HYDROGEO
Groundwater and Environment

Flood Risk Assessment

Field Meadow Farm, Hampton Bishop, Hereford

On Behalf of

MDM Farming

Quality Management

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1 Introduction

1.1 Background

This Flood Risk Assessment has been prepared by Hydrogeo Ltd to support a planning application at Field Meadow Farm, Hampton Bishop, Hereford. This FRA includes an assessment of the existing and proposed surface water drainage of the site.

This FRA has been carried out in accordance with guidance contained in the National Planning Policy Framework (NPPF)[1] and associated Planning Practice Guidance[2]. This FRA identifies and assesses the risks of all forms of flooding to and from the development and demonstrates how these flood risks will be managed so that the development remains safe throughout the lifetime, taking climate change into account.

It is recognised that developments which are designed without regard to flood risk may endanger lives, damage property, cause disruption to the wider community, damage the environment, be difficult to insure and require additional expense on remedial works. The development design should be such that future users will not have difficulty obtaining insurance or mortgage finance, or in selling all or part of the development, as a result of flood risk issues.

1.2 National Planning Policy Framework (NPPF)

One of the key aims of the NPPF is to ensure that flood risk is taken into account at all stages of the planning process; to avoid inappropriate development in areas at risk of flooding and to direct development away from areas of highest risk.

It advises that where new development is exceptionally necessary in areas of higher risk, this should be safe, without increasing flood risk elsewhere, and where possible, reduce flood risk overall.

A risk based approach is adopted at stages of the planning process, applying a source pathway receptor model to planning and flood risk. To demonstrate this, an FRA is required and should include:

- whether a proposal is likely to be affected by current or future flooding from all source;
- whether it will increase flood risk elsewhere;
- whether the measures proposed to deal with these effects and risks are appropriate;
- if necessary provide the evidence to the LPA that the Sequential Test can be applied; and
- whether the development will be safe and pass part c) of the Exception Test if this is appropriate.

[1] Department for Communities and Local Government (2012) National Planning Policy Framework.

[2] Communities and Local Government (2014) Planning Practice Guidance - Flood Risk and Coastal Change.

1.3 Report Structure

This FRA has the following report structure:

- Section 2 details the sources of information that have been consulted;
- Section 3 describes the location area and the existing and proposed development;
- Section 4 outlines the flood risk to the existing and proposed development;
- Section 5 details the proposed surface water drainage for the site and assesses the potential impacts of the proposed development on surface water drainage;
- Section 6 outlines the required mitigation measures;
- Section 7 details the sequential and exception tests; and
- Section 8 presents a summary and conclusions.

2 Sources of Information

2.1 Discussion with Regulators

Consultation and discussions with the relevant regulators have been undertaken during the preparation of this FRA including with the Environment Agency, the Local Planning Authority (LPA), the Lead Local Flood Authority (LLFA) and Sewerage Undertakers.

2.1.1 Environment Agency

The Flood and Water Management Act 2010 gives the Environment Agency a strategic overview role for all forms of flooding and coastal erosion. They also have direct responsibility for the prevention, mitigation and remediation of flood damage for main rivers and coastal areas. The Environment Agency is the statutory consultee with regards to flood risk and planning.

Environment Agency Flood Risk Standing Advice for England, the NPPF and the Practice Guidance to the NPPF has been consulted and reviewed during this FRA. This has confirmed the level of FRA required and that a surface water drainage assessment is to be undertaken.

Information regarding the current flood risk at the site, local flood defences and flood water levels has been obtained from the Environment Agency (see Appendix 1).

2.1.2 Herefordshire Council

Herefordshire Council is the LPA and the Lead Local Flood Authority (LLFA) and has responsibilities for 'local flood risk', which includes surface runoff, groundwater and ordinary watercourses. Planning guidance written by Herefordshire Council regarding flood risk was consulted to assess the mitigation policies in place.

The Herefordshire Council Strategic Flood Risk Assessment (SFRA) and Herefordshire Council Preliminary Flood Risk Assessment (PFRA) which cover the site have been reviewed.

2.1.3 Dwr Cymru/Welsh Water

Dwr Cymru/Welsh Water is responsible for the disposal of waste water and supply of clean for this area. Information with regards to sewer and water main flooding contained within the Herefordshire Council SFRA and the Herefordshire Council PFRA have been consulted. All Water Companies have a statutory obligation to maintain a register of properties/areas which are at risk of flooding from the public sewerage system, and this is shown on the DG5 Flood Register.

3 Location & Development Description

3.1 Site Location

The site is located at Field Meadow Farm, Hampton Bishop, Hereford (see Drawing 1). The National Grid Reference (NGR) of the site is 354114, 238747. Field Meadow Farm is a small farm of approximately 80 acres to the south east of Hereford, in the Parish of Hampton Bishop in Herefordshire. The site is accessed from the north via an access road off the B4224.

3.2 Existing Development

The site currently comprises a series of low level timber and steel framed agricultural buildings. The buildings are used for storage and agricultural purposes.

3.3 Proposed Development

It is understood that the proposals are for a change of use planning application. A number of the existing dilapidated and functionally obsolescent buildings are to be demolished and then replaced with metal shipping containers to be used as storage (see Appendix 2). The site proposals include a site office, access and roadways. It is proposed that the shipping containers will be located 0.50m or 500mm above ground levels on concrete plinths.

3.4 Ground Levels

A topographical survey of the site has recently been completed (see Appendix 3). Site levels gradually fall moving south across the site from 48.60 metres Above Ordnance Datum (mAOD to 48.49mAOD. The finished floor level of the existing buildings are 48.47mAOD to 48.51mAOD.

The site access road from the north has a ground level from 48.61mAOD to 48.40mAOD. The ground level of the B4224 rises to the west of the site with a ground level at the site entrance of 48.61mAOD.

3.5 Catchment Hydrology

The River Wye is located to the south of the site and a drainage ditch is located to the west of the site (see Drawing 1). A flood embankment, known as The Stank, is located to the south of the site, between the site and the River Wye, the drainage ditch discharges through the embankment via a culvert with a flapped outfall.

3.6 Geology

The British Geological Survey (BGS) Map indicates that the bedrock underlying the site consists of the Raglan Mudstone Formation – siltstone and mudstone, interbedded. The superficial deposits consist of Alluvium - Clay, Silt, Sand and Gravel.

BGS borehole records near to the site record firm to stiff brown sandy silty clay underlain by dense brown fine to medium subrounded gravel with some sandy silty clay which is then underlain by very stiff red brown silty clay to depths of 6.50m below ground level (mbgl).

3.7 Groundwater

The Environment Agency has designated the bedrock and superficial deposits as Secondary A Aquifers - permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

BGS borehole records near to the site (<350m to the north west) prove that the upper strata beneath the site comprises alluvial clays, silts and gravels and a shallow groundwater level was present at around 3.5mbgl during Summer (August) 1989. It is likely that shallow groundwater will be closer to ground surface in the alluvium deposits during Autumn, winter and spring.

3.8 Source Protection Zone

The site is not located within a Natural Resources Wales Source Protection Zone.

3.9 Soil

Information from the National Soil Resource Institute[3] details the site area as being situated on freely draining floodplain soils which drain to local groundwater feeding into rivers. The Flood Studies Report WRAP soil map classification is Type 3: i) Relatively impermeable soils in boulder and sedimentary clays, and in alluvium, especially in eastern England; ii) Permeable soils with shallow ground water in low-lying areas; and iii) Mixed areas of permeable and impermeable soils, in approximately equal proportions.

3.10 Permeability/Infiltration Rate

In determining the future surface runoff from the site, the potential of using infiltration devices has been considered. An overview of the general ground conditions (see Sections 3.6 to 3.9) may be used to gauge if there is potential for their application. The general ground conditions suggest that the permeability and infiltration rate of the site will be low to moderate.

However, due to the close proximity of the site to the River Wye and adjacent drainage ditch it is likely that groundwater levels will prohibit the use of infiltration devices such as soakaways. Also, due to the lack of suitable space for infiltration devices will further prohibit their use.

Whilst this should ideally be confirmed by a site investigation into the hydrogeology of the site, the ground conditions in the area support the conclusion that infiltration techniques are unlikely to work and will not provide a suitable option at the site.

If an infiltration system is proposed, it is recommended that a series of infiltration/soakaway tests are carried out on site to BRE Digest 365 Guidelines to confirm the assumptions made in the calculations. Such work is beyond the scope of this FRA, but should be undertaken to inform the detailed drainage strategy for the site.

[3] https://www.landis.org.uk/soilscapes/

4 Flood Risk

4.1 Climate Change

Projections of future climate change in the UK indicate more frequent, short-duration, high intensity rainfall and more frequent periods of long duration rainfall. Guidance included within the NPPF recommends that the effects of climate change are incorporated into FRA. Recommended precautionary sensitivity ranges for peak rainfall intensities and peak river flows are outlined in the associated Planning Practice Guidance to the NPPF[4].

Table 4.1 shows peak river flow allowances by river basin district and Table 4.2 shows the anticipated changes in extreme rainfall intensity in small and urban catchments.

The flood risk assessments: climate change allowances guidance recommends that for 'less vulnerable' uses in Flood Zone 3a that the Central to Higher central are used to assess a range of allowances over the life time of the proposed development.

There is reasonable level of certainty that the future impacts of climate change will lie somewhere between the Central and Upper allowances. Therefore, given the scale of the development it is felt that mitigation measures should be determined and planned for in the scheme up to the Higher central allowance, with sensitivity testing completed against the Upper allowance to understand potential impacts and any 'cliff-edge' effects, where the flooding consequences of the Upper allowance may shift and become extremely severe.

Table 4.1 - Peak River Flow Allowances by River Basin District (use 1961 to 1990 baseline)

River Basin District	Allowance category	**2015 to 2039**	**2040 to 2059**	**2060 to 2115**
Severn	Upper end	25%	40%	70%
	High central	15%	25%	35%
	Central	10%	20%	25%

Table 4.2 - Peak Rainfall Intensity Allowance in Small and Urban Catchment (use 1961 to 1990 baseline)

Allowance category	**2015 to 2039**	**2040 to 2059**	**2060 to 2115**
Upper end	+ 10%	+ 20%	+ 40%
Central	+ 5%	+ 10%	+ 20%

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

4.2 Sources of Flooding

All sources of flooding have been considered, these are; Fluvial (river) Flooding, Tidal (coastal) Flooding, Groundwater Flooding, Surface Water (pluvial) Flooding, Sewer Flooding and Flooding from Artificial Drainage Systems/Infrastructure Failure.

The key consequences of flooding are death/personal injury, extensive damage to property, properties uninhabitable for long periods, properties cannot be sold, insurance unavailable or too expensive, expense of installing flood resilience measures and business interruptions.

4.2.1 Fluvial (river) Flooding

River Wye

Fluvial flood risk from the River Wye poses the primary flood risk to the site. Table 4.3 shows the Environment Agency modelled fluvial water levels for the site. Modelled water levels for the 1 in 2 year, 1 in 5 year, 1 in 10 year, 1 in 20 year, 1 in 30 year, 1 in 50 year, 1 in 75 year, 1 in 100 year, 1 in 100 year (+20%), 1 in 200 year, 1 in 500 year and 1 in 1000 year events have been provided (see Appendix 1).

To account for the effects of climate change throughout the lifetime of the development, which is 60 years as per Environment Agency guidance, the increase in water level between the 1 in 100 year and 1 in 100 year (+20%) event has been calculated per 1% of climate change increase and then pro-rated over a 25% and 35% increase in climate change.

The modelled water levels have been compared to the ground level of the site and areas within the vicinity of the site to assess the flood risk at the site in detail. Using the most conservative approach the modelled water levels from node 283 has been used to assess the flood risk to the site (highlighted in yellow).

Table 4.3 - River Wye Modelled Water Levels (source Environment Agency)

Node	2	5	10	20	50	75	100	100 (+20%)	100 (+25%)	100 (+35%)	200	1000
283	47.86	48.13	48.31	48.42	48.59	48.76	48.87	49.25	49.35	49.54	49.13	49.70
284	47.82	48.08	48.22	48.33	48.51	48.69	48.80	49.19	49.29	49.48	49.07	49.65
285	47.77	48.02	48.17	48.28	48.51	48.69	48.81	49.18	49.27	49.46	49.07	49.61
286	47.72	47.99	48.15	48.26	48.46	48.62	48.73	49.08	49.17	49.34	48.98	49.49
287	47.76	48.04	48.21	48.31	48.49	48.65	48.76	49.10	49.19	49.36	48.99	49.50
288	47.69	47.99	48.17	48.28	48.47	48.63	48.74	49.08	49.17	49.34	48.98	49.49

Actual Risk

A flood embankment known as The Stank is located on this section of the River Wye and provides protection against flooding (see Section 4.4) which reduces the flood risk posed to the site. The Standard of Protection (SoP) of the flood defences within the vicinity of the site is 1 in 100 years with various freeboards.

The Environment Agency flood outlines confirm that the site will not be inundated with floodwater for all events up to and including 1 in 1000 year event (see Appendix 1). The actual risk of flooding during a fluvial flood event on the River Wye is reduced compared to the extent of flooding shown in the Environment Agency Flood Zones. The actual risk posed to the site is low with a chance of flooding of less than 1 in 1000 (0.1%) years.

Residual Risk

Considerable investment has been made in the provision of the flood defences to protect the site from fluvial flooding. However, the flood defences can only protect up to a point, they may malfunction, can be overtopped/breached and have a finite structure life. Therefore, there is a residual risk of fluvial flooding. The condition of the flood defences is good to fair therefore; it is unlikely that a breach in the flood defences would occur.

If the flood defences were not there, the area may be flooded. However, an area of land may benefit from the presence of flood defences even if the flood defences are overtopped/breached, the presence of the flood defences means that the floodwater does not extend as far as it would if the flood defences were not there.

The actual risk of flooding caused by overtopping/breaching of the defences during a fluvial flood event on the River Wye will be reduced compared to the extent of flooding shown in the Environment Agency Flood Zones.

Water Levels have been modelled at 48.42mAOD during the 1 in 20 year event and the minimum site ground level is 48.49mAOD. Therefore, the site will not be inundated with floodwater during the 1 in 20 year event. The site will be flood free during the 1 in 20 year event.

Water levels at this location have been modelled at 48.87mAOD, 49.35mAOD and 49.54mAOD during the 1 in 100 year, 1 in 100 year (+25%) and 1 in 100 year (+35%) events respectively. Therefore, the site may be inundated with floodwater to a maximum water depth of 0.38m, 0.86m and 1.05m during the 1 in 100 year, 1 in 100 year (+25) and 1 in 100 year (+35%) events respectively.

Water levels at this location have been modelled the 1 in 1000 year event. Therefore, the site may be inundated with floodwater to a maximum water depth of 1.21m during the 1 in 1000 year event.

However, the proposed contained units will be raised by 0.50m or 500mm above the exiting ground level, normally the container units are only raised by 0.30m or 300mm above ground levels. Therefore, the container units will have a finished floor level of 48.97mAOD, which provides a freeboard of 0.10m (100mm) above the 1 in 100 year event. Therefore, the container units will be flood free during the 1 in 100 year event.

The mechanism for flooding from the River Wye is generally prolonged episodes of heavy rainfall, which affords good time for flood warnings to be issued. The likelihood of a rapid river level rise within the River Wye and possible rapid inundation of urban areas posing a risk to life is considered to be minimal. This is primarily due to the large River Wye system and its substantial upper contributing catchment area which allows the Environment Agency, with its current flood warning system, to provide forewarning of two (2) days of a pending flood event.

The site is located within a low risk area where the onset of flooding is very gradual (many hours) as per Flood Risk Assessment Guidance for New Development Phase 2, R&D Technical Report FD2320/TR2.

Therefore, the risk of flooding from the fluvial sources is considered to be of **medium significance**. The risk of fluvial flooding will be further managed and mitigated by using a number of property level protection measures to manage and reduce the overall flood risk at the site (see Section 6.0).

Drainage Ditch

A drainage ditch is located to the west of the site (see Drawing 1). The drainage ditch discharges through the flood embankment (The Stank) via a culvert with a flapped outfall. This provides protection against flooding by stopping water backing up the drainage ditch which reduces the flood risk posed to the site. The drainage ditch can back up along the length immediately below The Stank but never comes up to the flapped outfall.

The flood risk can be considered to be limited due to the difference in elevations. The ground levels of the site are a minimum of 0.50m above the normal water level of the drainage ditch. Flood risk to the site from the drainage ditch can also be considered to be limited, since the drainage ditch is located on the boundary of the site. Any overbank flow would follow the contours of the surrounding area and would flow directly away from the site rather than flowing towards the site.

Therefore, the risk of flooding from the fluvial sources is considered to be of **low significance**. The risk of fluvial flooding will be further managed and mitigated by using a number of property level protection measures to manage and reduce the overall flood risk at the site (see Section 6.0).

4.1.2 Tidal (coastal) Flooding

The site is not located within the vicinity of tidal flooding sources and the risk of tidal flooding is considered to be **not significant**. Therefore, flooding from this source has not been considered further within this FRA.

4.1.3 Groundwater Flooding

Groundwater flooding is defined as the emergence of groundwater at the ground surface or the rising of groundwater into man-made ground under conditions where the normal range of groundwater levels is exceeded.

Groundwater flooding tends to occur sporadically in both location and time. When groundwater flooding does occur, it tends to mostly affect low-lying areas, below surface infrastructure and buildings (for example, tunnels, basements and car parks) underlain by permeable rocks (aquifers).

Site ground conditions suggest the risk from groundwater flooding is low. There are no historical records of groundwater flooding at or within the vicinity of the site. Also, no below surface infrastructure and buildings are located or are proposed for the site.

Therefore, the risk of flooding from groundwater flooding is considered to be **not significant**. Therefore, flooding from this source has not been considered further within this FRA.

4.1.4 Surface Water (pluvial) Flooding

Surface water flooding tends to occur sporadically in both location and time such surface water. The site is not situated on and adjacent to areas of permeability and areas with geology which may result in surface water flooding.

The Environment Agency Surface Water flood map shows that the site has a low risk of surface water flooding with chance of flooding of less than 1 in 1000 (0.1%) years (see Drawing 2).

The risk of flooding from surface water flooding is considered to be **not significant**. Therefore, flooding from these sources has not been considered further within this FRA.

4.1.5 Sewer Flooding

Sewer flooding occurs when urban drainage networks become overwhelmed and maximum capacity is reached. This can occur if there is a blockage in the network causing water to back up behind it or if the sheer volume of water draining into the system is too great to be handled. Sewer flooding tends to occur sporadically in both location and time such flood flows would tend to be confined to the streets around the development.

There are no existing sewers located within the vicinity of the site; therefore, the site is not at risk of sewer flooding. The risk of flooding from sewers is considered to be **not significant**. Therefore, flooding from these sources has not been considered further within this FRA.

4.1.6 Flooding from Artificial Drainage Systems/Infrastructure Failure

Claerwen reservoir (NGR 286919, 263645) is located upstream of the site. The Environment Agency Reservoir flood map shows that the site is at risk of reservoir flooding (see Drawing 3). This map shows the largest area that might be flooded if a reservoir were to fail and release the water it holds.

The Environment Agency Reservoir flood map has been prepared for emergency planning purposes and for this reason they reflect a worst case scenario. Since this is a prediction of a worst case scenario, it's unlikely that any actual flood would be this large.

Reservoir flooding is extremely unlikely; reservoirs in the UK have a very good safety record. There has been no loss of life in the UK from reservoir flooding since 1925. Since then reservoir safety legislation has been introduced to make sure reservoirs are well maintained.

A flood plan should have been developed for the reservoirs which includes: identifying the extent and severity of flooding which could result from an uncontrolled release of water (i.e. breaching or failure), an on-site plan setting out what the undertaker would do in an emergency to try and contain and limit the effects of the incident and a communication plan with external organisations, mainly the emergency services.

The hazard is well managed through effective legislation and it is unlikely that the impact zone downstream of the identified reservoirs should preclude the proposed development. The risk of flooding from reservoir flooding is considered to be **not significant**. The risk from this source will be further mitigated by using a number of property level protection measures to manage and reduce the overall flood risk at the site (see Section 6.0).

4.3 Historic Flooding

The Environment Agency historical flood outlines show that the site did not flood during the April 1947, December 1960 or July 2007 flood events (see Appendix 1). There are no records of anecdotal information of flooding at the site. The British Hydrological Society "Chronology of British Hydrological Event[5]" has no information on flooding within

[5] http://www.dundee.ac.uk/geography/cbhe/

the vicinity of the site. No other historical records of flooding for the site have been recorded. Therefore, it has been assumed that the site has not historically flooded.

However, the village of Hampton Bishop has historically flooded most recently in December 1960, July 2007 and February 2014.

4.4 Existing and Planned Flood Defence Measures

A flood embankment, known as The Stank, is located to the south of the site, between the site and the River Wye. This is marked on the Environment Agency Flood Zone Map (see Drawing 4), which shows the extent of fluvial flood risk in this area.

Recent work to raise these defences has given it a SoP of 1 in 100 years with various freeboards. This means that it is expected to protect Hampton Bishop from any flood with a return period of up to that value.

Therefore, the site would not be inundated with floodwater for all events up to and including the 1 in 100 year event. However, he Environment Agency flood outlines confirm that the site will not be inundated with floodwater during the 1 in 1000 year event (see Appendix 1). The actual risk posed to the site is low with a chance of flooding of less than 1 in 1000 (0.1%) years.

The Herefordshire County Council SFRA states that the flood defences are ancient in origin but is periodically reconstructed and repaired. The Herefordshire County Council SFRA confirms that the defences have been breached on several occasions, most notably and recently in July 2007. This most recent breach caused significant damage and led to people being evacuated from properties within Hampton Bishop.

A flapped outfall is located at the downstream limit of the drainage ditch culvert, where it discharges through the flood embankment (The Stank). This provides protection against flooding by stopping water backing up the drainage ditch which reduces the flood risk posed to the site. The drainage ditch can back up along the length immediately below The Stank but never comes up to the flapped outfall.

Further risk management measures will be used to protect the site from flooding these are discussed in Section 6.0.

4.5 Environment Agency Flood Zones

A review of the Environment Agency's Flood Zones indicates that the site is located within Flood Zone 3 and therefore has a 'high probability' of fluvial flooding, with a 1 in 100 or greater annual probability of river flooding (>1%) in any year (see Drawing 4).

The site is not located within Flood Zone 3b – Functional Floodplain. The site will not be inundated with floodwater during the 1 in 20 year event. The Environment Agency flood outlines confirm that the site will not be inundated with floodwater during the 1 in 20 year event (see Appendix 1). The site will be flood free during the 1 in 20 year event.

Also within the Planning Practice Guidance to the NPPF, Flood Zone 3b – Functional Floodplain is defined as: *'This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency'.* The definition in the Planning Practice Guide to the NPPF allows flexibility to make allowance for local circumstances and should not be defined on rigid probability parameters. It is essential to balance the need to ensure long term

sustainability (i.e. taking into account the fact that these areas will be flooded) against the importance of avoiding possible 'blight' in existing communities as a result of onerous planning conditions. Developed areas are not generally part of the functional floodplain.

The B4224 adjacent to the site entrance is located within Flood Zone 2 and therefore, has a 'medium probability' of fluvial flooding with between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) in any year (see Drawing 4).

The Flood Zones are the current best information on the extent of the extremes of flooding from rivers or the sea that would occur without the presence of flood defences, because these can be breached, overtopped and may not be in existence for the lifetime of the development. The Flood Zones show the worst case scenario.

The Environment Agency Flood Zones and acceptable development types are explained in Table 4-4. Table 4-4 shows that some development types are generally acceptable in Flood Zone 3a.

4.6 Flood Vulnerability

In the Planning Practice Guidance, appropriate uses have been identified for the Flood Zones. Applying the Flood Risk Vulnerability Classification in the Planning Practice Guidance, the existing and proposed development is classified as 'less vulnerable'.

Therefore, the vulnerability of the site will not change as part of the planning application. The proposals do not constitute a change from a 'less vulnerable' use to a 'more vulnerable' use. The proposed development will not therefore increase the vulnerability of the development or introduce new development into the Flood Zone.

The proposed development will actually reduce the vulnerability of the site to flooding. The proposed development will improve the sites resilience, resistance to flooding and by using property level protection measures to protect the site from flooding the vulnerability of the site will be improved (see Section 6.0).

Table 4-5 of this report and the Planning Practice Guidance state that 'less vulnerable' uses are appropriate within Flood Zone 3a after the completion of a satisfactory FRA.

Table 4-4 Environment Agency Flood Zones and Appropriate Land Use.

Flood Zone	Probability	Explanation	Appropriate Land Use
Zone 1	Low	Less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%)	All development types generally acceptable
Zone 2	Medium	Between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% 0.1%) in any year	Most development type are generally acceptable
Zone 3a	High	A 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year	Some development types not acceptable
Zone 3b	'Functional Floodplain'	Land where water has to be flow or be stored in times of flood. SFRAs should identify this zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1% flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes)	Some development types not acceptable

Table 4-5 Flood Risk Vulnerability and Flood Zone 'Compatibility'

Flood Risk Vulnerability Classification	**Essential Infrastructure**	**Water Compatible**	**Highly Vulnerable**	**More Vulnerable**	**Less Vulnerable**
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	✓	Exception test required	✓	✓
Zone 3a	Exception test required	✓	×	Exception test required	✓
Zone 3b 'Functional Floodplain'	Exception test required	✓	×	×	×

Key:

✓: Development is appropriate, ×: Development should not be permitted.

4.7 Site Specific Flood Risk Assessment

A summary of the sources of flooding and a review of the risk posed by each source at the site is shown in Table 4-6.

Table 4-6 Risk Posed by Flooding Sources

Sources of Flooding	Potential Flood Risk	Potential Source	Probability/Significance
Fluvial (river) Flooding	Yes	River Wye Drainage Ditch	Medium Low
Tidal (coastal) Flooding	No	None Reported	Not significant
Groundwater Flooding	No	None Reported	Not significant
Surface Water (pluvial) Flooding	No	None Reported	Not significant
Sewer Flooding	No	None Reported	Not significant
Flooding from Artificial Drainage Systems/Infrastructure Failure	No	None Reported	Not significant

The site is unlikely to flood except in extreme conditions. The primary, but unlikely, flood risk to the site is from fluvial flooding from the River Wye however, the flood defence measures identified are expected to afford the site significant protection from fluvial flooding. The flood defences provide a 1 in 100 year SoP. However, the Environment Agency flood outlines confirm that the site will not be inundated with floodwater during the 1 in 1000 year event. The actual risk of flooding during a fluvial flood event on the River Wye is reduced compared to the extent of flooding shown in the Environment Agency Flood Zones. The actual risk posed to the site is low with a chance of flooding of less than 1 in 1000 (0.1%) years.

The flood risk posed to the site from fluvial flooding is of a residual flood risk and would only occur if the flood defences were to be overtopped/breached. The site will not be inundated with floodwater during the 1 in 20 year event. The site will be flood free during the 1 in 20 year event.

However, the site may be inundated with floodwater during the 1 in 100 year or greater event. The proposed contained units will be raised by 0.50m or 500mm above the exiting ground level. Therefore, the container units will have a finished floor level of 48.97mAOD, which provides a freeboard of 0.10m (100mm) above the 1 in 100 year event. The container units will be flood free during the 1 in 100 year event.

Therefore, the risk of flooding from the River Wye is considered to be of **medium significance**. A secondary flooding source has been identified which may pose a **low significant** risk to the site. This is:

- Fluvial flooding – drainage ditch

The existing and proposed development is classified as 'less vulnerable'. 'Less vulnerable' and more vulnerable' uses are appropriate in Flood Zone 3a. The vulnerability of the site will not change as part of the planning application. The proposals do not constitute a change from a 'less vulnerable' use to a 'more vulnerable' use. The proposed development will not therefore increase the vulnerability of the development or introduce new development into the Flood Zone.

The proposed development will actually reduce the vulnerability of the site to flooding. The proposed development will improve the sites resilience, resistance to flooding and by using property level protection measures to protect the site from flooding the vulnerability of the site will be improved.

The proposed development will have no impact on the movement of floodwater across the site. The overall direction of the movement of water will be maintained within the developed site and surrounding area. The conveyance routes (flow paths) will not be blocked or obstructed. There will be no increase in the flood water levels due to the proposed development.

Paragraph 10[6] of the Technical Guidance to the NPPF confirms that minor developments such as this are unlikely to raise significant flood risk issues.

The overall risk of flooding at the site, assuming flood defence measures fail and/or are overtopped is medium however, there are existing flood defence measures that protect the site and further property level protection measures are used to managed and mitigate the flood risk to a low level of flood risk.

The chance of flooding each year is less than 0.1% (1 in 1000 years). This takes into account the effect of any flood defences that may be located within the vicinity of the site as well property level protection measures.

[6] Paragraph 10 of the Technical Guidance to the NPPF confirms that minor developments are:
- Minor non-residential extensions: industrial/commercial/leisure etc. extensions with a footprint less than 250m^2.
- Alterations: development that does not increase the size of buildings e.g. alterations to the external appearance.
- Householder development: e.g. sheds, garages, games rooms etc. within the curtilage of the existing dwelling in addition to physical extensions to the existing dwelling itself. This definition excludes any proposed development that would create a separate dwelling within the curtilage of the existing dwelling e.g. subdivision of houses into flats.

5 Surface Water Drainage

5.1 Surface Water Management Overview

It is recognised that consideration of flood issues should not be confined to the floodplain. The alteration of natural surface water flow patterns through developments can lead to problems elsewhere in the catchment, particularly flooding downstream. For example, replacing vegetated areas with roofs, roads and other paved areas can increase both the total and the peak flow of surface water runoff from the development site. Changes of land use on previously developed land can also have significant downstream impacts where the existing drainage system may not have sufficient capacity for the additional drainage.

A surface water management strategy for the site proposals has been developed to manage and reduce the flood risk posed by the surface water runoff from the site. An assessment of the surface water runoff rates has been undertaken, in order to determine the surface water options and attenuation requirements for the site. The assessment considers the impact of the development compared to current conditions. Therefore, the surface water attenuation requirement for the developed site can be determined and reviewed against existing arrangements.

The requirement for managing surface water runoff from developments depends on the pre-developed nature of the site. If it is an undeveloped greenfield site, then the impact of the development will need to be mitigated so that the runoff from the site replicates the natural drainage characteristics of the pre-developed site. In the case of brownfield sites, drainage proposals will be measured against the existing performance of the site, although it is preferable for solutions to provide runoff characteristics that are similar to greenfield behaviour.

The surface water drainage arrangements for any development site should be such that the volumes and peak flow rates of surface water leaving a developed site are no greater than the rates prior to the proposed development, unless specific off-site arrangements are made and result in the same net effect.

It should be acknowledged that the satisfactory collection, control and discharge of surface water runoff are now a principle planning and design consideration. This is reflected in recently implemented guidance and the recently released National Sustainable Drainage Systems (SUDS) Standards. It is necessary to demonstrate that the surface water from the proposed development can be discharged safety and sustainably.

5.2 Opportunities for Discharge of Surface Water

There are four possible options to discharge the surface water runoff in accordance with the requirements the Defra non-statutory technical standards for SUDS. The Runoff Destination is (in order of preference):

a. To ground;

b. To surface water body;

c. To road drain or surface water sewer;

d. To combined sewer

It is necessary to identify the most appropriate method of controlling and discharging surface water. The design should seek to improve the local runoff profile by using systems that can either attenuate runoff and reduce peak flow rates or positively impact on the existing surface water runoff.

5.2.1 Discharge to Ground

In determining the future surface runoff from the site, the potential of using infiltration devices has been considered. The ground conditions suggest infiltration techniques will not work and will not provide a suitable option at the site (see Section 3.11).

5.2.2 Discharge to a Water Body

Should infiltration be found to be unsuitable, the next option is discharge to a watercourse. It is understood that the site is currently drained via a positive system to the adjacent drainage ditch. At this stage, it is anticipated that the surface water runoff will be discharged to this watercourse. This option should be explored further.

5.2.3 Discharge to Sewers

In the event that discharge of surface water via infiltration or discharge to a watercourse is deemed unsuitable, then discharge to the public sewer may be possible. However, due to the distance between the site and any public sewers this option has been deemed as impractical at this stage. If required, this option should be explored further.

5.3 Site Areas

It is understood that the existing drainage infrastructure at the site efficiently and effectively manages surface water runoff generated at the site. It is understood that the site is currently drained via a positive system to the adjacent drainage ditch. The existing buildings are to be demolished and replaced with metal shipping containers for the use as storage containers.

Table 5-1 shows that the pre-development site is constructed from 0.2150ha (100%) of impermeable surfaces with 0.00ha (0%) of permeable surfaces. The ground surface underneath the proposed containers units and the roadways will be constructed from semi-permeable surfaces rather than sealed concrete or tarmac which will allow some infiltration of rainfall which will result in a decrease in the surface water runoff rates and volumes post-development. The area beneath the container units will total 0.0758ha and the semi-permeable hardstanding areas will total 0.0836ha for a total permeable area of 0.1594ha.

The post-development site will be constructed from 0.0556ha (26%) of impermeable surfaces with 0.1594ha (74%) permeable surfaces. The proposed development will increase the permeable areas of the site by 0.1594ha or 76%. The proposed development will decrease the impermeable area and will therefore, generate lower surface water runoff rates and volumes post-development. The proposed increase in the amount of semi-permeable surfaces allows flow attenuation by infiltration of runoff and evaporation.

Table 5-1 Site Areas (ha).

Element	Pre-application	Post-application	Difference
Permeable Surfaces	0.0000 (000m^2)	0.1594 (1,594m^2)	+ 0.1594 (1,594m^2)
Impermeable Surfaces	0.2150 (2,150m^2)	0.0556 (556m^2)	- 0.0556 (556m^2)
Total	**0.2150 (2,150m^2)**	**0.2150 (2,150m^2)**	------

5.4 Surface Water Runoff

An estimation of runoff is required to permit effective site water management and prevent any increase in flood risk to off-site receptors. The SUDS Manual recommends the use of Institute of Hydrology Report No. 124 (IoH124)[7] for site runoff calculations for sites less than 50ha but a recent Environment Agency Research & Development report[8] recommends that this method should no longer be used.

Using rainfall data calculated using rainfall depth-duration-frequency (DDF) modelling within the Flood Estimation Handbook (FEH) CD-ROM[9], the potential surface water runoff generated from the site during the 1 in 1, 1 in 2, 1 in 30 and 1 in 100 year rainfall events with different storm duration. The Rational Method has been used to calculate the runoff from the impermeable surfaces. The flow rate as given by the Rational Method is:

Q = 2.78 x C x rainfall intensity x impermeable area

C is the runoff coefficient which varies for different surfaces, for the impermeable surfaces, it has been assumed that 100% runoff will occur and for the semi-permeable surfaces, it has been assumed that 80% will occur.

The method used for calculating the runoff complies with the NPPF, as well as the new Defra non-statutory technical standards for SUDS, and assumes that the excess runoff associated with the proposed development (plus an allowance for future climate change) will need to be managed.

Table 5-2 and 5-3 show the surface water runoff from the post-application site will be less than the pre-application site. The surface water runoff from the developed site will be 15% less, during all events, post-application compared to pre-application. There will be no increase in surface water run-off or exacerbation of off-site risk as a result of the development.

To provide betterment compared to the existing situation the surface water runoff from the site will be reduced by 15% due to the reduction in impermeable area therefore, reducing the risk of flooding to the site and off-site locations.

In accordance with The SUDS Manual, the Greenfield run-off from the site (i.e. from the site if it was entirely permeable) has been calculated using the IoH124 method. QBAR (rural) has been calculated to be 0.48l/s for the whole site area of 0.21ha.

[7] Institute of Hydrology Report No. 124, Flood Estimation for Small Catchments.
[8] Estimating flood peaks and hydrographs for small catchments: Phase 1, SC090031, June 2012.
[9] NERC (2009) WINFAP-FEH CD-ROM version 3.0.

Table 5-2 Existing Surface Water Runoff Rates.

Return Period (yrs)	Storm Duration							
	15 min	30 min	1 hr	2 hr	4 hr	6 hr	8 hr	10 hr
1	1.97	2.63	3.47	4.60	6.16	8.31	8.13	8.97
2	4.00	5.14	6.51	8.31	10.64	20.50	13.57	14.64
30	11.24	13.51	16.26	19.60	23.55	43.70	28.39	30.12
100	17.03	20.02	23.55	27.67	32.51	59.40	38.19	40.23

Table 5-3 Proposed Surface Water Runoff Rates.

Return Period (yrs)	Storm Duration							
	15 min	30 min	1 hr	2 hr	4 hr	6 hr	8 hr	10 hr
1	1.68	2.24	2.95	3.92	5.24	7.08	6.92	7.64
2	3.41	4.38	5.55	7.08	9.06	10.44	11.56	12.47
30	9.57	11.51	13.85	16.70	20.06	22.25	24.18	25.66
100	14.51	17.05	20.06	23.57	27.69	30.24	32.53	34.26
100+20%	17.41	20.46	24.07	28.28	33.23	36.29	39.04	41.11
100+40%	20.31	23.88	28.08	33.00	38.77	42.33	45.54	47.96

5.5 SUDS and Water Quality

Current guidance promotes sustainable water management through the use of SUDS. SUDS measures should be used to control the surface water runoff from the proposed development site therefore, managing the flood risk to the site and surrounding areas from surface water runoff.

One of the aims of the NPPF is to provide not only flood risk mitigation but also to maximise additional gains such as improvements in runoff quality and provision of amenity and bio-diversity. Systems incorporating these features are often termed SUDS and it is the requirement of the NPPF that these are considered as the primary means of collection, control and disposal for storm water as close to source as possible.

A hierarchy of techniques is identified[10]:

1. Prevention – the use of good site design and housekeeping measures on individual sites to prevent runoff and pollution (e.g. minimise areas of hard standing).

2. Source Control – control of runoff at or very near its source (such as the use of rainwater harvesting, permeable paving, soakaways and/or green roofs).

3. Site Control – management of water from several sub-catchments (including routing water from roofs and car parks to one/several large soakaways for the whole site, swales and/or infiltration trenches).

4. Regional Control – management of runoff from several sites, typically in a detention pond, basins, tanks and/or wetland.

[10] CIRIA (2004) Report C609, Sustainable Drainage Systems – Hydraulic, Structural and Water Quality advice.

It is generally accepted that the implementation of SUDS as opposed to conventional drainage systems, provides several benefits by:

- reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream;
- reducing the volumes and frequency of water flowing directly to watercourses or sewers from developed sites;
- improving water quality over conventional surface water sewers by removing pollutants from diffuse pollutant sources;
- reducing potable water demand through rainwater harvesting;
- improving amenity through the provision of public open spaces and wildlife habitat; and
- replicating natural drainage patterns, including the recharge of groundwater so that base flows are maintained.

The most appropriate attenuation system will need to satisfy three main characteristics, firstly, provide the required volume of storage, secondly, minimise the loss of developable land and thirdly, where possible provide local amenity.

The application of the SUDS Manual[11] requires that the runoff from sites is not only restricted to meet the Greenfield runoff characteristics but also that SUDS systems are utilised to improve the quality of the runoff prior to outfall to watercourses.

The SUDS Manual and Environment Agency guidance applies a sustainability hierarchy to the various types of SUDS systems, this is summarised in Table 5-1.

Table 5-1 Sustainability Hierarchy.

Most Sustainable	SUDS Technique	Flood Reduction	Pollution Reduction	Landscape & Wildlife
↕	**Living Roofs**	✓	✓	✓
	Basins and ponds - Constructed wetlands - Balancing ponds - Detention basins - Retention ponds	✓	✓	✓
	Filter strips and swales	✓	✓	✓
	Infiltration Devices - Soakaways	✓	✓	✓
	Permeable Surfaces and Filter Drains - Gravelled areas - Solid paving blocks - Permeable paving	✓	✓	
	Tanked systems	✓		

[11] CIRIA C697 SUDS Manual, 2007.

Least Sustainable	- Over-sized pipes/tanks - Cellular storage			

Systems at the top of the hierarchy provide a combination of attenuation, treatment and ecology and are deemed the most sustainable options. There are always specific scenarios where systems are more suitable than others and at this stage it is not possible to guide the development towards a particular strategy.

In addition to the above hierarchy the SUDS Manual (Table 5.6) identifies the number of treatment trains or SUDS devices through which flow should pass from various point sources of runoff (see Table 5-4). This is designed to ensure that the receiving environments are not put at risk of pollution by new development therefore; accordingly, one treatment train will be used on this site.

The usual approach is to consider the 'SUDS train' where each of the above options are considered in turn until a suitable solution is found. Thus, source control techniques such as soakaways, rainwater harvesting and/or infiltration trenches, if suitable on a site, are considered preferable to permeable conveyance and passive treatment systems such as tanks or ponds.

Table 5-4 Number of Treatment Train Components.

Runoff Catchment Characteristic	**Receiving Watercourse Sensitivity**		
	Low	**Medium**	**High**
Roof only	1	1	1
Residential roads Parking areas Commercial zones	2	2	3
Refuse collection Industrial areas Loading bays Lorry parks Highways	3	3	4

5.6 SUDS Strategy

The objective of this SUDS Strategy is to ensure that a sustainable drainage solution can be achieved which reduces the peak discharge rate to manage and reduce the flood risk posed by the surface water runoff from the site. The SUDS Strategy takes into account the following principles:

- No increase in the volume or runoff rate of surface water runoff from the site.
- No increase in flooding to people or property off-site as a result of the development.
- No surface water flooding of the site.
- The proposals take into account a 40% increase in rainfall intensity due to climate change during the next 60 years which is the lifetime of the development.

In line with adopting a 'management train' it is recommended that water is managed as close to source as possible. This will reduce the size and cost of infrastructure further downstream and also shares the maintenance burden more equitably. It is therefore recommended that the site provides its own attenuation. This will be in the form of:

- An increase in semi-permeable surfaces.

SUDS are increasingly being used to mitigate the flows and pollution from urban runoff. The required drainage capacities to deal with runoff from the site for different storm events including the impact of climate change.

The proposed development incorporates aspects of sustainable drainage design by including a reduction in the area of impermeable surfaces from the existing to the proposed development with the introduction semi-permeable surfaces underneath the proposed containers units and the semi-permeable hardstanding areas.

The post-development site will be constructed from 0.0556ha (26%) of impermeable. The proposed development will increase the permeable areas of the site by 0.1594ha or 76%.

The proposed increase in the amount of semi-permeable surfaces allows flow attenuation by infiltration of runoff and evaporation. The proposed development will decrease the impermeable area and will therefore, generate lower surface water runoff rates and volumes post-development.

To provide betterment compared to the existing situation the surface water runoff from the site will be reduced by 15% due to the reduction in impermeable area therefore, reducing the risk of flooding to the site and off-site locations. There will be no increase in surface water run-off or exacerbation of off-site risk as a result of the development.

It is understood that the site is currently drained via a positive system to the adjacent drainage ditch. It is assumed that the existing drainage network has the capacity to accommodate the current site drainage and there are no records of historical flooding of the site. The existing drainage will therefore be adequate for receiving the runoff from the proposed development since the runoff rates and volumes will decrease overall during storm events.

On this basis, no further SUDS features will be required to ensure that the proposed development does not lead to an increase in runoff and a subsequent increase in the offsite flood risk to adjacent properties. It also would be impractical to use formal SUDS features as the development of the site will lead to a reduction in surface water runoff rates and volumes. The reduction in surface water runoff rates and volumes will also reduce the risk of water backing up and/or not being able to discharge during periods of high river levels in the receiving watercourse.

6 Risk Management

6.1 Introduction

In this flood zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of the development and the use of flood mitigation measures.

A number of techniques and mitigation strategies to manage and reduce the overall flood risk in the area will be used. This will ensure the development will be safe and there is:

- Minimal risk to life;
- Minimal disruption to people living and working in the area;
- Minimal potential damage to property;
- Minimal impact of the proposed development on flood risk generally; and;
- Minimal disruption to natural heritage.

6.2 Finished Floor/Threshold Level

Raising the finished floor and threshold levels of the container units will be used to mitigate the effects of flooding at the site. The proposed contained units will be raised by 0.50m or 500mm above the exiting ground level, normally the container units are only raised by 0.30m or 300mm above ground levels. Therefore, the container units will have a finished floor level of 48.97mAOD, which provides a freeboard of 0.10m (100mm) above the 1 in 100 year event. Therefore, the container units will be flood free during the 1 in 100 year events.

It is recognised however that owing to development constraints and practical working practices it is considered impractical to raise the finished floor levels further. Therefore, in order to further mitigate against this, it is recommended that a flood plan is adopted. It is also proposed that flood protection measures are employed within the building design to reduce the overall risk to the occupants. This is discussed below.

6.3 Flood Resilience and Resistance

The development of the layout should always consider that the site is potentially at risk from an extreme event and as such the implementation of flood resilience and resistance methods should be assessed.

To make the buildings more resistant to seepage the following measures will be incorporated. Sealant will be used around external doors and windows. All external doors and windows will be constructed from durable materials and the walls of the buildings will be durable.

To improve the buildings resilience to flooding the following measures will be incorporated. All electrical wiring, switches, sockets, socket outlets, electrical, and gas meters etc. will be located a minimum of 600mm above the 1 in 100 year (+35%) year water of 49.54mAOD at 50.14mAOD.

6.4 Flood Plan

A Flood Plan outlining the precautions and actions you should take when a flood event is anticipated to help reduce the impact and damage flooding may cause will be developed.

Suitable precautions include ensuring all facility electrical equipment is raised above anticipated flood levels. In addition, consider what actions you would take should the site need to be evacuated including access and egress routes and preparing a flood kit in advance containing warm clothing, medication, a torch, food and wellingtons.

The Flood Plan is a 'living' document and therefore should be periodically reviewed and updated to provide advice and guidance to occupants in the event of an extreme flood. The Flood Plan will therefore reduce the vulnerability of the occupants to flooding and makes them aware of the mechanisms of flooding at the property.

6.5 Safe Access and Egress Routes

Access routes should be such that occupants can safely access and exit properties in design flood conditions. These routes must also provide the emergency services with access to the development during a flood event and enable flood defence authorities to carry out any necessary duties during the period of flood.

The B4224 adjacent to the site entrance is located within Flood Zone 2 and therefore, has a 'medium probability' of fluvial flooding with between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) in any year (see Drawing 4).

A safe access and egress routes, including emergency access can be maintained for vehicles and/or by foot via the B4224 to the west of the site (see Drawing 5). The site is one of the last places in the area to flood and remains flood free when other areas close by are flooded. The site is at such a ground level that it would only flood in the most extreme flood events; the site will remain flood free for the vast majority of flood events during the lifetime of the proposed development.

The actual risk posed to the site is low with a chance of flooding of less than 1 in 1000 (0.1%) years. The flood risk posed to the site from fluvial flooding is of a residual flood risk and would only occur if the flood defences were to be overtopped/breached.

Therefore, safe access and egress can be maintained for all events up to and including the 1 in 100 year (plus climate change) event in accordance with the NPPF and Environment Agency Guidance.

6.6 Flooding Consequences

The property level mitigation measures detailed above show that the flood risk can be effectively managed and therefore the consequences of flooding are acceptable.

The site is unlikely to flood except in extreme conditions. The overall risk of flooding at the site, is medium however, further property level protection measures are used to managed and mitigate the flood risk to a low level of flood risk.

7 Sequential Approach

7.1 Sequential and Exception Tests

The risk-based Sequential Test in accordance with the NPPF aims to steer new development to areas at the lowest probability of flooding (i.e. Flood Zone 1).

Paragraph 104 of the NPPF states that:

'Applications for minor development and changes of use should not be subject to the Sequential or Exception Tests12 but should still meet the requirements for site-specific flood risk assessments'.

The planning application is for a change of use therefore, the Sequential and Exception Tests will not need to be undertaken as part of this planning application.

[12] Except for any proposal involving a change of use to a caravan, camping or chalet site, or to a mobile home or park home site, where the Sequential and Exception Tests should be applied as appropriate.

8 Summary and Conclusions

8.1 Introduction

This report presents a FRA in accordance with the NPPF for the proposed development at Field Meadow Farm, Hampton Bishop, Hereford. The FRA includes an assessment of the existing and proposed surface water drainage of the site.

8.2 Flood Risk

The site is unlikely to flood except in extreme conditions. The primary, but unlikely, flood risk to the site is from fluvial flooding from the River Wye however, the flood defence measures identified are expected to afford the site significant protection from fluvial flooding. The flood defences provide a 1 in 100 year SoP. However, the Environment Agency flood outlines confirm that the site will not be inundated with floodwater during the 1 in 1000 year event. The actual risk of flooding during a fluvial flood event on the River Wye is reduced compared to the extent of flooding shown in the Environment Agency Flood Zones. The actual risk posed to the site is low with a chance of flooding of less than 1 in 1000 (0.1%) years.

The flood risk posed to the site from fluvial flooding is of a residual flood risk and would only occur if the flood defences were to be overtopped/breached. The site will not be inundated with floodwater during the 1 in 20 year event. The site will be flood free during the 1 in 20 year event.

However, the site may be inundated with floodwater during the 1 in 100 year or greater event. The proposed contained units will be raised by 0.50m or 500mm above the exiting ground level. Therefore, the container units will have a finished floor level of 48.97mAOD, which provides a freeboard of 0.10m (100mm) above the 1 in 100 year event. The container units will be flood free during the 1 in 100 year event.

Therefore, the risk of flooding from the River Wye is considered to be of **medium significance**. A secondary flooding source has been identified which may pose a **low significant** risk to the site. This is:

- Fluvial flooding – drainage ditch

The existing and proposed development is classified as 'less vulnerable'. 'Less vulnerable' and more vulnerable' uses are appropriate in Flood Zone 3a. The vulnerability of the site will not change as part of the planning application. The proposals do not constitute a change from a 'less vulnerable' use to a 'more vulnerable' use. The proposed development will not therefore increase the vulnerability of the development or introduce new development into the Flood Zone.

The proposed development will actually reduce the vulnerability of the site to flooding. The proposed development will improve the sites resilience, resistance to flooding and by using property level protection measures to protect the site from flooding the vulnerability of the site will be improved.

The proposed development will have no impact on the movement of floodwater across the site. The overall direction of the movement of water will be maintained within the developed site and surrounding area. The conveyance routes (flow paths) will not be blocked or obstructed. There will be no increase in the flood water levels due to the proposed development.

Paragraph 10 of the Technical Guidance to the NPPF confirms that minor developments such as this are unlikely to raise significant flood risk issues.

The overall risk of flooding at the site, assuming flood defence measures fail and/or are overtopped is medium however, there are existing flood defence measures that protect the site and further property level protection measures are used to managed and mitigate the flood risk to a low level of flood risk.

The chance of flooding each year is less than 0.1% (1 in 1000 years). This takes into account the effect of any flood defences that may be located within the vicinity of the site as well property level protection measures.

8.3 Surface Water Drainage

The SUDS Strategy will ensure that a sustainable drainage solution can be achieved which reduces the peak discharge rate to manage and reduce the flood risk posed by the surface water runoff from the site. The SUDS Strategy takes into account the following principles:

- No increase in the volume or runoff rate of surface water runoff from the site.
- No increase in flooding to people or property off-site as a result of the development.
- No surface water flooding of the site.
- The proposals take into account a 40% increase in rainfall intensity due to climate change during the next 60 years which is the lifetime of the development.

In line with adopting a 'management train' it is recommended that water is managed as close to source as possible. This will reduce the size and cost of infrastructure further downstream and also shares the maintenance burden more equitably. It is therefore recommended that the site provides its own attenuation. This will be in the form of:

- An increase in semi-permeable surfaces.

SUDS are increasingly being used to mitigate the flows and pollution from urban runoff. The required drainage capacities to deal with runoff from the site for different storm events including the impact of climate change.

The proposed development incorporates aspects of sustainable drainage design by including a reduction in the area of impermeable surfaces from the existing to the proposed development with the introduction semi-permeable surfaces underneath the proposed containers units and the semi-permeable hardstanding areas.

The post-development site will be constructed from 0.0556ha (26%) of impermeable. The proposed development will increase the permeable areas of the site by 0.1594ha or 76%.

The proposed increase in the amount of semi-permeable surfaces allows flow attenuation by infiltration of runoff and evaporation. The proposed development will decrease the impermeable area and will therefore, generate lower surface water runoff rates and volumes post-development.

To provide betterment compared to the existing situation the surface water runoff from the site will be reduced by 15% due to the reduction in impermeable area therefore,

reducing the risk of flooding to the site and off-site locations. There will be no increase in surface water run-off or exacerbation of off-site risk as a result of the development.

It is understood that the site is currently drained via a positive system to the adjacent drainage ditch. It is assumed that the existing drainage network has the capacity to accommodate the current site drainage and there are no records of historical flooding of the site. The existing drainage will therefore be adequate for receiving the runoff from the proposed development since the runoff rates and volumes will decrease overall during storm events.

On this basis, no further SUDS features will be required to ensure that the proposed development does not lead to an increase in runoff and a subsequent increase in the offsite flood risk to adjacent properties. It also would be impractical to use formal SUDS features as the development of the site will lead to a reduction in surface water runoff rates and volumes. The reduction in surface water runoff rates and volumes will also reduce the risk of water backing up and/or not being able to discharge during periods of high river levels in the receiving watercourse.

8.4 Risk Management

The flooding sources will be managed and mitigated on the site by using a number of techniques, and mitigation strategies to manage and reduce the overall flood risk at the site. This will ensure the development will be safe. Measures used:

Finished Floor/Threshold Level: Raising the finished floor and threshold levels of the container units will be used to mitigate the effects of flooding at the site. The proposed contained units will be raised by 0.50m or 500mm above the exiting ground level, normally the container units are only raised by 0.30m or 300mm above ground levels. Therefore, the container units will have a finished floor level of 48.97mAOD, which provides a freeboard of 0.10m (100mm) above the 1 in 100 year event. Therefore, the container units will be flood free during the 1 in 100 year events.

It is recognised however that owing to development constraints and practical working practices it is considered impractical to raise the finished floor levels further. Therefore, in order to further mitigate against this, it is recommended that a flood plan is adopted. It is also proposed that flood protection measures are employed within the building design to reduce the overall risk to the occupants. This is discussed below.

Flood Resilience and Resistance: To make the buildings more resistant to seepage the following measures will be incorporated. Sealant will be used around external doors and windows. All external doors and windows will be constructed from durable materials and the walls of the buildings will be durable.

To improve the buildings resilience to flooding the following measures will be incorporated. All electrical wiring, switches, sockets, socket outlets, electrical, and gas meters etc. will be located a minimum of 600mm above the 1 in 100 year (+35%) year water of 49.54mAOD at 50.14mAOD.

Flood Plan: A Flood Plan outlining the precautions and actions you should take when a flood event is anticipated to help reduce the impact and damage flooding may cause will be developed.

Safe Access and Egress Routes: The B4224 adjacent to the site entrance is located within Flood Zone 2 and therefore, has a 'medium probability' of fluvial flooding with

between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) in any year.

A safe access and egress routes, including emergency access can be maintained for vehicles and/or by foot via the B4224 to the west of the site (see Drawing 5). The site is one of the last places in the area to flood and remains flood free when other areas close by are flooded. The site is at such a ground level that it would only flood in the most extreme flood events; the site will remain flood free for the vast majority of flood events during the lifetime of the proposed development.

The actual risk posed to the site is low with a chance of flooding of less than 1 in 1000 (0.1%) years. The flood risk posed to the site from fluvial flooding is of a residual flood risk and would only occur if the flood defences were to be overtopped/breached.

Therefore, safe access and egress can be maintained for all events up to and including the 1 in 100 year (plus climate change) event in accordance with the NPPF and Environment Agency Guidance.

8.5 Sequential Approach

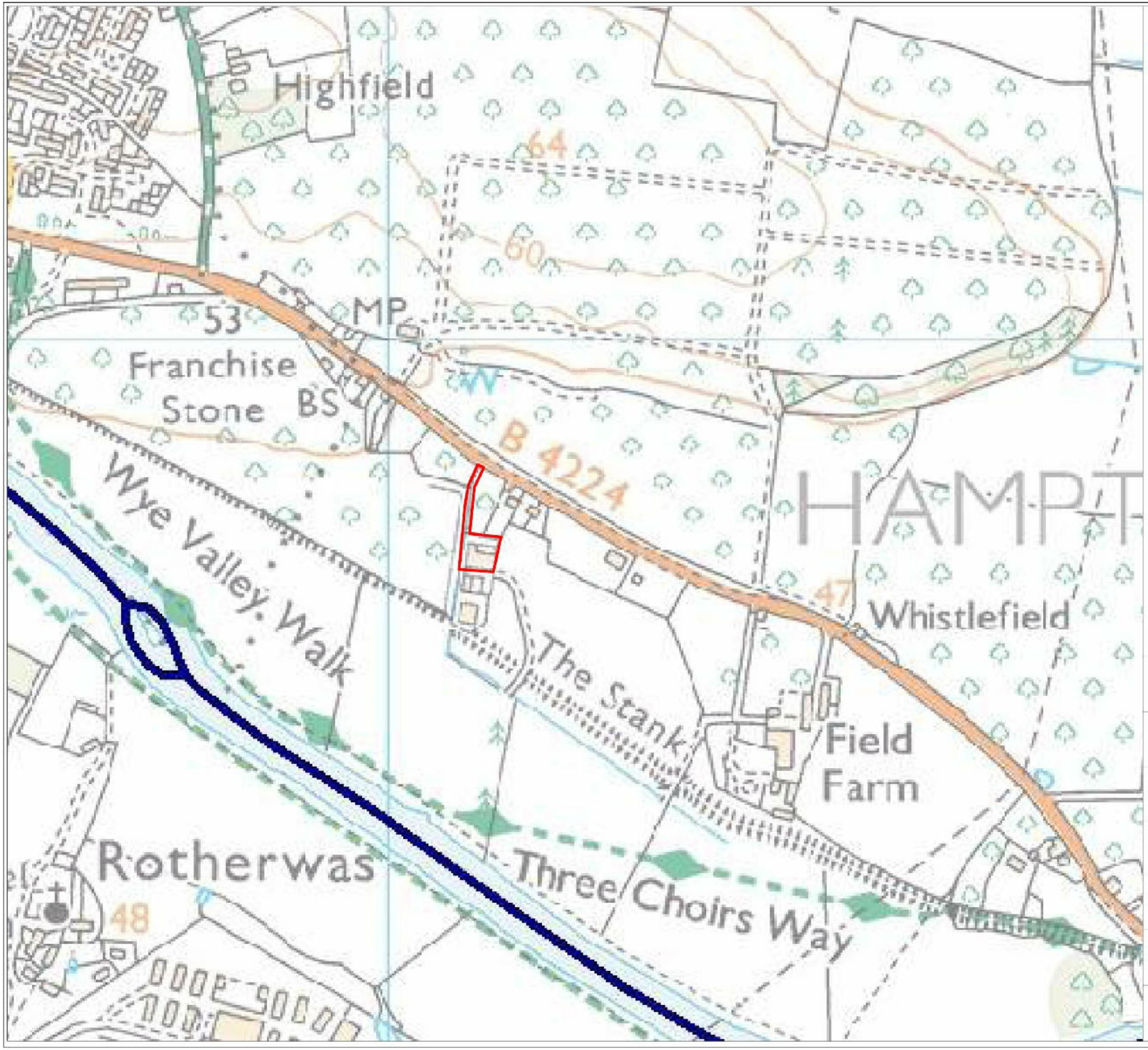
The development proposals should be considered by the LPA to satisfy the Sequential and Exception Tests as set out in the NPPF.

8.6 Conclusion

This FRA demonstrates that the proposed development would be operated with minimal risk from flooding, would not increase flood risk elsewhere and is compliant with the requirements of the NPPF.

The development should not therefore be precluded on the grounds of flood risk.

Drawings



KEY

Site Boundary

HYDROGEO
Groundwater and Environment

PROJECT
Field Meadow Farm, Hampton Bishop, Hereford

CLIENT
MDM Farming

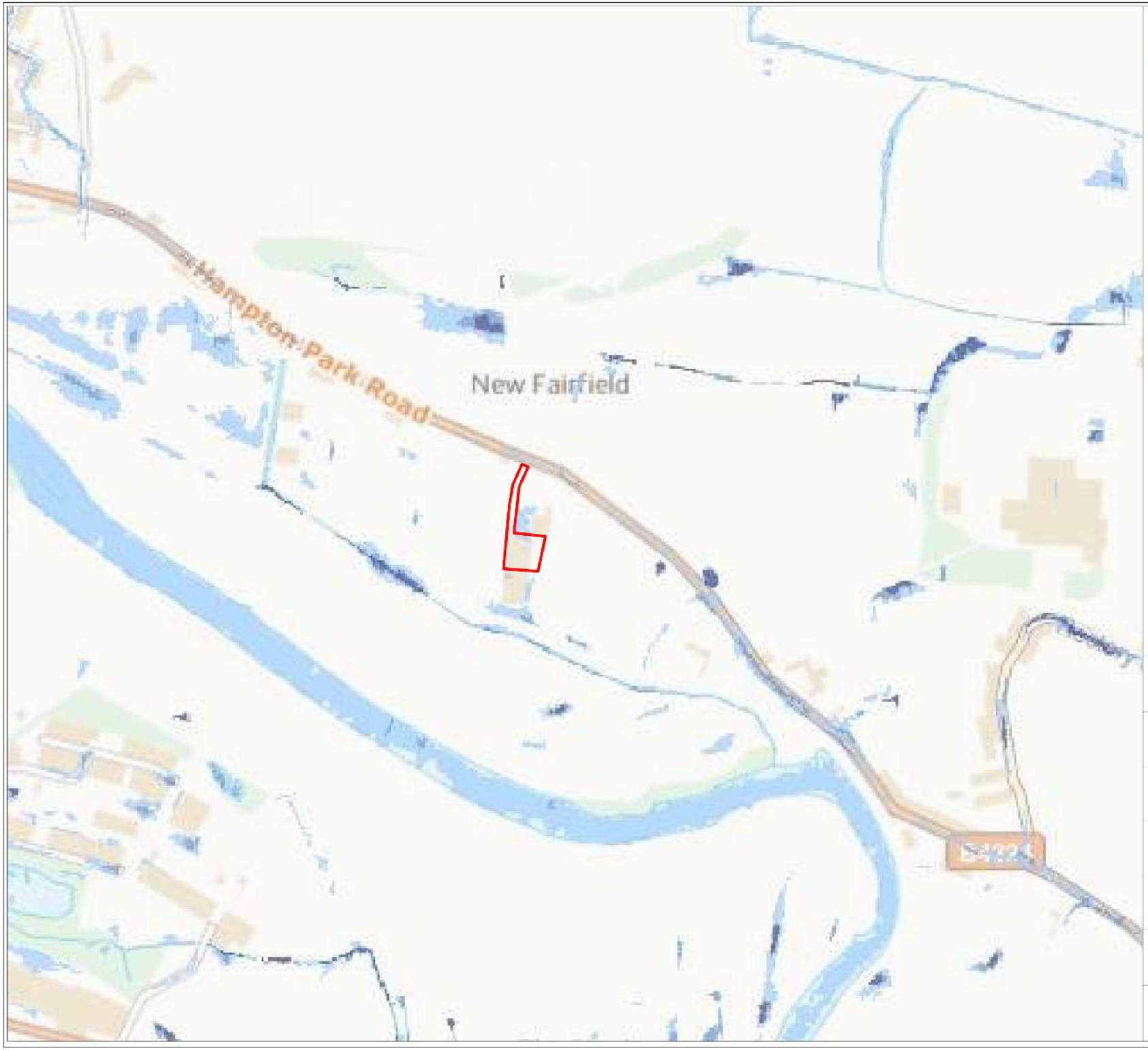
TITLE
Site Location

PROJECT REF
HYG288

DRAWING NO
1

SCALE
NTS@A3

DATE
August 2016



KEY

- Site Boundary
- Very Low
- Low
- Medium
- High

HYDROGEO
Groundwater and Environment

PROJECT
Field Meadow Farm, Hampton Bishop, Hereford

CLIENT
MDM Farming

TITLE
Environment Agency Surface Water Flood Map

PROJECT REF
HYG288

DRAWING NO
2

SCALE
NTS@A3

DATE
August 2016

KEY

Site Boundary

Reservoir Flood Outline

HYDROGEO
Groundwater and Environment

PROJECT
Field Meadow Farm, Hampton Bishop, Hereford

CLIENT
MDM Farming

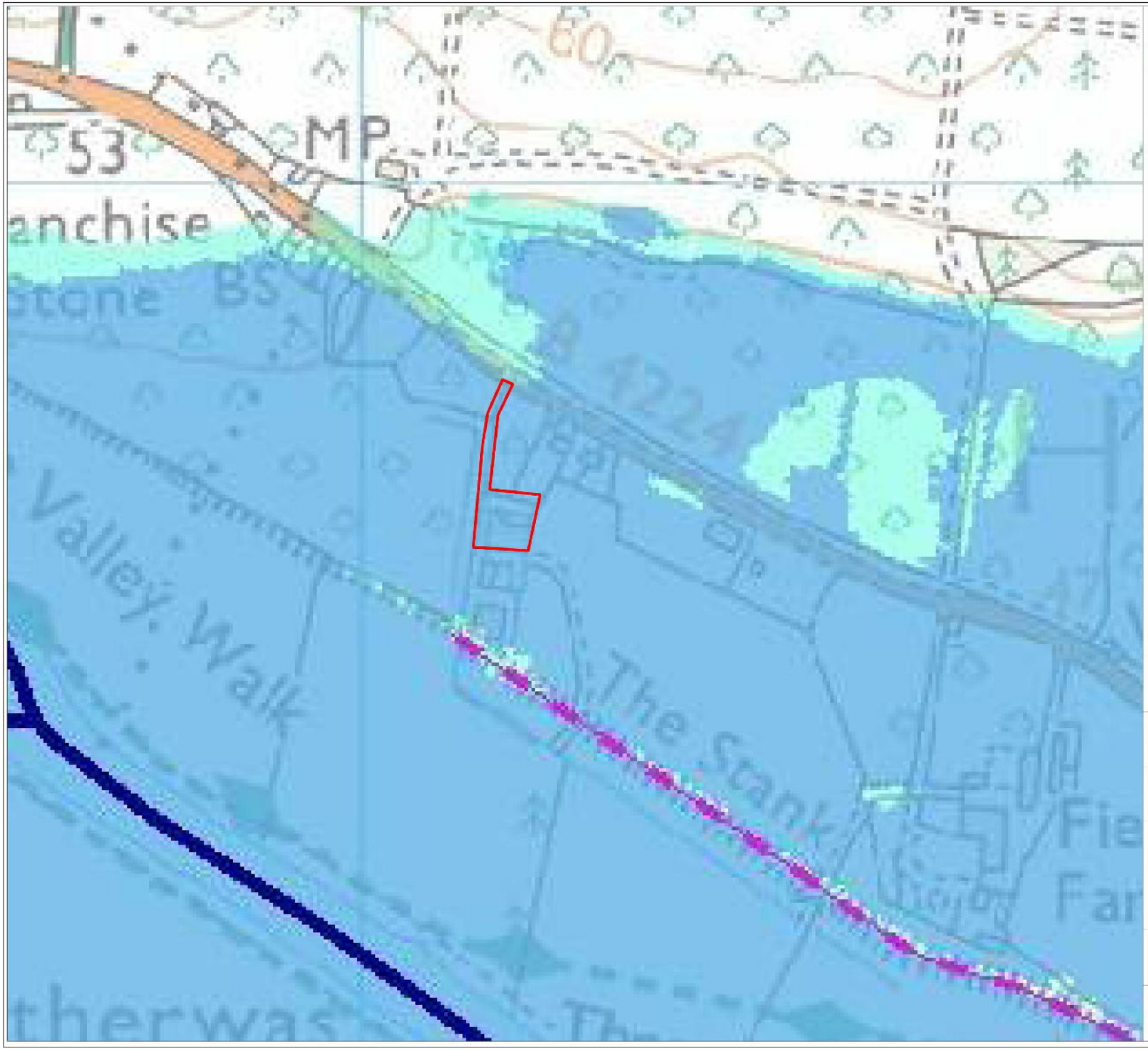
TITLE
Environment Agency Reservoir Flood Map

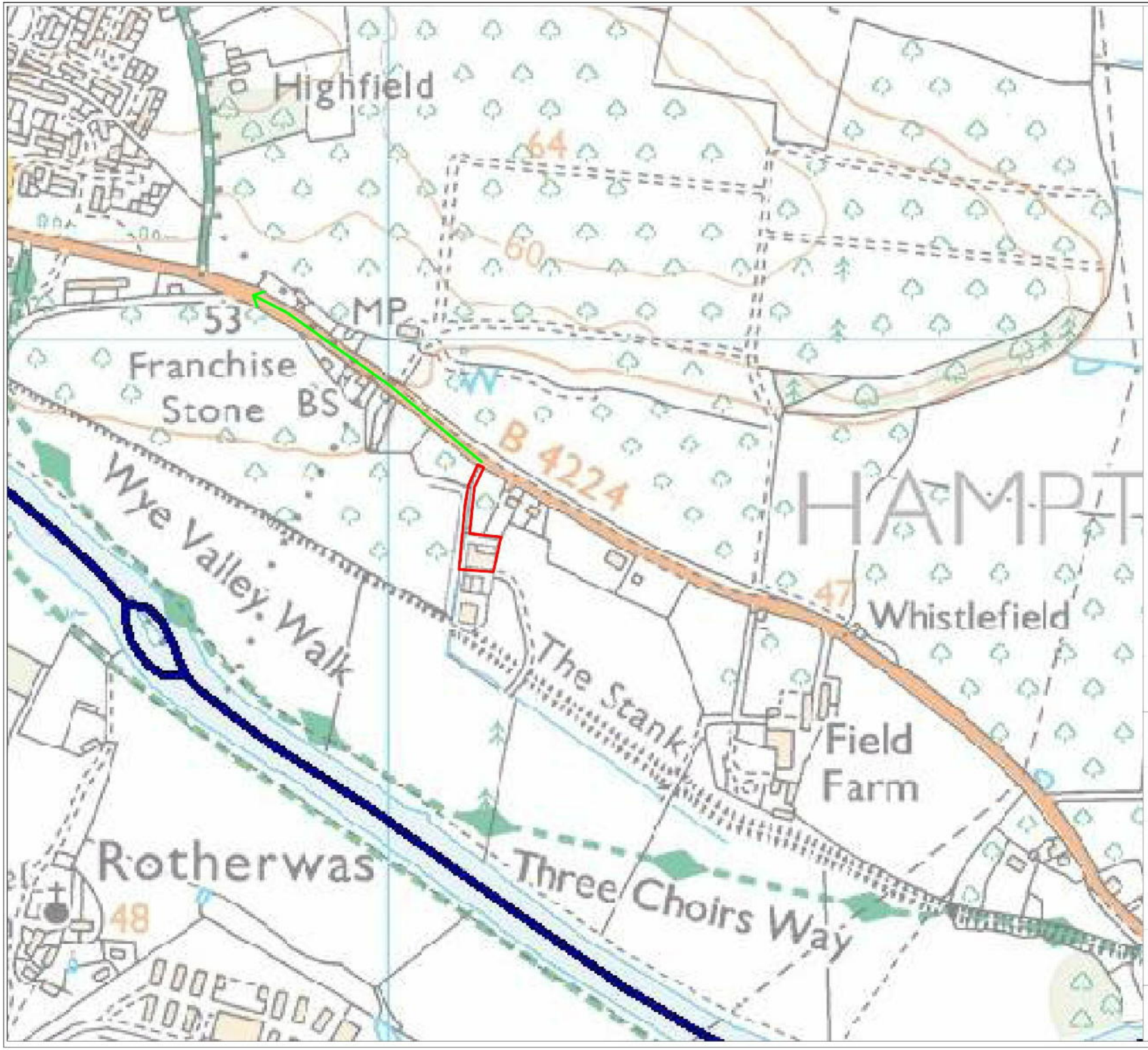
PROJECT REF
HYG288

DRAWING NO
3

SCALE
NTS@A3

DATE
August 2016


KEY
Site Boundary
Flood Zone 3
Flood Zone 2
Flood Zone 1
HYDROGEO
Groundwater and Environment
PROJECT
Field Meadow Farm, Hampton Bishop, Hereford
CLIENT
MDM Farming
TITLE
Environment Agency Flood Zones
PROJECT REF
HYG288
DRAWING NO
4
SCALE
NTS@A3
DATE
August 2016



KEY

Site Boundary

Safe Access and Egress Route

HYDROGEO
Groundwater and Environment

PROJECT
Field Meadow Farm, Hampton Bishop, Hereford

CLIENT
MDM Farming

TITLE
Safe Access and Egress Route

PROJECT REF
HYG288

DRAWING NO
5

SCALE
NTS@A3

DATE
August 2016

Appendices

Appendix 1

Environment Agency Information

Our Ref: 18822

Your Ref:

Date: 28 July 2016

Dear Keelan Serjeant

Provision of: Product-4 FRA River Wye - Field Medaow Farm, Hampton Bishop, Hereford, HR1 4JP.

Thank you for your request of 25 July 2016 to use Environment Agency data.

Please see attached detailed Flood Risk Assessment (FRA) map.

A flood plain is an area of land over which river or sea water flows or is stored in times of flood, or would flow but for the presence of flood defences where they exist. This is a precautionary approach in case flood defences are overtopped or breached.

We use historical flood records, river flow data and computer models to estimate specific flood events. Information from these models is also used to show the need for flood alleviation measures in certain areas and to advise on development within the floodplain. The flood zones refer to the land at risk of flooding and does not refer to single properties. It is possible for a property to be built at a level above the floodplain but still fall within the risk area.

The Flood Map does not reflect future predicted changes in climate. Nor does it provide information on flood depth, speed or volume of flow. Flooding can also occur from other sources such as groundwater or sewers, which are the responsibilities of other organisations.

Modelled flood levels

The following table details the modelled flood levels we have available for the River Wye at this location. Levels are given in MAOD. The term **'mAOD (N)'** means 'metres above Ordnance Datum (at Newlyn, Cornwall)'. Ordnance Datum is the National standard datum of the Ordnance Survey from which all levels, relative to sea level, are quoted and has been used in Great Britain since 1936.

Environment Agency, Riversmeet House, Newtown Industrial Estate, Northway Lane, Tewkesbury, Gloucestershire, GL20 8JG.
Customer services line: 03708 506 506
E-mail: enquiries@environment-agency.gov.uk
www.gov.uk/environment-agency

River Wye Level (mAOD)										
Node	2 year	5 year	10 year	20 year	50 year	75 year	100 year	100 year (+CC)	200 year	1000 year
283	47.86	48.13	48.31	48.42	48.59	48.76	48.87	49.25	49.13	49.70
284	47.82	48.08	48.22	48.33	48.51	48.69	48.80	49.19	49.07	49.65
285	47.77	48.02	48.17	48.28	48.51	48.69	48.81	49.18	49.07	49.61
286	47.72	47.99	48.15	48.26	48.46	48.62	48.73	49.08	48.98	49.49
287	47.76	48.04	48.21	48.31	48.49	48.65	48.76	49.10	48.99	49.50
288	47.69	47.99	48.17	48.28	48.47	48.63	48.74	49.08	48.98	49.49

IMPORTANT: The levels given above are based upon the River Wye model which was produced in 2012 it does not include the updated climate change figures released in February 2016. Updated Flood Risk Climate Change allowances for Planning Matters are at: **www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances**

Historical Flooding
Please see attached Flood Event Outline Maps.

Our records of Historic Flooding show the extents of known flooding from rivers, the sea and groundwater. You may also wish to contact your local authority or internal drainage board, to see if they have other relevant local flood information.

Supporting Information
Please find attached a copy of the Flood Map for Planning (Rivers and Sea) for the area relating to your address.

Further details about the Environment Agency information supplied can be found on the GOV.UK 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 Flood Risk Assessments

https://www.gov.uk/planning-applications-assessing-flood-risk
https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion

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I hope that we have correctly interpreted your request. Please see the attached Open Government Licence (OGL) or Special Licence for details of permitted use.

We respond to requests for recorded information that we hold under the Freedom of Information Act 2000 (FOIA) and the associated Environmental Information Regulations 2004 (EIR).

Environment Agency, Riversmeet House, Newtown Industrial Estate, Northway Lane, Tewkesbury, Gloucestershire, GL20 8JG.
Customer services line: 03708 506 506
E-mail: enquiries@environment-agency.gov.uk
www.gov.uk/environment-agency

If you are not satisfied with our response to your request for information you can contact us within 2 calendar months to ask for our decision to be reviewed.

If you have any queries or would like to discuss the content of this letter further please call us on 08708 506506.

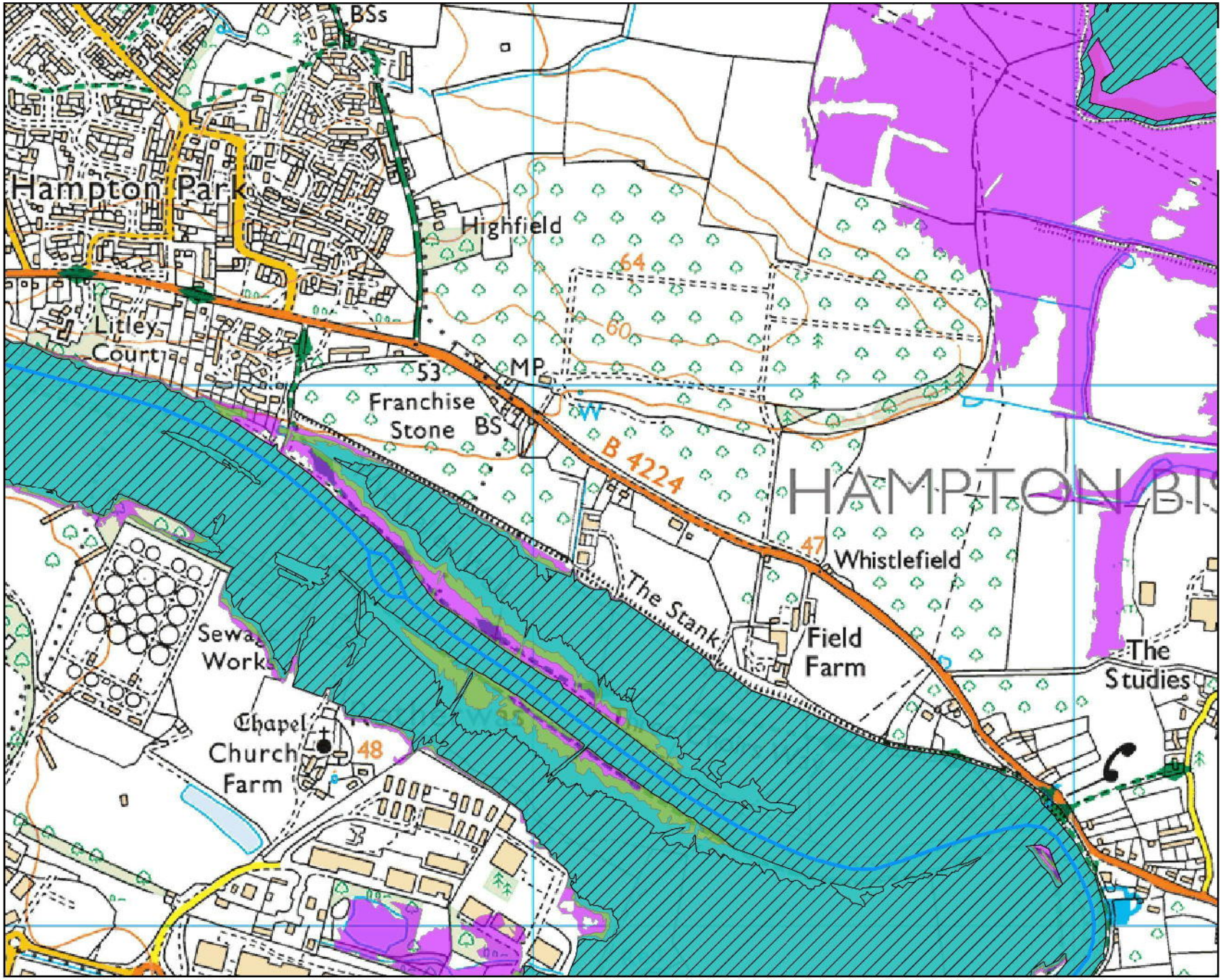
Yours sincerely

Rachel Hamer
Customer & Engagement Officer

For further information please contact the Customer & Engagement Team

Tel: **02030251678 or 02030251665**
Direct e-mail: SHWGenquiries@environment-agency.gov.uk

Modelled Extent Outline Map Centred on HR1 4JP, the River Wye - created 27 July 2016 (18822)



Environment Agency

1: 10,000

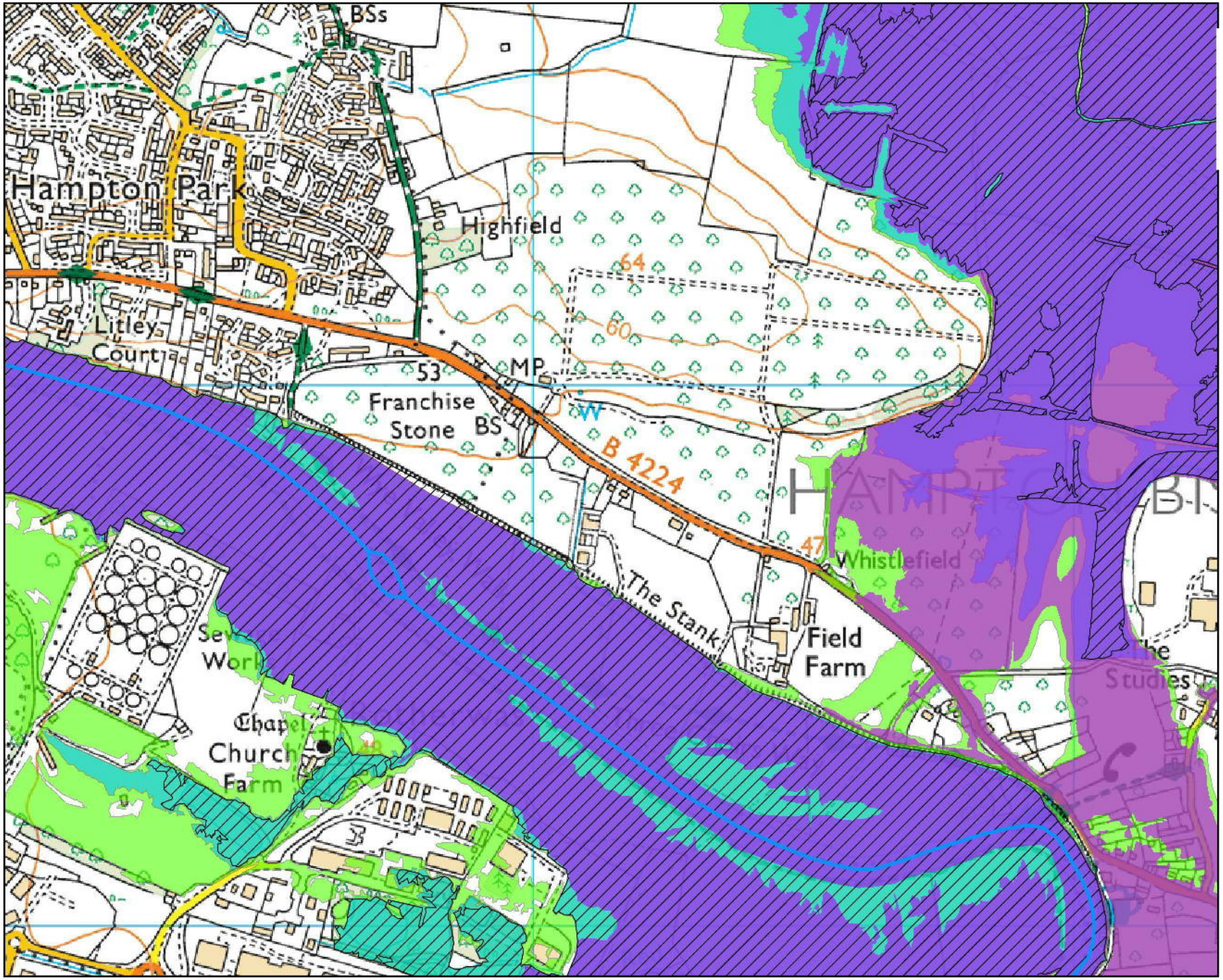
N
W
E
S

Legend

- Main River
- 5 Yr
- 10 yr
- 20 yr
- 50 yr

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Modelled Extent Outline Map Centred on HR1 4JP, the River Wye - created 27 July 2016 (18822)



Environment Agency

1: 10,000

N
W
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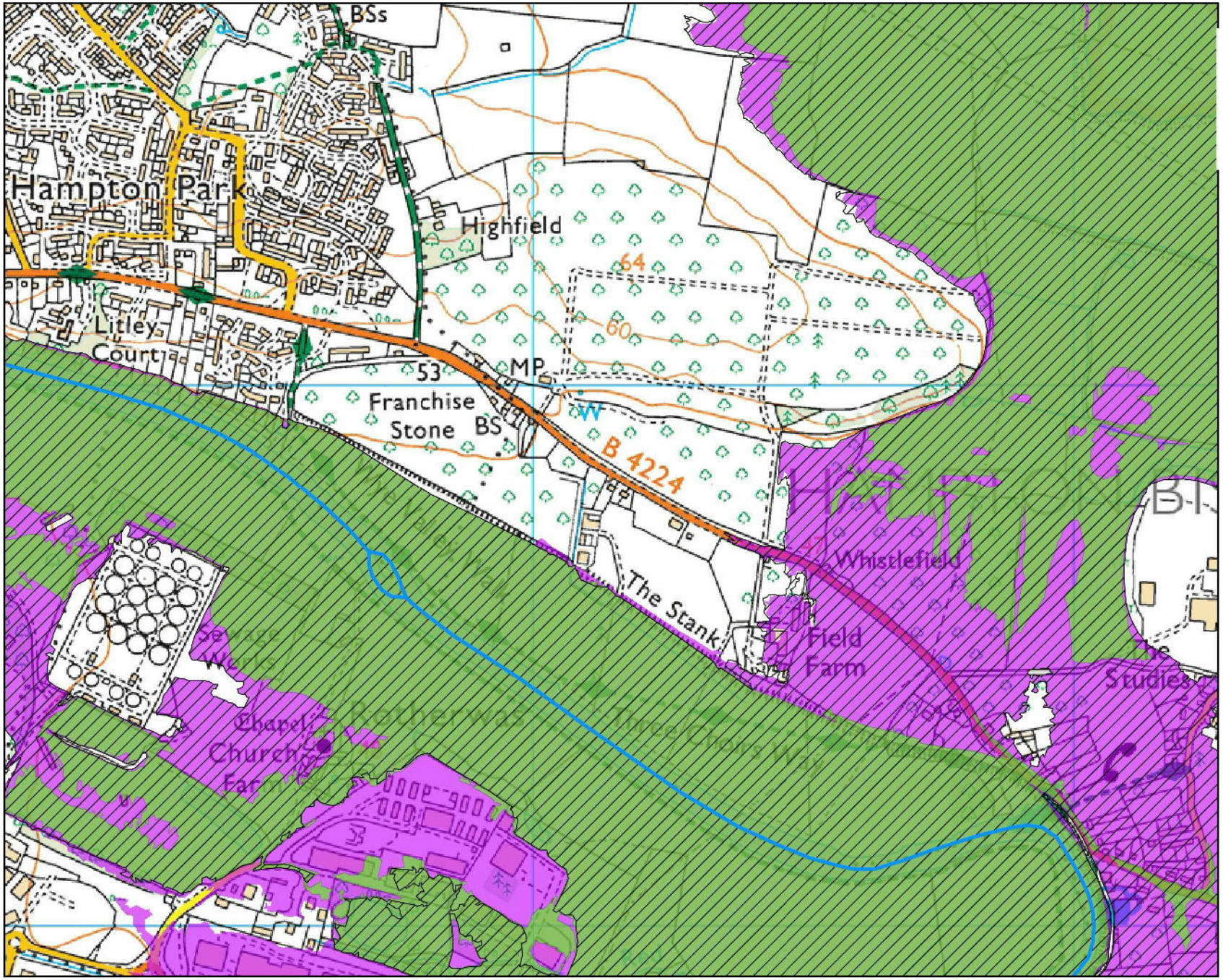
S

Legend

- Main River
- 75 yr
- 100 yr UD
- 100 yr
- 100 yr (+CC)

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Modelled Extent Outline Map Centred on HR1 4JP, the River Wye - created 27 July 2016 (18822)



Environment Agency

1: 10,000

N
W
E
S

Legend

- Main River
- 1000 yr UD
- 200 yr
- 1000 yr

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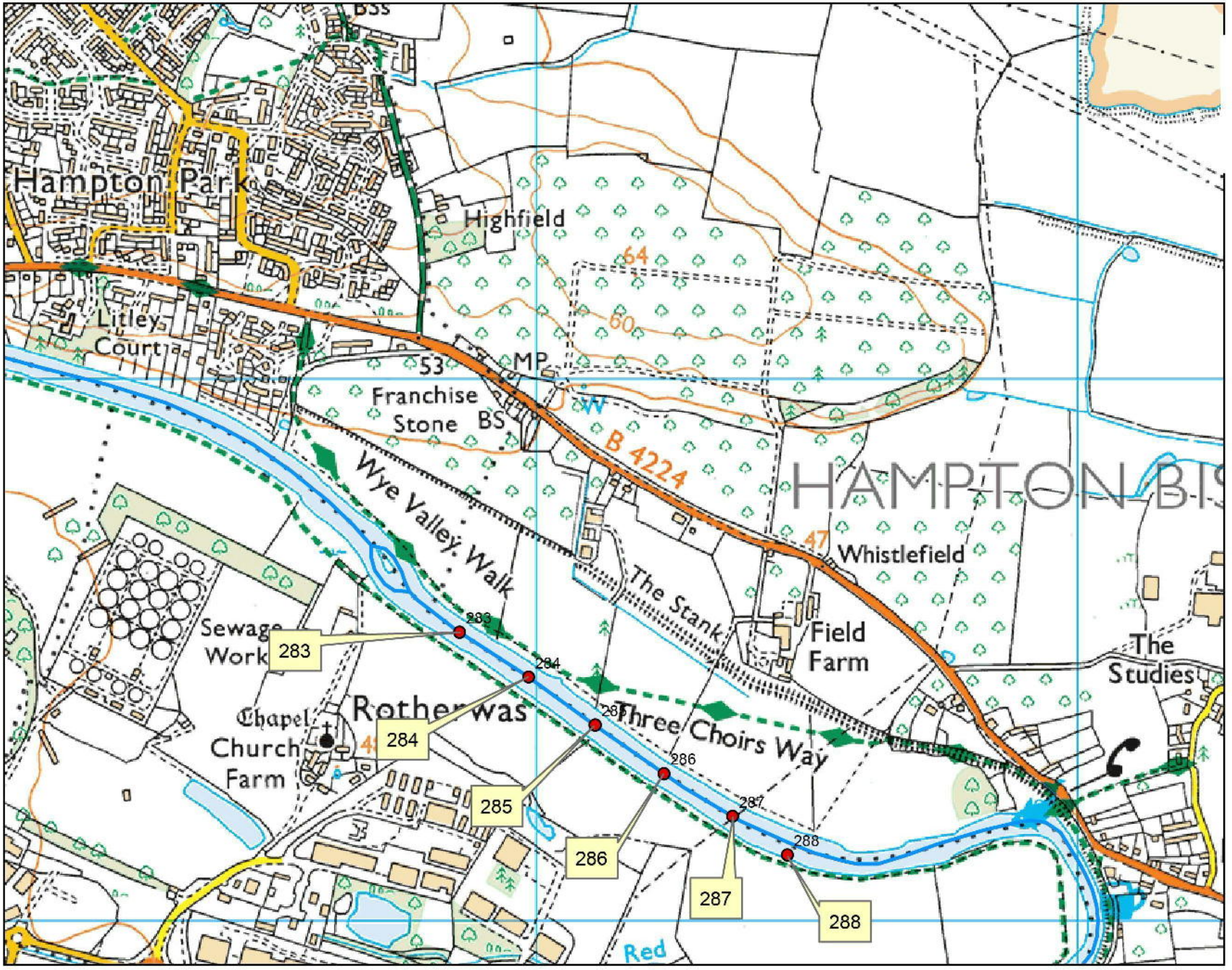
Model Node Locations Map Centred on HR1 4JP, the River Wye - created 27 July 2016 (18822)



Environment Agency

1: 10,000

N W E S

Legend

- Node Location
- Main River

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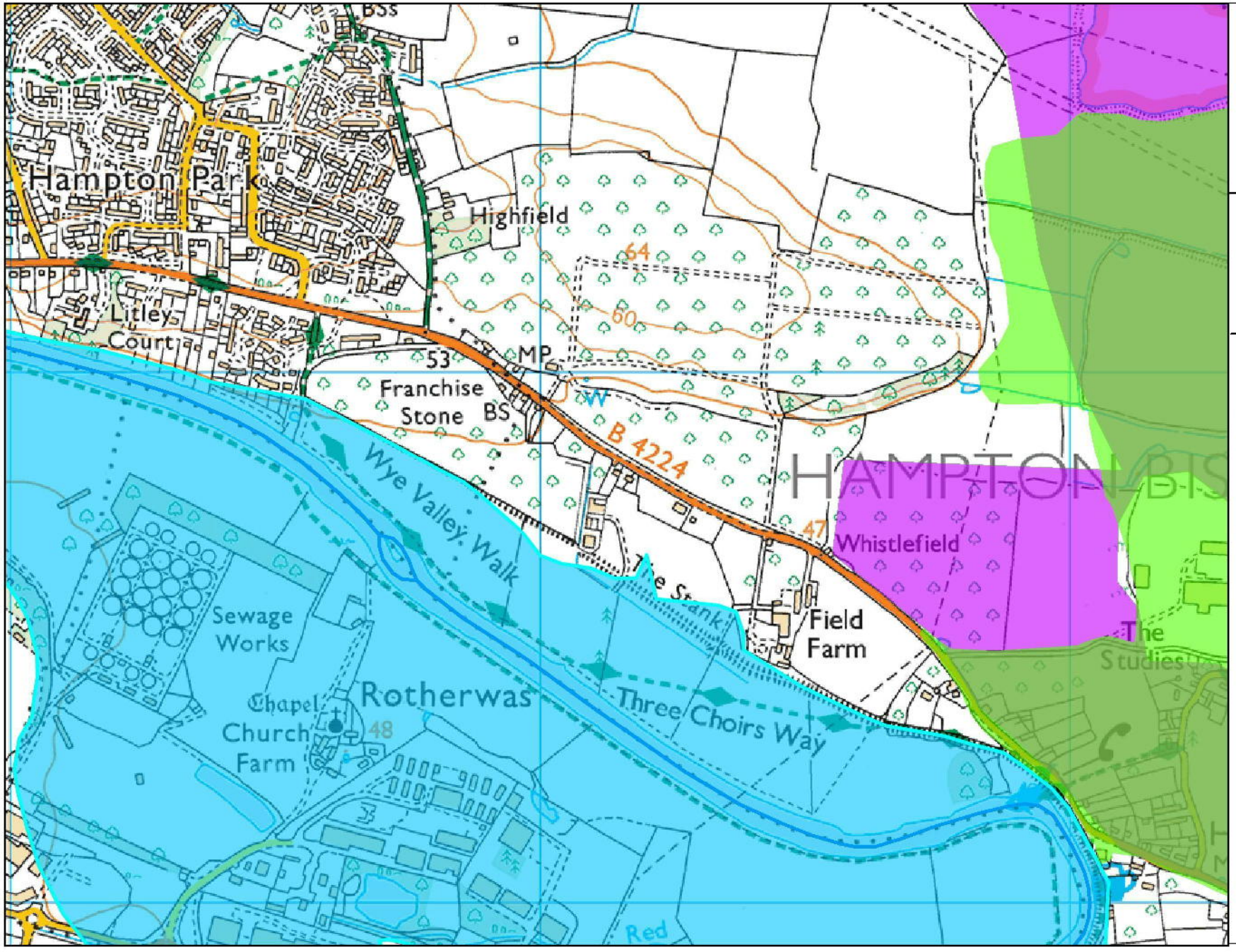

Environment Agency

1: 10,000

N
W E
S

Legend

- July 2007
- December 1960
- April 1947
- main rivers

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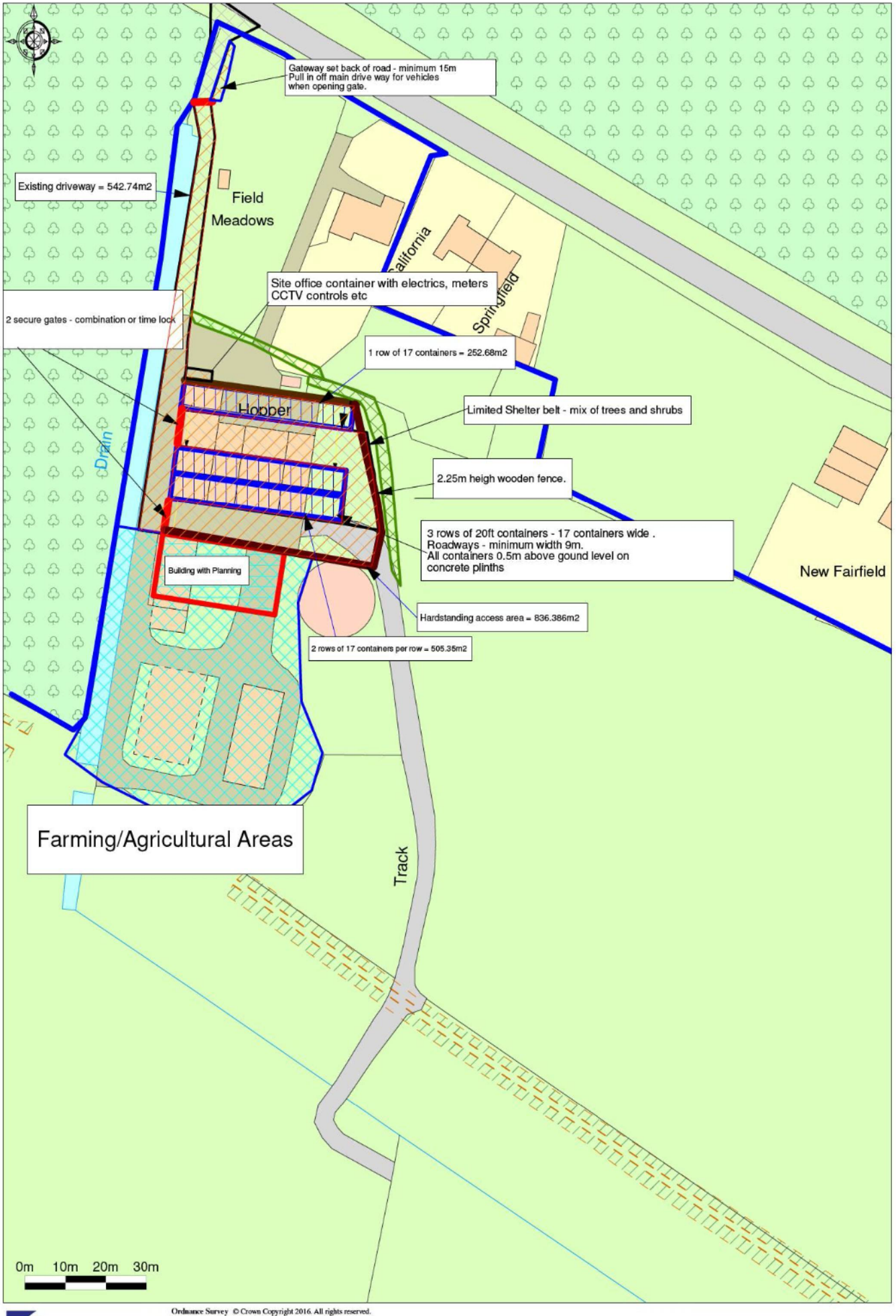
Appendix 2

Proposed Site Layout



Appendix 3

Topographical Survey