



RSK ADAS

Worlds End Farm, Worlds End Lane, Berkeley

**Flood Risk Assessment & Outline Surface Water Drainage
Strategy**

881946-R1(05)-FRA



APRIL 2021

RSK



RSK GENERAL NOTES

Project No.: 881946-R1(05)-FRA

Site: Worlds End Farm, Worlds End Lane, Berkeley

Title: Flood Risk Assessment & Outline Surface Water Drainage Strategy

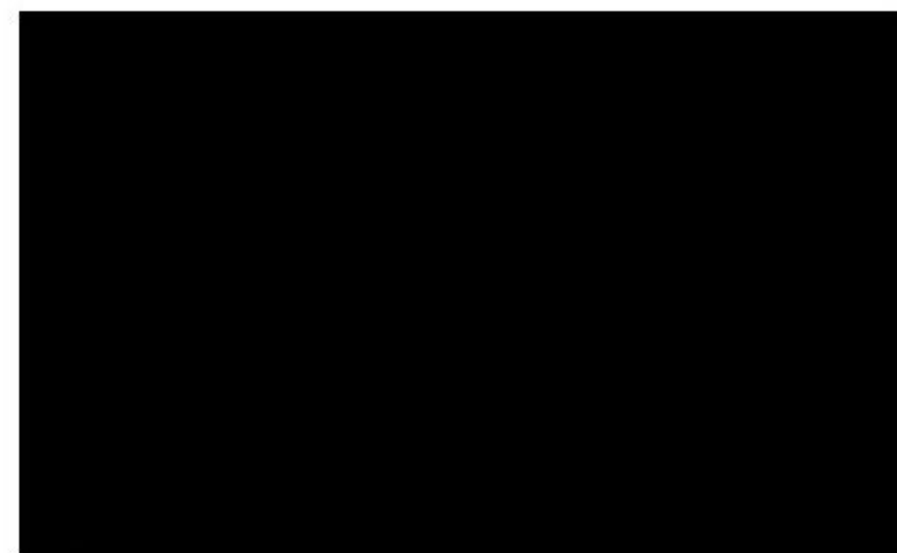
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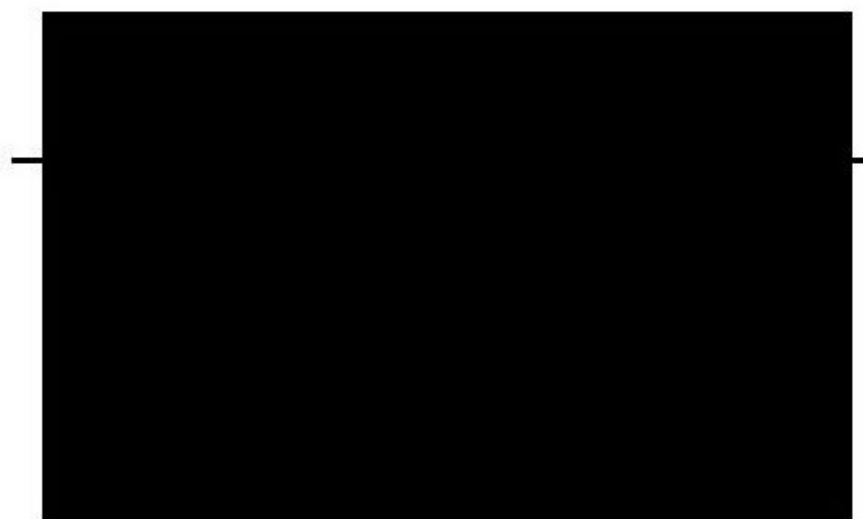
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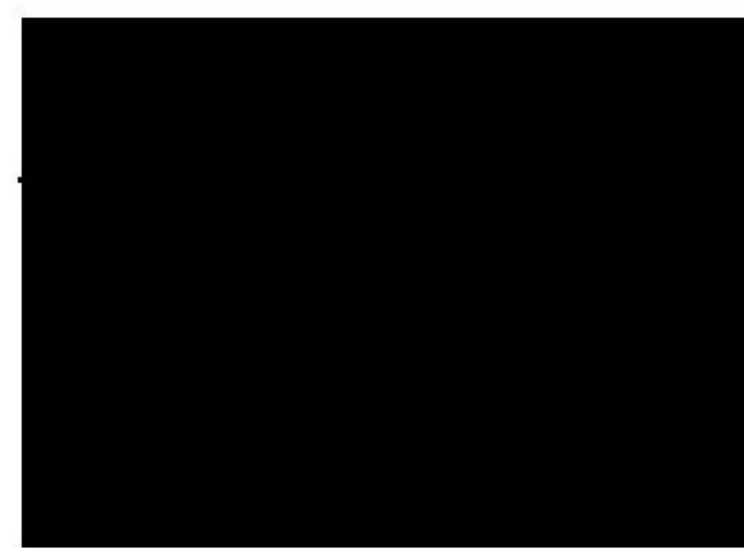
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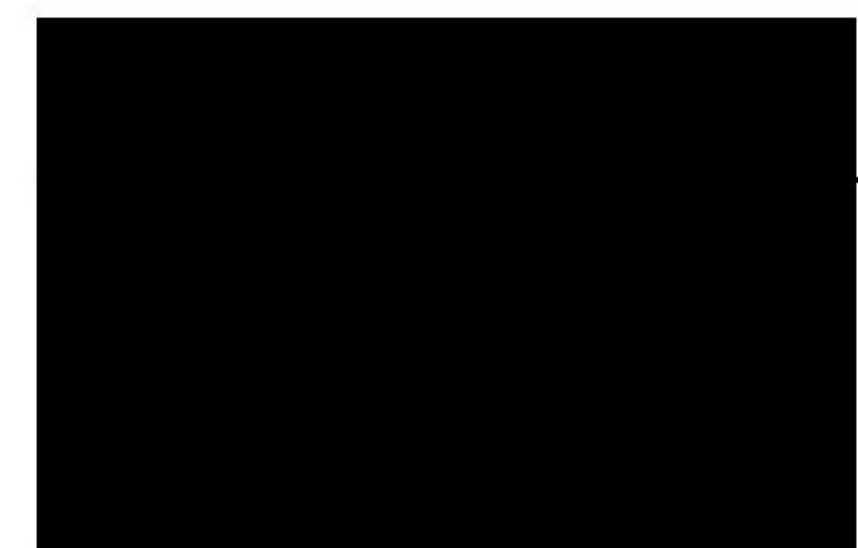
Project manager



Signature

Date: April 2021

Project Director



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Date: April 2021

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Where field investigations have been carried out, these have been restricted to a level of detail required to achieve the stated objectives of the work.

This work has been undertaken in accordance with the quality management system of RSK LDE Ltd.

RSK ADAS

Worlds End Farm, Worlds End Lane, Berkeley

Flood Risk Assessment & Outline Surface Water Drainage Strategy

881946-R1(05)-FRA

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1 INTRODUCTION

1.1 Context

RSK Land and Development Engineering Ltd (RSK) was commissioned to carry out a Flood Risk Assessment (FRA) for RSK ADAS (the 'client'). The assessment is in support of the detailed planning submission for the proposed solar farm at the land off Worlds End Farm, Worlds End Lane, Berkeley (the 'site').

The assessment has been prepared in accordance with the National Planning Policy Framework (NPPF)¹ and its accompanying Planning Practice Guidance², the Interim Code of Practice for Sustainable Drainage³, BS 8533-2011 Assessing and Managing Flood Risk in Development Code of Practice⁴, BS 8582:2013 Code of practice for surface water management for development sites⁵ and the Non-statutory technical standards for sustainable drainage systems⁶, with site-specific advice from the Environment Agency (EA), the Lead Local Flood Authority (LLFA), the Local Planning Authority (LPA), the architect and the client.

The NPPF sets out the criteria for development and flood risk by stating that inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere.

The key definitions within the PPG are:

- "Flood risk" is a combination of the probability and the potential consequences of flooding from all sources – including from rivers and the sea, directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources; and,
- "Areas at risk of flooding" means areas at risk from all sources of flooding. For fluvial (river) and sea flooding, this is principally land within Flood Zones 2 and 3. It can also include an area within Flood Zone 1 which the EA has notified the local planning authority as having critical drainage problems.

For this site, the key aspects that require the assessment are:

- The EA's indicative flood zone map shows that the site is located within Flood Zone 3 (shown in Figure 1.1); and,
- The site area is 64.62Ha therefore surface water drainage must be considered, and sustainable drainage systems (SuDS) incorporated, where possible.

¹ Communities and Local Government, 'National Planning Policy Framework', February 2019.

² Communities and Local Government, 'Planning Practice Guidance - Flood Risk and Coastal Change, ID 7', March 2014.
<http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/>

³ DEFRA, 'Interim Code of Practice for Sustainable Drainage Systems' National SUDS Working Group, July 2004.

⁴ BSI, 'BS 8533-2011 Assessing and managing flood risk in development Code of practice', October 2011.

⁵ BSI, 'BS 8582:2013 Code of practice for surface water management for development sites', November 2013.

⁶ DEFRA, 'Sustainable Drainage Systems - Non-statutory technical standards for sustainable drainage systems', March 2015.

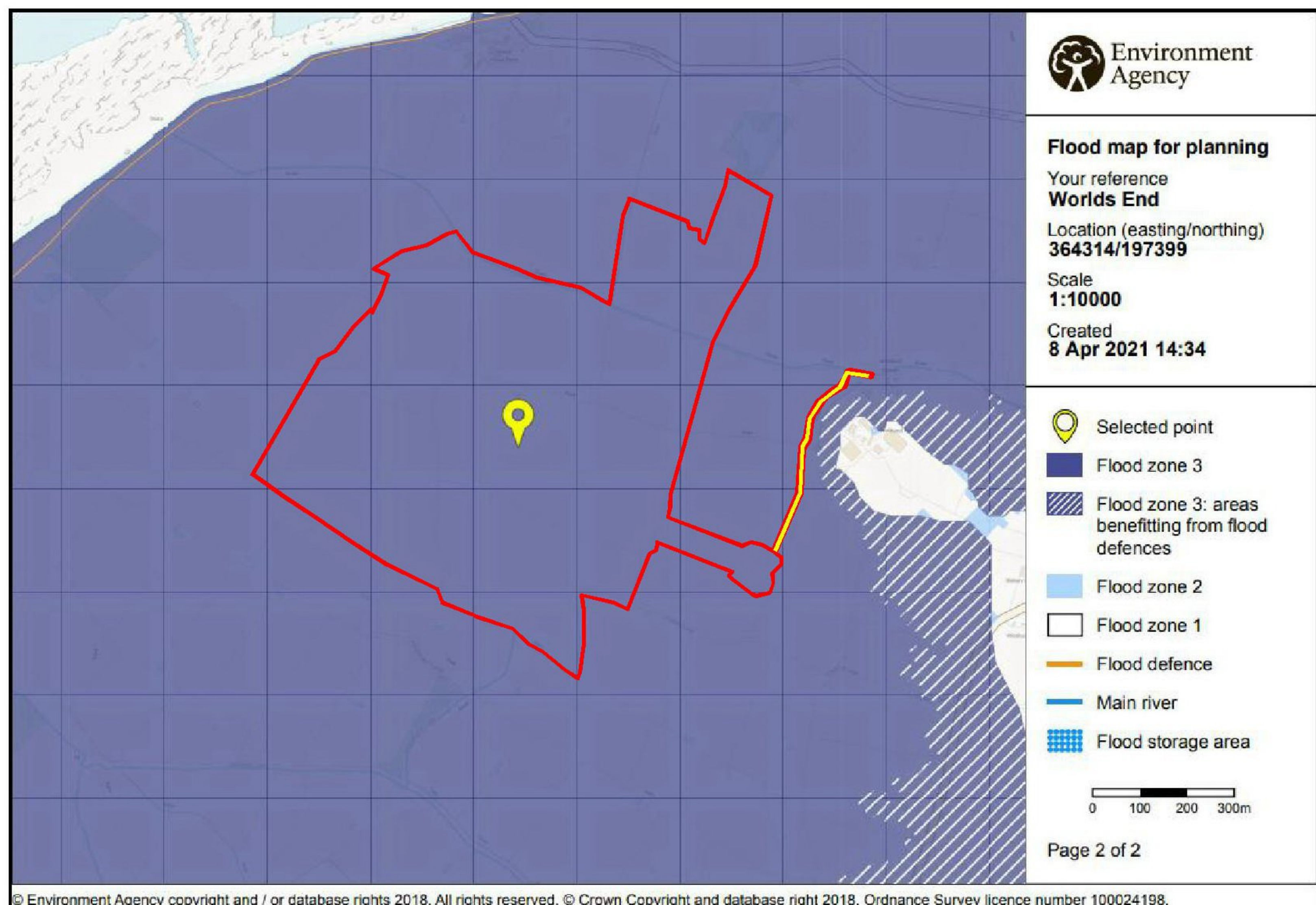


Figure 1.1: Environment Agency 'Flood map for planning' (accessed April 2021)

1.2 Scope of work

A key element of project development is to prepare a FRA to establish the flood risk associated with the proposed development and to propose suitable mitigation, if required, to reduce the risk to a more acceptable level.

The scope of work relating to a FRA is based on the guidance provided in Section 14 of the NPPF and its accompanying Planning Practice Guidance.

A site-specific FRA must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall. The scope of this assessment therefore comprises the following elements:

- To review architect plans, planning information and other studies to determine existing site conditions;
- To obtain information on the hydrology and hydrological regime in and around the site;
- To obtain the views of the EA/LLFA including scope, location and impacts;
- To determine the extent of new flooding provision and the influence on the site;
- To assess the impact on the site from climate change effects and anticipated increases in rainfall over a 25 year period for energy production uses;
- To review site surface water drainage based on the proposed layout and, if necessary, to determine the extent of infrastructure required; and
- To prepare a report including calculations and summaries of the source information and elements reviewed.



Reliance has been placed on factual and anecdotal data obtained from the sources identified. RSK cannot be held responsible for the scope of work, or any omissions, misrepresentation, errors or inaccuracies with the supplied information. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.

The comments given in this report and opinions expressed are subject to RSK Group Service Constraints provided in **Appendix A**.

2 SITE DESCRIPTION

2.1 Existing site

2.1.1 Location

Site Name and Address: Worlds End Farm, Worlds End Lane, Berkeley, Gloucestershire, GL13 9QX

Site National Grid Reference: (E) 364194; (N) 197469

The site is approximately 64.62Ha in size and is located to the west of Bevington, approximately 5.6km south-west of Berkeley. The site is comprised of a several agricultural fields. The site is located off Worlds End Lane and can be accessed via an access track to the east, off Worlds End Lane.

Table 2.1: Site setting

Direction	Characteristic
North	To the north are agricultural fields, with a pond directly adjacent to the north-eastern site boundary.
East	Directly to the east are agricultural fields, with Worlds End Farm beyond.
South	To the south are agricultural fields.
West	To the west are agricultural fields

Figure 2.1 shows a site location map.

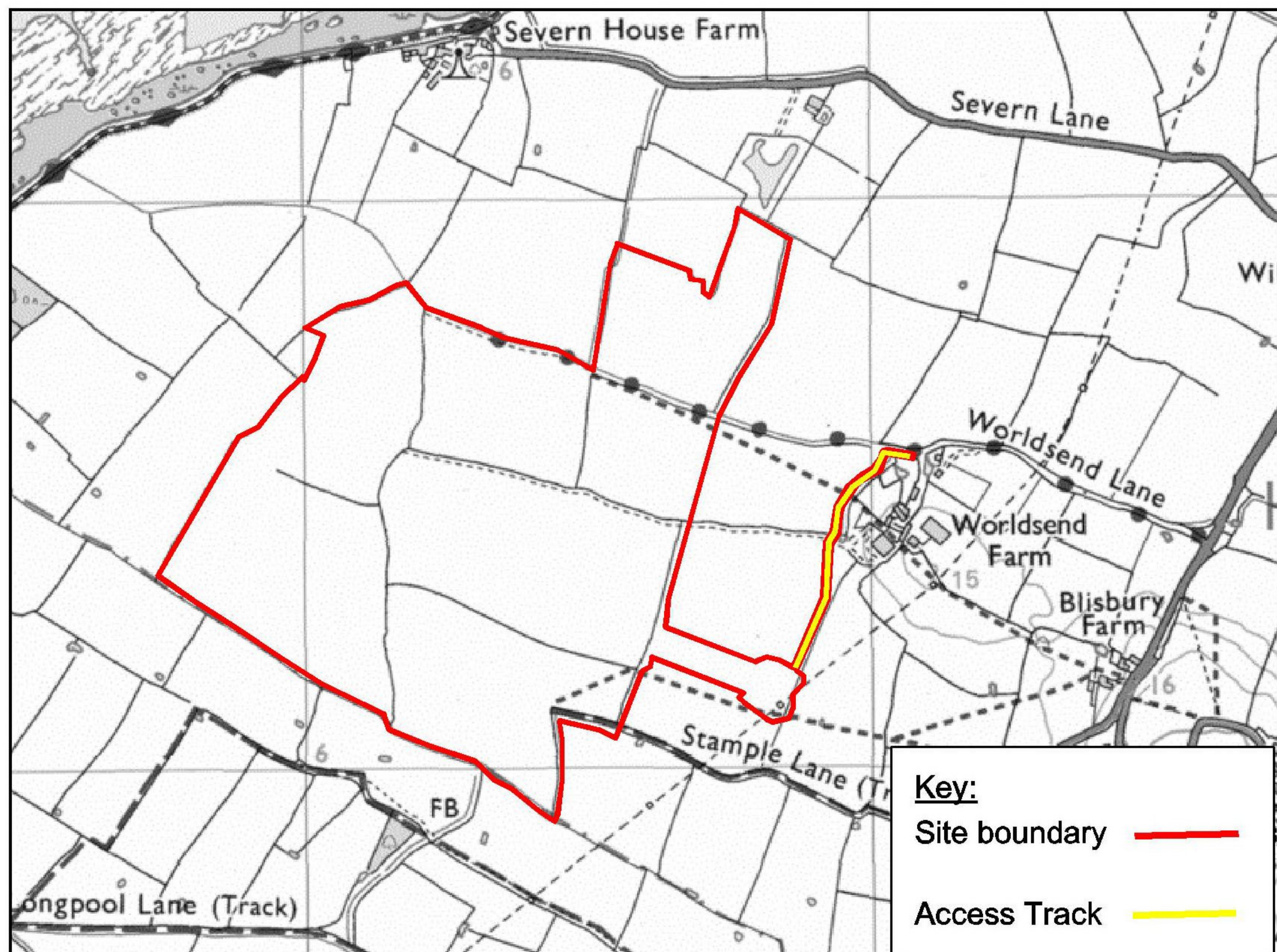


Figure 2.1: Site location map

2.1.2 Land use and topography

The existing site is currently comprised of several undeveloped agricultural fields, and therefore the site can be described as being Greenfield.

The approximate land use of the site is as follows:

Table 2.2: Existing site land uses

Land use	Area (Ha)	Percentage (%)
Impermeable	0.0	0
Permeable	64.62	100
Total	64.62	100

A site-specific topographic survey has been undertaken for the site. The survey shows the whole of the site to be relatively flat, with levels ranging from approximately 6.00mAOD (Above Ordnance Datum) to approximately 6.70mAOD.

The full topographic survey is in **Appendix B**.

2.1.3 Hydrology

An 'Ordinary watercourse' crosses the site within the northern extent, conveying flow in a westerly direction for approximately 1.0km and discharging into the River Severn estuary. The watercourse has an on-site culvert crossing.

Off-site, adjacent to the south-east site boundary a second 'Ordinary watercourse' conveys flow south for approximately 0.7km and then north-west for approximately 1.5km to discharge into the River Severn estuary.

There are field boundary ditches on-site located between each of the fields, which convey flow into the two 'ordinary watercourses' that both eventually discharge into the River Severn.

A pond is located off-site to the north, adjacent to the northern site boundary.

2.1.4 Geology

2.1.4.1 Desk Study

According to British Geological Surveying mapping, the underlying geology on the site can be described as the following:

- Superficial Geology:
 - Tidal Flat Deposits - Clay and Silt. Superficial Deposits formed up to 2 million years ago in the Quaternary Period. Local environment previously dominated by shorelines (U).
- Bedrock Geology:
 - Mercia Mudstone Group - Mudstone. Sedimentary Bedrock formed approximately 201 to 252 million years ago in the Triassic Period. Local environment previously dominated by hot deserts.

BGS Borehole data records were searched for nearby borehole logs that may give relevant information regarding the on-site geology. There were no records found within close proximity to the site.

2.1.5 Hydrogeology

Hydrogeological information was obtained from the online Magic Maps service. The site is underlain with bedrock geology designated as 'Secondary B', described as predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers. The site is underlain with superficial deposits designated as 'Unproductive' strata, described as geological strata with low permeability that have negligible significance for water supply or river base flow.

The site is not located within a Groundwater Source Protection Zone (SPZ). The nearest Groundwater SPZ is a Zone II - Subsurface Activity located approximately 8.4km east of the site.

2.2 Development proposals

The proposed development is for energy end use. The development consists of a 49.99 MV Solar PV array, comprising ground mounted solar PV panels, vehicular access from Worlds End Lane with internal access tracks, landscaping and associated infrastructure including security fencing, CCTV cameras, and grid connection infrastructure including inverter and substation buildings.

The approximate land uses of the proposed site are summarised in Table 2.3 below.

Table 2.3: Proposed site land uses

Land use	Area (m ²)	Percentage
Impermeable	0.54	1%
Permeable	64.08	99%
Total	64.62	100%

3 LEGISLATION, POLICY AND GUIDANCE

3.1 National policy

Table 3.1: National legislation and policy context

Legislation	Key provisions
National Planning Policy Framework (2019)	<p>The aims of planning policy on development and flood risk are to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk.</p> <p>Where new development is, exceptionally, necessary in such areas, policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall.</p>
Planning Practice Guidance (2014)	<p>The NPPF is supported by an online Planning Practice Guidance, which provide additional guidance on flood risk.</p>
Flood and Water Management Act 2010 ⁷	<p>The Flood and Water Management Act (FWMA) aims to implement the findings of the 2007 Pitt Review and co-ordinate control of drainage and flood issues.</p> <p>There are a number of increased responsibilities within the Act that affect adoption of SuDS features and the role of the EA to expand on the mapping data they provide. The implementation of SuDS features has many beneficial impacts on the treatment of surface water during remediation works.</p>
Water Resources Act 1991 ⁸	<p>Section 24 – The EA is empowered under this Act to maintain and improve the quality of ‘controlled’ waters</p> <p>Section 85 – It is an offence to cause or knowingly permit pollution of controlled waters</p> <p>Section 88 – Discharge consents are required for discharges to controlled waters</p>
Water Framework Directive (2000) ⁹	<p>The Water Framework Directive (WFD) requires all inland and coastal waters to reach ‘good’ chemical and biological status by 2015. Flood risk management is unlikely to have a significant impact on chemical water quality except where maintenance works disturb sediment (such as de-silting) or where pollutants are mobilised from contaminated land by floodwaters.</p> <p>The main impact of the WFD on flood risk management, both now and in the future, relates to the ecological quality of water bodies. Channel works, such as straightening and deepening, or flood risk management schemes that modify geomorphological processes can change river morphology. The WFD aims to protect conservation sites identified by the EC Habitats Directive and</p>

⁷ Flood and Water Management Act, 2010

⁸ Water Resources Act, 1991

⁹ EU Water Framework Directive, 2000

Legislation	Key provisions
	Birds Directive that have water-related features, by designating them as 'protected sites'.

3.2 Local policy

Table 3.2: Local policy legislation and policy context

Legislation	Key provisions
Stroud District Local Plan Review Draft Plan for Consultation 2019 ¹⁰	<p>'Delivery Policy ES4 Water resources, quality and flood risk</p> <p>The Strategic Flood Risk Assessments (SFRA 1 and 2) will be used to inform the location of future development within the District, including to take account of climate change.</p> <p>In considering proposals for development the District Council will weigh up all of the relevant policy issues when giving full consideration to the sequential test and implementing the "Exception Test" where necessary. Applications will be supported by Flood Risk Assessments (FRA) where appropriate that demonstrate the development will be safe, not increase flood risk elsewhere, and maximise opportunities to reduce flood risk (including Natural Flood Management).</p> <p>All new developments shall incorporate appropriate Sustainable Drainage Measures (SuDs) in accordance with National Standards for Sustainable Drainage Systems. This should be informed by specific catchment and ground characteristics, and will require the early consideration of a wide range of issues relating to the management, long term adoption and maintenance of SuDs.</p> <p>For all developments in areas with known surface water flooding issues, appropriate mitigation and construction methods will be required including, where appropriate, contributions towards upstream rural SuDS projects.</p> <p>Applications and proposals which relate specifically to reducing the risk of flooding (e.g. defence / alleviation work, retro-fitting of existing development, off site detention / retention basins for catchment wide interventions) will be sought.</p> <p>New development in areas with known ground and surface water flooding issues will seek to provide betterment in flood storage and to remove obstructions to flood flow routes where appropriate. Development will:</p> <ol style="list-style-type: none"> 1. Conserve and enhance the ecological flood storage value of the water environment, including watercourse corridors and catchments 2. Open up any culverted watercourse where safe and practicable to create an asset of community value 3. Improve water efficiency through incorporating appropriate water conservation techniques including rainwater harvesting and grey water recycling

¹⁰ Stroud District Local Plan Review Draft Plan for Consultation, Stroud District Council, November 2019

Legislation	Key provisions
	<ol style="list-style-type: none"> 4. Discharge surface run-off, not collected for use, to one or more of the following, listed in order of priority: <ol style="list-style-type: none"> a. discharge into the ground (infiltration); or, where not reasonably practicable b. discharge into a surface water body; or, where not reasonably practicable c. discharge to a surface water sewer, highway drain, or other drainage system; or, where not reasonably practicable d. discharge to a combined sewer 5. Connect to the main foul sewer network where possible 6. Consider the cumulative impact of adjacent development(s) in devising an appropriate drainage strategy.'

3.3 Area guidance

Table 3.3: Area Guidance

Study	Overview of key provisions and policies
<p>SFRA:</p> <p>Stroud District Council Strategic Flood Risk Assessment Level 1 2008¹¹</p>	<p>The principle aim of the SFRA was to map all forms of flood risk in order to provide an evidence base to locate new development. It also aims to provide appropriate policies for the management of flood risk and identify the level of detail required for site-specific FRAs. The SFRA contains information and maps detailing flood sources and risks. Information relevant to the site is detailed in Section 4 of this report.</p> <p>In 1981 severe flooding occurred along the Severn Estuary as a result of high tides coinciding with heavy rainfall and a high surge, with the worst affected areas at Avonmouth and Severnside (outside of the District). Further flooding was experienced along the estuary in November and December 2000, affecting mainly rural floodplain within the District. This flooding occurred primarily as a result of significant rainfall in the Severn catchment.</p> <p>On 20th July 2007 over 3 inches of rain fell in just 12 hours over much of south and south west England. Resultant severe flooding was experienced across Gloucestershire. Up to 10,000 people were left stranded on the M5 as drivers were forced to abandon cars, and 500 people were stranded at Gloucester railway station as the railway network failed.</p> <p>DG5 data received from Severn Trent Water and Wessex Water did not include the postcode of the site to be noted as one of the postcodes with the highest level of risk from artificial drainage systems, whilst in general within the district there is a low-medium level of risk from this source.</p>

¹¹ Stroud District Council Strategic Flood Risk Assessment for Local Development Framework Level 1 Volume 1 - FINAL, Halcrow Group Limited, September 2008

Study	Overview of key provisions and policies
	<p>Consultation with the District Council has indicated that there are known groundwater issues within the District, however the areas at risk from groundwater flooding are largely unknown.</p> <p>There is currently no dataset depicting predicted surface water flood risk areas, and time restraints have precluded surface water flood risk mapping for Gloucestershire as part of the SFRA.</p>
<p>PFRA: Gloucestershire County Council Preliminary Flood Risk Assessment 2011¹²</p>	<p>Preliminary Flood Risk Assessments (PFRAs) are produced by Lead Local Flood Authorities (LLFAs) in England and Wales. A Preliminary Flood Risk Assessment (PFRA) is the first part of the planning cycle for flood risk management as set out in the Flood Risk Regulations (2009), which implement the requirements of the European (EU) Floods Directive (2007). The EU Floods Directive aims to provide a consistent approach to managing flooding across Europe.</p> <p>The PFRA is organised and produced by the LLFA (in this case Gloucestershire County Council). The PFRA considers local sources of flooding that the LLFA is responsible for: ordinary watercourses, surface water, groundwater and sewers where flooding is wholly or partially caused by rainwater or other precipitation entering or affecting the system. Information is gathered from existing sources on past floods and flood models to identify Flood Risk Areas.</p> <p>In Stroud District approximately 200 properties were flooded during the summer 2007 floods, the area of Berkeley was noted to have flooded during this time period.</p>

¹² Gloucestershire County Council Draft Preliminary Flood Risk Assessment, Gloucestershire County Council, March 2011

Study	Overview of key provisions and policies
CFMP: Severn Tidal Tributaries Catchment Flood Management Plan 2009 ¹³	<p>Catchment Flood Management Plans (CFMP) give an overview of the flood risk from inland sources across each river catchment and recommend ways of managing those risks now and over the next 50-100 years. The EA is responsible for producing CFMPs.</p> <p>The site falls within the 'Severn Vale' sub-catchment and the policy applicable to this site is Policy Option 3 which states "Areas of low to moderate flood risk where we are generally managing existing flood risk effectively".</p> <p>There is a relatively low level of fluvial flood risk, but tide-locking is a significant source of this flooding, for instance around Berkeley.</p> <p>There is an intended focus here on restoring sustainable natural storage of floodwater on undeveloped floodplains, in order to reduce dependence on raised flood defences and maintaining most of the existing flood defences at the current physical level.</p> <p>The CFMP provides the following key proposed actions:</p> <ul style="list-style-type: none"> • 'Make sure floodplains are not inappropriately developed. Follow the sequential approach of PPS 25; • Encourage rural best practices in land-use and in land-management to restore more sustainable natural floodplains and to reduce run-off, • Review how effective and sustainable each flood defence is. Review maintenance operations to ensure they are proportionate to flood risk, • Initiate a study to look at opportunities to remove some flood embankments and so increase the connection of the floodplain with the rivers where it reduces overall flood risk, and; • Support ecological improvements. Investigate the feasibility of improving its condition and increasing its size by reconnecting the river to the floodplain.'

3.4 Site-specific consultation

As part of this assessment, the following authorities have been contacted to obtain relevant data/guidance and establish key site constraints:

Table 3.4: Key site-specific consultations

Consultee	Date issued	Enquiry	Appendix
Lead Local Flood Authority (LLFA) – Gloucestershire County Council	November 2019	Pre-application enquiry	Appendix C

¹³ Severn Tidal Tributaries Catchment Flood Management Plan: Summary Report, Environmental Agency, December 2009

Consultee	Date issued	Enquiry	Appendix
Environment Agency (EA)	November 2019	Product data Pre-application enquiry	Appendix D
Lower Severn Internal Drainage Board	November 2019	Pre-application enquiry	No response to date

Key findings are referred to in the relevant part of Section 4 and full details are contained in the relevant appendices.

4 SOURCES OF FLOOD RISK

4.1 Criteria

In accordance with the NPPF¹ and advice from the EA, a prediction of the flood sources and levels is required along with the effects of climate change from the present for the design life of the development (in this case assumed to be 25 years).

Changes to climate change guidance in February 2016 indicate that increased allowances in peak river flow and rainfall intensity should now be incorporated within any assessment. The appropriate allowance for peak river flow is based on the site's location in the country, the lifetime of development, the relevant flood zone and the vulnerability of the proposed end use.

The flood risk elements that need to be considered for any site are defined in BS 8533 as the "Forms of Flooding" and are listed as:

- Flooding from rivers (fluvial flood risk);
- Flooding from the sea (tidal flood risk);
- Flooding from the land;
- Flooding from groundwater;
- Flooding from sewers (sewer and drain exceedance, pumping station failure etc); and
- Flooding from reservoirs, canals and other artificial structures.

The following section reviews each of these in respect of the subject site.

4.2 Flooding from rivers (fluvial flood risk)

4.2.1 Main river

The EA Flood Zone mapping study for England and Wales is available on their website at: <https://flood-map-for-planning.service.gov.uk>.

The latest Environment Agency published flood zone map (Figure 4.1), taking into account the presence of flood defences, shows the site to be located in Flood Zone 3 (representing a 1 in 100 or greater annual probability of river flooding).

In December 2013, the EA released an additional form of mapping 'Risk of Flooding from Rivers and Sea', which is available at:

<https://flood-warning-information.service.gov.uk/long-term-flood-risk>

The latest 'Risk of Flooding from Rivers and Sea' flood map (Figure 4.2), which shows the Environment Agency's assessment of the likelihood of flooding from rivers and the sea at any location and is based on the presence and effect of all flood defences,

predicted flood levels, and ground levels, indicates that the site is considered to be at **'medium-high'** risk of flooding.

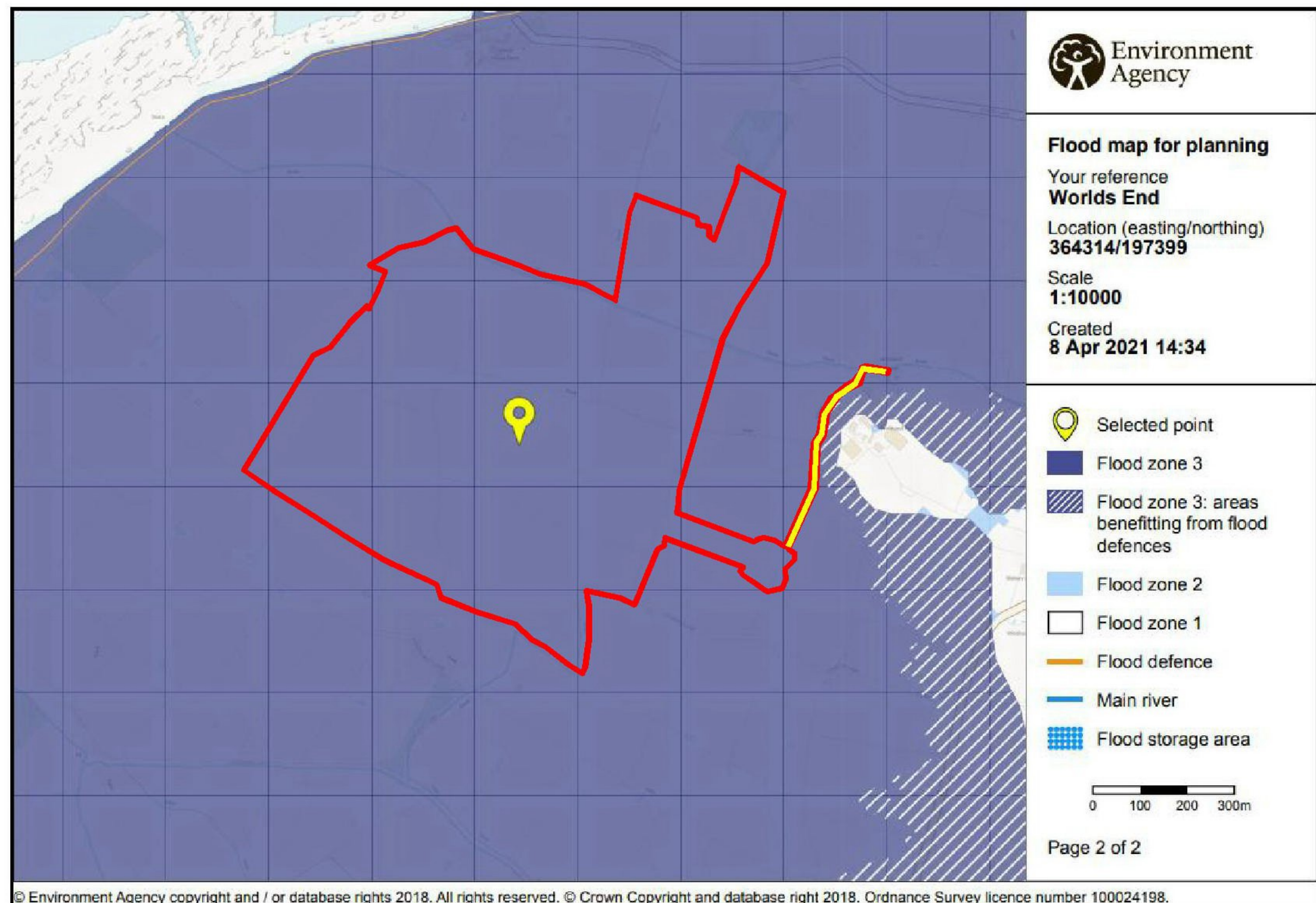


Figure 4.1: Environment Agency 'Flood map for planning' (accessed April 2021)

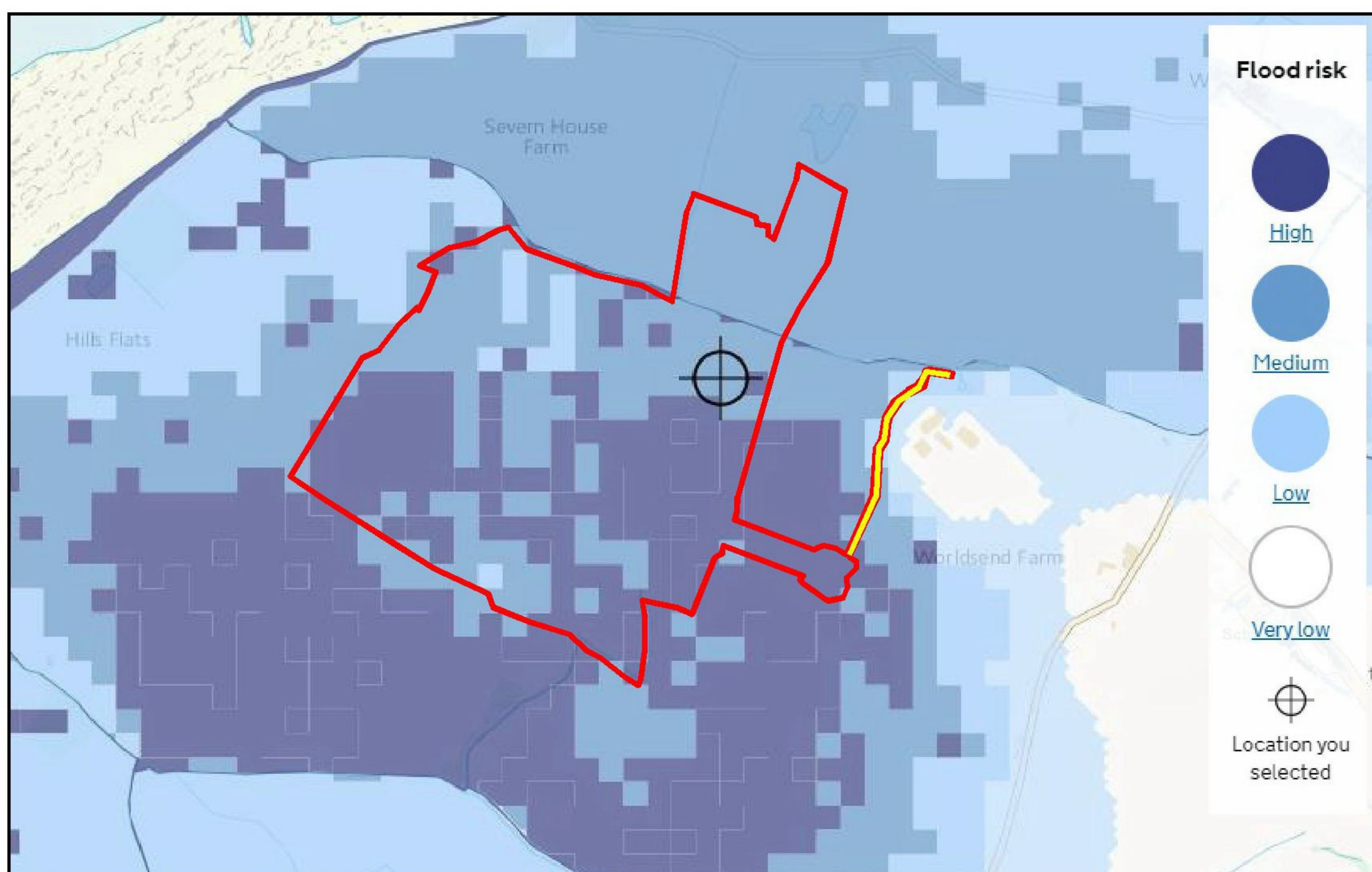


Figure 4.2: Environment Agency 'Flood risk from rivers or the sea' map (accessed April 2021)

The Environment Agency has stated, within **Appendix D**, that they do not hold any data from fluvial events, it is therefore assumed that tidal flooding is the principal source of flood risk at this site. a number of minor field drains are present on site, however the risk of flooding to the proposals from this source is considered to be low.

The resultant fluvial flood risk to the developable area is considered to be **low-medium**.

4.2.2 Climate change

Fluvial flooding is likely to increase as a result of climate change. A greater intensity and frequency of precipitation is likely to raise river levels and increase the likelihood of a river overtopping its banks. Climate change guidance for river modelling was updated by the EA in February 2016. No model re-runs have been undertaken as part of this site-specific FRA, and the supplied EA data therefore represents the best available and up-to-date data when considering the flood risk to the site. The impact upon the developable area of the site is significant given its location within Flood Zone 3.

4.3 Flooding from the sea (tidal flood risk)

The site is considered to be at risk from tidal flooding due to its coastal location and its lower elevated position (approximately 6.00mAOD), indicating a 'high' risk of flooding.

The site is considered to be at risk of flooding from tidal sources from the River Severn Estuary. Tidal levels have been supplied by the Environment Agency within the vicinity of the site (**Appendix D**) based on tidal model analysis undertaken in 2012.

The tidal analysis is contained within **Table 4.1**.

Table 4.1: Defended Tidal Level – Wessex North Coast Model 2012

AEP	Maximum Depth (metres)	Maximum Level (mAOD)
0.5%	2.16	7.00

The site is at risk of tidal flooding from a modelled defended 1 in 200 year return period flood event of which the maximum level is 7.00mAOD, with the minimum on-site ground level being approximately 6.00mAOD, according to the topographic survey.

In terms of a breached scenario, the flood depths on-site would largely be between 0.5-1.0m, reaching >2.0m within the field boundary ditches. The assets closest to the site (39 and 40) are coastal embankments, as shown within Environment Agency flood mapping in **Appendix D**.

The SFRA states that in 1981 severe flooding occurred along the Severn Estuary as a result of high tides coinciding with heavy rainfall and a high surge. The site was not specifically mentioned as one of the areas affected by the flooding.

4.3.1 Climate change

Climate change is considered to result in an increased risk of tidal flooding to the site. It has been calculated using the Environment Agency's sea level allowances¹⁴ that for a 30 year lifespan of the development (starting in 2022), for a defended 1 in 200 year return period plus climate change the maximum flood level on-site will reach 7.36mAOD. In addition, for a 40 year lifespan of the development (starting in 2022), for a defended 1 in 200 year return period plus climate change the maximum flood level on-site will reach 7.47mAOD. These values have been calculated by adding the climate change allowances to the 7.00mAOD flood level, from the 2012 from the Wessex North Coast Model.

If sensitive electrical equipment is raised 600mm above the maximum level, the development will not be at risk from a 1 in 200 year plus climate change flood event for either lifespan.

4.4 Flooding from the land (overland pluvial flood risk)

If intense rain is unable to soak into the ground or be carried through manmade drainage systems, for a variety of reasons, it can run off over the surface causing localised floods before reaching a river or other watercourse.

Generally, where there is impermeable surfacing or where the ground infiltration capacity is exceeded, surface water runoff can occur. Excess surface water flows from the site are believed to drain naturally to the local water features, either by overland flow or through infiltration.

The EA's surface water flood map (Figure 4.4) shows multiple surface water flow paths of very low-medium flood risk following the on-site field boundaries. There are small localised areas of ponding on-site, being mainly of low flood risk, with a singular ponded area of high risk being located to the south-west of the site.

¹⁴Environment Agency, 'Table 3: sea level allowance for each epoch in millimetres (mm) per year, with total sea level rise for each epoch in brackets (use 1981 to 2000 baseline) by river basin district', December 2019. <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#table-3>

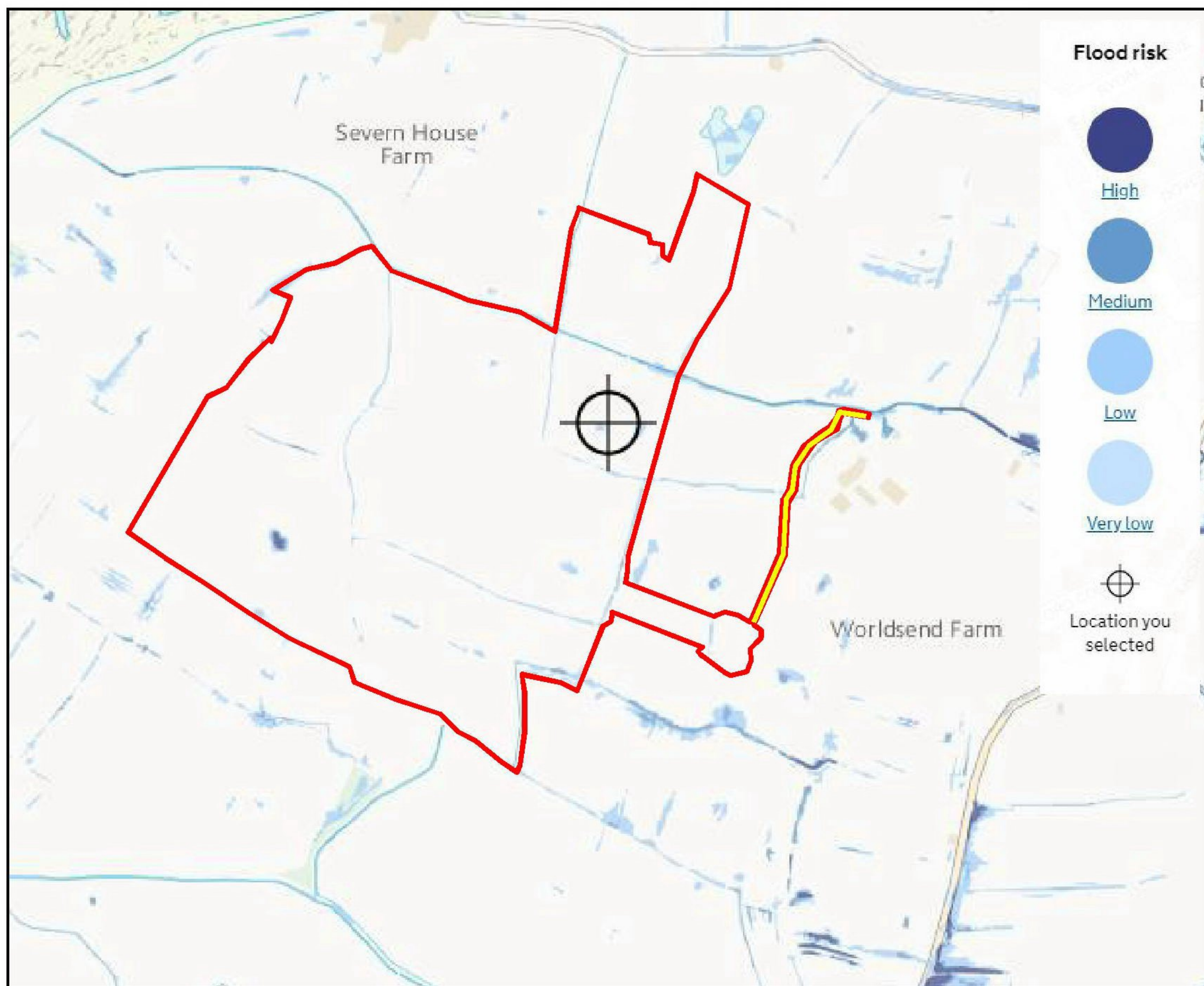


Figure 4.4: Environment Agency ‘Flood risk from surface water’ map (accessed April 2021)

The topographic survey shows that surface water runoff across the majority of the site will flow into the on-site field boundary drainage ditches.

Unmitigated, the proposed development is likely to generate significant quantities of on-site surface water runoff, which needs to be controlled to prevent surface water flooding elsewhere. The scheme will incorporate a suitable surface water drainage system for the development and will ensure that any runoff generated from the development will be controlled and managed in a suitable manner. This is discussed further in Section 7.

The risk of surface water flooding at the site is considered to be **low**.

4.4.1 Climate change

Surface water flooding is likely to increase as a result of climate change in a similar ratio to fluvial flooding. Increased intensity and frequency of precipitation is likely to lead to reduced infiltration and increased overland flow. Climate change guidance for rainfall intensity has recently been updated by the EA in late February 2016. Revised allowances for climate change have been included in the indicative drainage strategy (refer to Section 7).

4.5 Flooding from groundwater

Groundwater flooding tends to occur after much longer periods of sustained high rainfall. Higher rainfall means more water will infiltrate into the ground and cause the water table to rise above normal levels. Groundwater tends to flow from areas where the ground level is high, to areas where the ground level is low. In low-lying areas the water table is usually at shallower depths anyway, but during very wet periods, with all the additional groundwater flowing towards these areas, the water table can rise up to the surface causing groundwater flooding.

It is noted that within the data provided by Gloucestershire County Council (**Appendix C**), the site is in an area that scored 11 for vulnerability to groundwater flooding in the Gloucestershire Groundwater Management Plan which is classified as intermediate risk.

There were no British Geological Survey borehole records located within close proximity to the site which would indicate any risk of groundwater flooding.

From the above and due to the sporadic nature of groundwater flooding, the design of the development and the possibility of groundwater emergence at the site, it is unlikely that groundwater flooding would affect the development.

The resultant groundwater flood risk is considered to be **medium**.

4.5.1 Climate change

Climate change could increase the risk of groundwater flooding as a result of increased precipitation filtering into the groundwater body. If winter rainfall becomes more frequent and heavier, groundwater levels may increase. Higher winter recharge may however be balanced by lower recharge during the predicted hotter and drier summers. This is less likely to cause a significant change to flood risk than from other sources, since groundwater flow is not as confined. It is probable that any locally perched aquifers may be more affected, but these are likely to be isolated. The change in flood risk is likely to be low.

4.6 Flooding from sewers

Flooding from artificial drainage systems occurs when flow entering a system, such as an urban storm water drainage system, exceeds its conveyance capacity, the system becomes blocked or it cannot discharge due to a high water level in the receiving watercourse. A sewer flood is often caused by surface water drains discharging into the combined sewer systems; sewer capacity is exceeded in large rainfall events causing the backing up of floodwaters within properties or discharging through manholes.

Most adopted surface water drainage networks are designed to the criteria set out in Sewers for Adoption¹⁵. One of the design parameters is that sewer systems be designed such that no flooding of any part of the site occurs in a 1 in 30 year rainfall event. By definition a 1 in 100 year event would exceed the capacity of the surrounding sewer network as well as any proposed drainage.

When exceeded, the surcharged pipe work could lead to flooding from backed up manholes and gully connections. This could lead to immediate flooding within highways

¹⁵ WRC, 'Sewers for Adoption' 7th Edition, August 2012

surrounding the site. As described above, surface water would most likely follow the topography of the site and flow into the on-site field drainage ditches.

Sewer details have been referenced from sewer record plans obtained from Severn Trent Water (included in **Appendix E**). The plans indicate there to be no mapped sewers on-site, nor any surrounding the site.

According to Severn Trent Water public sewer records, there is an aqueduct that runs north-east to south-west, approximately 600m east of the site.

Development has the potential to cause an increase in impermeable area, an associated increase in surface water runoff rates and volumes, and a consequent potential increase in downstream flood risk due to overloading of sewers, watercourses, culverts and other drainage infrastructure.

To ensure that sewer and surface water flooding is not exacerbated; surface water must be considered within the design of the site. This ensures that any additional surface water and overland flows are managed correctly, to minimise flood risk to the site and the surrounding area. The proposed surface water network on the site should be designed to ensure exceedance of the network has been considered.

The resultant sewer flood risk is considered to be **very low**.

4.6.1 Climate change

The impact of climate change is likely to be negative regarding flooding from sewers. Increased rainfall and more frequent flooding put existing sewer and drainage systems under additional pressure resulting in the potential for more frequent surcharging and potential flooding. This would increase the frequency of local sewer flooding but would not impact the site.

4.7 Other sources of flooding

4.7.1 Reservoirs

Flood events can occur from a sudden release of large volumes of water from reservoirs, canals and artificial structures.

The EA reservoir flood map (reproduced as **Figure 4.5**) shows the largest area that might be flooded if a reservoir were to fail and release the water it holds. Since this is a prediction of a worst-case scenario, it is unlikely that any actual flood would be this large. According to the EA Reservoir flood maps the site is not at risk of flooding from reservoirs.

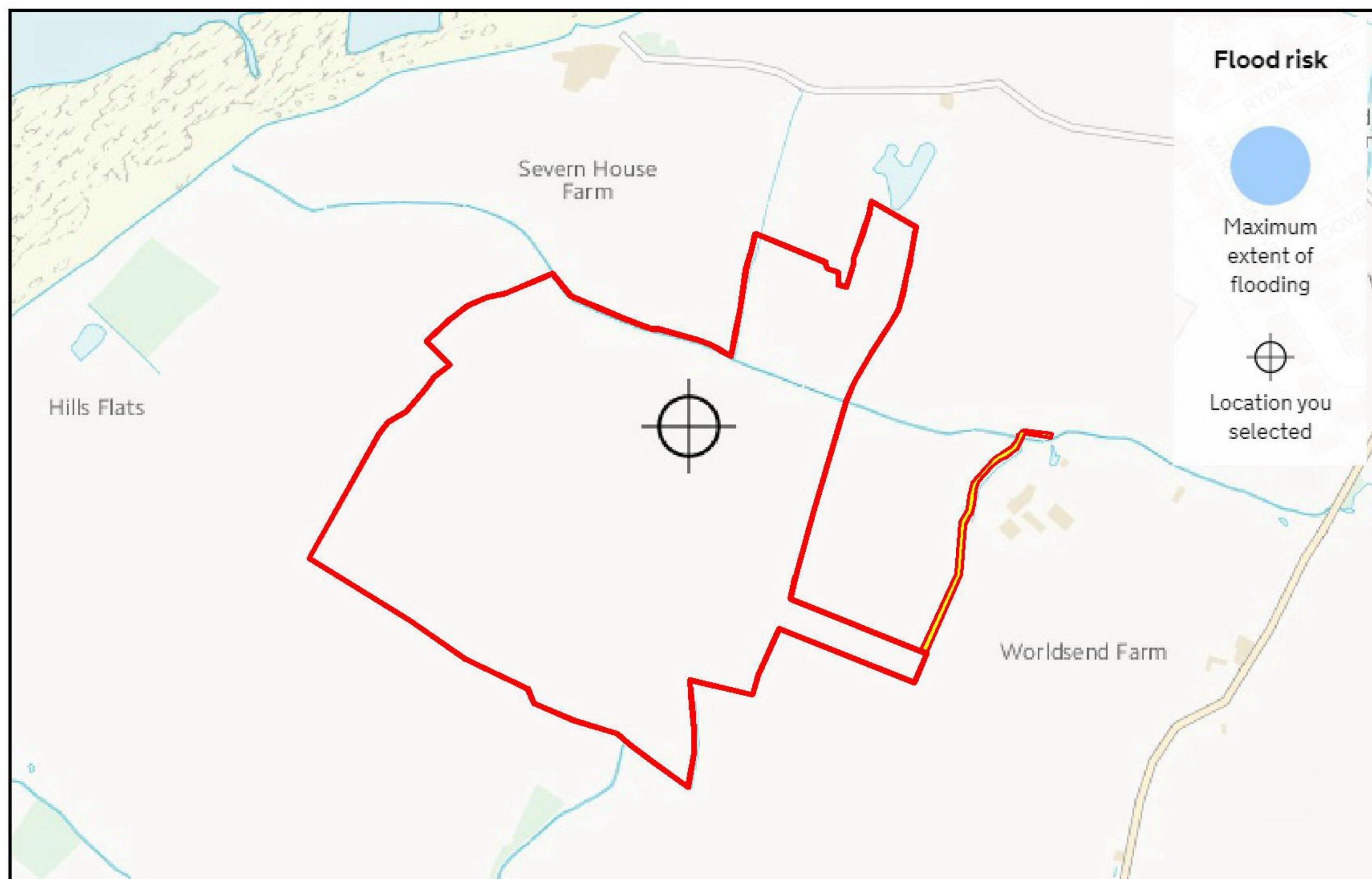


Figure 4.5: Environment Agency 'Flood risk from reservoirs' map (accessed April 2021)

Reservoir flooding is also extremely unlikely. There has been no loss of life in the UK from reservoir flooding since 1925. Since then reservoir safety legislation has been introduced to ensure reservoirs are maintained.

The resultant flood risk is considered to be **very low**.

Reservoirs can be managed over time, controlling inflow/outflow of water and therefore there is the capacity to control the effects of climate change. Increased rainfall has the potential to increase base flow, but this should be minimal. It is unlikely that there will be a substantial change to the risk of flooding for this site.

4.7.2 Canals

There are no Canal & Rivers Trust owned canals by the within the vicinity of the site. As a result, the risk to the site from this source is considered low.

4.7.3 Blockages of artificial drainage systems

There is a possibility that flooding may result due to culverts and/or sewers being blocked by debris or structural failure. This can cause water to backup and result in localised flooding, as well as placing areas with lower ground levels at risk.

There are multiple on-site field boundary drainage ditches across the site, of which there are several crossings between the fields that cut across these ditches. If these crossings are blocked, then flows will potentially back up within the surrounding fields on-site. However, if the crossings are kept clear and maintained, then blockages can be prevented, therefore blockages are not thought to pose a risk.

Within the SFRA, it states that DG5 data received from Severn Trent Water and Wessex Water did not include the postcode of the site to be noted as one of the postcodes with the highest level of risk from artificial drainage systems. In general, within the district there is a low-medium level of flood risk from this source, however this is not site specific.

The risk of flooding from artificial drainage systems is considered to be **low**.

Climate change is unlikely to affect the flooding risk to the site from such blockages.

5 FLOOD MITIGATION MEASURES

5.1 Overview

The site lies within Flood Zone 3. To facilitate the development of the site a surface water drainage network has been designed.

5.2 Overland flood flow

No further overland flow control measures are proposed as all surface water runoff up to the 1 in 100 year climate change storm will be stored on site and discharged via infiltration into the ground/ or to the nearby watercourses.

There are multiple surface water flow paths of very low-medium flood risk following the on-site field boundaries, of which originate on-site and thus surface water will be captured and conveyed within the existing field boundary ditches.

5.3 Finished floor levels

The developable area of the site will be within the areas on-site affected by tidal and pluvial flooding, and as such freeboard levels should be incorporated into the finished levels of the design.

It has been calculated that the level of the sensitive electrical equipment will need to be 600mm above the modelled defended 1 in 200 year return period flood event level, of which the maximum level is 7.00mAOD. As the minimum level on-site is approximately 6.00mAOD, levels will need to be raised by a minimum of 1.6m in these low-lying areas, so they are not at risk of flooding from a 1 in 200 year defended return flood period.

Alternatively, should it not be possible to raise the finished floor levels of the DNO substation to 7.60m AOD, then it may be possible to raise the sensitive internal electrical components so that they are above the 1 in 200 year flood level plus 600mm (7.60mAOD). In addition to this, any air vents or other water ingress points on the building should be above this flood level.

It is likely that it is unfeasible to raise the levels of the DNO substation by 1.6m, as such alternative methods of flood protection will be required (discussed in Section 5.4).

5.4 Flood resilience/resistance

If there is any vulnerable electrical equipment within the DNO substation that cannot be raised above the 1 in 200 year flood level plus 600mm (7.60mAOD) finished floor level, then demountable defences could be erected surrounding the building. Demountable defences are reliant on timely erection prior to the onset of flooding.

These defences shall be erected prior to a flood event and removed once the flood waters have resided.

5.5 Flood management

The Environment Agency provides a free flood warning service for many areas at risk of flooding from rivers and the sea. In some parts of England, the Environment Agency may be able to provide warnings when flooding is possible. The Environment Agency free flood warning service can provide advance notice of flooding and can provide time to prepare for a potential flood event.

The main means by which flood risks will be managed is through the Environment Agency's flood warning dissemination plan. This makes arrangements for warnings to be provided within this Council's area, including individual warnings to high-risk properties.

Flood Warning and Flood Alert Areas can be viewed on the Environment Agency website. The Environment Agency issue flood warnings to homes and businesses when flooding to properties is expected. Upon receipt of a flood warning, occupants should take immediate action. The Environment Agency also issue flood alerts when flooding to low lying land and roads is expected. Flood alerts cover larger areas than flood warnings and are issued more frequently. Upon receipt of an alert, occupants should be prepared for flooding and to take action. Flood warnings and flood alerts are signed up to separately, however when signing up for flood warnings homes and businesses must agree to receive flood alerts.

All staff should sign up to receive these flood warnings.

5.6 Environmental Permit/Ordinary watercourse easement and consents

Under the Water Resources Act 1991 and associated byelaws, works in, over, under or adjacent to main rivers require the consent of the EA and works in, over, under or adjacent to ordinary watercourses will require IDB, Local Authority or LLFA consent. This is to ensure that they neither interfere with the IDB/EA/LPA/LLFA's work nor adversely affect the environment, fisheries, wildlife and flood defence in the locality.

There is an Ordinary Watercourse located on-site to the north, so consent from the LLFA will be needed for any works on-site concerning proximity to a watercourse, with the possible requirement for specific easements for watercourses.

Any consent works usually take place post planning, prior to construction; however, the principals of any development within the appropriate easements should be agreed at the planning stage.

5.7 Flood compensation

As the total site is within Flood Zone 3, with the majority of the surrounding land also within Flood Zone 3, it is not viable to provide flood compensatory measures. The area of land which is proposed to be cleared to provide space for the inverter stations, DNO substation and private switch is only small being 0.54Ha in total. Hence, flood compensation is not deemed necessary.

5.8 Safe access/egress

The developable area of the site lies within the 1 in 1000 year flood extent. Therefore, safe access and egress will be required up to this storm event. Safe egress from the site will be in an easterly direction along Worlds End Lane to join an unnamed road, and then in a southerly direction along this unnamed road for approximately 150m to the edge of the floodplain.

6 PLANNING CONTEXT

6.1 Application of planning policy

Section 14 of the NPPF includes measures specifically dealing with development planning and flood risk using a sequential characterisation of risk based on planning zones and the EA Flood Map. The main study requirement is to identify the flood zones and vulnerability classification relevant to the proposed development, based on an assessment of current and future conditions.

6.2 Land use vulnerability

Planning Practice Guidance (PPG) includes a list of appropriate land uses in each flood zone dependent on vulnerability to flooding. In applying the Sequential Test, reference is made to Table 6.1 below, reproduced from Table 3 of PPG.

Table 6.1: Flood risk vulnerability and flood zone ‘compatibility’

Flood Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	Zone 1	Appropriate	Appropriate	Appropriate	Appropriate	Appropriate
	Zone 2	Appropriate	Appropriate	Exception Test Required	Appropriate	Appropriate
	Zone 3a	Exception Test Required	Appropriate	Should not be permitted	Exception Test Required	Appropriate
	Zone 3b functional floodplain	Exception Test Required	Appropriate	Should not be permitted	Should not be permitted	Should not be permitted

With reference to Table 2 of the PPG, the use as a solar farm energy production site is classed as ‘Essential Infrastructure’. This classification of development requires the exception test for development within Flood Zone 3.

6.3 Sequential Test

The Sequential Test is required to assess flood risk and the PPG recommends that the test be applied at all stages of the planning process to direct new development to areas with the lowest probability of flooding (Flood Zone 1).

According to NPPF, if there is no reasonably available site in Flood Zone 1, the flood vulnerability of the proposed development (see NPPF Technical Guidance Table 2) can be taken into account in locating development in Flood Zone 2 and then Flood Zone 3. Within each Flood Zone new development should be directed to sites at the lowest probability of flooding from all sources.

Due to the requirement for the electrical equipment to be sited in close proximity to the associated DNO substation (located on site), there are no appropriate locations within flood zones 1 or 2 suitable for development.

The development proposal includes 'Essential Infrastructure' industrial uses to be developed on this site. With reference to Table 6.1 above, as the site is located within Flood Zone 3, the proposed development is required to satisfy the Exception Test to be permitted. If this is satisfied, then this development would be appropriate for location within Flood Zone 3a.

6.4 Exception Test

In accordance with NPPF, for the exception test to be passed:

- it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a Strategic Flood Risk Assessment where one has been prepared
- a site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increase flood risk elsewhere, and, where possible, will reduce flood risk overall.

To satisfy the first point, the development will result in increased employment during the construction of the proposed development and in respect of the provision of maintenance services to the application site of benefit to the local economy.

To satisfy the second point, the development will be designed to remain operational during times of flooding or be able to be remotely shut down and re-started following such an event.

The site is designed to be operated on an unmanned basis, and as such there would be no staff on-site and emergency evacuation would not be required.

Suitable mitigation will be included within the design of the development to reduce flood risk to an acceptable level.

The development will not result in the increased flood risk elsewhere as the proposed impermeable area is negligible in size being 0.54Ha.

On-site drainage will be managed to ensure there is no increase in flood risk from increased surface water runoff from the site.

7 SURFACE WATER DRAINAGE ASSESSMENT

7.1 Scope

The site is located in Flood Zone 3, and is greater than 1ha in size, therefore the EA requires such development to focus on the management of surface water run-off. This section discusses the potential quantitative effects of the development on both the risk of surface water flooding on-site and elsewhere within the catchment, as well as the type of potential SuDS features that could be incorporated as part of the masterplan.

In accordance with the Defra Non-Statutory Technical Standards, the surface water drainage strategy should seek to implement a SuDS hierarchy that aspires to achieve reductions in surface water runoff rates to greenfield rates. Where a reduction to the greenfield rate is not practicable, the proposed surface water drainage strategy should not exceed the existing runoff rate.

In addition, Building Regulations Part H¹⁶ requires that the first choice of surface water disposal should be to discharge to an adequate soakaway or infiltration system, where practicable. If this is not reasonably practicable then discharge should be to a watercourse, the least favourable option being to a sewer (surface water before combined). Infiltration techniques should therefore be applied wherever they are appropriate.

This assessment includes an overview and comparison of the existing greenfield scenario and proposed development scenario. For the ease of reference, the existing and proposed areas have been duplicated from Table 2.2 and Table 2.4 in the Table below:

Table 7.1: Existing and proposed site areas

Land use	Existing area (Ha)	Proposed area (Ha)
Impermeable	0.0(0%)	0.54(1%)
Permeable	64.62(100%)	64.08(99%)
Total	64.62	64.62

The impermeable and permeable areas are pro-rata to the size of the developable areas provided on the development framework plans provided, as shown within Table 7.1.

7.2 Pre-development situation

The existing site area is 64.62Ha and 0% impermeable.

¹⁶ HM Government (2010 with 2013 amendments), 'The Building Regulations 2010: Approved Document H - Drainage and Waste Disposal (2002 Edition incorporating 2010 amendments)'

The pro-rata loH 124 method¹⁷ has been used to estimate the Greenfield surface water runoff for the total site area of the site, shown in Table 7.2. Calculations are contained in **Appendix F**.

Table 7.2: IOH 124 surface water runoff (greenfield) for total site area (64.62Ha)

Return period	Peak flow (l/s)
QBar	264.2
1 in 1 year	206.1
1 in 25 year	485.1
1 in 30 year	503.6
1 in 100 year	639.3

7.3 Off-site discharge options and limits

7.3.1 Infiltration

Infiltration should be considered as the primary option to discharge surface water from the developed site. The effectiveness of infiltration is completely dependent on the physical conditions at the site. Potential obstacles include:

- Local variations in permeability preventing infiltration – It is understood from the BGS geological mapping that the site is underlain with superficial clay and sand geology, underlain with Mercia Clay bedrock geology, therefore testing maybe required to ascertain if this is a feasible option;
- Shallow groundwater table - For infiltration drainage devices, Building Regulation approved document H2 states that these “should not be built in ground where the water table reaches the bottom of the device at any time of the year”; and,
- Source Protection Zones - The site is not located within a Groundwater Source Protection Zone.

Based on the underlying geology of the site, any infiltration techniques used in the surface water drainage design will be designed based off poor infiltration rates, pending any infiltration testing.

7.3.2 Discharge to watercourse

Discharging surface water directly to a local watercourse is considered feasible for the whole of the site which, as a network of field boundary ditches are located on-site between each of the fields. The field boundary ditches ultimately convey flow west, discharging into the River Severn estuary. Following the sites topography, the site is generally flat, however there are localised falls towards the field boundary ditches which

¹⁷ Institute of Hydrology (IoH), 'Flood Estimation for small catchments - Report 124', 1994

will capture any surface water runoff generated from the site. These provide feasible discharge points allowing for gravitational drainage of the site.

The whole of the site drains naturally towards these ditches, and therefore formalising the existing connection will act to mimic the natural scenario.

7.3.3 Discharge to surface water sewer

No surface water sewers are shown within the site boundary or within the vicinity of the site on the available sewer records, hence discharge to sewer is not feasible.

7.4 Post-development situation

According to the principles of the BRE planning guidance for the development of large-scale ground mounted solar PV systems, in general solar panels do not increase the impermeable area of a site and it is generally considered that they do not contribute to an increase in surface water runoff from the site.

The impermeable areas across the site are diminutive (0.54Ha); therefore, no formal drainage is required. As such a pragmatic approach has been developed to promote infiltration and provide storage areas across the site to reduce the volume of water entering the ordinary watercourses to the north and the south-east. This will involve the design of soakaways for the transformer stations, DNO control room/customer switch room and private switch, and backfilled trenches / swale features for the solar panels. These features will intercept and attenuate runoff, promoting infiltration across the site.

7.4.1 Solar arrays

7.4.1.1 Design

It is anticipated that any precipitation falling on each solar panel will runoff the panels and flow towards / infiltrate in the rain shadow of the down-slope modules. The rows of panels on the site are aligned at a 22° angle to the contours of the site (**Appendix G**). As such rainwater falling of the trailing edge of the panels will generally flow away from the base of the panels between a 90° and 45° angle towards the rain shadow of the down-slope panels. This feature will enable the use of the rain shadow area of the panels to maintain the infiltration potential of the site.

In some instances, runoff from solar panels could result in the kinetic compaction of soils at the base of the panels and the intensification of runoff into rivulets running along the trailing edge of the rows of panels. This could conceivably lead to a slight increase in the amount of runoff when compared to the pre-development situation resulting from a decrease in infiltration potential.

The specifications of the solar array supports are to be designed to be widely spaced and are driven vertically into the ground with no additional foundations. The arrays are in rows with spaces of several metres (3m) in between the leading edge of one row and the trailing edge of the row behind.

The panels are typically mounted in triple horizontal rows and are separated by a horizontal 'rainwater' gap. This gap allows rainwater to drain freely to the ground between the panels helping to replicate the Greenfield runoff conditions.

Whilst it is considered that solar arrays will not result in a material increase in surface water runoff flow rates and volumes, it is proposed to use a form of SuDS (swales / infiltration trenches) to intercept extreme flows which may already exist flowing off-site. As such it is emphasised that the swales / infiltration trenches do not form part of a formal drainage scheme for the development but are proposed as a form of 'betterment' on existing rates.

7.4.1.2 Vegetation and soil structure

Sustainable management of the post development situation in terms of vegetation planting and soil type can be used as a means of managing surface water runoff from the solar panels. As such to ensure that there is no increase in surface water runoff managed sustainable vegetation (with a good soil structure e.g. chisel ploughed soils) will be allowed to grow beneath the solar panels, which will avoid kinetic compaction and ensure that any potential instances of rivulet formation are minimised and surface water runoff flows over the ground in a natural way. Vegetation planting and soil management should be site wide to encompass all solar panel rows.

7.4.2 Transformer Stations, DNO Substation and Private Switch

It is intended that surface water runoff from the transformer stations, DNO substation and private switch will be discharged to the ground after passing through a drainage trench to closely mimic the existing situation. The design rainfall event for this assessment has been taken as the 6 hour, 1 in 100-year event with the intention of retaining any additional surface water runoff generated as a result of the development on the site in the drainage trench. The possible methods of discharging surface water from the site will be via the existing drainage infrastructure on site or due to the small volumes of runoff, by using natural infiltration / evaporation.

Table 7.2 details the specifications of the indicative drainage trenches that could be used to serve the transformer stations, DNO substation and private switch. The length of the drainage trench has been determined using the perimeters of the transformer stations, DNO substation and private switch.

Table 7.1: Approximate Drainage Trench Sizing and Volumes

Description	1 in 100-year Rainfall (m)	Impermeable Development Area (m ²)	1 in 100 yr Surface Water Volume Required (m ³)	1 in 100yr Volume Required with 10% Climate Change (m ³)	Trench Sizing				Volume Created (m ³)
					Side Slope	Base Width (m)	Depth (m)	Length (m)	
Transformer Station	0.0659	61.3	4.04	4.44	Vertical	0.9	0.9	20	4.86
DNO Substation	0.0659	3099.0	204.22	224.64	Vertical	2.0	1.9	200	228.00
Private Switch	0.0659	88.1	5.81	6.39	Vertical	0.8	1.4	20	6.72

The rainfall data used in the calculations has been gathered from the Centre of Ecology and Hydrology's Flood Estimation Handbook rainfall database (FEH CD ROM Version 3). In accordance with National Planning Policy Framework, climate change has been taken into consideration for the lifetime of the development; as such an increase in rainfall of 10% has been included in the storage requirements.

The attenuation volume (m³) calculated per metre for the hardstanding, has been calculated using a void ratio of 0.3 of the total volume of aggregate in the trench. The trenches are to be a back filled with suitably sized and sourced aggregate, to allow appropriate attenuation.

If natural infiltration on site is not adequate to effectively discharge surface water runoff from the transformer stations, DNO substation and private switch, the trenches would be utilised as on-site attenuation. These would be designed to store excess runoff before naturally discharging at greenfield rates towards the ordinary watercourses to the north and to the south-east.

7.4.3 Access track surface water drainage

Where required, access tracks are kept to a minimum, and be a temporary measure. As such, 'floating roads' could be used on site, typically these will require a wide strip of geotextile laid on the ground covered by a nominal layer of stone to form the track. As such the access tracks will maintain a permeable nature and not increase the surface water runoff from the development. Any flows in excess of the infiltration rates will discharge to the surrounding ground and will not impact on land outside of the site. For solar panel maintenance access could be gained by way of using 4x4 vehicle, quadbike or agricultural vehicles to minimise impacts on the ground.

7.4.4 Maintenance

Maintenance of any drainage network is essential to ensure optimal performance of the drainage elements. As such maintenance requirements of the drainage system will include, but not be limited to the inspection and cleaning of backfilled trenches / swales to ensure that the capacity and infiltration rates are maintained.

The drainage systems are likely to remain in private ownership and therefore the site operator will be responsible for the maintenance of the drainage features on site.

8 CONCLUSIONS AND RECOMMENDATIONS

This FRA complies with the NPPF and Planning Practice Guidance and demonstrates that flood risk from all sources has been considered in the proposed development. It is also consistent with the Local Planning Authority requirements with regard to flood risk.

The whole of the site lies in an area designated by the EA as Flood Zone 3, outlined to have a chance of flooding of 1 in 100 or greater ($\geq 0.1\%$) in any year.

NPPF sets out a Sequential Test, which states that preference should be given to development located within Flood Zone 1. This flood risk assessment demonstrates that the requirements of the Sequential Test have been met, with the site area located within Flood Zone 3 and 'Essential Infrastructure' classification of the development.

This flood risk assessment has considered multiple sources of flooding and concluded the following:

Table 8.1: Flood risk summary

Source	Level of risk	Mitigation
Fluvial	Low-Medium	The developable area of the site is located within an area designated as Flood Zone 3 by the Environment Agency; however, they do not hold any data from fluvial events. As a result, the risk from this source in this location is considered low-medium.
Tidal	High	Using data from the Wessex North Coast Model 2012, supplied by the Environment Agency, the modelled flood level for the site is recorded to be at risk from 2.16m of tidal flooding from a modelled defended 1 in 200 year return period. The finished floor levels of the sensitive electrical equipment will be raised to be 600mm above this recorded flood level, with demountable defences in place for the DNO substation and as such risk from this source should be mitigated.
Surface water	Low	There are multiple very low-medium flood risk surface water flow paths which coincide with the on-site field boundary drainage ditches. Hence, surface water runoff across the majority of the site will be flowing into these existing ditches, to be eventually conveyed away from the site.
Groundwater	Medium	Mudstone bedrock would indicate there to be a lower risk of groundwater flooding due to its impermeability. There are no historic borehole records in close proximity to the site that would indicate on-site groundwater levels. Gloucestershire Groundwater Management Plan classified the site to be within an area at

Source	Level of risk	Mitigation
		intermediate risk from groundwater. The site is thus at a medium risk from groundwater flooding.
Sewers	Very Low	Sewer records indicated there no mapped sewers on-site, nor any surrounding the site.
Artificial sources	Low	Within the district it is stated there to be a low-medium level of flood risk from this source, however this is not site specific. There are several crossings over the field boundary ditches, of which if kept clear and maintained, then blockages can be prevented.

The site is currently a greenfield site and is existing agricultural land. The proposed development will only alter the impermeable area on site by a diminutive amount, resulting in a negligible increase in surface water runoff from the inverter stations, DNO substation and private switch. The solar panels will not increase the impermeable area on site, and therefore will not increase the volume of surface water runoff.

Sensitive electrical equipment will need to be raised by a minimum of 1.6m in the lowest-lying areas, so they are not at risk of flooding from a 1 in 200 year defended return flood period. It is likely that it is unfeasible to raise the levels of the DNO substation by 1.6m to 7.6mAOD. As a result, demountable defences could be erected surrounding the DNO substation, which should be erected prior to a flood event and removed once the flood waters have resided.

Alternatively, it may be possible to raise the sensitive internal electrical components, so they are above 7.60mAOD. Any air vents or other water ingress points on the building should be above this flood level.

There is the potential for the inclusion of small backfilled trenches to provide a betterment for off-site discharge to be placed near the perimeters of the transformer stations, DNO substation and private switch. Using this measure as outlined in Section 7.4, there is potential to provide on-site storage, thereby reducing the amount of greenfield runoff that eventually enters the River Severn, and as such assisting in reduced flood risks downstream.

NPPF sets out a Sequential Test, which states that preference should be given to development located within Flood Zone 1. This flood risk assessment demonstrates that the requirements of the Sequential Test and the Exception Test have been met, with the site's location within Flood Zone 3 and 'Essential Infrastructure' classification of the development.

Overall, taking into account the above points, the development of the site should not be precluded on flood risk grounds.



APPENDIX A

RSK GROUP SERVICE CONSTRAINTS

1. This report and the drainage design carried out in connection with the report (together the "Services") were compiled and carried out by RSK LDE Ltd (RSK) for RSK ADAS (the "client") in accordance with the terms of a contract between RSK and the "client". The Services were performed by RSK with the skill and care ordinarily exercised by a reasonable civil engineer at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the client.
2. Other than that expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.
3. Unless otherwise agreed in writing, the Services were performed by RSK exclusively for the purposes of the client. RSK is not aware of any interest of or reliance by any party other than the client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. Any such party would be well advised to seek independent advice from a competent environmental consultant and/or lawyer.
4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date of this report, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.
5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.
6. The observations and conclusions described in this report are based solely upon the Services, which were provided pursuant to the agreement between the client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off the site of asbestos, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials.
7. The Services are based upon RSK's observations of existing physical conditions at the site gained from a walk-over survey of the site together with RSK's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the walk-over survey. Further RSK was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the client and RSK.
8. The phase II or intrusive environmental site investigation aspects of the Services is a limited sampling of the site at pre-determined borehole and soil vapour locations based on the operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition, chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and RSK] [based on an understanding of the available operational and historical information,] and it should not be inferred that other chemical species are not present.
9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site. Features (boreholes, trial pits etc) annotated on site plans are not drawn to scale but are centred over the appropriate location. Such features should not be used for setting out and should be considered indicative only.



APPENDIX B

TOPOGRAPHIC SURVEY





APPENDIX C

GLOUCESTERSHIRE COUNTY COUNCIL

CORRESPONDENCE

In response to the request for pre-application advice on surface water drainage on the above application the Lead Local Flood Authority (LLFA) can advise as follows. It should be noted that the LLFA is a statutory consultee on major development only and the applicant might want to seek advice from Stroud District Council should the development not meet our criteria.

A surface water drainage strategy is required for all applications and for sites greater than 1 ha or those within the Environment Agency's flood zones 2 or 3, a site specific flood risk assessment (FRA) is also required. Guidance on FRAs can be found at: <https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications>. The site at Worldsend Farm is in Flood Zone 3. The Flood Map for Planning can be found here: <https://flood-map-for-planning.service.gov.uk/>

Information regarding risk of flooding from surface water (including depths and direction of flow) and risk of flooding from reservoirs can be found at: <https://flood-warning-information.service.gov.uk/long-term-flood-risk/map> using the detailed view. There are small areas at risk of flooding from surface water throughout the site.

The LLFA has no records of property flooding in or around the site. The site is in an area that scored 11 for vulnerability to groundwater flooding in the Gloucestershire Groundwater Management Plan (see attached map) which is classified as intermediate risk.

The drainage strategy should comply with the principles of Sustainable Drainage Systems (SuDS) hierarchy for surface water. In doing so, consideration should be given first to infiltration, then discharge to a watercourse, then connecting to a public surface water sewer and finally connecting to a public combined sewer (with the necessary permissions from the relevant water company) if there are no other viable options. Where connections require crossing of third party land, agreement in principle from the relevant party should be included.

Where necessary, infiltration tests should be completed to BRE Digest 365 standard and the results provided. Please note that discharging to an ordinary watercourse (which includes ditches) may require Land Drainage Consent from Stroud District Council. If the strategy is to discharge into a watercourse then there would need to be proof that the site will still be able to drain or there is sufficient storage onsite for when the watercourse is in high flow or when the watercourse is in flood. If the site doesn't currently drain into the watercourse then we would need to provide proof that the risk of flooding is not increased as a result of increasing the discharge into it.

There should be no surface water flooding on site for rainfall events up to and including the 1 in 30 year event and no internal flooding to properties (including basements) up to the 1 in 100 year event (plus 40% for climate change). Development should not increase flood risk outside of the site. Exceedance flow

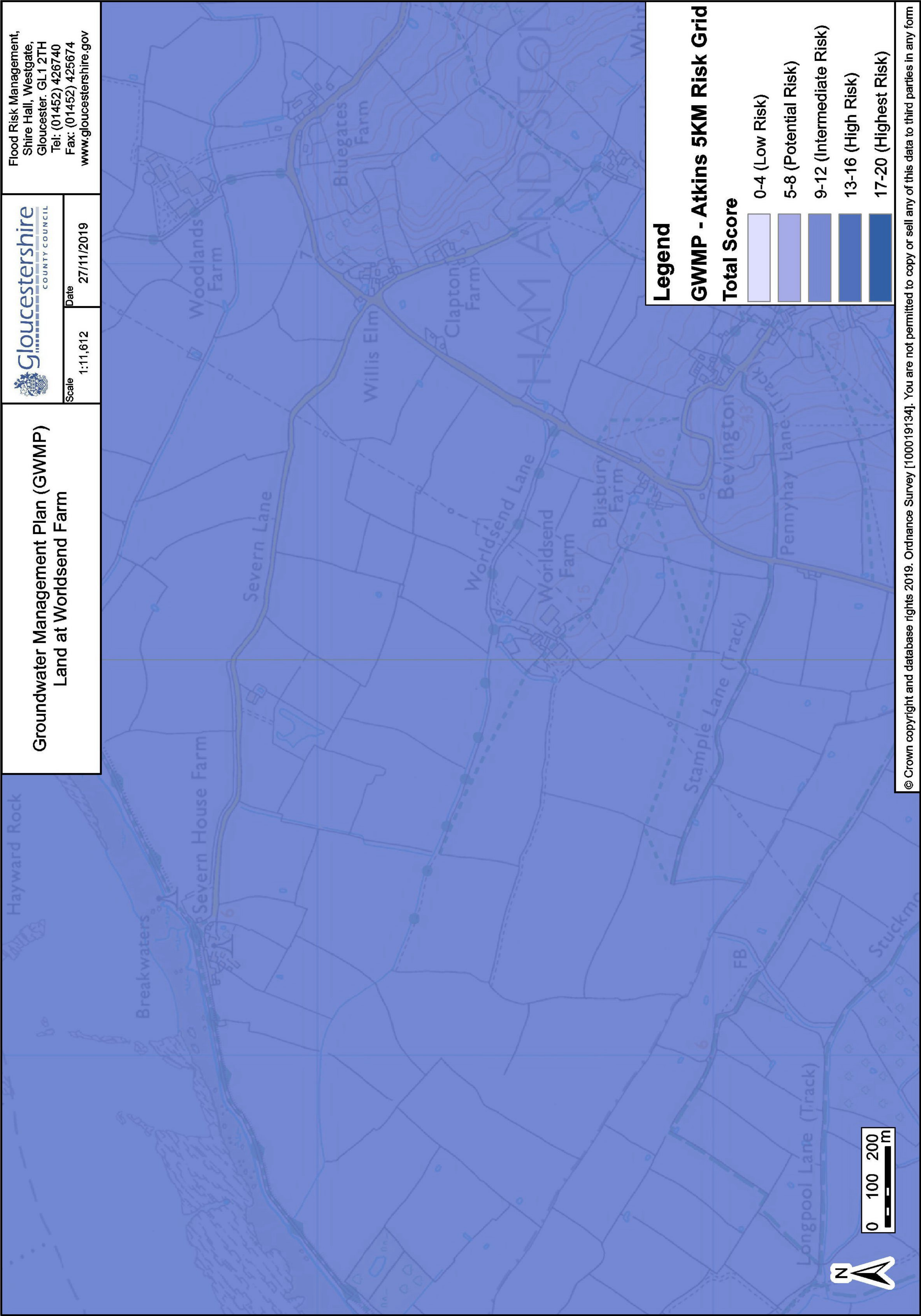
routes for events greater than the 1 in 100 year storm should be identified and should avoid properties including gardens. When developing next to a watercourse, it is recommended a 5-8m strip of land be kept free for maintenance purposes.

Any attenuation features should be shown including calculations for stored volumes and discharge rates. For greenfield developments, the peak discharge rate up to the 1 in 100 year rainfall event (plus 40% for climate change) should never exceed the peak greenfield runoff rate for the same event. For brownfield developments, the peak discharge rate from the development up to the 1 in 100 year rainfall event (plus 40%) should be as close as is reasonably practicable to the greenfield runoff rate for the same event. If this is not feasible then Gloucestershire County Council will accept a 40% reduction over the pre development discharge rate. It should never exceed the pre-development discharge rate for the same event.

For greenfield developments, the runoff volume up to the 1 in 100 year, 6 hour rainfall event (plus 40% climate change) should not exceed the greenfield runoff volume for the same event. For brownfield sites the runoff volume up to the 1 in 100 year, 6 hour event (plus 40% climate change) should be constrained to a value as close as is reasonably practicable to the Greenfield runoff volume. Where this isn't practicable, the runoff volume should be reduced by 40% of the existing volume and should never exceed it.

The strategy should not result in any deterioration in water quality and the use of SuDS should improve water quality wherever possible. Information provided by the SuDS manual, CIRIA C753, should be considered when designing the SuDS system.

For more information and to access our "Standing Advice and Development Guidance" and "Gloucestershire SuDS Design and Maintenance Guide" documents please visit our website: <http://www.gloucestershire.gov.uk/planning-and-environment/flood-risk-management/surface-water-drainage-and-major-planning-applications/>.





APPENDIX D

ENVIRONMENT AGENCY CORRESPONDENCE

Our ref: 152191-WX
Your ref:
Date: 19 December 2019

Dear [REDACTED]

Thank you for your enquiry which was received on 26 November 2019.

Abstract

Name	Product 4
Description	Detailed Flood Risk Assessment Map for Worlds End Farm, Worlds End Lane, Berkeley, GL13 9QX
Information Warnings	<i>The mapping of features provided as a background in this product is © Ordnance Survey. It is provided to give context to this product. The Open Government Licence does not apply.</i>
Attribution	Contains Environment Agency information © Environment Agency and/or database rights. Contains Ordnance Survey data © Crown copyright 2019 Ordnance Survey 100024198.

Flood Map for Planning

The Flood Map for Planning is now classed as Open Data. It can be downloaded free of charge under an open data licence from the following weblink:

<https://data.gov.uk/publisher/environment-agency>

If you search for the 'flood map for planning' in the search box the following datasets will be available for you select and download the data:

- Flood Map for Planning (Rivers and the Sea) – Flood Zones 2 and 3
- Flood Map for Planning (Rives and Sea) – Areas Benefiting from Defences
- Flood Map for Planning (Rivers and Sea) Flood Storage Areas
- Flood Map for Planning – Spatial Flood Defences (without Standard attributes)
- Recorded Flood Outlines
- Historic Flood Map
- Risk of Flooding from Surface Water Extent for:
 - 3 percent annual chance
 - 1 percent annual chance
 - 0.1 percent annual chance

If you have requested this information to help inform a development proposal, then you should also note the detail in the attached advisory text on the use of Environment Agency Information and Further Guidance for FRAs.

Flooding history

We no longer produce pdf copies of the Historic Flood Map. This information is available to search select, and download free of charge as part of the Government's 'open data' as

- Recorded Flood Outlines
- the Historic Flood Map

These are GIS layers and can be download from: <https://data.gov.uk/publisher/environment-agency>

If you have requested this information to help inform a development proposal, then you should also note the detail in the attached advisory text on the use of Environment Agency Information and Further Guidance for FRAs.

Strategic Flood Risk Assessment (SFRA)

Planning

If you have questions regarding the planning nature of your enquiry, or require advice on floor levels, please contact our Sustainable Places team on NWX.SP@environment-agency.gov.uk. Please be aware that we now charge for planning advice when consulted on pre-application enquiries. This new approach provides advice to developers in two ways. Firstly there is the provision of 'free' advice available to everyone where we give a preliminary opinion on a proposed development. This sets out the environmental constraints together with any issues this raises for us. Should you wish us to review in detail any of these issues then we can do this through a chargeable scheme aimed at recovering our costs.

Flood Levels

Fluvial flood levels and depths

We do not hold any 1D (fluvial) modelling for the vicinity of your site.

Coastal/tidal flood levels and depths

The tables below show the maximum modelled tidal flood levels and depths for defended (actual situation) and undefended (natural floodplain) scenarios taken from our 2012 Wessex North Coast Model. For the undefended scenarios the 0.5% (1 in 200 year return period) and 0.1% (1 in 1000 year return period) annual exceedance probability (AEP) is given. Only the 0.5% (1 in 200 year) AEP is available for the defended scenario.

Defended

AEP	Maximum depth (in metres)	Maximum level (mAOD)
0.5%	2.16	7.00

Undefended

AEP	Maximum depth (in metres)	Maximum level (mAOD)
0.5%	4.74	9.68
0.1%	5.09	10.01

NB 0.00 (m or mAOD) indicates the data does not reach the site

Customer & Engagement, Wessex
Rivers House, East Quay, Bridgwater, Somerset, TA6 4YS
Phone: 02030 250 376
Email: wessexenquiries@environment-agency.gov.uk
www.environment-agency.gov.uk

VAT No: 662 4901 34

Levels and depths have been extracted based upon the site boundary plan provided.

There is no climate change data available from our 2012 Wessex North Coast Model.

Please be aware that this model did not include data for climate change allowances.

If you intend undertaking a FRA for a planning application using climate change flood level information supplied in this letter, you should consider whether it is appropriate in light of a range of potential allowances for fluvial flood flow now advised in current planning guidance on 'Flood risk assessments: climate change allowances'. The relevant guidance is available at the following website address: <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

Flood Defences

Please find enclosed details of Flood Defences within the vicinity of the site boundary. This information has been taken from our Asset Information Management System database(AIMS).

Please note that flood defences can increase water levels elsewhere eg through channels being restricted by defences, or because defences prevent flood water flowing back into the river channel.

Environmental Permit for Flood Risk Activities

In addition to any other permission(s) that you may have already obtained e.g. planning permission, you may need an environmental permit for flood risk activities (formerly known as Flood Defence Consent prior to 06 April 2016) if you want to do work:

- in, under, over or near a main river (including where the river is in a culvert)
- on or near a flood defence on a main river
- in the flood plain of a main river
- on or near a sea defence

For further information and to check whether a permit is required please visit:

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

For any further advice, please contact your local Environment Agency Office, at

bridgwater.frap@environment-agency.gov.uk.

Further Information

We advise that you also contact David Lesser, Sustainable Drainage Engineer, Flood Risk Management (Strategic Infrastructure), Gloucestershire County Council, 1st Floor, Block 5, Shire Hall, Westgate Street, Gloucester, GL1 2TG as they may be able to provide further advice with respect to localised flooding and drainage issues.

Further details about the Environment Agency information supplied can be found on our website:

<https://www.gov.uk/browse/environment-countryside/flooding-extreme-weather>

If you have requested this information to help inform a development proposal, then you should note the information on GOV.UK on the use of Environment Agency Information for FRAs:

<https://www.gov.uk/planning-applications-assessing-flood-risk>

<https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion>

We hope you find this information helpful and it is provided subject to the guidance below, which we strongly recommend you read.

Customer & Engagement, Wessex
Rivers House, East Quay, Bridgwater, Somerset, TA6 4YS
Phone: 02030 250 376
Email: wessexenquiries@environment-agency.gov.uk
www.environment-agency.gov.uk

VAT No: 662 4901 34

Yours sincerely



Customer & Engagement, Wessex
Rivers House, East Quay, Bridgwater, Somerset, TA6 4YS
Telephone number: 02030 250 376
Email: wessexenquiries@environment-agency.gov.uk

Please note our new telephone number and email address

Enc: Use of Environment Agency Information for Flood Risk Assessments (below)
152191-WX Defence Map
152191-WX Defence Data

Customer & Engagement, Wessex
Rivers House, East Quay, Bridgwater, Somerset, TA6 4YS
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www.environment-agency.gov.uk

VAT No: 662 4901 34

Use of Environment Agency Information for Flood Risk Assessments (FRAs)

Important

Use of Environment Agency data: you should note that

1. Information supplied by the Environment Agency may be used to assist in producing a Flood Risk Assessment (FRA) where one is required, but the use of Environment Agency information does not constitute such an assessment on its own.
2. As part of your data request, we have provided all of the modelled data we hold for your location. Please note that some of our modelled information may have been produced for purposes other than for flood zone generation. This may mean that some of the modelled data you have been provided with has a lower confidence level, and has not been used in producing our flood map, nor definitively reflects the predicted flood water level at the property/development site scale. To check the suitability of the use of this information in your FRA please contact your local Partnership & Strategic Overview (PSO) team.
3. This information covers flood risk from main rivers and the sea, and you will need to consider other potential sources of flooding, such as groundwater or surface water runoff. The information produced by the Local Planning Authority and the Lead Local Flood Authority (LLFA) may assist in assessing other sources of flood risk.
4. Where a planning application requires a FRA and this is not submitted or deficient, the Environment Agency may well raise an objection.
5. For more significant proposals in higher flood risk areas, we would be pleased to discuss details with you ahead of making any planning application, and you should also discuss the matter with your Local Planning Authority.

Pre-Planning Advice from the Environment Agency

If you have requested this information to help inform a development proposal, then we recommend that you undertake a formal pre-application enquiry using the form available from our website:

Pre-application Preliminary Opinion:

<https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion>

Pre-application Charged Service:

<https://www.gov.uk/government/publications/planning-advice-environment-agency-standard-terms-and-conditions>

Depending on the enquiry we may also provide advice on other issues related to our responsibilities, including flooding, waste, land contamination, water quality, biodiversity, navigation, pollution, water resources, foul drainage or Environmental Impact Assessment.

Flood Risk Assessment (FRA) Guidance

You should refer to the Planning Practice Guidance of the National Planning Policy Framework (NPPF) and the Environment Agency's Flood Risk Standing Advice for information about Flood Risk Assessment (FRA) for new development in the different Flood Zones. These documents can be accessed via:

National Planning Policy Framework Planning Practice Guidance:

<http://planningguidance.planningportal.gov.uk/>

Customer & Engagement, Wessex
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VAT No: 662 4901 34

Environment Agency advice on FRAs:

<https://www.gov.uk/flood-risk-assessment-for-planning-applications#when-to-follow-standing-advice>

<https://www.gov.uk/government/publications/planning-applications-assessing-flood-risk>

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www.environment-agency.gov.uk

VAT No: 662 4901 34

Our ref: 152191-WX
Your ref:
Date: 19 December 2019

Dear [REDACTED]

Information request for:

Worlds End Farm, Worlds End Lane, Berkeley, GL13 9QX

Thank you for your enquiry which was received on 26 November 2019.

Name	Product 6
Description	Model Output Data for model: North Coast Tidal Model 2012
Conditions	<ol style="list-style-type: none">1 You may use the Information for your internal or personal purposes and may only sublicense others to use it if you do so under a written licence which includes the terms of these conditions and the agreement and in particular may not allow any period of use longer than the period licensed to you.2 Notwithstanding the fact that the standard wording of the Environment Agency Conditional Licence indicates that it is perpetual, this Licence has a limited duration of 5 years at the end of which it will terminate automatically without notice.3 We have restricted use of the Information as a result of legal restrictions placed upon us to protect the rights or confidentiality of others. In this instance it is because of third party data. If you contact us in writing (this includes email) we will, as far as confidentiality rules allow, provide you with details including, if available, how you might seek permission from a third party to extend your use rights.4.1 The Information may contain some data that we believe is within the definition of "personal data" under the Data Protection Act 1998 but we consider that we will not be in breach of the Act if we disclose it to you with conditions set out in this condition and the conditions above. This personal data comprises names of individuals or commentary relating to property that may be owned by an individual or commentary relating to the activities of an individual.4.2 Under the Act a person who holds and uses or passes to others personal data is responsible for any compliance with the Act and so we have no option but to warn you that this means you have responsibility to check that you are compliant with the Act in respect of this personal data.5. The location of public water supply abstraction sources must not be published to a resolution more detailed than 1km².

	<p>Information about the operation of flood assets should not be published.</p> <p>6.1 Where we have supplied model data which may include model inputs or outputs you agree to supply to the Environment Agency copies of any assessments/studies and related outputs, modifications or derivatives created pursuant to the supply to you of the Information, all of which are hereinafter referred to as “the Data”.</p> <p>6.2 You agree, in the public interest to grant to the Environment Agency a perpetual royalty free non-exclusive licence to use the Data or any part thereof for its internal purposes or to use it in any way as part of Environment Agency derivative products which it supplies free of charge to others such as incorporation into the Environment Agency's Open Data mapping products.</p>
Information Warnings	Please be aware that model data is not raw, factual or measured but comprises of estimations or modelled results based on the data available to us.
Attribution	Contains Environment Agency information © Environment Agency and/or database rights.

Further Information

We advise that you also contact David Lesser, Sustainable Drainage Engineer, Flood Risk Management (Strategic Infrastructure), Gloucestershire County Council, 1st Floor, Block 5, Shire Hall, Westgate Street, Gloucester, GL1 2TG as they may be able to provide further advice with respect to localised flooding and drainage issues.

Further details about the Environment Agency information supplied can be found on our website: <https://www.gov.uk/browse/environment-countryside/flooding-extreme-weather>

We hope you find this information helpful.

Yours sincerely



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www.environment-agency.gov.uk

VAT No: 662 4901 34

Our ref: 152191-WX
Your ref:
Date: 19 December 2019

Dear [REDACTED]

Information request for:

Worlds End Farm, Worlds End Lane, Berkeley, GL13 9QX

Thank you for your enquiry which was received on 26 November 2019.

Name	Product 7
Description	Calibrated and Verified Model Input Data for: North Coast Tidal Model 2012
Licence	This information is not immediately available with a licence for use. Please contact us if you want to know if, and under what conditions, we would be able to license you.
Attribution	Contains third party information. May contain Environment Agency information © Environment Agency and/or database rights.

Further Information

We advise that you also contact David Lesser, Sustainable Drainage Engineer, Flood Risk Management (Strategic Infrastructure), Gloucestershire County Council, 1st Floor, Block 5, Shire Hall, Westgate Street, Gloucester, GL1 2TG as they may be able to provide further advice with respect to localised flooding and drainage issues.

Further details about the Environment Agency information supplied can be found on our website:

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We hope you find this information helpful.

Yours sincerely

[REDACTED]
Customer & Engagement, Wessex
Rivers House, East Quay, Bridgwater, Somerset, TA6 4YS
Telephone number: 02030 250 376
Email: wessexenquiries@environment-agency.gov.uk

Customer & Engagement, Wessex
Rivers House, East Quay, Bridgwater, Somerset, TA6 4YS
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VAT No: 662 4901 34

Our ref: 152191-WX
Your ref:
Date: 19 December 2019

Dear [REDACTED]

Information request for:

Worlds End Farm, Worlds End Lane, Berkeley, GL13 9QX

Thank you for your enquiry which was received on 26 November 2019.

The attached Product 8 data is based upon breach/asset failure modelling that was commissioned in 2014 using our Wessex North Coast Tidal 2012 model. This analysis has sought to provide the Environment Agency with an indication of risk associated with the breach/failure scenarios as well as an indication of the risk mitigation significance of a defence or structure at the 200yr still water level.

The Product 8 format shows the **combined** maximum of depth, hazard and velocity for individual breach/asset failure scenarios. The locations of the breach/asset failure are shown on the maps and further details may be found in the accompanying data table.

This study does not address the impact of wave overtopping on the scenarios modelled and presented here. Wave data, where applicable can be viewed in the Somerset North Coast Flood Warning Improvements (JBA, 2012). Models have been run to simulate low frequency events (200 yr still water level). When an asset failure is added to the event, the scenario becomes less likely in accordance with the strength of the structure simulated to fail. In addition, many structures are fitted with secondary defences such as penstocks on the landward side and these structures provide additional mitigation that has not been modelled in the scenarios.

Please be aware, the selection of the breaches and assets is not an indication of a probability of failure and breaches or failures could occur at any point of our coastal defences. As such, it is unlikely that the modelling and mapping will be representative of the highest potential source of breach hazard for your specific site. Please also note that the modelled scenarios will also include residual risk which exists in a 200yr still water event without any breach or failure.

As the modelling was not commissioned for the purposes of site specific Flood Risk Assessments, we can make no guarantee that the results are suitable for this purpose. We do, however, hope that you will find it useful in your overall assessment of flood risk at your site.

Please also refer to the data Conditions and Information Warnings below

Name	Product 8
Description	Breach hazard map
Conditions	<p>1.0 You may use the Information for your internal or personal purposes and may only sublicense others to use it if you do so under a written licence which includes the terms of these conditions and the agreement and in particular may not allow any period of use longer than the period licensed to you.</p> <p>2.0 Notwithstanding the fact that the standard wording of the Environment Agency Conditional Licence indicates that it is perpetual, this Licence has a limited duration of 5 years at the end of which it will terminate automatically without notice.</p> <p>3.0 We have restricted use of the Information as a result of legal restrictions placed upon us to protect the rights or confidentiality of others. In this instance it is because of sensitive data.</p>
Information Warnings	<p>1.0 This map shows the level of flood hazard to people (called a hazard rating) if our flood defences are breached at certain locations, for a range of scenarios. The hazard rating depends on the depth and velocity of floodwater, and maximum values of these are also mapped.</p> <p>2.0 The map is based on computer modelling of simulated breaches at specific locations. Each breach has been modelled individually and the results combined to create this map. Multiple breaches, other combinations of breaches, different sized tidal surges or flood flows may all give different results.</p> <p>3.0 The map only considers the consequences of a breach, it does not make any assumption about the likelihood of a breach occurring. The likelihood of a breach occurring will depend on a number of different factors, including the construction and condition of the defences in the area. A breach is less likely where defences are of a good standard, but a risk of breaching remains.</p> <p>4.0 Please contact the Environment Agency for further information on emergency planning associated with flood risk in this area.</p>
Information Warning - OS background mapping	<p><i>The mapping of features provided as a background in this product is © Ordnance Survey. It is provided to give context to this product. The Open Government Licence does not apply to this background mapping. You are granted a non-exclusive, royalty free, revocable licence solely to view the Licensed Data for non-commercial purposes for the period during which the Environment Agency makes it available. You are not permitted to copy, sub-license, distribute, sell or otherwise make available the Licensed Data to third parties in any form. Third party rights to enforce the terms of this licence shall be reserved to OS.</i></p>

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Further Information

We advise that you also contact David Lesser, Sustainable Drainage Engineer, Flood Risk Management (Strategic Infrastructure), Gloucestershire County Council, 1st Floor, Block 5, Shire Hall, Westgate Street, Gloucester, GL1 2TG as they may be able to provide further advice with respect to localised flooding and drainage issues.

Further details about the Environment Agency information supplied can be found on our website:

<https://www.gov.uk/browse/environment-countryside/flooding-extreme-weather>

We hope you find this information helpful.

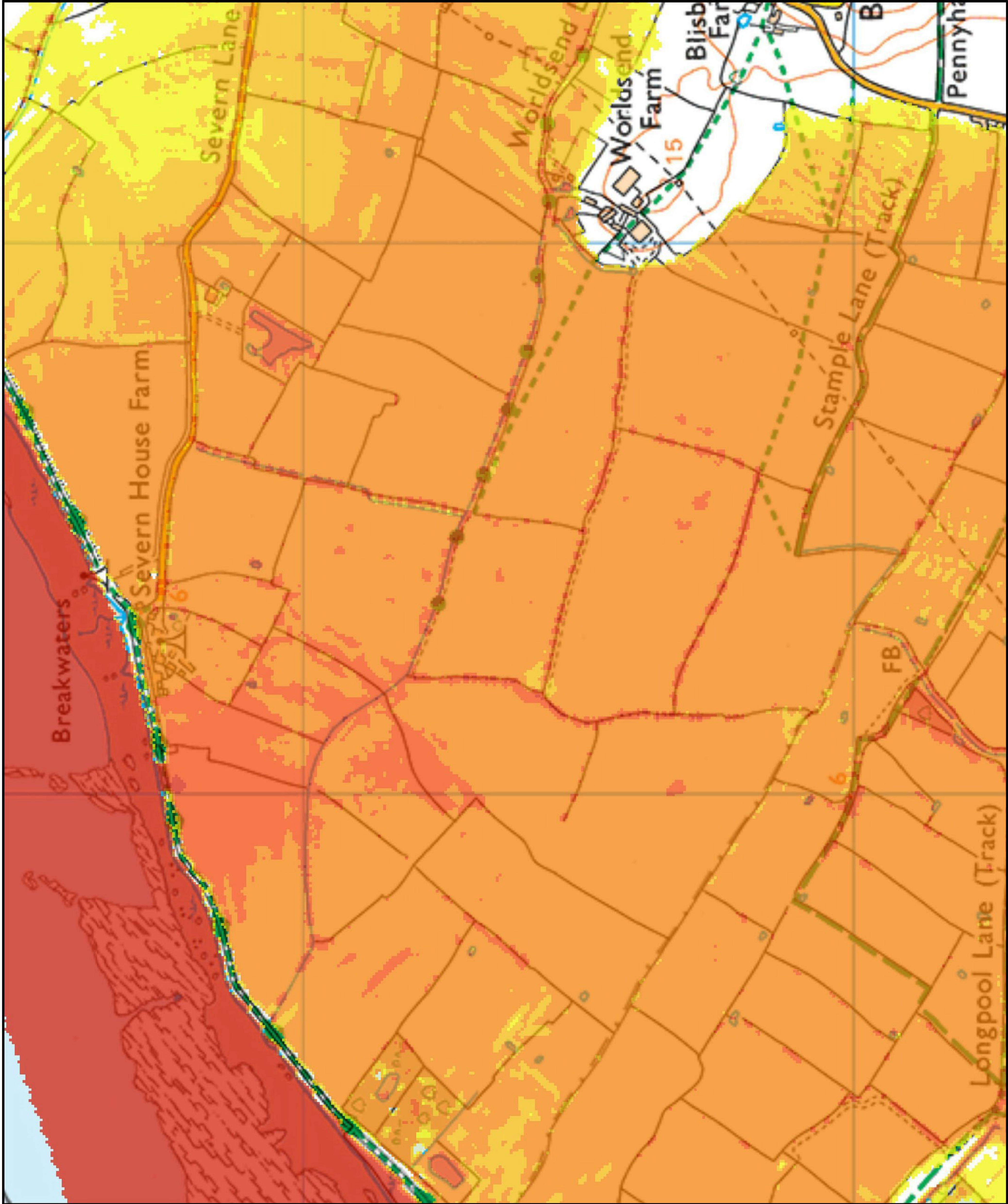
Yours sincerely



Customer & Engagement, Wessex
Rivers House, East Quay, Bridgwater, Somerset, TA6 4YS
Telephone number: 02030 250 376
Email: wessexenquiries@environment-agency.gov.uk

Enc: 152191-WX Breach hazard map
152191-WX Breach velocity map
152191-WX Breach depth map

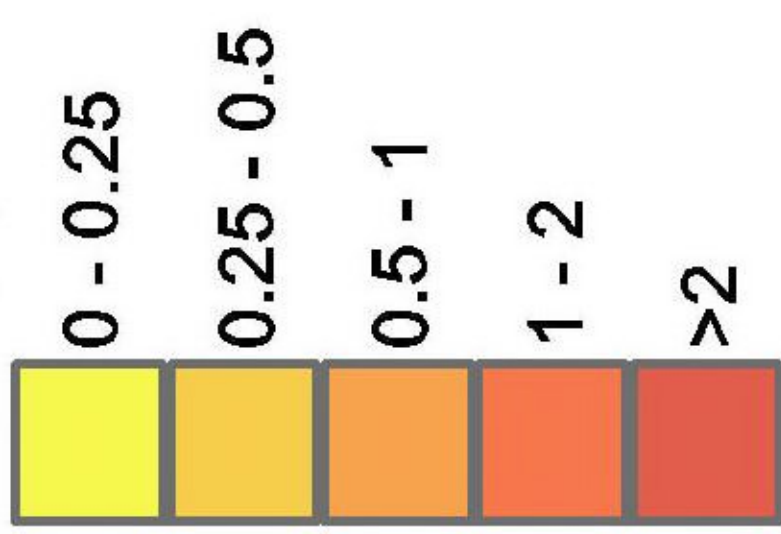
Breach map (depth) centred on ST 64194 97469 - created 16/12/2019 [Ref: 152191-WX]

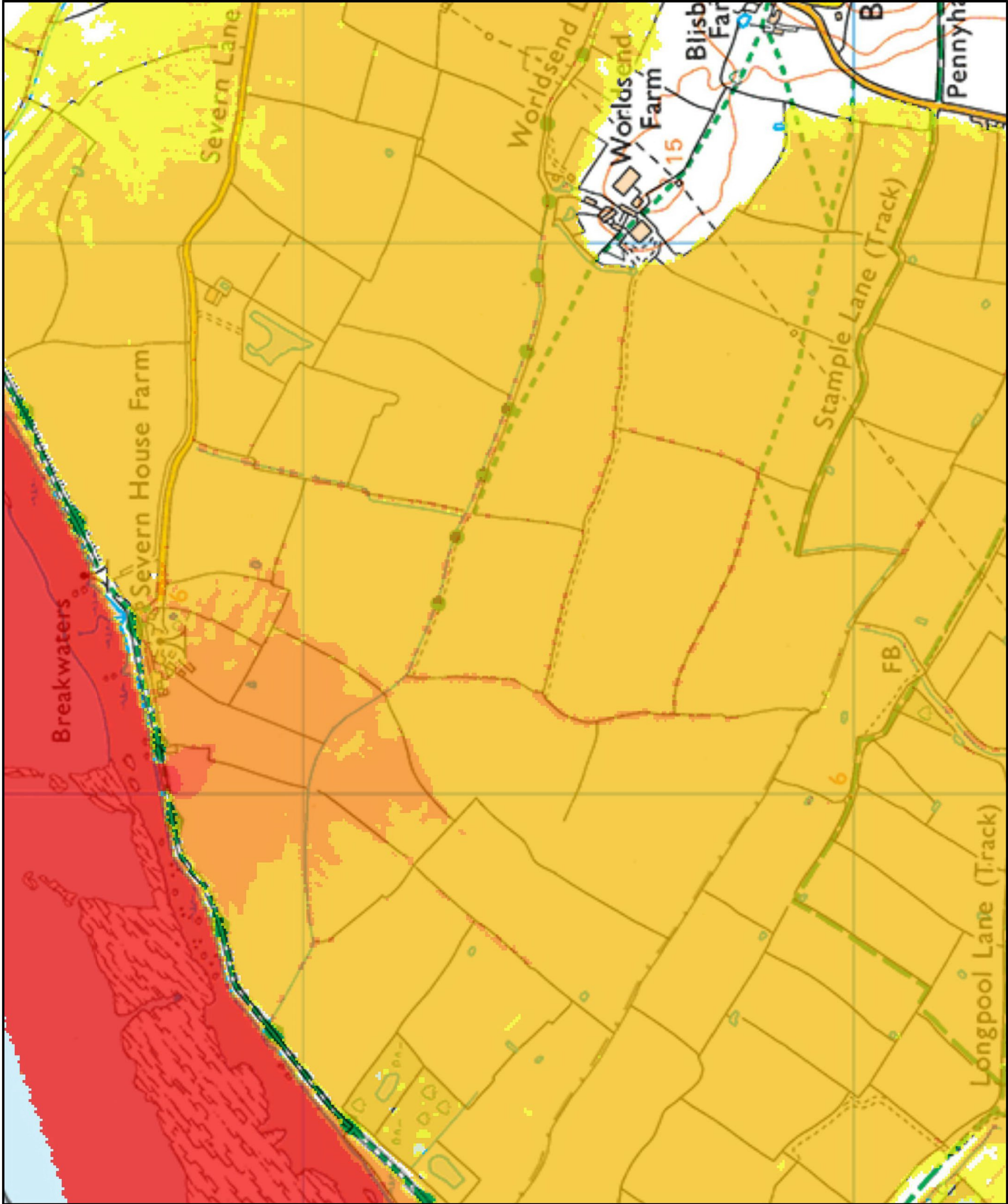


Scale: 1:10,000

Legend

Aust_to_Sharpness_50to58_Depth
Depth (m)

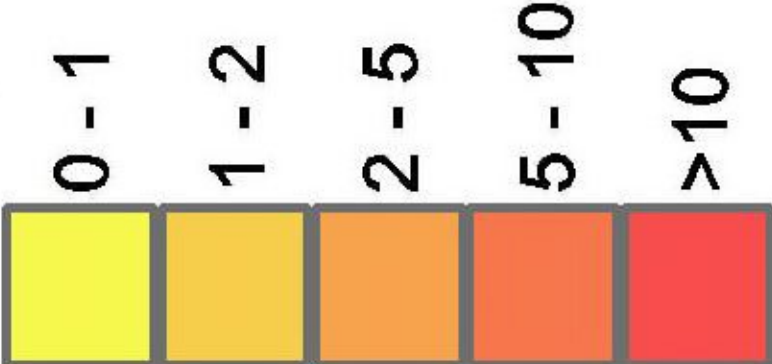




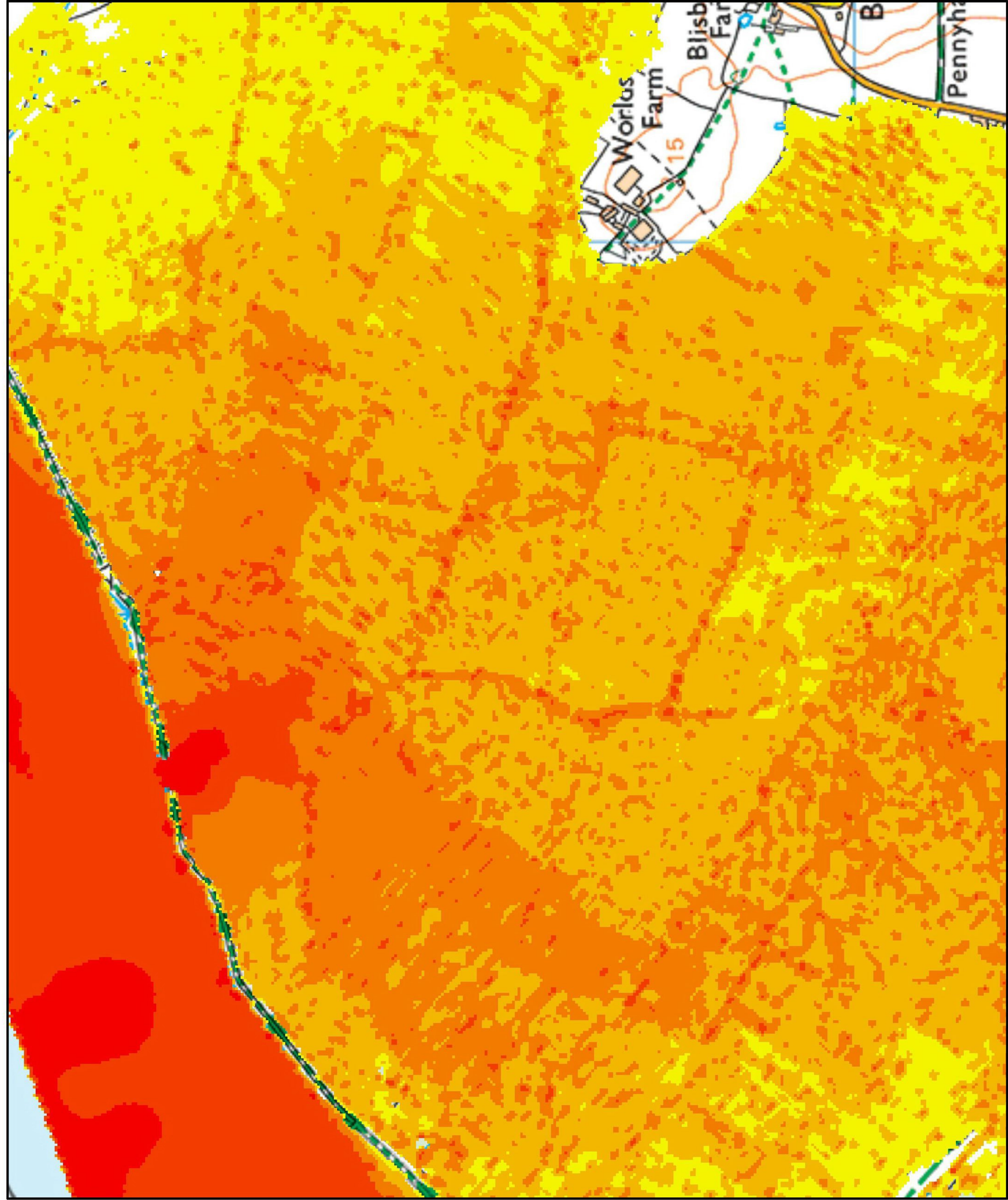
Scale: 1:10,000

Legend

Aust_to_Sharpness_50to58_Hazard
Hazard (zUK)



Breach map (velocity) centred on ST 64194 97469 - created 16/12/2019 [Ref: 152191-WX]



Product 4 - AIMS Information

152191-WX

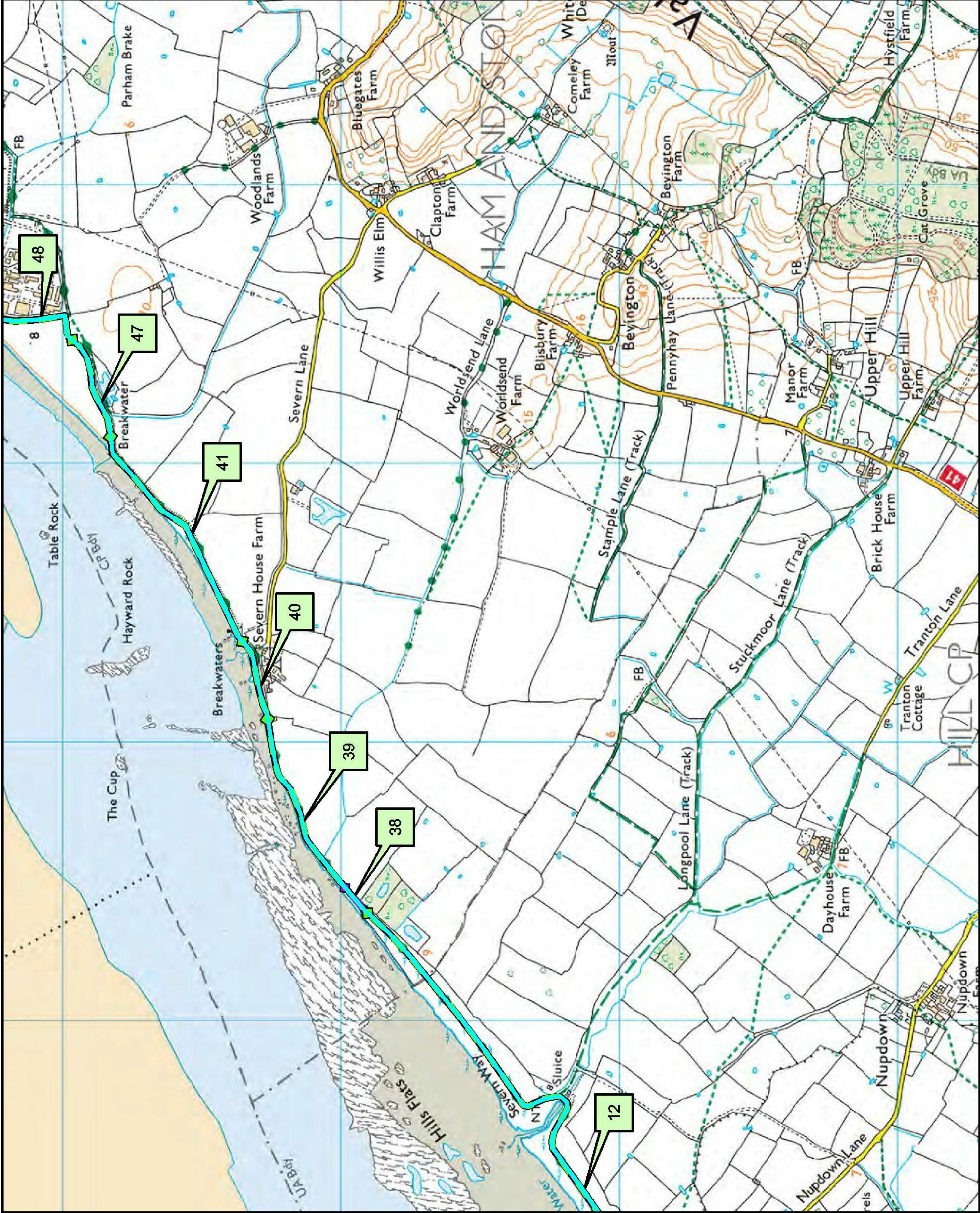
Date: 27/11/2019


Map Ref	Asset ID	Asset Type	Asset Description	Approx length (m)	Right or left bank	Actual fluvial downstream crest level (mAOD)	Actual fluvial downstream crest level accuracy	Actual fluvial upstream crest level (mAOD)	Actual fluvial upstream crest level accuracy	Actual fluvial coastal crest level (mAOD)	Actual fluvial coastal crest level accuracy	NGR	Most recent Inspection	Overall condition
12	35334	embankment	Earth Embankment Def	2855.05	coastal	DNR	DNR	DNR	DNR	9.26	+/- 1 to 5cm	ST6260297235	21/01/2019	3
38	97292	wall	Earth Embankment with inward stone revetment, concrete upstand and part concrete crest	125.01	coastal	DNR	DNR	DNR	DNR	10.05	+/- 1 to 5cm	ST6349698004	21/01/2019	3
39	97293	embankment	Earth Embankment Def, Inward stone revetment with concrete upstand and part concrete crest	680.00	coastal	DNR	DNR	DNR	DNR	9.82	+/- 1 to 5cm	ST6382898180	21/01/2019	3
40	98636	embankment	Earth Embankment with inward stone revetment, concrete upstand and part concrete crest	299.20	coastal	DNR	DNR	DNR	DNR	10.00	+/- 1 to 5cm	ST6423298305	21/01/2019	3
41	98637	embankment	Clapton Pill to end of sea wall	894.99	coastal	DNR	DNR	DNR	DNR	9.69	+/- 1 to 5cm	ST6494998743	01/11/2019	3
47	129694	embankment	End of sea wall to end of embankment	382.30	coastal	DNR	DNR	DNR	DNR	9.70	+/- 1 to 5cm	ST6632498898	01/11/2019	3
48	129695	embankment	Embankment	340.12	coastal	DNR	DNR	DNR	DNR	DNR	DNR	ST6551599090	10/12/2009	2

Notes

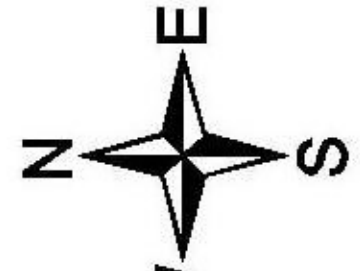
- * Overall Condition has been taken from the most recent inspection
 - * Inspections are of a purely visual nature and do not necessarily reflect the true condition of the asset
 - * Condition 1 = very good, Condition 2 = good, Condition 3 = fair, Condition 4 = poor, Condition 5 = very poor
- DNR = data not recorded

Current Flood Defences centred on NGR ST 64198 97475, created 27/11/2019 Ref: 152191-WX





Scale: 1:20,000



Legend

Defences

- bridge_abutment
- barrier_beach
- cliff
- demountable
- embankment
- flood_gate
- high_ground
- promenade
- quay
- wall
- beach
- dunes

Channels

- open_channel
- simple_culvert

This data has been extracted from the Asset Information Management System (AIMS) which was created to draw various data sources into one database and has been populated with information of varying quality.



APPENDIX E

SEVERN TRENT SEWER RECORDS



© Crown copyright and database rights 2019 Ordnance Survey 10001873
Data updated: 9/09/19

Scale: 1:1200
Map Centre: 508368.191644

Date: 08/11/19
Our Ref: 302002-0

Client: Water Plan A1
Powered by: d3.js

Hydrant	Valve	Aqueduct
Meter	Water Main	Duct
Air Valve	Abandoned Pipe	Service Pipe

email.payments@atkinsglobal.com

80763



Do not scale off this map. The plan and any information supplied with it is furnished as a general guide, is only valid at the date of issue and no warranty as to its correctness is given or implied. In particular this plan and any information shown on it must not be relied upon in the event of any development or works (including but not limited to extensions) in the vicinity of SEVERN TRENT WATER assets or for the purpose of determining the suitability of a point of connection to the sewerage or distribution systems. Reproduction by permission of Ordnance Survey on behalf of HMSO. © Crown Copyright and database rights 2004. All rights reserved. Ordnance Survey license number 100031673. Document users other than SEVERN TRENT WATER business users are advised that this document is provided for reference purpose only and is subject to copyright, therefore, no further copies should be made from it.

GENERAL CONDITIONS AND PRECAUTIONS TO BE TAKEN WHEN CARRYING OUT WORK ADJACENT TO SEVERN TRENT WATERS APPARATUS

Please ensure that a copy of these conditions is passed to your representative and/or your contractor on site. If any damage is caused to Severn Trent Water Limited (STW) apparatus (defined below), the person, contractor or subcontractor responsible must inform STW immediately on: 0800 783 4444 (24 hours)

- These general conditions and precautions apply to the public sewerage, water distribution and cables in ducts including (but not limited to) sewers which are the subject of an Agreement under Section 104 of the Water Industry Act 1991 (a legal agreement between a developer and STW, where a developer agrees to build sewers to an agreed standard, which STW will then adopt); mains installed in accordance with an agreement for the self-construction of water mains entered into with STW and the assets described at condition b) of these general conditions and precautions. Such apparatus is referred to as 'STW Apparatus' in these general conditions and precautions.
- Please be aware that due to The Private Sewers Transfer Regulations June 2011, the number of public sewers has increased, but many of these are not shown on the public sewer record. However, some idea of their positions may be obtained from the position of inspection covers and their existence must be anticipated.
- On request, STW will issue a copy of the plan showing the approximate locations of STW Apparatus although in certain instances a charge will be made. The position of private drains, private sewers and water service pipes to properties are not normally shown but their presence must be anticipated. This plan and the information supplied with it is furnished as a general guide only and STW does not guarantee its accuracy.
- STW does not update these plans on a regular basis. Therefore the position and depth of STW Apparatus may change and this plan is issued subject to any such change. Before any works are carried out, you should confirm whether any changes to the plan have been made since it was issued.
- The plan must not be relied upon in the event of excavations or other works in the vicinity of STW Apparatus. It is your responsibility to ascertain the precise location of any STW Apparatus prior to undertaking any development or other works (including but not limited to excavations).
- No person or company shall be relieved from liability for loss and/or damage caused to STW Apparatus by reason of the actual position and/or depths of STW Apparatus being different from those shown on the plan.

In order to achieve safe working conditions adjacent to any STW Apparatus the following should be observed:

- All STW Apparatus should be located by hand digging prior to the use of mechanical excavators.
- All information set out in any plans received from us, or given by our staff at the site of the works, about the position and depth of the mains, is approximate. Every possible precaution should be taken to avoid damage to STW Apparatus and will be responsible for the cost of repairing any loss and/or damage caused (including without limitation replacement parts).
- Water mains are normally laid at a depth of 900mm. No records are kept of customer service pipes which are normally laid at a depth of 750mm; but some idea of their positions may be obtained from the position of stop tap covers and their existence must be anticipated.
- During construction work, where heavy plant will cross the line of STW Apparatus, specific crossing points must be agreed with STW and suitably reinforced where required. These crossing points should be clearly marked and crossing of the line of STW Apparatus at other locations must be prevented.
- Where it is proposed to carry out piling or boring within 20 metres of any STW Apparatus, STW should be consulted to enable any affected STW Apparatus to be surveyed prior to the works commencing.
- Where excavation of trenches adjacent to any STW Apparatus affects its support, the STW Apparatus must be supported to the satisfaction of STW. Water mains and some sewers are pressurised and can fail if excavation removes support to thrust blocks to berde and other fittings.
- Where a trench is excavated crossing or parallel to the line of any STW Apparatus, the backfill should be adequately compacted to prevent any settlement which could subsequently cause damage to the STW Apparatus. In special cases, it may be necessary to provide permanent support to STW Apparatus which has been exposed over a length of the excavation before backfilling and reinstatement is carried out. There should be no concrete backfill in contact with the STW Apparatus.
- No other apparatus should be laid along the line of STW Apparatus irrespective of clearance. Above ground apparatus must not be located within a minimum of 3 metres either side of the centre line of STW Apparatus for smaller sized pipes and 6 metres either side for larger sized pipes without prior approval. No manhole or chamber shall be built over or around any STW Apparatus.
- A minimum radial clearance of 300 millimetres should be allowed between any plant or equipment being installed and existing STW Apparatus. We reserve the right to increase this distance where strategic assets are affected.
- Where any STW Apparatus coated with a special wrapping is damaged, even to a minor extent, STW must be notified and the trench left open until the damage has been inspected and the necessary repairs have been carried out. In the case of any material damage to any STW Apparatus causing leakage, weakening of the mechanical strength of the pipe or corrosion-protection damage, the necessary remedial work will be recharged to you.
- It may be necessary to adjust the finished level of any surface boxes which may fall within your proposed construction. Please ensure that these are not damaged, buried or otherwise rendered inaccessible as a result of the works and that all stop taps, valves, hydrants, etc. remain accessible and operable. Minor reduction in existing levels may result in conflict with STW Apparatus such as valve spindles or tops of hydrants housed under the surface boxes. Checks should be made during site investigations to ascertain the level of such STW Apparatus in order to determine any necessary alterations in advance of the works.
- You are advised that STW will not agree to either the erection of posts, directly over or within 1.0 metre of valves and hydrants.
- No explosives are to be used in the vicinity of any STW Apparatus without prior consultation with STW.

TREE PLANTING RESTRICTIONS


There are many problems with the location of trees adjacent to sewers, water mains and other STW Apparatus and these can lead to the loss of trees and hence amenity to the area which many people may have become used to. It is best if the problem is not created in the first place. Set out below are the recommendations for tree planting in close proximity to public sewers, water mains and other STW Apparatus.

- Please ensure that, in relation to STW Apparatus, the mature root systems and canopies of any tree planted do not and will not encroach within the recommended distances specified in the notes below.
- Both Poplar and Willow trees have extensive root systems and should not be planted within 12 metres of a sewer, water main or other STW Apparatus.
- The following trees and those of similar size, be they deciduous or evergreen, should not be planted within 6 metres of a sewer, water main or other STW Apparatus. E.g. Ash, Beech, Birch, most Conifers, Elm, Horse Chestnut, Lime, Oak, Sycamore, Apple and Pear. Asset Protection Statements Updated May 2014
- STW personnel require a clear path to conduct surveys etc. No shrubs or bushes should be planted within 2 metres of the centre line of a sewer, water main or other STW Apparatus.
- In certain circumstances, both STW and landowners may wish to plant shrubs/bushes in close proximity to a sewer, water main or other STW Apparatus for screening purposes. The following are shallow rooting and are suitable for this purpose: Blackthorn, Broom, Cotoneaster, Elder, Hazel, Laurel, Privet, Quickthorn, Snowberry, and most ornamental flowering shrubs.



APPENDIX F

GREENFIELD RUNOFF CALCULATIONS

RSK LDE Ltd		Page 1
18 Frogmore Road Hemel Hempstead Herts, HP3 9RT		
Date 23/04/2021 09:10 File	Designed By XXXXXXXXXX Checked By	
Elstree Computing Ltd	Source Control W.12.5	

ICP SUDS Mean Annual Flood

Input

Return Period (years)	25	Soil	0.400
Area (ha)	64.620	Urban	0.000
SAAR (mm)	839	Region Number	Region 8

Results 1/s

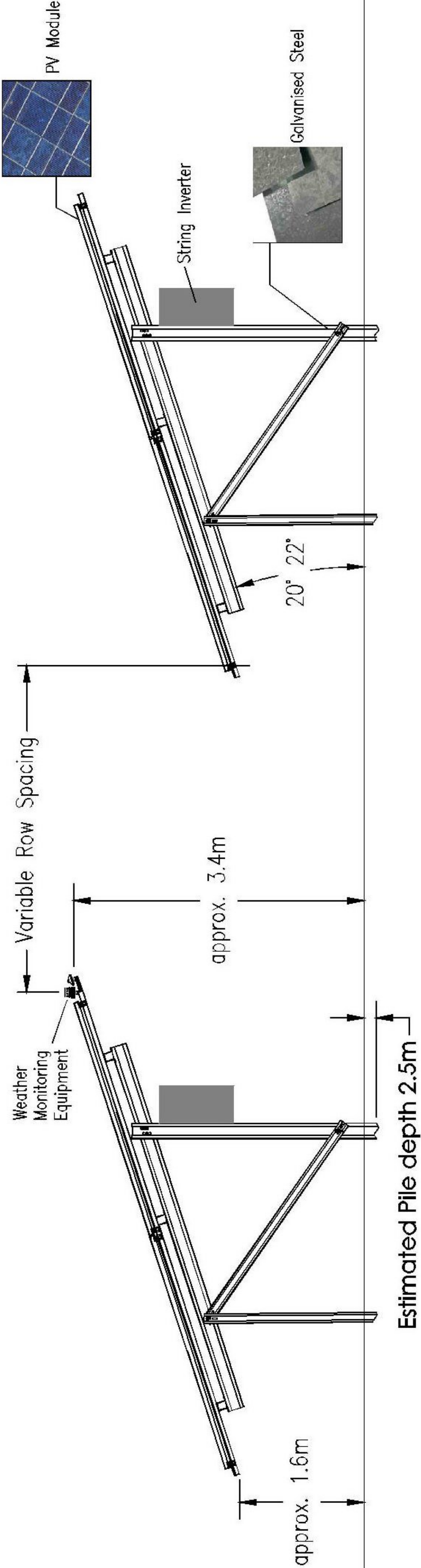
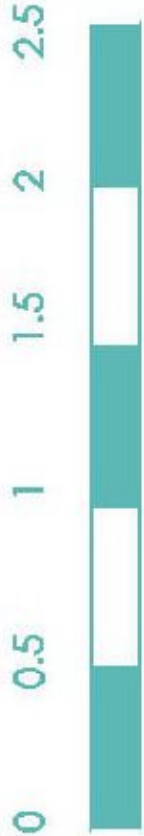
QBAR Rural	264.2
QBAR Urban	264.2
Q25 years	485.1
Q1 year	206.1
Q30 years	503.6
Q100 years	639.3

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APPENDIX G

MOUNTING SYSTEM TILT DIAGRAM



Rev:	Revision History:	Date:	By:
01	Initial Issue	22/01/2020	AK
02	Updated Dimensions	13/03/2020	AK
03	Layout revised / Locked	02/03/21	JA

35 and 35a The Mallings
Lower Chatham Trading Estate, T01 652 22490
Shepton Mallet,
Somerset BA4 5QE
United Kingdom

Est:ell@bbs-renewables.com
T01 652 22490
www.bbsrenewables.com

Project:	Worlds End Farm Solar Park
Location:	Worlds End Clapton, Berkeley, GL139RA
Title:	Mounting System
Scale:	1:50 @ A3
Issue Number:	Layout updated
Drawn By:	JA
Checked By:	MS
Approved By:	CH
Issue Date:	02/02/21
Checked Date:	02/02/21
Approved Date:	24/03/21



Drawing Number:
1650-0201-28

Drawn By: JA
Checked By: MS
Approved By: CH

Issue Date: 02/02/21
Checked Date: 02/02/21
Approved Date: 24/03/21

Drawing Status:
Approved

Issue:
03