0	20.05.2021	Draft	L Ruddick	C Anderson	M Stewart
V1.1	15.06.2021	Draft	L.Ruddick	C Anderson	M Stewart
V1.2	19.08.2021	Final	L.Ruddick	C Anderson	M Stewart

Kaya Consulting Limited
Stanhope House, 12 Stanhope Place
Edinburgh, EH12 5HH, UK
Tel: 0131 466 1458, Web: www.kayaconsulting.co.uk

Table of Contents

List of Figures

List of Tables

1 Introduction

Kaya Consulting Ltd. was commissioned by Renewable Connections Development Ltd (Renewable Connections) to undertake an assessment of the risk of flooding for the proposed development of a solar farm with battery storage and associated infrastructure at Vicarage Drove in the south of Lincolnshire located to the north-west of Bicker. An outline Drainage Strategy has also been prepared as part of the assessment.

The site is located approximately 2.5 km to the north-west of Bicker village and approximately 2 km north-west of Northorpe (Figure 1). In total, the site measures approximately 80.4 ha in area and is comprised of agricultural land.

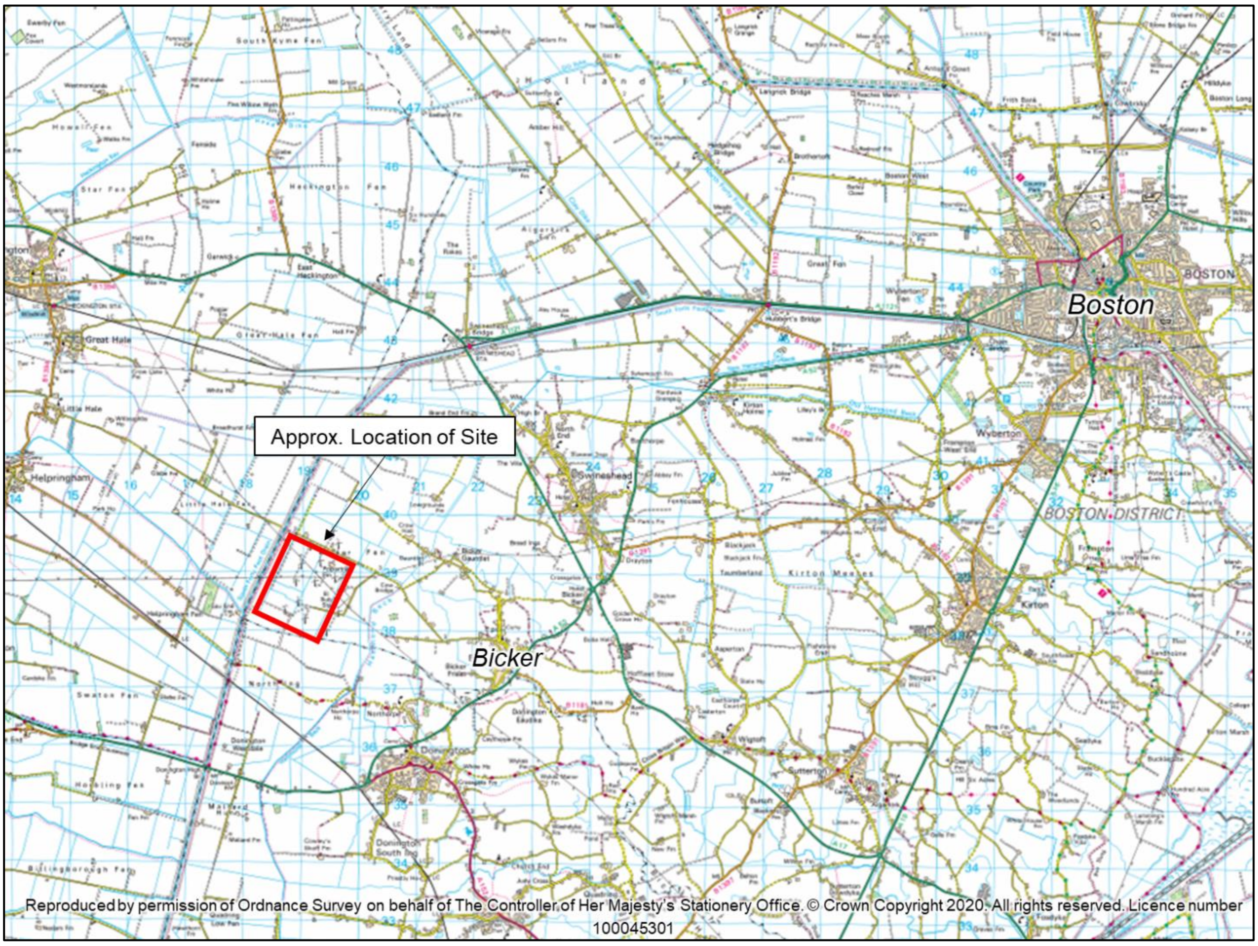
The South Forty Foot (SFF) Drain flows north, parallel to the western boundary of the site with two tributaries converging with the main SFF Drain channel upstream of the site. Hammond Beck also flows to the north, approximately 700 m to the east of the site. Numerous unnamed field drains are present within and surrounding the site boundary.

Based on Environment Agency (EA) mapping, the site is situated within Flood Zones 1, 2 and 3 and thus, there is a range of flood risk at the site.

This Flood Risk Assessment (FRA) and Drainage Strategy (DS) has been prepared to support a planning application for a proposed solar farm development. An FRA is required because the site covers an area in excess of 1 ha.

The work carried out to assess the flooding risk of the site and the main findings of the study are summarised in the following sections.

Figure 1: Location of the site within South Lincolnshire



2 Legislative and Policy Aspects

2.1 The National Planning Policy Framework (NPPF)

The NPPF was implemented by the Department for Communities and Local Government (DCLG) in 2012 and was most recently updated in July 2021. The NPPF sets out the Government's planning policies for England and how these should be applied. It provides a framework within which locally-prepared plans for developments can be produced.

2.1.1 Flood Zones and Vulnerability

Flood risk to a development site is classified using a sequential characterisation of risk. The NPPF considers flood risk as a function of both probability and vulnerability. Table 1 shows the NPPF Flood Risk Vulnerability Classifications. The vulnerability classifications are used in conjunction with Table 2 which detail how Flood Zones relate to planning policy as stated in the NPPF. Table 3 summarises flood zone and vulnerability compatibility. These flood zones are found on the EA's 'Flood map for planning' which has been created from large-scale modelling. The Environment Agency's (EA) 'Flood map for planning' does not account for the influence of flood defence schemes or residual risks (those remaining after applying the sequential approach to the location of development and taking mitigating actions). Flood Zones apply to rivers designated as 'Main Rivers' by the EA, these are usually larger rivers and streams and are the responsibility of the EA. Other watercourses are known as 'Ordinary Watercourses' and are represented in the 'Flood Risk from Surface Water Maps'. Ordinary watercourses are the responsibility of the LLFA, typically a County Council.

2.1.2 Sequential and Exception Tests

The NPPF necessitates that a sequential approach to site selection is undertaken so that development is (where reasonably possible) situated where the risk of flooding is at its lowest. This is ensured by applying the 'Sequential Test' (by Local Planning Authorities) and in some instances, the 'Exception Test'. The Exception Test is applied when there are no reasonably available sites in Flood Zone 1 and in some cases Flood Zone 2 when the proposed development provides wider sustainability benefits to the community that outweigh flood risk, and that it will be safe for its lifetime, without increasing flood risk elsewhere and where possible reduce flood risk overall. Details of when the exception test is applicable to development can be found in Table 2.

2.2 Local Planning Authority (LPA) and Lead Local Flood Authority (LLFA)

The site falls within the LPA administrative area of Boston Borough Council. The role of the LPA is to set out the Local Plan and the framework for local development in the council area. The NPPF with its associated Planning Policy Guidance (PPG) states that LPAs are responsible for ensuring that flood risk is managed using a sequential risk approach. To achieve this, LPAs undertake Strategic Flood Risk Assessments (SFRA) which accompany their Local Plans.

Lincolnshire County Council is the LLFA for the site. Under the Flood and Water Management Act of 2010 the LLFA has the duty of leading the coordination of flood risk management from surface water, groundwater and ordinary watercourses in the local area. LLFAs are required to prepare and maintain a strategy for local flood risk management in their areas, coordinating views and activity with other local bodies and communities through public consultation and scrutiny, and delivery planning. They must consult Risk Management Authorities and the public about their strategy. LLFAs are also responsible for carrying out work to manage local flood risks in their areas. Under the Land Drainage Act of 1991 they have the power to regulate ordinary watercourses to maintain a proper flow by issuing consents for altering features on ordinary watercourses and enforcing obligations to maintain flows in watercourses. They undertake a statutory consultee role providing technical advice on surface water drainage to local planning authorities regarding major developments (10 or more dwellings) and play a lead role in emergency planning and recovery after a flood event.

2.2.1 South East Lincolnshire Joint Strategic Planning Committee and the Local Plan

Boston Borough Council alongside South Holland District Council is part of the South East Lincolnshire Joint Strategic Planning Committee.

The South East Lincolnshire Joint Strategic Planning Committee works together to plan for the future development of South East Lincolnshire and as of March 2019 the committee adopted the South East Lincolnshire Local Plan 2011-2036 (SELJSPC, 2019).

The South East Lincolnshire Local Plan sets out the planning strategy for future growth over from 2011-2036. It describes how policymakers aim to deliver sustainable development across the district and provide a spatial strategy for the delivery of the required future infrastructure including development management policies and strategic site allocations.

2.2.2 Black Sluice Internal Drainage Board

Internal Drainage Boards (IDB) are independent public authorities that manage drainage districts throughout England and Wales, particularly the water levels in areas where there is a need to ensure the quality and effectiveness of drainage. IDBs carry out these works through the operation of pumping stations, flail mowing, removing silt and obstructions, piling slipping banks, and maintaining grids, culverts and other flood defence structures.

The site is situated within the Black Sluice IDB. The Bicker Fen Pump Station in located immediately adjacent to the northwest corner of the site boundary. The Black Sluice IDB should be notified of any development in, under, over or adjacent to any ditch or watercourse within the district and should be contacted to establish access arrangements to watercourses within the site.

Table 1: Flood Risk Vulnerability Classifications (adapted from: NPPF Planning Practice Guidance)

Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water-compatible development
• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk • Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including infrastructure for electricity supply including generation, storage and distribution systems; and water treatment works that need to remain operational in times of flood • Wind turbines • Solar farms	• Police and ambulance stations; fire stations and command centres; telecommunications installations required to be operational during flooding • Emergency dispersal points • Basement dwellings • Caravans, mobile homes and park homes intended for permanent residential use • Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as 'Essential Infrastructure'.)	• Hospitals • Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels • Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. • Non–residential uses for health services, nurseries and educational establishments. • Landfill* and sites used for waste management facilities for hazardous waste • Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan	• Police, ambulance and fire stations which are not required to be operational during flooding. 75 • Buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution; non-residential institutions not included in the 'more vulnerable' class; and assembly and leisure. • Land and buildings used for agriculture and forestry. • Waste treatment (except landfill* and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Water treatment works which do not need to remain operational during times of flood. • Sewage treatment works, if adequate measures to control pollution and manage sewage during flooding events are in place. • Car parks	• Flood control infrastructure • Water transmission infrastructure and pumping stations. • Sewage transmission infrastructure and pumping stations. • Sand and gravel working. • Docks, marinas and wharves. • Navigation facilities. • Ministry of Defence installations. • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping accommodation). • Lifeguard and coastguard stations. • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

Table 2: Flood Zone Classifications (adapted from: NPPF Planning Practice Guidance)

Zone	Return Period	Flood Risk Assessment Requirements
1: Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding.	For developments of 1 ha or more, or if less than 1 ha when development increases to a more vulnerable class (where they could be affected by sources of flooding other than rivers and the sea), or in an area which has critical drainage problems as notified by the Environment Agency.
2: Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding.	All development proposals in this zone should be presented with a Flood Risk Assessment.
3a: High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding.	All development proposals in this zone should be presented with a Flood Risk Assessment.
3b: The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency.	All development proposals in this zone should be presented with a Flood Risk Assessment.

Table 3: Flood Zone and Vulnerability Compatibility Summary (adapted from: NPPF Planning Practice Guidance)

Flood Zone (Table 2)	**Vulnerability Classification**				
	Water Compatible	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	✔	✔	✔	✔	✔
Zone 2	✔	✔	*Exception Test*	✔	✔
Zone 3a	✔	*Exception Test*	✘	*Exception Test*	✔
Zone 3b	✔	*Exception Test*	✘	✘	✘

3 Site Location and Description

3.1 Existing Site

The proposed development is for a solar farm with battery storage and associated infrastructure at Vicarage Drove in the south of Lincolnshire located to the north-west of Bicker. A detailed location map of the site is shown in Figure 2.

The site measures approximately 80.4 ha in area and is comprised of land used for agricultural purposes. The site is located approximately 2.5 km to the north-west of Bicker village and approximately 2 km north-west of Northorpe

Three Environment Agency (EA) designated ‘Main watercourses’ flow within the immediate surroundings of the site, all of which form the South Forty Foot (SFF) Drain. The main body of the SFF Drain flows north, parallel to the west boundary of the site with the two tributaries converging with the main channel approximately 275 m and 800 m upstream of the site. The SFF Drain meets the River Witham in the town of Boston (at which point the watercourse becomes ‘the Haven’) before flowing into the North Sea approximately 25 km downstream of the site.

Hammond Beck, an EA designated ‘Ordinary watercourse’ flows to the north, approximately 650 m to the east of the site. Numerous unnamed field drains, also classified as ordinary watercourses, are present within, and surrounding the site boundary. Ordinary Watercourses do not influence the EA designated Flood Zones.

Although the SFF Drain is not directly influenced by tidal levels at the site, a tidal lock at Black Sluice in Boston prevents the SFF Drain from discharging into the Haven during periods of high tide. This prevents Internal Drainage Boards from pumping floodwaters into the SFF Drain and may lead to residual flooding on the Fens.

Tidal defences can be identified on maps along both banks of the SFF Drain. The EA states that the existing fluvial defences consist of earth embankments in fair condition that reduce the risk of fluvial (river) flooding to a 20% (1 in 5) chance of occurring in any year and tidal flooding to a 0.67% (1 in 150) chance of occurring in any year. The EA also states that these defences are routinely inspected to identify any defects. The elevation at the top of the right (east) embankment adjacent to the site is between 3.5 and 5.2 mAOD (Above Ordnance Datum), at least 3.8 m above the LiDAR derived bed level of the SFF Drain.

The topography of the Fens is typically very flat and at low elevation. 2m LiDAR DTM data for the surrounding area is shown in Figure 3. Excluding the field drains running through the site, the lowest ground levels are found in the centre of the site at approximately 1.30 mAOD, with ground levels highest in the northwest corner at approximately 2.40 mAOD. The bed levels of the drains running through the site range from approximately 0.30 mAOD to 1.60 mAOD with the higher elevations in the north of the site. LiDAR-derived bed levels of the SFF Drain are approximately -0.4 mAOD adjacent to the site.

3.2 Proposed Development

Proposals include a renewable energy development consisting of both solar PV panels with battery storage and associated infrastructure. The associated infrastructure includes inverters, a substation compound and internal site access roads.

The NPPF classifies Solar Farms as ‘Essential Infrastructure’ (Table 1) which means that their construction is allowed within Flood Zones 1 and 2 (Table 3). An Exception Test is necessary if the development site is located within either Flood Zone 3a or 3b.

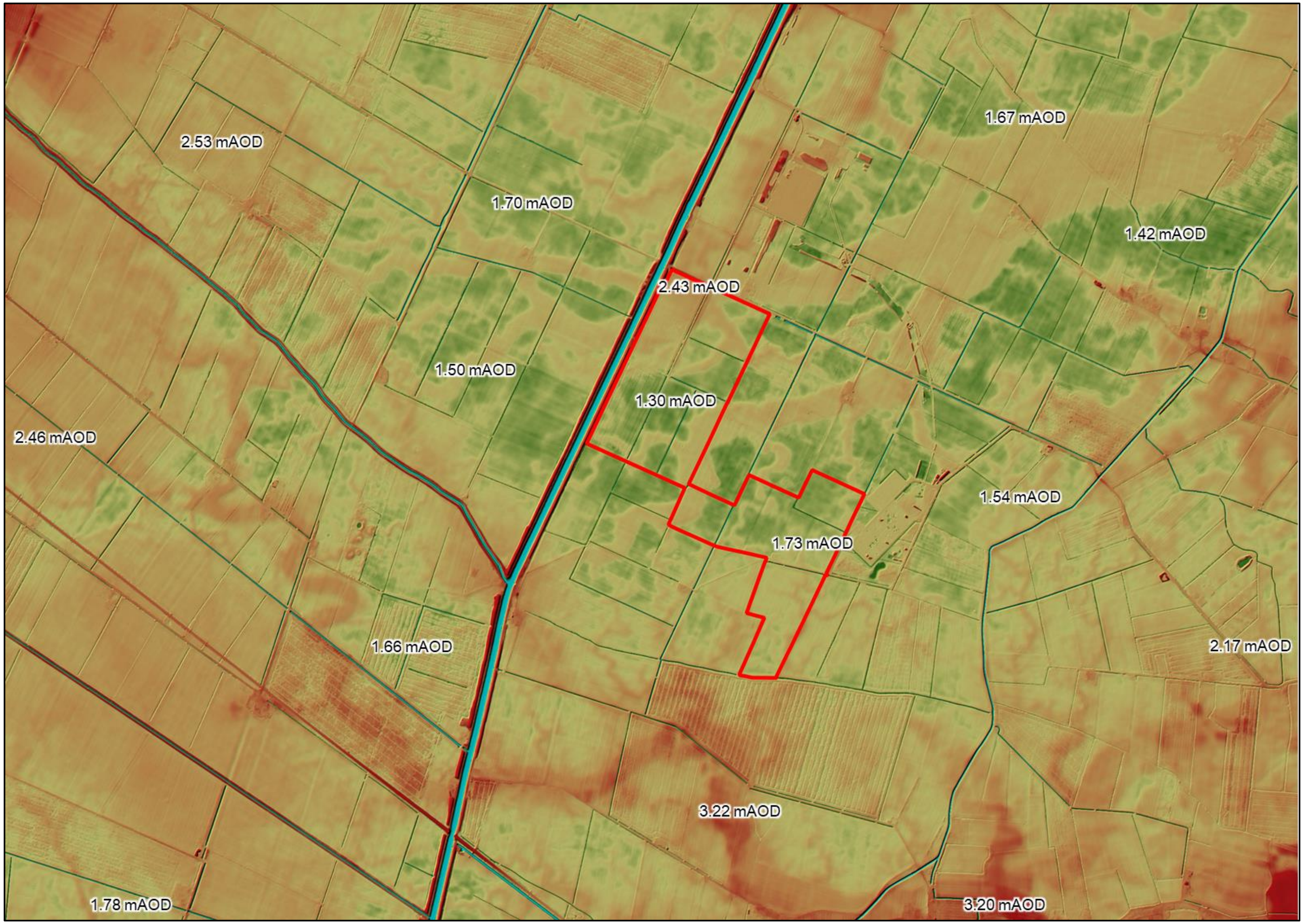
3.3 Historical Flood Search

Historic flood extents were extracted from the EA’s ‘Recorded Flood Outlines’ dataset. The dataset revealed no historic records of flooding in the area.

A general internet search indicated that the Fens are prone to flooding primarily due to the low-lying topography; however, no site-specific information could be found.

Figure 2: Detailed site location

Figure 3: Topography of the site and surrounding area from LiDAR Data



4 Flood Risk Assessment

The flood risk assessment considers the risk from:

1. Fluvial and Coastal Flooding;
2. Surface Water Flooding;
3. Groundwater Flooding; and
4. Infrastructure,

4.1 Risk of Fluvial and Coastal Flooding

Although not directly at risk from coastal flooding, water levels in the SFF drain are influenced by downstream levels due to the tide lock at Black Sluice in Boston.

Figure 4 shows the location of the site within Flood Zones 2 and 3, classified by the EA as land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (Flood Zone 2) and land having a 1 in 200 or greater annual probability of sea flooding (Flood Zone 3). It is important to note that EA flood zone maps do not take flood defences into account.

Typically, Flood Zone 3 can be partitioned further into Flood Zone 3a and Flood Zone 3b, with Flood Zone 3a defined as having a 1 in 100 or greater annual probability of river flooding and Flood Zone 3b defined as the functional floodplain (typically a 1 in 20 or greater annual probability of river flooding). Following correspondence with the EA (*Appendix: 12/03/2021*) the site was deemed to be situated outwith the functional floodplain.

Extreme flows and water levels at the development site were obtained from the EA's 'South Forty Foot' hydraulic model (*Appendix: 12/01/2021*). Table 4 below summarises the data received from the EA across a range of design events.

Flows are consistent at approximately 44m^3/s regardless of the return period and after consideration for climate change. The likely cause of this is explained in a modelling report by Royal HaskoningDHV (2017) commissioned by South Holland District Council, which states that where flows arise from pumping rather than natural run-off (including the Fenland sub-catchments of the SFF Drain), peak flow rates for future eras have been taken as current rates due to the assumption that all flood risk management measures will remain in their current state into the future.

Table 4: Flows and in-channel water levels obtained from the EA's South Forty Foot hydraulic model.

Design Event	Flow (m^3/s)	In-channel Water Level (mAOD)
1 in 20-year	39.56	2.85
1 in 100-year	42.92	3.04
1 in 200-year	44.28	3.06
1 in 1000-year	44.86	3.09
1 in 1000-year plus CC	43.90	3.10

It was noted that the modelled in-channel extreme flood levels were lower than the height of the flood defence embankments (approximately 3.5 – 5.2 mAOD) suggesting that the site would be free from fluvial overtopping flood risk entirely, however, maps provided by the EA (Figure 5) at the site show flooding despite the model taking flood defences into account. After further discussion with the EA (*Appendix: 26/0/2021*) it was concluded that flooding across the site is likely a residual risk resulting from the inability to pump water from the Fens into the SFF drain as discussed in Section 3.1.

Maximum water levels at the site have been derived by comparing flood extents with LiDAR data and are therefore predicted to reach 1.95 mAOD for the 1000-year plus climate change uplift event. Figure 6 shows the predicted flood depths across the development site.

Recommendations based on fluvial and coastal flood risk can be found in Section 5.

4.1.1 Risk of Flooding from a Flood Defence Breach

In addition to assessing residual fluvial flood risk, a 2D FloodModeller Pro model was set-up to provide a simple and indicative breach hazard analysis.

A peak flow of 44 m^3/s representing the entire 1000-year plus climate change uplift flow (Table 4) was modelled to 'breach' the flood defence embankment at the location where the top of the eastern river bank was at the lowest elevation adjacent to the site (approximately 3.5 mAOD).

The inflow hydrograph used in the model, breach location and resulting flood depths are presented in Figure 7 with recommendations based on these results found in Section 5.

Figure 4: EA Flood Zones at the development site and wider area

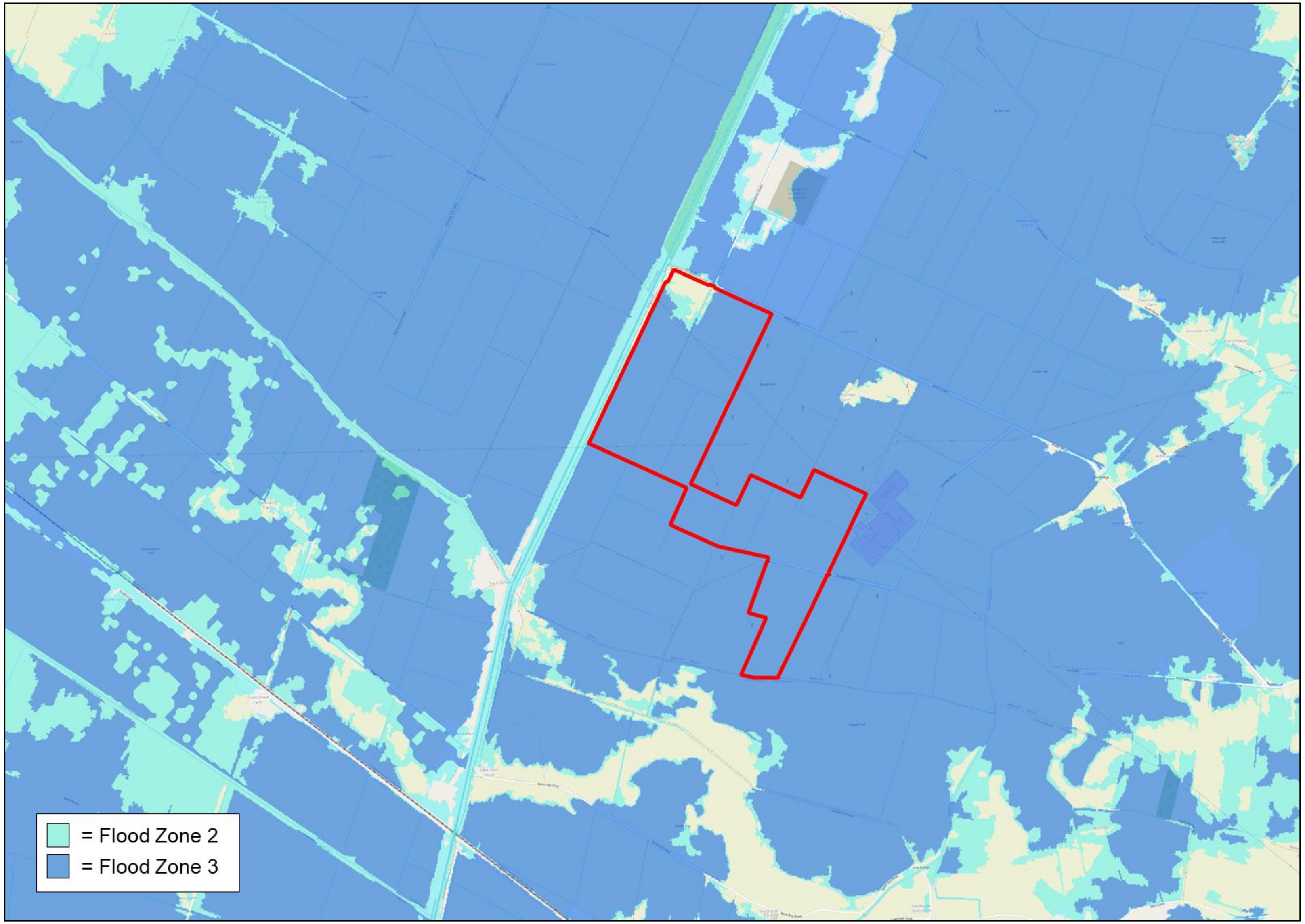


Figure 5: Flood extent at the development site obtained from the EA's South Forty Foot Drain hydraulic model

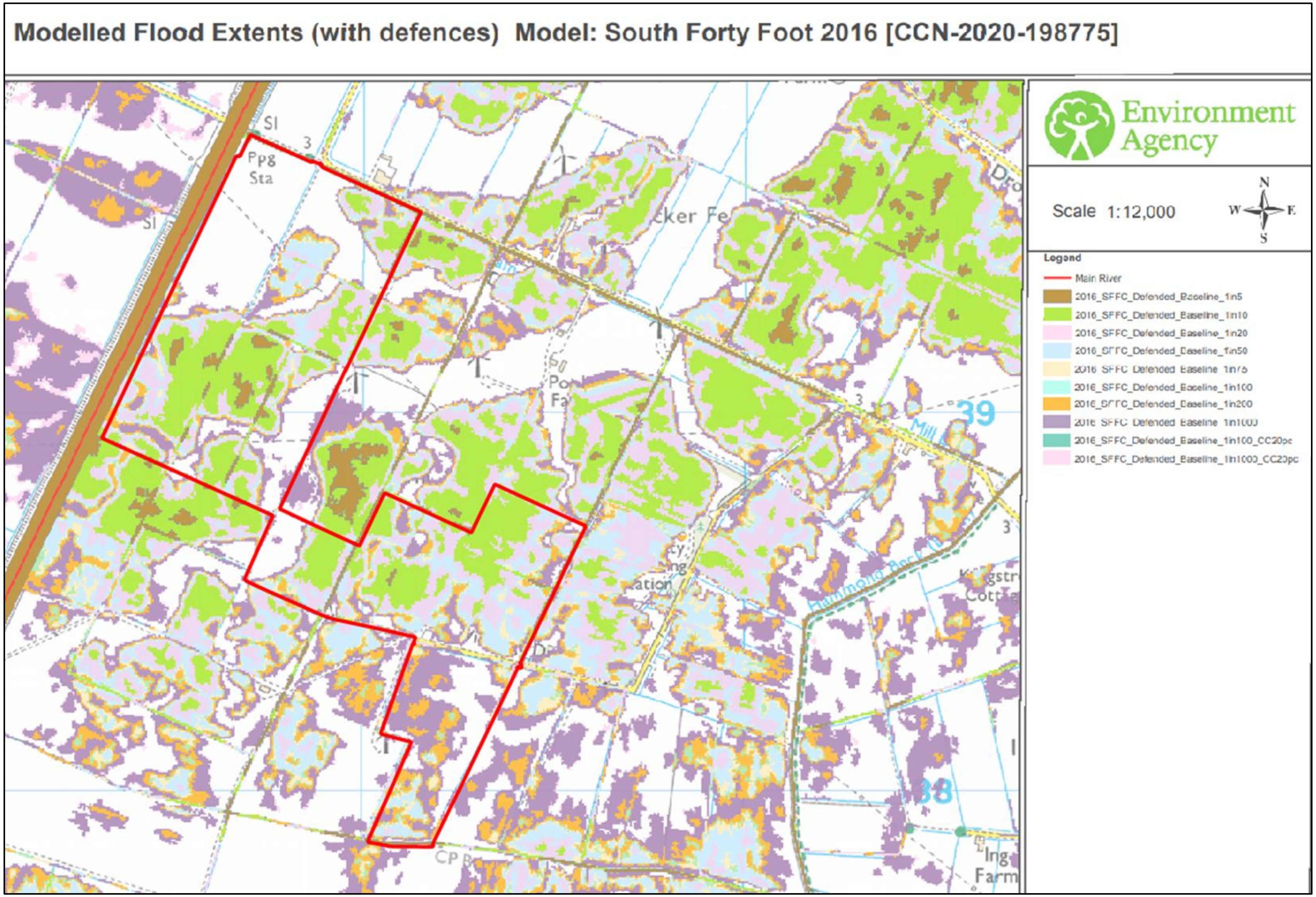


Figure 6: 1000-year plus climate change uplift flood depths at the development site

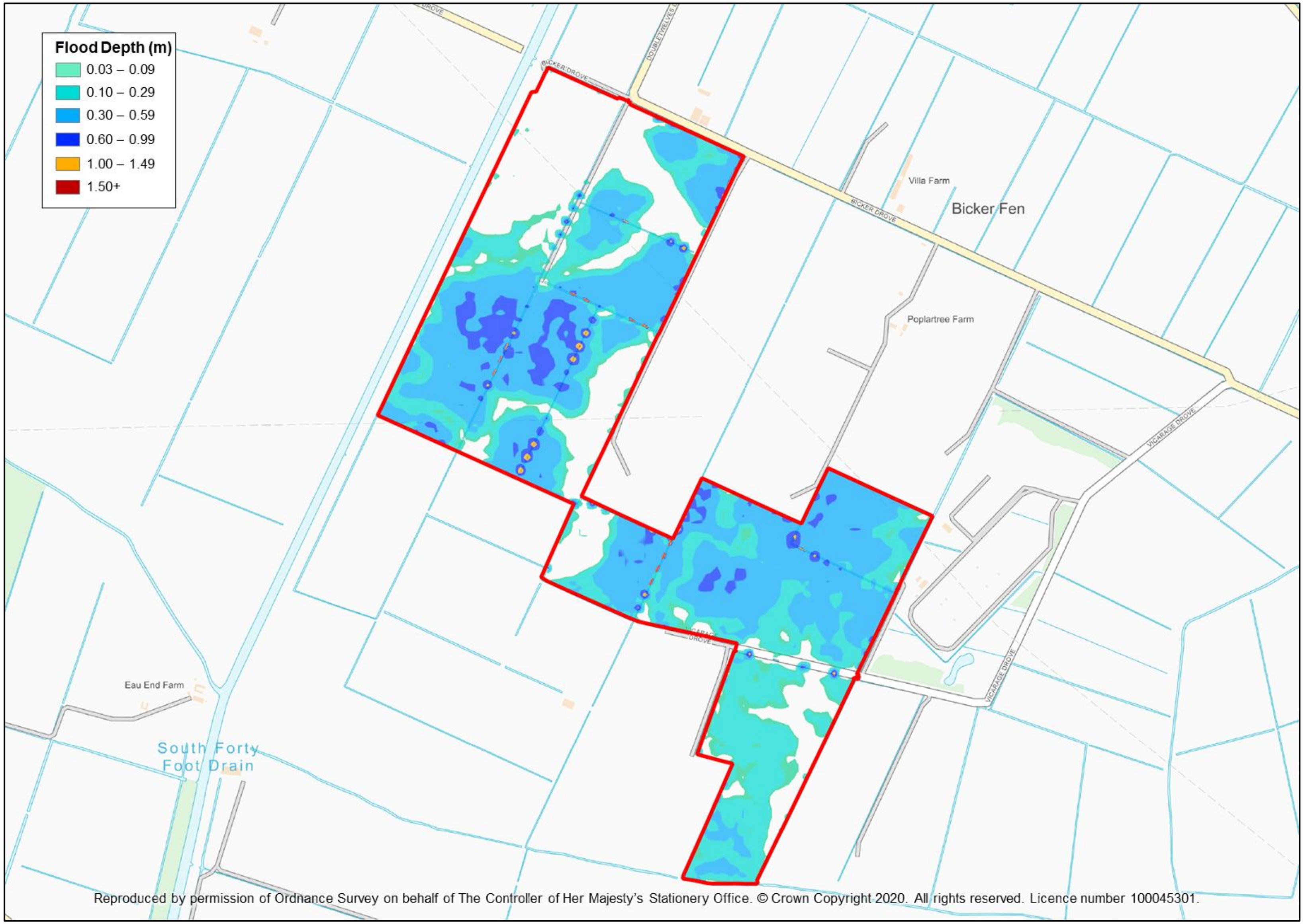
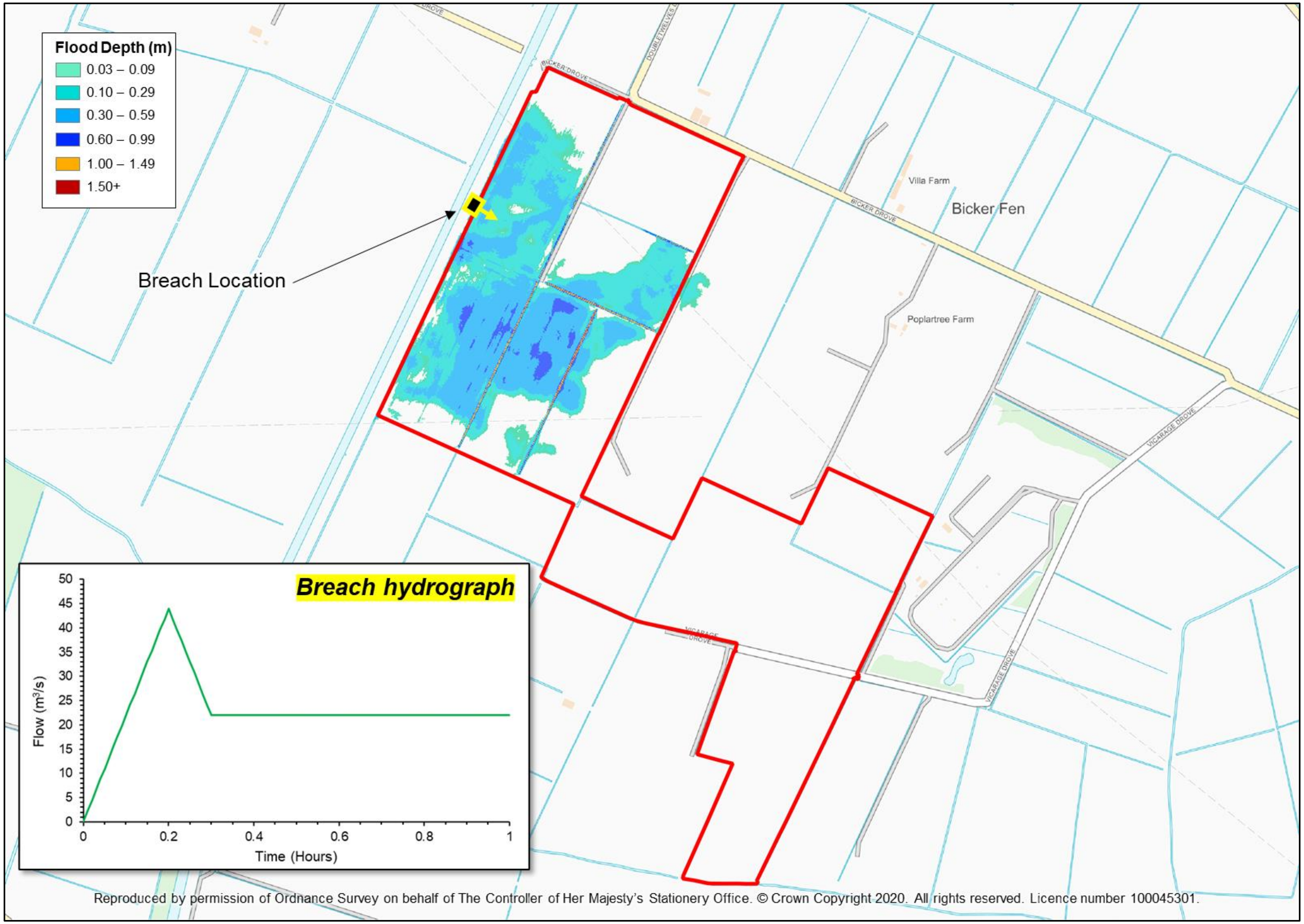


Figure 7: Indicative breach analysis flood depths at the development site with breach flow hydrograph



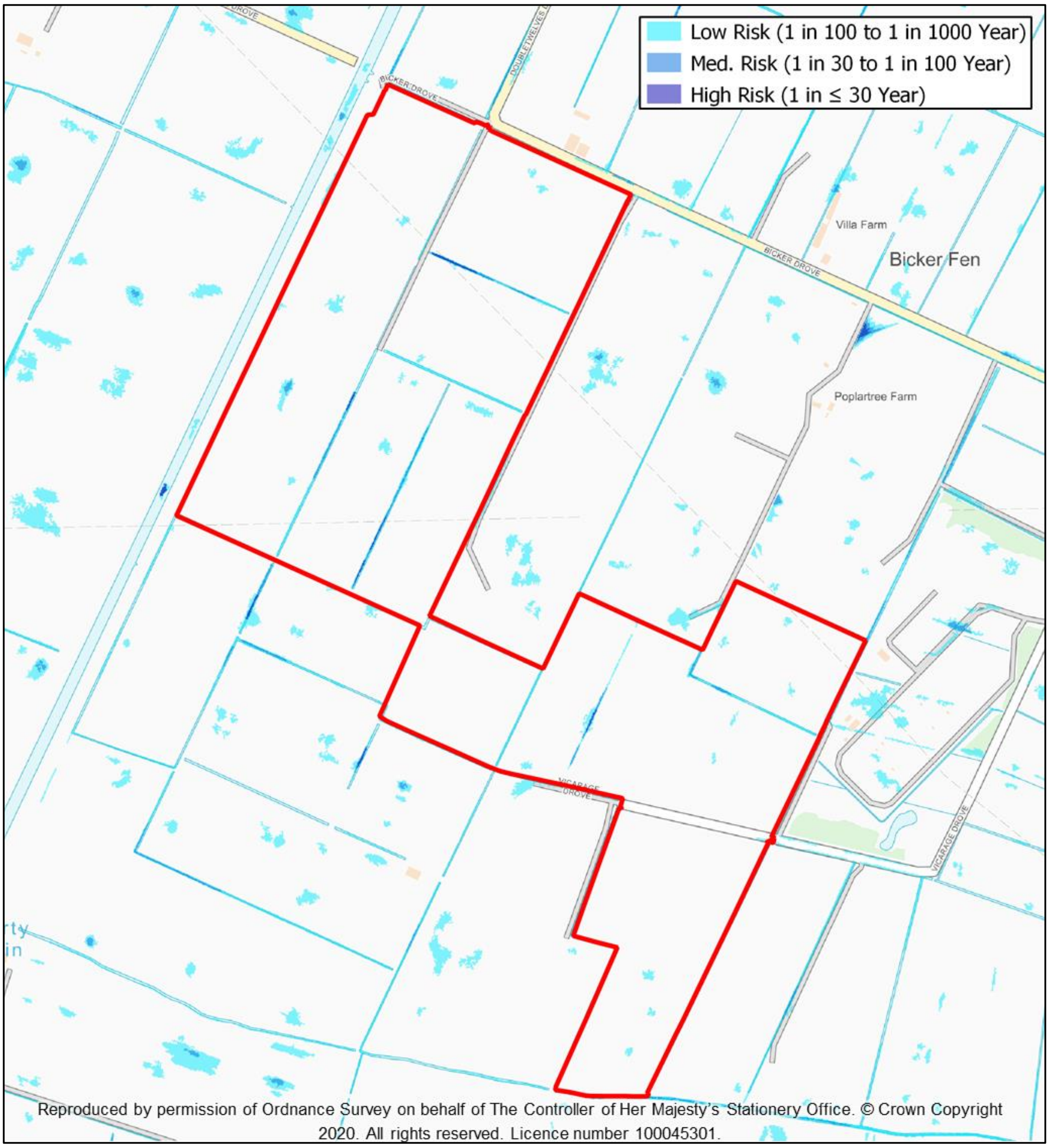
4.2 Risk of Surface Water Flooding

Several unnamed field drains are present within the site. The EA Flood Risk from Rivers and the Sea maps do not assess flood risk from these ordinary watercourses. Figure 8, which shows the EA Surface Water Risk Map, indicates that no areas outwith the field drains are predicted to flood in the 30-year event.

For more extreme events, the residual risk of flooding from the inability to pump water into the SFF Drain as discussed in Section 4.1, poses a greater risk to the site. The site is therefore considered to be at low risk from surface water flooding.

As part of the proposed development a suitable drainage system, employing SuDS where possible, will be designed to deal with surface water within the site.

Figure 8: EA surface water risk map



4.3 Groundwater Flooding

High groundwater tables and low soil infiltration rates are prevalent issues in the Fens due to the low-lying topography (Lincolnshire County Council, 2017).

British Geological Society Hydrogeology (1:625,000 scale) maps indicate that the site is situated on the Kellaways Formation and Oxford Clay Formation. This formation is characterized as ‘rocks with essentially no groundwater’; however, data from boreholes in the area surrounding the site suggests the water table is found 1.7m below ground level.

Groundwater monitoring is generally undertaken as part of a geotechnical investigation. If it is determined that there is a high groundwater table in this area, suitable mitigation measures should be undertaken post-determination if required to mitigate against the risk from flooding. Given that most of the proposed development is for solar panels with no concrete foundations, the risk from elevated groundwater levels is minimal however at the location of critical infrastructure such as transformers alterations to foundations and the positioning of SuDS so that they can operate effectively may be necessary if the groundwater table is high.

4.4 Flooding from Infrastructure

4.4.1 Flood Risk from the Drainage System

The site is undeveloped, and a drainage system will be provided. An overview of the proposed Drainage Strategy is present in Section 6.

4.4.2 Flood Risk Reservoirs

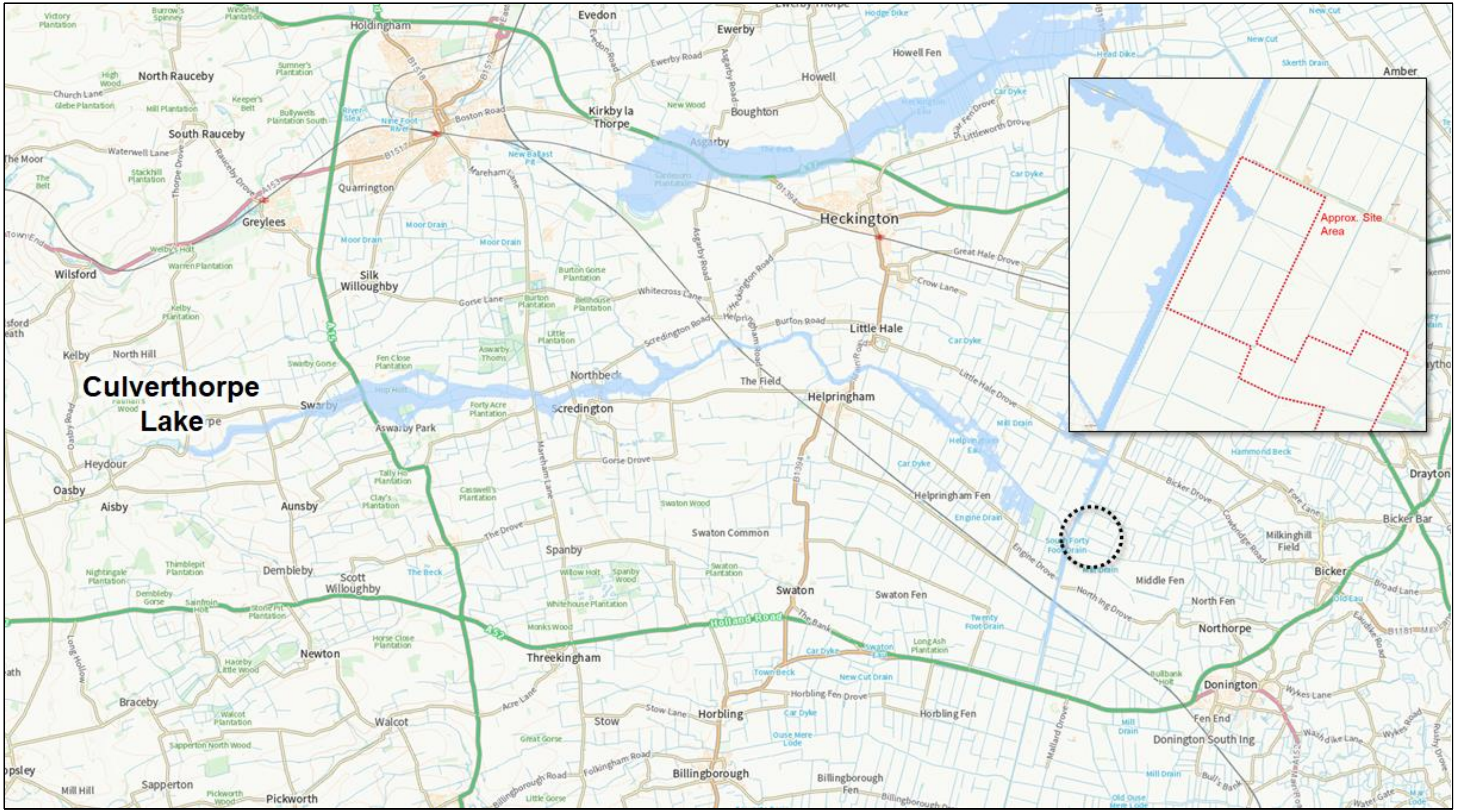
Culverthorpe Lake Reservoir is situated approximately 16 km to the west of the site. The EA Risk of Flooding from Reservoirs map shows a small parcel of land at risk in the northwest corner of the site (Figure 9). Reservoirs in the UK are however well regulated and undergo frequent maintenance by qualified professionals. In addition, during extreme events, reservoirs are monitored and flood warnings are usually provided well in advance to downstream receptors. The risk of flooding is therefore likely to be low.

4.4.3 Safe Access and Egress

The proposed site access is situated in the east of the site as shown in Figure 2. Access to the site is proposed from a pre-existing unnamed access track between the site and Vicarage Drove road to the south of the site.

The pre-existing road is situated at between 2.1 – 2.5 mAOD and is therefore outwith the 1000-year plus climate change uplift floodplain (1.95 mAOD).

Figure 9: Flood Risk from reservoirs extracted from the EA Flood Maps



5 Flood Management

Section 4 describes the methods used to assess fluvial and coastal flood risk at the site as well as an indicative flood defence breach hazard analysis.

Areas of the site are predicted to fall within the 100-year, 1000-year and 1000-year plus climate change uplift floodplains. Additionally, parts of the site are at risk in the occurrence of a breach in the SFF Drain flood defence embankment.

Following discussion with the EA it was stated that they "*would not object to this development on grounds of flood risk but, as it is essential infrastructure, we would need to see evidence that the essential infrastructure would remain operational in the 1 in 1000 climate change flood level on site"* (*Appendix: 12/03/2021*). We would therefore recommend that all essential infrastructure such as inverters, customer switchgears, MVPS, etc. be placed outwith the floodplain shown in Figure 10, which shows the combined 1000-year plus climate change floodplain superimposed onto the breach hazard floodplain (Figure 7).

Based on the proposals provided to Kaya Consulting Ltd by the client, finished floor levels for critical infrastructure across the development are situated above the predicted 1 in 1000-year plus climate change flood level.

Figure 11 shows current proposed locations of inverters across the site are outwith this combined floodplain and would therefore remain operational during extreme flood events. Figure 11 also shows the location of the substation compound located in the east of the site and situated within the floodplain. Ground levels in this area are around 1.75 – 2 m AOD, we recommend that the substation compound is raised to at least 2.55 m AOD to provide a 600 mm freeboard above the 1000-year plus climate change uplift floodplain.

As the substation compound covers a relatively small area of the site (approximately 0.3 ha) and correspondence from the EA states that *"The need for compensatory storage is dependent on the amount of land being raised. If the entire site is raised then it may be necessary to consider compensatory storage, however if only elements of the development are raised then it will not be necessary"* (*Appendix: 12/03/2021*), the impact of raising the substation compound is likely to be negligible and any compensatory storage would be insignificant given the wider flood risk in the Fens.

Figure 10: Combined 1000-year plus climate change uplift and hazard breach floodplains

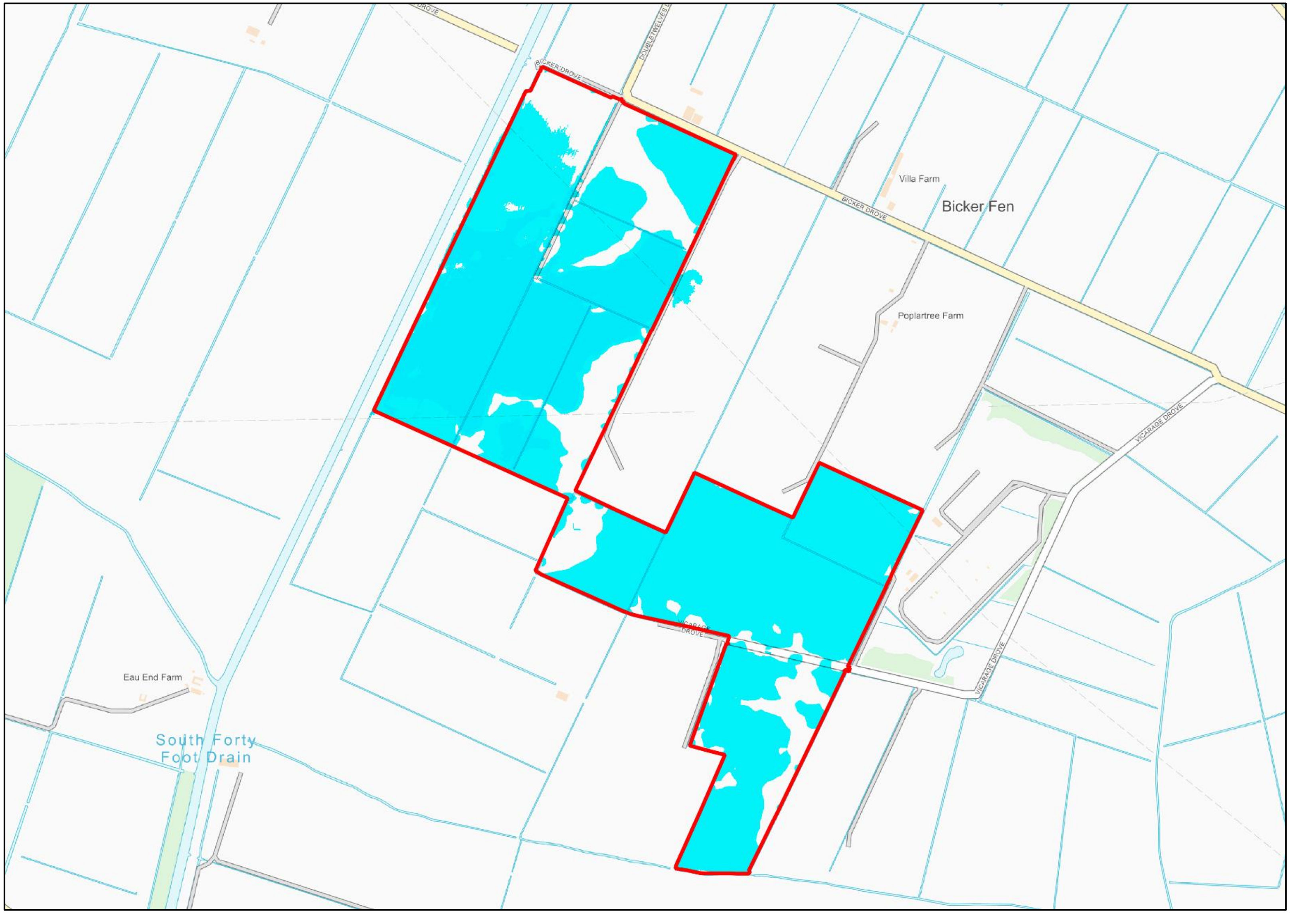
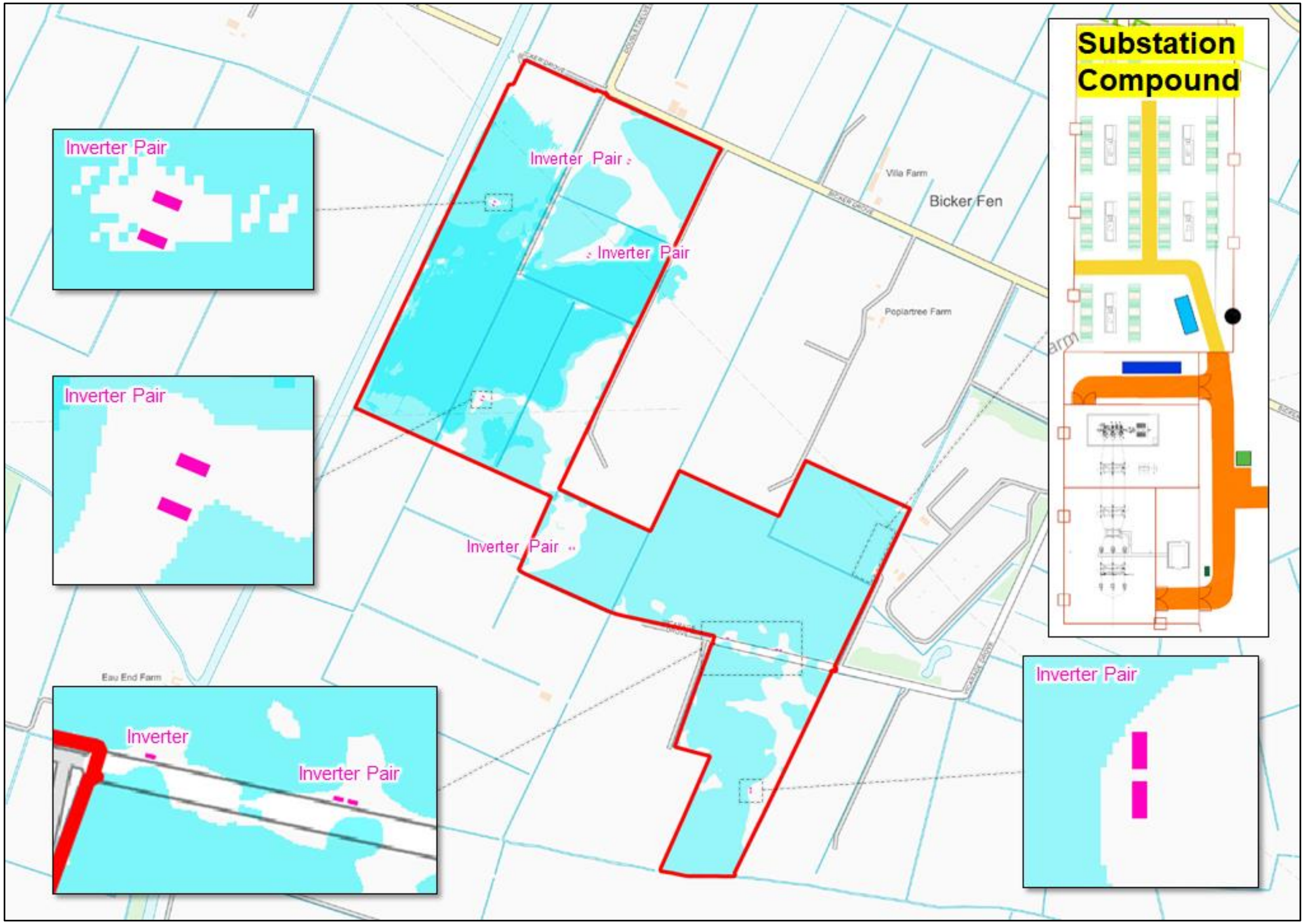


Figure 11: Proposed location of essential infrastructure within combined 1000-year plus climate change uplift and hazard breach floodplains



6 Drainage Strategy

6.1 Introduction

Relevant planning policy and Flood Risk Management Guidelines recognise that surface water should, as far as is practicable, be managed to mimic the surface water flows across the site prior to the Proposed Development, while reducing the flood risk to the site itself and elsewhere.

6.1.1 Proposed Drainage Arrangements

The Sustainable Drainage System (SuDS) Manual (CIRIA Report C768, 2017) is the current best practice guidance on the use of SuDS. It promotes the use of a hierarchical approach to managing runoff. This approach is outlined below:

1. Prevention – Preventing runoff by reducing impermeable areas;
2. Source Control – Effective control of runoff at or very near its source;
3. Site Control – Planned management of water in a local area or site; and
4. Regional Control – Designing a system that can efficiently manage the runoff from a site, or several sites.

The proposed surface water drainage strategy for the Vicarage Drove Solar Farm Development seeks to provide a sustainable and integrated surface water management scheme for the whole site and aims to ensure no increase in downstream flood risk by managing discharges from the site to the local water environment in a controlled manner.

In compliance with the above, the drainage strategy has been developed to meet the following key principles;

- Mimic existing (greenfield) drainage arrangements as far as possible;
- Avoid increases in the greenfield rate, volume and frequency of offsite discharge;
- Avoid significant deterioration in water quality of discharges and no detrimental impact in downstream water quality;
- Achieve the above criteria for all storms up to and including the 100-year event; and
- Incorporate an allowance for climate change (40%).

Figure 12 provides an indicative layout of the drainage structures and features proposed at the development site.

The larger substation compound will drain into a storage area (swale) running along the western and southern boundaries of the compound. The swale will then drain to the unnamed field drain to the south of the compound via an outfall pipe restricted to greenfield runoff rates. As the inverters are much smaller in area, totalling 0.028% of the site, and distributed across the site, it would not be feasible to drain each inverter to a watercourse directly. Instead, storage areas will drain each inverter, allowing for enhanced infiltration. As a minimum, storage areas should be sized for the 100-year plus climate change uplift event.

To ensure that only additional runoff generated by the impermeable structures is captured in the storage areas, ground levels around the upslope boundary of some structures will be raised to divert existing surface water runoff around the area (i.e. a diversion bund that segregates the runoff from the impermeable structure only). In most instances, diversion bunds are not required as the inverters are positioned at local high points (as to be situated outwith the floodplain) and the catchment draining to these inverters is negligible. Likewise, the substation compound will be raised above surrounding ground levels.

Access tracks to the development and the associated infrastructure will be formed of crushed aggregate which will be permeable and will not be tarmac (i.e. impermeable). Alternative materials such as well graded sand and gravel has been discounted as it would be more prone to potholing, rutting, and washing off, potentially leading to siltation of adjacent watercourses.

Some rock types are suitable after crushing for use on track construction particularly in the upper 100–150mm ’running’ surface. However, the strength of different types of rock varies widely. Some can quickly degrade or breakdown under the weight of vehicles. Expert geotechnical advice will be sought when confirming track material.

It is suggested that enhanced infiltration measures are included within the storage areas in the form of an infiltration trench which will be filled with stone/aggregate within the bed of the area. This additional measure will not only enhance the infiltration potential but also provide additional storage within the dedicated area, see example shown in Figure 13. The slopes of the swale should have minimal slope gradients, to encourage infiltration. An additional freeboard allowance 0.3m is recommended for each swale. Swales should be grassed and kept free of excessive overgrown vegetation.

Figure 12: Indicative Drainage Strategy (Inverters shown across the site in pink)

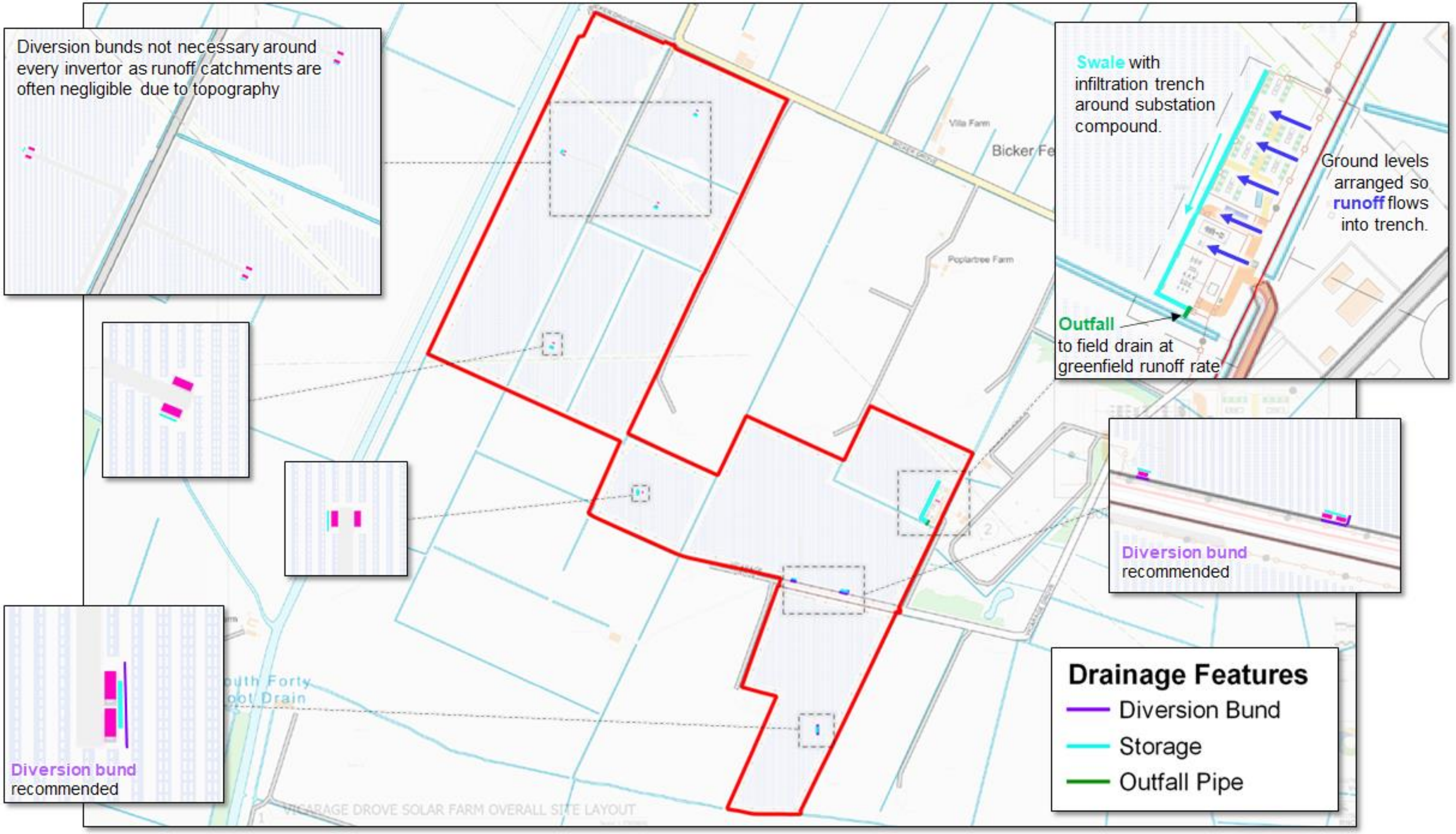
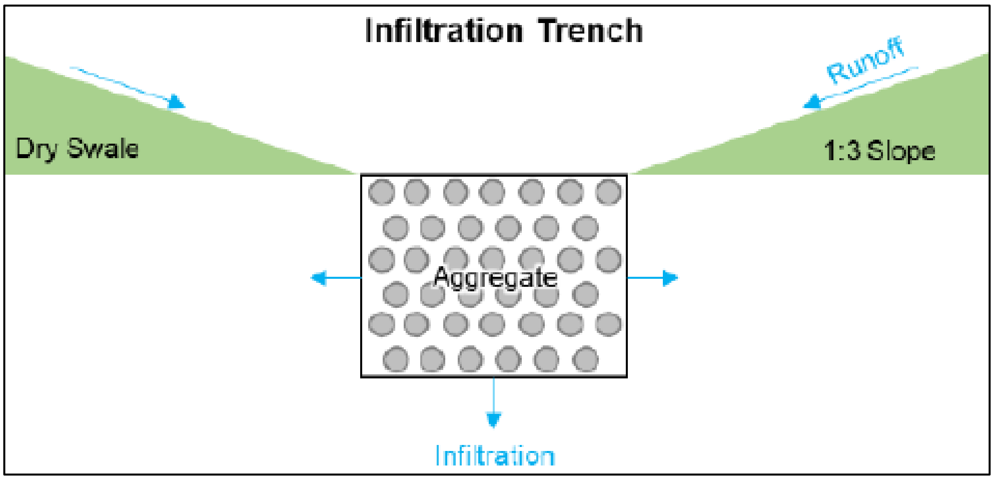


Figure 13: Example of Swale with Infiltration Trench



6.2 Methodology for calculation of run-off and storage volume

Greenfield and post-development runoff volumes have been calculating using the Wallingford Procedure. Runoff volumes were calculated for 1-hour, 3-hour and 6-hour storm durations for a range of return periods including an allowance for climate change, which is considered at a 40% uplift as stated in the Lincolnshire County Council SuDS Design & Evaluation Guide (2018).

For the post-development runs, the run-off factor of the hard-standing areas was set to 0.9 to represent the imperviousness of these areas

6.2.1 Greenfield Runoff and Stormwater Storage

In total, impermeable areas at the site will be limited to 0.36 ha as shown in Table 5. The extent of hardstanding areas introduced will be approximately 0.44% of the total site area.

It should be noted that the site compound is considered impermeable. In reality this is a conservative assumption as the compound will likely be surfaced with gravel aggregate and infiltration will still occur.

Recent studies (Wallingford Hydrosolutions, 2017 and Sharp et al., 2017) suggest that solar farms have insignificant impact on surface water runoff rates and volumes (compared to the greenfield runoff rate) permitting that surface water flow pathways and site vegetation coverage remain largely similar to pre-development conditions. As storage and attenuation structures within the site are designed in a way that maintains surface water flow pathways to pre-development conditions and significant changes to vegetation cover are not expected, it is highly likely that the solar panels will have negligible impact on surface water runoff rates and volumes. Rainwater falling onto each panel will drain freely onto the ground beneath the panels and infiltrate the ground as the same rate as it currently does. Therefore, the total surface area of the photovoltaic array will not be considered in this assessment.

Access tracks will be permeable (non-tarmac) so any rainwater falling onto the permeable access tracks will soak into the ground beneath at the same rate that it presently does.

Table 5: Impermeable areas throughout the site

Infrastructure	Total Area (m^2)
15 x Inverters	225
Substation Compound Area	3,350
Total Impermeable Area	**3,575**

The total peak runoff rates and volumes for the 1-hour, 3-hour and 6-hour storm duration were calculated using the Wallingford procedure. Table 6 compares the runoff volumes for the pre- and post-development scenarios.

Table 6: Runoff volume for pre and post development scenarios for all groups

Phase	Return Period (years)	Runoff Volume (m^3)		
		1hr	3hr	6hr
Pre-Dev	2	17.34	26.51	32.69
Pre-Dev	30	43.15	59.66	73.75
Pre-Dev	100	58.54	81.72	101.67
Pre-Dev	100+40%	81.96	114.41	142.34
Post-Dev	2	47.72	72.97	89.97
Post-Dev	30	118.76	164.19	202.99
Post-Dev	100	161.13	224.92	279.82
Post-Dev	100+40%	225.59	314.89	391.75
Return Period (years)		**Difference in Runoff (m^3)**		
2		30.38	46.46	57.28
30		75.61	104.54	129.24
100		102.59	143.20	178.15
100+40%		143.62	200.48	**249.42**

Following the Lincolnshire County Council SuDS Design & Evaluation Guide (2018), the 6-hour 100-year storm will be considered as the design event for designing SuDS. Table 6 indicates that with development in place, a conservative estimate of 249.4 m^3 of additional surface water would be generated during a 100-year plus climate change uplift storm across the site.

SuDS should be designed to store this volume within the site boundaries and limit runoff rates leaving the site similar to pre-development values.

Table 7 indicates the total storage volume required for each impermeable feature. Table 8 shows greenfield runoff rates for the area of the substation compound. Flows discharging into the unnamed field drain should not exceed these rates.

Table 7: Runoff volume for pre and post development scenarios for all groups

Infrastructure	Storage Volume (m^3) Required for the 100-year plus 30% event
Each Inverter*	1.04
Substation Compound	233.72

**Total of 15 Inverters across the site*

Table 8: Greenfield runoff rate for substation compound area

Return Period	Flow (l/s)
2	0.42
10	0.78
50	1.33
100	1.69

6.2.1.1 Construction Phase Drainage Arrangements

During the construction phase, additional drainage measures should be implemented to help attenuate the increase in surface water flows if surface water is observed discharging from the construction compound.

Runoff from these areas is anticipated to have high silt loading due to mobilised soil from excavated surfaces, fines from track aggregate and sludge due to traffic.

We would recommend that hardstanding runoff be directed to a swale on the site lower points. This drainage scheme can be removed at the end of the construction stage and the area reinstated. It is recommended that vegetation disturbance is minimised during construction. Decompaction of ground post-construction should be provided at the areas where necessary.

If any underground culverts or land drains are damaged as part of the construction phase, then they should be repaired or replaced.

6.2.1.2 Designing for Exceedance Events

Storage areas should be designed so that flooding will not occur up to and including the 1 in 100-year plus climate change uplift event.

Overland flow routes will not be altered by the construction of the solar farm as it is not proposed to significantly vary ground levels.

In the event of multiple storms, surface water runoff from the impermeable structures will discharge into the storage area swales before overspilling in a controlled manner. As the site is relatively flat exceedance runoff from the swales will remain within site, resulting in no predicted increase in flood risk downstream.

There are existing drainage ditches within the site. It is recommended that the drains are not removed and maintained to convey excess of surface water.

6.2.1.3 Summary

Research has shown that solar panels do not significantly increase surface water runoff. Therefore, the two main sources of surface water runoff from the site occur from the substation compound and the inverters.

Surface water runoff from the compound will be captured and attenuated before being discharged into the unnamed field drain at greenfield runoff rates. However, due to the very small impermeable areas generated by the inverters, calculations have shown that it is not possible or practical to discharge surface water at greenfield runoff rates via a traditional piped network. Based on national guidance, the approach seeks to use infiltration in the first instance with enhancements made to infiltration and storage features. Due to the very small areas involved and available land, a small area (lowered in the form of an enhanced swale, see Figure 13) would be sufficient to store more than double the required volume for the most common impermeable area (assuming a negligible infiltration/evaporation rate).

During an exceedance event, runoff from the surcharging swales will remain in site, resulting in no predicted increase in risk downstream of the development.

7 Summary & Conclusions

Kaya Consulting Ltd. was commissioned by Renewable Connections Developments Ltd to undertake an assessment of the risk of flooding alongside a drainage strategy for the proposed development of a solar farm with battery storage and associated infrastructure at Vicarage Drove in the south of Lincolnshire located to the north-west of Bicker.

The NPPF classifies electricity generating infrastructure as that of 'essential infrastructure' and is therefore appropriate for development in Zones 1 and 2 with an exception test required if the site is situated within Flood Zones 3a or 3b. Essential infrastructure at the site has been raised or set out with flood zone 1 and is therefore suitable for development based on NPPF.

Although the site is not directly at coastal or fluvial flood risk due to the presence of an embankment along the SFF Drain, a downstream tidal lock prevents the SFF Drain from discharging into the Haven during periods of high tide, in-turn preventing the pumping of flood waters from the Fens into the drain causing residual flooding at the site.

Extreme flood extents and depths at the site were derived from the results of the EA's SFF Drain Hydraulic Model and an indicative breach analysis was undertaken using the extreme flows provided in the model results. Analysis revealed that areas of the site are predicted to fall within the 100-year, 1000-year and 1000-year plus climate change uplift floodplains with some areas of the site also at risk if a breach occurred in the SFF Drain embankment adjacent to the site.

The EA have commented however, that they would not object to the development on the grounds of flood risk so long as essential infrastructure remains operational during the 1000-year plus climate change uplift event. Layouts provided to Kaya Consulting Ltd. suggest that this is the case with the exception of a Substation Compound which would need to be raised 250 mm above current ground levels.

Compensatory storage to mitigate the raising of the Substation Compound is likely not required as discussed with the EA.

Access to the site is proposed from a pre-existing unnamed access track between the site and Vicarage Drove road to the south of the site. The access road is situated outwith the 1000-year plus climate change floodplain.

Given that most of the proposed development is for solar panels with no concrete foundations, the risk from elevated groundwater levels is low.

The risk from surface water flooding is low. It is recommended that Finished Floor Levels are set above local ground levels (ideally by at least 300mm) to prevent surface water flooding.

It should be noted that risk of flooding can be reduced but not totally eliminated, given the potential for events exceeding design conditions and the inherent uncertainty associated with estimating hydrological parameters for any given site.

The proposed drainage strategy will see surface water runoff from the substation compound captured and attenuated before being discharged into the unnamed field drain at greenfield runoff rates. As the runoff volumes generated from the inverters are too small for a traditional pipe network, oversized storage areas in the form of enhanced swales will be implemented to allow for infiltration following national guidance. During an exceedance event, runoff from the surcharging swales will remain in site and will therefore not increase the risk to others.

8 References

Lincolnshire County Council (2017), Highway & Lead Local Flood Authority, Lincolnshire Development Roads And Sustainable Drainage Design Approach, November 2017 Edition.

Royal Haskoning DHV (2017), 2016 Update of South Holland Strategic Flood Risk Assessment - Modelling and Mapping Note, February 2017.

South East Lincolnshire Joint Strategic Planning Committee (2019), South East Lincolnshire Local Plan 2011-2036, Adopted March 2019.

Lincolnshire County Council (2018), Lincolnshire County Council SuDS Design & Evaluation Guide (2018).

Appendix – Email Correspondence

From: Emma Haines
Sent: Fri 12/03/2021 10:49 (Forwarded)
To: Lee Ruddick
Subject: RE: 201223/DM28 Flood info request for site near Boston, Lincolnshire CCN/2020/198775

Good morning

Please see below for answers to your queries in red. I have also attached some amended maps.

I hope this is helpful.

Kind regards
Emma

- We think the E.A. online flood maps are based on the undefended flood maps? Can you confirm this?
  If this is in reference to the flood map for planning then I can confirm the flood zones are based on the undefended scenario.

- The un-defended flood maps have been provided but we are unable to view the 100/1000yr outlines clearly. Can the maps be provided in Ascii format so that we are also able to plot depths?
  The flood zones would not be beneficial in determining flood depths. It is the residual risk from a breach of the South Forty Foot Drain that needs to be calculated.

- You mentioned that the Forty Foot Drain is not predicted to overtop, and flooding at the site is residual, likely from IDB pumps being turned off etc. Would flooding at the site be classed as surface water flooding instead of fluvial?
  In my previous response I mentioned it is also possible that some out of channel extents may be the result of low spots along the embankments of the South Forty Foot. Flooding at the site in the defended extents scenario would be classed as fluvial as it is caused by flooding from either the main river or drainage systems.

- Does the E.A. class the functional floodplain as the flood extent including or excluding defences?
  The site is not considered to be functional floodplain. Functional floodplain is defined as areas that are flood storage areas or that would flood in a 1:20 annual chance scenario (with defences scenario.) But this site is not functional floodplain (flood zone 3b.)

- The defended scenario is the best estimate of flood risk at the site. As the development is for a Solar Farm (which is likely to be classed as Essential Infrastructure) it would theoretically be possible for the client to build within the defended floodplain.
  We would not object to this development on grounds of flood risk but, as it is essential infrastructure, we would need to see evidence that the essential infrastructure would remain operational in the 1 in 1000 climate change flood level on site. This would include the potential levels on site from a breach on the South Forty Foot. We do not have modelled data of this kind so this is something that needs to be assessed.

- If built development is permitted on the floodplain, there must be no loss of storage or increase in flood risk to others. The development is for Solar Panels which can flood up to 1m (i.e. no land raising) but electrical infrastructure would need to be raised. Are we correct in stating that to raise land within the defended floodplain, we would need to provide compensatory storage? If so, what return period volume would need to be compensated for? If the residual flooding at the site is from surface water flooding then would compensatory storage be required?
  The need for compensatory storage is dependent on the amount of land being raised. If the entire site is raised then it may be necessary to consider compensatory storage, however if only elements of the development are raised then it will not be necessary. Generally raising of land in the fens creates little loss of storage in such large floodplains.

- It was stated in product 4 that "fluvial defences reducing the risk of flooding to this site consist of earth embankments"…"they reduce the risk of flooding (at the defence) to a 20% (1 in 5) chance of occurring in any year" – does this mean that the defences are not effective when the return period is greater e.g. a 100 year event? If this is the case and the defences are not effective, would the floodplain extent of the model derived 100 year defended extent not look more similar to the undefended 100 year map? Or would it be more accurate to say that the defences still offer some protection for those higher return period events and thus produce maps with much reduced flooding as shown in product 4?
  Whilst not preventing flooding in a 1 in 100 annual chance flood the defences do reduce the extent of flooding. The undefended map shows the consequence of no defences in the catchment on main rivers and coastal areas. Flood zone 3 on the site is the effect of both tidal and fluvial inundation, assuming no defences.

- Is there any further information available on the defences risk of failure?
  There is always a risk of failure of flood defences, particularly on raised embankments. It is the consequence of such a failure that must be mitigated for in the planning application.

- The client may potentially build solar panels close to the defence, would a breach assessment be required? Previous correspondence suggests that it wouldn't, can you confirm?
  A breach assessment is crucial to understanding the flood risk at this site and the potential flood level. We do not have breach modelling for the South Forty Foot which makes an assessment even more necessary. This assessment does not necessarily have to include breach modelling. An appropriate hand calculation will suffice to give estimated depths on the site.

- Hammond Beck appears to have a catchment exceeding 3km^2 (approximately 36km^2 adjacent to the site on the FEH website) can you confirm that this is not a major watercourse and there is no fluvial flood risk associated with the channel?
  We do not have any modelled data for Hammond Beck as it not a designated Main River. It falls under the control Black Sluice IDB who may be able to assist.

Emma Haines
Partnerships and Strategic Overview Officer
Lincolnshire and Northamptonshire Area
Environment Agency
✉ Ceres House, 2 Searby Road, Lincoln, LN2 4DW
☎ 02084745374
☎ 45374 (internal)
emma.haines@environment-agency.gov.uk

From: Lee Ruddick
Sent: 01 March 2021 16:02
To: 'PSO LINCS' <PSOLINCS@environment-agency.gov.uk>
Subject: RE: 201223/DM28 Flood info request for site near Boston, Lincolnshire CCN/2020/198775
Hi Emma,

Thanks for your prompt response to my previous email, it is much appreciated.

We had a couple of additional questions which we would like to ask, I appreciate that you have already answered a few so we would be happy to pay for the further advice service if that is required? I have prepared the questions below and would be grateful if you would be able to answer, or alternatively, we would be happy to chat over a Teams/Zoom call.

- We think the E.A. online flood maps are based on the undefended flood maps? Can you confirm this?
- The un-defended flood maps have been provided but we are unable to view the 100/1000yr outlines clearly. Can the maps be provided in Ascii format so that we are also able to plot depths?
- You mentioned that the Forty Foot Drain is not predicted to overtop, and flooding at the site is residual, likely from IDB pumps being turned off etc. Would flooding at the site be classed as surface water flooding instead of fluvial?
- Does the E.A. class the functional floodplain as the flood extent including or excluding defences?
- The defended scenario is the best estimate of flood risk at the site. As the development is for a Solar Farm (which is likely to be classed as Essential Infrastructure) it would theoretically be possible for the client to build within the defended floodplain.
- If built development is permitted on the floodplain, there must be no loss of storage or increase in flood risk to others. The development is for Solar Panels which can flood up to 1m (i.e. no land raising) but electrical infrastructure would need to be raised. Are we correct in stating that to raise land within the defended floodplain, we would need to provide compensatory storage? If so, what return period volume would need to be compensated for? If the residual flooding at the site is from surface water flooding then would compensatory storage be required?
- It was stated in product 4 that “fluvial defences reducing the risk of flooding to this site consist of earth embankments”…”they reduce the risk of flooding (at the defence) to a 20% (1 in 5) chance of occurring in any year” – does this mean that the defences are not effective when the return period is greater e.g. a 100 year event? If this is the case and the defences are not effective, would the floodplain extent of the model derived 100 year defended extent not look more similar to the undefended 100 year map? Or would it be more accurate to say that the defences still offer some protection for those higher return period events and thus produce maps with much reduced flooding as shown in product 4?
- Is there any further information available on the defences risk of failure?
- The client may potentially build solar panels close to the defence, would a breach assessment be required? Previous correspondence suggests that it wouldn’t, can you confirm?
- Hammond Beck appears to have a catchment exceeding 3km^2 (approximately 36km^2 adjacent to the site on the FEH website) can you confirm that this is not a major watercourse and there is no fluvial flood risk associated with the channel?

In addition to the above, our site is formed of two areas (attached as a shapefile). Are you able to provide results that cover the eastern area as well?

Apologies for the long list, but this information is critical to whether the client is minded to pursue development at the site and we don’t want to misinform him.

We would be grateful to receive answers to the above or chat via teleconference.

Many thanks,
Lee Ruddick

From: PSO LINCS <PSOLINCS@environment-agency.gov.uk>
Sent: 26 February 2021 12:55
To: Lee Ruddick <lee.ruddick@kayaconsulting.co.uk>
Subject: RE: 201223/DM28 Flood info request for site near Boston, Lincolnshire CCN/2020/198775

Hello Lee

I can confirm that the South Forty Foot fluvial model does not have a tidal influence other than the effect of tide lock at Black Sluice when the South Forty Foot is unable to discharge into the Witham Haven at high tide. The fluvial defended extents covering the site are likely to be a result of rainfall included in the model falling on lower lying land as well as exceeding storage in lowland drains in the IDB flood cells. Although the drains were not specifically included in the model, the extents are likely to be influenced by the IDB high level cut off which was included. When a certain level is reached in the South Forty Foot the IDBs stop pumping into the South Forty Foot Drain so that the river and embankments are not overloaded, this would result in some of the lower land in the fens being affected. It is also possible that some out of channel extents may be the result of low spots along the embankments of the South Forty Foot.

The tidal defences mentioned in the CCN letter refer to the nearest tidal defence to the site which are the embankments of the Witham Haven. Tidal risk has been considered separately and is not included in the South Forty Foot model.

We have modelled tidal breach hazard mapping (product 8 data,) however the extents do not affect your site. The site is still at risk of tidal flooding in the without defences scenario.
We do not have any fluvial breach hazard mapping for this area (i.e the South Forty Foot Drain.)

I hope this is helpful.

Kind regards
Emma

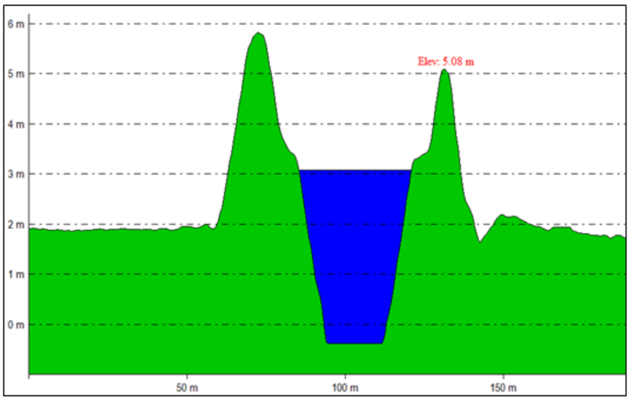
Emma Haines
Partnerships and Strategic Overview Officer
Lincolnshire and Northamptonshire Area
Environment Agency

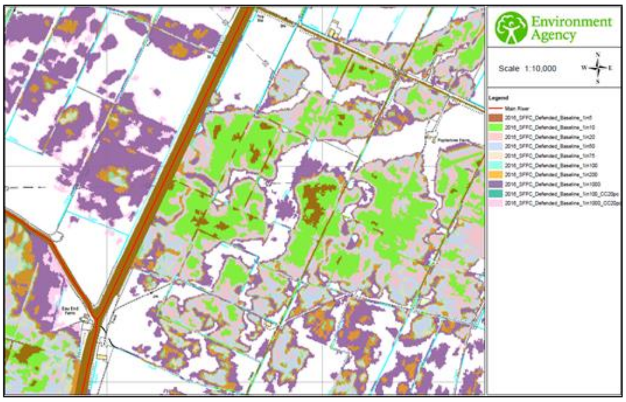
From: Lee Ruddick [mailto:lee.ruddick@kayaconsulting.co.uk]
Sent: 11 February 2021 13:18
To: PSO LINCS <PSOLINCS@environment-agency.gov.uk>
Subject: RE: 201223/DM28 Flood info request for site near Boston, Lincolnshire CCN/2020/198775

Thank you for sending this through. Is it possible for you to please provide clarification on the following:

It is noted that the 1 in 100-year in-channel fluvial water levels provided are modelled to reach 3.01-3.08 mODN; however, flood defence embankments are raised to approx. 5.08 mODN. It would therefore be expected that the site would not fall within the fluvial floodplain of the defended 1 in-100 year event, however, the attached maps show that parts of the site are inundated at the event as little as the 1 in 5yr. Can you clarify why this would be the case when the surrounding watercourses are 'Ordinary' and their associated floodplains would not be included in these maps? Does the fluvial model include tributaries? Does the fluvial model have a tidal influence?

I note that the Hammond Beck Drain flows north along the eastern boundary of part of the development site. Following on from my point above, does the flood map below include the flood risk from this drain; i.e. flood waters not able to enter the Forty Foot Drain backing up and vice versa.





Additionally, the correspondence states that the site has protection from tidal defences, which reduce the risk of flooding at the defence to a 1 in 150yr return period. I was unsure where the defence was? Does it relate to the earth embankment along the Forty Foot Drain? The CFB levels appear quite high, at say Fosdyke Bridge (5.83 mODN) so I would expect a higher water level at the site. Has a joint probability been undertaken in the assessment with an extreme tide and flows in the Forty Foot Drain or has tidal risk been considered separately?

Finally, is it possible to also receive product 8 regarding Flood Defence Breach Hazard Map including, maximum flood depth, maximum flood velocity, maximum flood hazard?

Kind regards,
Lee Ruddick

From: PSO LINCS <PSOLINCS@environment-agency.gov.uk>
Sent: 13 January 2021 12:11
To: Lee Ruddick <lee.ruddick@kayaconsulting.co.uk>
Subject: RE: 201223/DM28 Flood info request for site near Boston, Lincolnshire CCN/2020/198775

Dear Lee

Enquiry regarding Bicker Fen

Thank you for your enquiry which was received on 23rd December 2020.

We respond to requests under the Freedom of Information Act 2000 and Environmental Information Regulations 2004.

I enclose Product 4 data. Please refer to Open Government Licence which explains the permitted use of this information.

Regarding your planing advice query, the information provided in the attached CCN, including level data, should be enough for you to do a technical assessment within your FRA without the need to do a detailed modelling study. The levels provided along with an analysis of LiDAR should be sufficient and assessment of flood risk at the site.

The site is not affected by our tidal Hazard Breach mapping in either our modelled present day or climate change scenarios, however it is still at risk of tidal flooding without defences in place. The site is at risk of fluvial flooding from the South Forty Foot Drain and a “extents with defences” map has been included in the attached data.

The SE Lincs Standing Advice for this type of development is:

The application must be referred to the Environment Agency together with a supporting Flood Risk Assessment, which demonstrates that the proposal will remain operational during a 0.1% event (2115 scenario) and that appropriate mitigation measures/flood resilient construction techniques have been incorporated into the development.

Please be aware that any work/structure within 8m of a main river defence may require a flood risk permit from ourselves. For more information about permits please take a look at the following website:

https://www.gov.uk/guidance/flood-risk-activities-environmental-permits

Please contact us at the PSOLINCS@environment-agency.gov.uk address if you require more information regarding permitting.

Please get in touch if you have any further queries or contact us within two months if you’d like us to review the information we have sent.

Kind regards,

Emma Haines
Partnerships and Strategic Overview Officer
Lincolnshire and Northamptonshire Area
Environment Agency

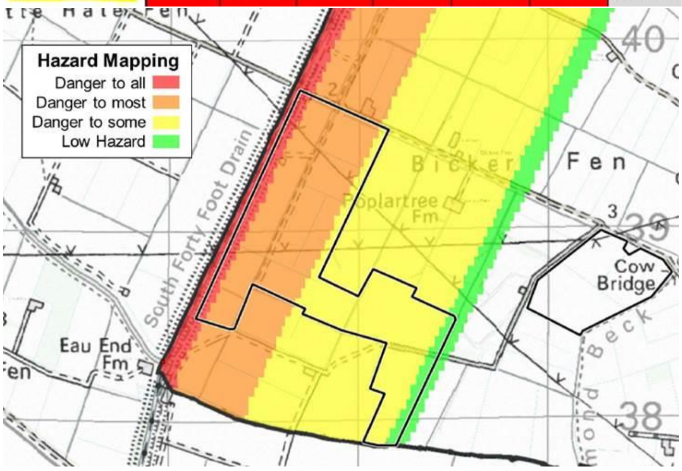
From: Lee Ruddick [mailto:lee.ruddick@kayaconsulting.co.uk]
Sent: 21 December 2020 12:54
To: Enquiries, Unit <enquiries@environment-agency.gov.uk>
Subject: 201223/DM28 Flood info request for site near Boston, Lincolnshire

Dear Sir/Madam,

I am currently writing a Flood Risk Assessment for a solar farm development near Boston, Lincolnshire and would like to request '**Product 4'** regarding flood information at the development site please - **The coordinates of the site are: 518672, 338734**

Additionally, the South East Lincolnshire Local Plan (2011-36) states that planning applications are to be supported by the identification of the breach/overtopping levels of flood defences and details of mitigation measures if flood defences fail. The South East Lincolnshire Strategic Flood Risk Assessment (SFRA) states that hazard maps should be used for this and the Standing Advice Matrix below present in the document informs that the EA must be consulted regarding hazards for essential infrastructure. Could you please confirm the level of detail the EA would deem appropriate for a breach analysis for essential infrastructure development? – Would a detailed modelling study be required or would the hazard map presented in the SE Lincolnshire SFRA be appropriate?

Please refer to the National Planning Practice Guidance (Table 3) for advice on when the Sequential and Exception Tests are applicable	[illegible]	Danger to ALL (Hazard Rating >2)	Danger to MOST (Hazard Rating 1.25 - 2)	Danger to SOME (Hazard Rating 0.75 - 1.25)	Low Hazard (Hazard Rating 0 - 0.75)	Flood Zone 3	Flood Zone 2
Water Compatible (excluding development that includes essential ancillary sleeping or residential accommodation)	Consult EA	Appropriate Mitigation	Appropriate Mitigation	Appropriate Mitigation	Appropriate Mitigation	No Comment	No Comment
Major & Non-major" 'Less Vulnerable' uses, e.g. commercial/industrial development	Consult EA	Consult EA	Appropriate Mitigation	Appropriate Mitigation	No Comment	No Comment	No Comment
Tidal Risk Scenario advice only. New short-let **Camping and Caravan Sites** (incl. log cabins & chalets) - subject to flood warning and evacuation plan	Consult EA	Appropriate Mitigation	Appropriate Mitigation	Appropriate Mitigation	Appropriate Mitigation	Appropriate Mitigation	Appropriate Mitigation
Fluvial Risk Scenario advice only. New short-let **Camping and Caravan Sites** (incl. log cabins & chalets) - subject to flood warning and evacuation plan	Consult EA	EA **OBJECTS** to the principle of development due to risk to life	EA **OBJECTS** to the principle of development due to risk to life	Appropriate Mitigation	Appropriate Mitigation	Appropriate Mitigation	Appropriate Mitigation
Change of Use - Less Vulnerable to More Vulnerable or within More Vulnerable category, involving increase in risk to people - *please see note for other categories & exclusions*	Consult EA	Consult EA	Consult EA	Appropriate mitigation	Appropriate mitigation	No Comment	No Comment
Non-major" 'More Vulnerable' uses, including residential development & residential holiday accom. (less than 10 dwellings/units or less than 0.5ha in size), *except short-let caravan sites - see A5 & A6 above*	Consult EA	Consult EA	Appropriate Mitigation	Appropriate Mitigation	Appropriate Mitigation	No Comment	No Comment
Major" 'More Vulnerable' uses including residential development & residential holiday accom (not including camping/caravan sites) - greater than 10 dwellings/units or 0.5ha in size	Consult EA	Consult EA	Consult EA	Consult EA	Consult EA	Consult EA	No Comment
Essential Infrastructure	Consult EA	Consult EA	Consult EA	Consult EA	Consult EA	Consult EA	No Comment



Kind regards,
Lee Ruddick

SENT (to mailto:FloodRisk@lincolnshire.gov.uk)
21 December 2020 13:53

Dear Sir/Madam,

I am currently writing a Flood Risk Assessment for a solar farm development near Poplartree Farm and would like to request any information regarding flood information at the development site you may have please - **The coordinates of the site are: 518672, 338734**

The South East Lincolnshire Local Plan (2011-36) states that planning applications are to be supported by the identification of the breach/overtopping levels of flood defences and details of mitigation measures if flood defences fail. The South East Lincolnshire Strategic Flood Risk Assessment (SFRA) states that hazard maps should be used for this and the Standing Advice Matrix below present in the document informs that the EA must be consulted regarding hazards for essential infrastructure. I have contacted the EA but could you please comment on the level of detail Lincolnshire County Council would deem appropriate for a breach analysis for essential infrastructure development? – Would a detailed modelling study be required or would the hazard map presented in the SE Lincolnshire SFRA be appropriate?

RESPONSE:
Mon 18/01/2021 09:41

Good morning Lee.
This is something upon which we would leave to the Environment Agency to provide expert advice to the Local Planning Authority.
Regards,
Jon.

Lincolnshire COUNTY COUNCIL
Working for a better future
HIGHWAYS MANAGEMENT ACHIEVEMENT AWARDS 2019 WINNER MJ
www.lincolnshire.gov.uk

Jon Sharpe
Principal Development Management Officer
Place Directorate

01522 5(55749)
Lancaster House | 36 Orchard Street | Lincoln | LN1 1XX