OXFORD ROAD
BODICOTE

FLOOD RISK ASSESSMENT AND
DRAINAGE MANAGEMENT STRATEGY

For

Hollins Strategic Land,
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Manchester,
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MAY 2018
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OXFORD ROAD
BODICOTE

FLOOD RISK ASSESSMENT AND
DRAINAGE MANAGEMENT STRATEGY

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EXECUTIVE SUMMARY

This Flood Risk Assessment and Drainage Management Strategy was commissioned by Hollins Strategic Land referred to hereafter as ‘the client’. This report has been prepared to support an outline planning application for the construction of a residential development on land adjacent to Oxford Road in Bodicote.

**Flood Risk**
The site lies solely within Flood Zone 1 based on the Environment Agency Flood Map for Planning and is 2.204ha in size. Residential development is classified as ‘more vulnerable’ within the Planning Practice Guidance which supports the National Planning Policy Framework. The Planning Practice Guidance confirms that ‘more vulnerable’ development is appropriate to be located within Flood Zone 1, providing there is no increase in flood risk elsewhere due to the proposals.

This report has reviewed all sources of flood risk both to and resulting from the proposed development site. Consultations with the Environment Agency, Oxfordshire County Council, Cherwell District Council and Thames Water have been undertaken and did not identify any historical incidents of flooding to the site.

The proposals are considered to be at ‘very low’ flood risk from the majority of flood sources. The nearest watercourse to site is Sor Brook located approximately 1km south of site, the Oxford Canal is also located approximately 1.5km north with the River Cherwell located beyond. The primary flood risk however, is considered to be from ‘very low’ surface water run-off, which is closely associated with the existing topography on site. The risk associated with surface water flooding will be reduced and sustainably managed post-development, following the implementation of mitigation measures proposed within this assessment.

**Drainage Strategy**
Due to the relatively low flood risks identified, the principle focus of this assessment is on sustainable management of surface water run-off in accordance with national and local policy. Surface water discharge options have been assessed in accordance with the sustainable drainage hierarchy and based on the ground conditions identified by the online datasets, infiltration may offer a part or fully viable drainage solution for the development site due to the permeable strata. The mapping however, is considered to be large scale and infiltration rates vary on a site by site basis, it would therefore be recommended that further investigation (onsite testing) takes place upon planning approval as infiltration would be the primary means of discharging surface water run-off.

At this time the planning layout has allowed for an area of open space, this area could be used for an infiltration based approach such as an infiltration basin, soakaway or trench. Conditional on the outcome of the onsite soakaway testing and detailed design requirements upon planning approval. It would also be recommended that the specific infiltration methods to be used are discussed with the key stakeholders, including the Local Planning Authority and Thames Water at an early stage. Infiltration method(s) and any adoption design standards used will need to be to BRE365 standard and designed in accordance with the CIRIA Sustainable Drainage System Manual.
In terms of discharge rates, in accordance with the SuDS Manual (CIRIA 753) and the Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015) all sites should endeavour to achieve as close to pre-development greenfield rates as is viable. The proposals are therefore discharge at greenfield rates, the discharge rate will not exceed that of the existing onsite percolation rate(s) based on testing at the proposed depths of drainage infrastructure proposed.

The proposed onsite surface water drainage system will need to be sized to contain the 1 in 30yr return period event below ground with overland run-off from storm events up to and including the 1 in 100yr return period event with a 40% allowance for climate change being contained onsite. It would be beneficial to implement SuDS features including permeable surfaces, biofiltration and infiltration basin (or similar), to assist with this requirement.

Should infiltration be proven not be a feasible surface water drainage method for all the site following onsite testing, then the next outfall in the hierarchical approach is to discharge to the watercourse however, there are no watercourses suitable for outfall within close proximity of the site. The alternative would therefore be to discharge to the sewer network; subject to the relevant consents and agreements from Thames Water.

The Flood Risk Assessment and Drainage Management Strategy has been prepared in consultation with the relevant interested parties and incorporates their comments where possible. The report is considered to be commensurate with the scale and nature of the development proposals and in summary, the development can be considered appropriate in accordance with the Planning Practice Guidance.
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Specialist Software


Abbreviations & Acronyms

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<th>Description</th>
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<tr>
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<td>Annual Exceedance Probability</td>
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1.0 INTRODUCTION

1.1 Planning Policy Context
1.1.1 All forms of flooding and their impact on the natural and built environment are material planning considerations. The National Planning Policy Framework (NPPF) sets out the Government’s objectives for the planning system, and how planning should facilitate and promote sustainable patterns of development, avoiding flood risk and accommodating the impacts of climate change. Government policy with respect to development in flood risk areas is contained within the NPPF and the supporting Planning Practice Guidance (PPG) (refer to extracts in Appendix A).

1.1.2 A Flood Risk Assessment and Drainage Management Strategy (FRA&DMS) has been completed in accordance with NPPF/PPG to review all sources of flood risk both to and from the proposed development. The report also considers the most appropriate drainage options including the implementation of Sustainable Drainage Systems (SuDS) in line with the recent changes to national policy.

1.1.3 The proposals are considered to be solely ‘residential’ in nature and as such is classified as ‘more vulnerable’ in Table 2: Flood Risk Vulnerability Classification, within the Planning Practice Guidance. The PPG confirms that this type of land use is appropriate for Flood Zone 1, providing there is no increase in flood risk elsewhere due to the proposals.

1.2 Site Context
1.2.1 This FRA&DMS has been prepared to support an outline planning application for a residential development on land off Oxford Road in Bodicote. The proposals will be complete with access, car parking, external works and lighting, landscaping, boundary walls and fencing, external services and drainage.

1.3 Consultation
1.3.1 The preparation of this report has been undertaken in consultations with the Environment Agency (EA), Oxfordshire County Council (OCC), Cherwell District Council (CDC) and Thames Water (TW). Consultation responses can be seen in Appendix B, C and D respectively. The NPPF advises that CDC as the Local Planning Authority (LPA) should consult with the EA who will provide advice and guidance on flood issues at a strategic level and in relation to planning applications.
2.0 EXISTING SITE LOCATION

2.1 Location
2.1.1 The proposed development site is located adjacent to Oxford Road in Bodicote. The Ordnance Survey National Grid Reference (OS NGR) for the site is E: 446170, N: 238398 and the nearest postcode is OX15 4QL. The total site covers 2.204ha and is edged in red in Figure 1 (see location plan in Appendix E).

2.1.2 Adjacent to the north-eastern boundary of site is Oxford Road with existing residential dwellings with further residential development being undertaken. To the south-east of site is Park End Close residential estate and Cherwell District Council Offices. Further west of the council offices is Bishop Loveday C of E Primary School with White Post Road to the north-west of site. White Post Road is bounded by recreational land, residential dwellings, and Saltway Day Nursey (as illustrated in Figure 1).

![Figure 1: Aerial Photograph of site (Bing Maps, 2018)](image)

2.2 Existing and Historical Land Use
2.2.1 This assessment has identified that the site was historically used as the former Bodicote Flyover Farm Shop. There are numerous buildings onsite located within the south-west corner adjacent to the Bishop Loveday C of E Primary School. The undeveloped land located north of the Farm Shop compromises of low density vegetation, several trees, and taller shrubs along the site boundaries. No other historical uses of the site has been identified as part of this assessment.
2.3 Topography

2.3.1 The site is reasonably flat however, there is a gentle fall from 123.04m AOD in the north-eastern corner that slopes towards the south-western boundary of site, to a level of 120.51m AOD. A full topographical survey has been carried out and is included in Appendix B.
3.0 DEVELOPMENT PROPOSALS

3.1 Nature of the development

3.1.1 This assessment is to support an outline planning application for a residential development on land off Oxford Road. The application also includes demolition of the former Bodicote Flyover Farm Shop buildings. The proposals will be complete with access, car parking, external works and lighting, landscaping, ponds, boundary walls and fencing, external services and drainage as show on the illustrative masterplan in Figure 2 (Appendix G).

![Illustrative Masterplan (HSL, 2018)](image)

3.1.2 The total site covers 2.204ha and the proposed development area however excludes those areas that will remain undeveloped and equates to 1.806ha. The site is partly developed and the pre-development area is 20% impermeable at present. Due to the nature of the proposals the impermeable area post-development is assumed to increase to approximately 49% of the development site (0.878ha).

3.1.3 National and local policy identifies that Sustainable Drainage Systems (SuDS) should be incorporated into new development where at all feasible. There is likely to be scope to incorporate some SuDS features within the proposed open space/amenity areas on the site. Although detailed design will be required to confirm the specific types, subject to ground investigations and detailed levels review (refer to Section 5.0 for the proposed outline drainage strategy).
4.0 SOURCES OF FLOOD RISK

4.1 Fluvial Flood Risk

4.1.1 Information relating to flood risk at the site has been obtained from the Environment Agency and from the Gov.uk website. An extract of the EA’s Flood Zone Map for Planning is shown in Figure 3, which illustrates that the proposed development site is located solely within Flood Zone 1. Flood Zone 1 is an area considered to be at little or no flood risk from rivers and/or the sea (as defined by the EA).

![Figure 3: Fluvial/Tidal Flood Zone Map for Planning Extract (GOV.UK 2018)](image)

4.1.2 The nearest Main River to the site is Sor Brook located approximately 1km south of site, the River Cherwell and the Oxford Canal are also located approximately 1.5km to the north-east. The risk to the site from these potential flood sources is considered to be ‘very low’ due to their proximity from the site and the existing surrounding topography.

4.1.3 There are also Ordinary Watercourses (land drainage) located approximately 1km to the west of site. The flood risk from these features is also considered to be ‘very low’ due to the proximity and the surrounding topography, this can be seen in the Governments Long-Term Flood Risk Mapping, see Appendix B.

Safe Access and Egress

4.1.4 The proposed access road for the site will be via White Post Road adjacent to the north-eastern site boundary. This is shown on the EA’s Flood Zone Map for Planning, to also be located within Flood Zone 1 and is therefore at very low risk from fluvial/tidal flooding. Safe access and egress will therefore be maintained via the new proposed access road onto Oxford Road.
4.2 **Tidal Flood Risk**

4.2.1 The Bristol Channel is located approximately 100km of the development site and the Severn Estuary is also located approximately 90km south-west of site. Due to the distance from the coast, the associated flood risk from these sources is considered to be very low. This is supported by the EA’s Fluvial/Tidal Flood Zone Map for Planning as the site is located within Flood Zone 1 (Figure 3).

4.3 **Flood Risk Vulnerability Classification and Flood Zone Compatibility**

4.3.1 The proposals are solely ‘residential’ in nature and as such is classified as ‘more vulnerable’ in Table 2: Flood Risk Vulnerability Classification within the PPG. Table 3: Flood Risk Vulnerability and Flood Zone ‘Compatibility’ within the PPG confirms that this type of land use is appropriate for Flood Zone 1, providing there is no increase in flood risk elsewhere due to the proposals.

4.4 **Surface Water Flood Risk**

4.4.1 Surface water flooding occurs when rainwater is unable to drain away through the normal drainage systems or soak into the ground, but lies on or flows over the ground instead. The risk associated with surface water run-off is indicated by the long term flood mapping (extract shown in Figure 4).

![Figure 4: Surface Water Flood Map Extract (GOV.UK, 2018)](image)

4.4.2 As indicated in Figure 4, the site is considered to predominantly be at ‘very low’ risk from surface water flooding. There is an area onsite shown to be at ‘low’ risk from surface water, located on existing hardstanding areas associated with the former Bodicote Flyover Farm Shop. The ground has been identified as low-lying gravel (120.86mAOD) in comparison to the surrounding ground levels (121.15mAOD). Run-off naturally falling onsite would direct to the low-lying areas and is unable to direct elsewhere due to the surrounding higher land and therefore may be susceptible to ponding in the extreme storm events.
4.4.3 There could be potential for surface water exceedance from the adjacent highway to flow towards the site along the Oxford Road boundary, an interception method could be implemented if deemed necessary along this boundary to mitigate for any associated residual risks.

4.4.4 The risk to the proposals from surface water flooding will be inherently reduced, post-development through appropriate levels design and implementation of a sustainable surface water drainage regime. In order to further mitigate for any residual risks it is advised that (following any re-grade of the site) finished floor levels are elevated above the external levels to provide safe overland flood routes for excess surface water run-off.

**Pluvial (Overland run-off) Flood Risk**

4.4.5 Intense rainfall that is unable to soak into the ground or enter drainage systems can run-off land and result in flooding. Local topography and the land use can have a strong influence on the direction and depth of flow. The topography of the development and surrounding area means there is little likelihood of significant flows impacting on the proposed development or on land/property adjacent to the development. The only flows that are likely to be present on site are from direct rainfall on areas of hard-standing.

4.4.6 The volume and rate of overland flow from land can be exacerbated if development increases the percentage of impermeable area. Any overland flows generated by the development must be carefully controlled, safe avenues directing overland flow away from adjacent proposed development being advised.

**Sewer Flood Risk**

4.4.7 In urban areas, rainwater is frequently drained into surface water sewers or sewers containing both surface and waste water known as ‘combined sewers’. Foul water flooding often occurs in areas prone to overland flow and can result when the sewer is overwhelmed by heavy rainfall and will continue until the water drains away.

4.4.8 Thames Water sewer records identify there to be limited public surface water sewer infrastructure within the vicinity of the site however, the nearest public surface water sewer is located within Sycamore Drive approximately 118m north-west of site. We have contacted TW regarding the possibility of sewer flooding in the vicinity of the site, they have confirmed there has been no recorded of historical sewer flooding issues, refer to Appendix C.

**4.5 Groundwater Flood Risk**

4.5.1 High groundwater levels are usually the key source of groundwater flooding, which occurs when excess water emerges at the grounds surface (or within manmade underground structures such as basements). Groundwater flooding is often more insistent than surface water flooding and would typically last for weeks/months rather than days meaning the result to property is often more severe.

4.5.2 In general terms groundwater flooding can occur from three main sources:

- If groundwater levels are naturally close to the surface then this can present a flood risk during times of intense rainfall. No groundwater flood risk has been identified...
during review of the Oxfordshire County Council Strategic Flood Risk Assessment (Serala).

Seepage and percolation occur where embankments above ground level hold water. In these cases water travels through the embankment material and emerges on the opposite side of the embankment. At present there are no reported problems with groundwater flooding.

Groundwater recovery/rebound occurs where the water table has been artificially depressed by abstraction. When the abstraction stops the water table makes a recovery to its original level. There is the potential for groundwater flooding in low lying areas where groundwater levels have been depressed below their pre-pumping conditions, where these were at or close to ground level. As with the seepage scenario the likelihood of flooding from this source is low.

4.5.3 The EA mapping data for groundwater shows that the site is underlain by a Secondary A Bedrock Aquifer with no superficial deposits (Appendix B). The site is located within a High Groundwater Vulnerability Zone to a Minor Aquifer. No historical groundwater flooding of the site has been identified during consultation with interested parties. Irrespective, it is advised that external levels fall away from the property (where feasible) to minimise the flood risk from a variety of sources. By keeping the finished floor levels elevated relative to the externals, this should help create an overland flow route.

4.6 Artificial Sources of Flood Risk

4.6.1 National policy states that a FRA should consider the potential risks from a variety of other flood sources including artificial sources (such as risks from reservoirs and canals).

Reservoirs

4.6.2 The EA recognises reservoirs as bodies of water over 25,000cu.m and the long term flood mapping is included in Appendix B which shows the extents of flooding associated with reservoirs does not impact upon or near to the proposed development site.

Canals

4.6.3 The nearest canal to site is the Oxford Canal located approximately 1.5km north-east of the proposed development site. Consultation with the Canal & Rivers Trust did not identify any historical flooding to site during the preparation of this assessment as a result of canal flood sources. Due to the distance from site the risk of flooding associated with canals is considered to be ‘very low’.

Irrespective, it is advised that external levels fall away from the property (where feasible) to minimise the flood risk from a variety of sources. By keeping the finished floor levels elevated relative to the externals, this should help create an overland flow route in the event of a breach or any other source of flooding that could lead to overland flows including reservoir or canal flooding.
4.7 Historical and Anecdotal Flooding Information

4.7.1 An internet based search for flooding events did not recall any historical flooding to the immediate development site area. There has been instances of flooding recorded to the wider Oxford area associated with the River Cherwell and surface water run-off. However, due to the distance from the River Cherwell to site and the surrounding natural topography the risk to the proposals from the future events would be minimal.

4.7.2 Review of the Oxfordshire County Council Preliminary Flood Risk Assessment (PFRA) and the Cherwell District Council’s Strategic Flood Risk Assessment (SFRA) did not highlight any historic flooding pertinent to this FRA (general mapping data is included in Appendix H). Consultation with EA, OCC, CDC and TW failed to highlight any historical flooding directly to the site (see correspondence in Appendix B, C and D respectively).

4.8 Flood Risk Mitigation Measures & Residual Risks

4.8.1 The site is located within Flood Zone 1 and considered to be at little risk of fluvial/tidal flooding. To observe a conservative approach, mitigation measures have been proposed below to safeguard the development with regards to other potentials residual sources of flood risk and to consider the uncertainties of climate change in accordance with the NPPF and PPG.

Mitigation Measures

4.8.2 For ‘more vulnerable’ development located within Flood Zone 1, it is typical to set the Finished Floor Levels (FFL) of residential dwellings to a minimum of 150mm above the existing ground levels. By ensuring the FFLs are raised sufficiently above the external levels (following any re-grade) should mitigate any risk of flooding from a variety of sources, including groundwater and surface water run-off risks at the proposed development.

4.8.3 Any overland flows generated by the development must be carefully controlled. Safe avenues directing overland flow way from any existing and proposed buildings are advised.

4.8.4 To minimise the flood risk to the neighbouring properties it is recommended that the surface water run-off generated by the proposals be managed effectively with the peak rates of run-off being restricted to the equivalent of the pre-development situation (with betterment where required).

4.8.5 The proposed onsite surface water drainage system will need to be sized to contain the 1 in 30yr return period event below ground with exceedance from storm events up to and including the 1 in 100yr return period storm event with a 40% allowance for climate change being contained onsite.

4.8.6 As with any drainage system blockages within either the foul or surface water system have the potential to cause flooding or disruption. It is important that should any drainage systems not be offered for adoption to either the Water Company or the Local Authority then an appropriate maintenance regime should be scheduled with a suitably qualified management company for these private drainage systems.
Residual Risks

4.8.7 If an extreme rainfall event exceeds the design criteria for the drainage system it is likely that there will be some overland flows that are unable to enter the system, it is important that these potential overland flows are catered for within the development site in the event that the capacity of the drainage system is exceeded.
5.0 SURFACE WATER MANAGEMENT

5.1 Pre-Development Surface Water Run-off

5.1.1 The total site covers 2.204ha, however the proposed development area excludes areas which will remain undeveloped and covers a smaller portion at approximately 1.806ha. At present the development area is approximately 20% impermeable and it is assumed to have existing positive surface water drainage infrastructure to cater for the existing run-off generated; further investigation would be required to confirm the presence of these existing assets. Furthermore, the undeveloped areas located onsite are considered to discharge naturally to ground over an extended time.

5.1.2 As the existing method of surface water management is unconfirmed and national planning policy states new development should endeavour to achieve greenfield equivalent rates. The peak rates and volumes of run-off for the development area have therefore been calculated based on a greenfield scenario. The IH214 greenfield method has been utilised to calculate the figures noted in Table 1 (full details Appendix I).

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<td>1.806ha</td>
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*Table 1: Pre-Development Surface Water Run-Off Rates (Betts Hydro, 2018)*

5.2 Post Development Surface Water Run-Off

5.2.1 At present the indicative proposals show the development area to cover 1.806ha of the wider site. Based on the planning layout we have estimated that the post-development impermeable areas will increase to approximately 49% of the development area. The unrestricted post-development run-off rates have been detailed in Table 2.

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</table>

*Table 2: Post-Development Un-Restricted Run-Off Rates (Betts Hydro, 2018)*

5.2.2 The proposals however will be to restrict the rate of discharge from the development to mimic a pre-development greenfield situation (Table 1), betterment in the form of permeable surfaces will also be considered as part of detailed design where feasible to reduce surface water run-off rates. Permeable surfaces will also be considered as part of detailed design where feasible to reduce surface water run-off rates.

5.3 Sustainable Drainage Systems (SuDS)

5.3.1 Sustainable Drainage Systems (SuDS) have the ability to address four core objectives; water quantity, water quality, amenity and biodiversity. In accordance with the NPPF, SuDS should be specified wherever possible to manage surface water run-off generated onsite. With the appropriate system specified, all core objectives can be satisfied, this in turn reduces the burden downstream on both watercourses and sewerage systems.
5.3.2 Where possible, peak surface water discharge rates to watercourses and sewers should be appropriately managed and where possible reduced. Preference should always be given to SuDS over the traditional methods within green spaces (POS) areas, where SuDS features can be implemented. Given the indicative layout there may be the opportunity to incorporate methods such as swales and basins to provide a degree of treatment before flows are carried offsite. The photographs in Figure 7 illustrate similar residential schemes which have utilised SuDS as part of the surface water management strategy.

![Figure 5: SuDS Photographs (SusDrain, 2012)](image)

5.3.3 Should the ground conditions onsite prove favourable, it would also be recommended that permeable paving, swales or tree pits be utilised in non-adopted areas where at all feasible; if infiltration is proven not feasible then the permeable paving should be lined with a positive connection into the proposed main drainage for the site. Detailed design should confirm which SuDS method would be suitable for incorporation into the development proposals following more detailed analysis of levels, ground conditions, and attenuation requirements.

5.4 Methods of Surface Water Management
5.4.1 At present the proposed development site is 2.204ha and the proposed impermeable area is set to increase to 49% of the development area (1.806ha). There are three methods that have been reviewed for the management and discharge of surface water. These may be applied individually or collectively to form a complete strategy and should be applied in the order of priority listed below:

- Discharge via infiltration
- Discharge to watercourse
- Discharge to public sewerage system

5.5 Discharge via Infiltration
5.5.1 Any impermeable areas that can drain to soakaway or an alternative method of infiltration would significantly improve the sustainability of any surface water systems.
5.5.2 The Cranfield Soil and AgriFood Institute (CSAI), Soils where identifies the soils to be freely draining, slightly acid, but base-rich. The British Geology Survey (BGS) mapping data indicates that ground conditions are as follows:

- **Bedrock Geology**: Marlstone Rock Formation - Ferruginous Limestone and Ironstone.
- **Superficial Deposits**: None Recorded.

5.5.3 Based on the ground conditions identified by the online datasets it can be considered that infiltration may offer a part or fully viable drainage solution for the development site due to the permeable strata. The mapping however, is considered to be large scale and infiltration rates vary on a site by site basis. It would therefore be recommended further investigation in the form of Soakaway Testing to BRE365, takes place upon planning approval as infiltration is the primary proposed means of discharging surface water run-off.

5.5.4 The proposals are therefore to manage surface water run-off generated by the development via an infiltration based approach. At this time the planning layout has allowed for an area of open space; this area could incorporate an infiltration method such as a basin or below ground cellular crate(s) depending on the engineering constraints and onsite testing results.

5.5.5 It would be recommended that the specific infiltration method(s) to be used are designed to BRE365 standards in accordance with the CIRIA SuDS Manual. Discussion with the LLFA, the LPA and TW will also be required as part of detailed design to ensure the infiltration methods conform to their standards of design.

![Figure 6: Surface Water Constraints Drainage Strategy Plan extract (Betts Hydro, 2018)](image)

5.6.6 In terms of discharge rates, these will be in accordance with the SuDS Manual and Non-Statutory Technical Standard for SuDS. The proposed discharge will not exceed that of the
pre-development greenfield equivalent (existing onsite percolation rate determined during onsite testing). The proposed surface water drainage systems will be designed to cater for the storm events up to and including the 1 in 100 year return period event with 40% allowance for climate change.

5.6 **Discharge to Watercourse**

5.6.1 Should infiltration not be feasible then the next outfall in the hierarchical approach should be discharge to the watercourse. However, there are no watercourses suitable for outfall within close proximity of the site therefore, discharge to the sewer network would be the alternative approach; subject to the relevant consents and agreements.

5.7 **Discharge to Public Sewer Network**

5.7.1 Should infiltration not offer feasible solution for surface water management at the site, then the alternative option would be to discharge to the nearest Thames Water public surface water sewer. Thames Water have identified a public surface water sewers in proximity to site; the 225mm public surface water sewer is located approximately 118m north-west of site within Sycamore Drive (as illustrated in **Figure 6** previously). Presently, it is not clear whether a gravity solution to this sewer would be feasible therefore, a pumped solution may be required during detailed design.

5.7.2 Relevant consents and approaches for works to the public sewer network will be required from TW and early discussion will be needed to identify any additional capacity constraints and their preferred point(s) for connection. Any offsite works will need to be discussed and agreed with the relevant parties (including Highways Authority) during detailed design process.

5.7.3 At present the soil factor onsite is 0.150 (favourable to infiltration) however, if further testing identifies infiltration will not work onsite; then the proposals are to discharge to the public sewer network at a pre-development greenfield rate (QBar). The pre-development greenfield rate has been calculated using an increased soil factor (0.450) to reflect a more accurate representation of the surface water run-off onsite, should percolation rates onsite actually not favour an infiltration based approach. This approach has been agreed with the EA and the other LLFA on other schemes and is anticipated to be acceptable in this occasion.

5.7.4 The proposed discharge rate (using a higher soil factor) is 7.9l/s (QBar) (**Appendix I**). The restricted discharge rate will generate a storage requirement during the extreme storm events. The stormwater storage figures quoted in **Table 4** are estimates only for the site. Detailed drainage design will determine with accuracy the stormwater storage requirements.

<table>
<thead>
<tr>
<th>Impermeable Area (0.878ha)</th>
<th>1 In 1 Year</th>
<th>1 In 30 Year</th>
<th>1 In 100 Year + 40% CC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Restricted Run-Off Rate</strong></td>
<td>7.9l/s</td>
<td>7.9l/s</td>
<td>7.9l/s</td>
</tr>
<tr>
<td><strong>Estimated Stormwater Storage Volume</strong></td>
<td>65cu.m-108cu.m</td>
<td>215cu.m-305cu.m</td>
<td>469cu.m-636cu.m</td>
</tr>
</tbody>
</table>

**Table 4: Estimated Stormwater Storage Requirements (Betts Hydro, 2017)**
5.8 Climate Change

5.8.1 There are indications that the climate in the UK is changing significantly and it is widely believed that the nature of climate change will vary greatly by region. Current expert opinion indicates the likelihood that future climate change would produce more frequent short duration and high intensity rainfall events with the addition of more frequent periods of long duration rainfall. It is believed that the impact of climate change means there is likely to be a long term increase in the average sea levels, with an expectation that sea levels will rise gradually. An increase in flood water levels means that future flooding events will occur more frequently and will have a greater impact.

5.8.2 In light of the future uncertainties Climate Change should be accounted for within the design of all new developments. The recently published Environment Agency document ‘Adapting to Climate Change : Advice for Flood and Coastal Erosion Risk Management Authorities’ supersedes Defra’s policy statement on Flood Risk and Coastal Erosion Risk Management (2009) and should be used for future proposals. Climate change factors have been considered and any increase in the level of flood risk (to the site) from climate change is likely to be related to the increase in rainfall intensity and duration and its impact upon the surface water drainage system.

5.8.3 In accordance with the updated Climate Change projections provides estimated changes to rainfall intensity (Table 4) and based on the design life of the development (100yrs) the “total potential change figures for the 2080’s has been utilised.

<table>
<thead>
<tr>
<th>PROJECTIONS</th>
<th>TOTAL POTENTIAL CHANGE ANTICIPATED FOR THE 2080’S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper End Estimate</td>
<td>40%</td>
</tr>
<tr>
<td>Central Change Factor</td>
<td>20%</td>
</tr>
</tbody>
</table>

*Table 5: Change to Extreme Rainfall Intensity Compared to 1961-1990 Baseline (Environment Agency, 2016)*
6.0 FOUL WATER MANAGEMENT

6.1 Review of the TW sewer records identify there to be limited public sewer infrastructure in proximity to the site however, the nearest foul water sewer (150mm dia.) is located adjacent to the north-eastern site boundary within Oxford Road (refer to sewer records within Appendix C). Due to the site being brownfield there is a possibility there is an existing connection, however further investigation is required to confirm the condition and capacity of the existing sewer network.

6.2 The proposals are to connect into the nearest foul water sewer within Oxford Road adjacent to the north-eastern site boundary, the exact location of the proposed connection point is subject to early discussions with TW. Based on the proposals for the construction of 52 no. residential units the approximate peak foul water flows generated by the development will be 2.4l/s. This figure is calculated based on 4000 litres per dwelling per 24 hours; the guidance contained within Sewers for Adoption (SfA).

6.3 Detailed design will be required to confirm feasibility based on the topographic levels following further detailed investigation. It is not clear whether a full site gravity connection will be achievable onsite as further investigation as part of detailed design of the TW public sewer system is required to ascertain the existing invert levels.

6.4 Consents and relevant agreements will be required from TW prior to commencement of works. Early consultation with TW is recommended to identify any additional constraints and their preferred point(s) of connection. It is possible that offsite works would be required for a connection to the public sewer network. Any offsite asset routing works will also need to be considered in terms of consents with the relevant land owners (Highways Authority).
7.0 SUMMARY AND CONCLUSIONS

7.1 This Flood Risk Assessment and Drainage Management Strategy was commissioned by Hollins Strategic Land referred to hereafter as ‘the client’. This report has been prepared to support an outline planning application for the construction of a residential development on land adjacent to Oxford Road in Bodicote.

Flood Risk

7.2 The site lies solely within Flood Zone 1 based on the Environment Agency Flood Map for Planning and is 2.204ha in size. Residential development is classified as ‘more vulnerable’ within the Planning Practice Guidance which supports the National Planning Policy Framework. The Planning Practice Guidance confirms that ‘more vulnerable’ development is appropriate to be located within Flood Zone 1, providing there is no increase in flood risk elsewhere due to the proposals.

7.3 This report has reviewed all sources of flood risk both to and resulting from the proposed development site. Consultations with the Environment Agency Oxfordshire County Council, Cherwell District Council and Thames Water, have been undertaken and did not identify any historical incidents of flooding to the site.

7.4 The proposals are considered to be at ‘very low’ flood risk from the majority of flood sources. The nearest watercourse to site is Sor Brook located approximately 1km south of site, the Oxford Canal is also located approximately 1.5km north with the River Cherwell located beyond. The primary flood risk however, is considered to be from ‘very low’ surface water run-off, which is closely associated with the existing topography on site. The risk associated with surface water flooding will be reduced and sustainably managed post-development, following the implementation of mitigation measures proposed within this assessment.

Drainage Strategy

7.5 Due to the relatively low flood risks identified, the principle focus of this assessment is on sustainable management of surface water run-off in accordance with national and local policy. Surface water discharge options have been assessed in accordance with the sustainable drainage hierarchy and based on the ground conditions identified by the online datasets, infiltration may offer a part or fully viable drainage solution for the development site due to the permeable strata. The mapping however, is considered to be large scale and infiltration rates vary on a site by site basis, it would therefore be recommended that further investigation (onsite testing) takes place upon planning approval as infiltration would be the primary means of discharging surface water run-off.

7.6 At this time the planning layout has allowed for an area of open space, this area could be used for an infiltration based approach such as an infiltration basin, soakaway or trench. Depending on the outcome of the onsite soakaway testing and detailed design requirements. It would also be recommended that the specific infiltration methods to be used are discussed with the key stakeholders, including the Local Planning Authority and Thames Water at an early stage. Infiltration method(s) and any adoption design standards used will need to be to BRE365 standard and designed in accordance with the CIRIA Sustainable Drainage System Manual.
7.7 In terms of discharge rates, in accordance with the SuDS Manual (CIRIA 753) and the Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015) all sites should endeavour to achieve as close to pre-development greenfield rates as is viable. As the existing method of surface water management is unconfirmed and national planning policy states new development should endeavour to achieve greenfield equivalent rates. The peak rates and volumes of run-off for the development area have therefore been calculated based on a greenfield scenario.

7.8 The proposed onsite surface water drainage system will need to be sized to contain the 1 in 30yr return period event below ground with overland run-off from storm events up to and including the 1 in 100yr return period event with a 40% allowance for climate change being contained onsite. It would be beneficial to implement SuDS features including permeable surfaces, bio-filtration and infiltration basin (or similar), to assist with this requirement.

7.9 Should infiltration not be feasible for all of the site due to other constraints then the next outfall in the hierarchical approach is to discharge to the watercourse. At present, there are no watercourses suitable for outfall within close proximity of the site, therefore discharge to the sewer network would be required. Thames Water surface water sewer. Thames Water have identified a 225mm public surface water sewer located approximately 118m north-west of site within Sycamore Drive.

7.10 Consents for works to the public sewer network will be required from TW and early discussion will be needed to identify any additional capacity constraints and preferred point(s) for connection. Detailed design will be required to confirm the possibility of a site wide gravity connection following further investigations. If a gravity system is not feasible a pumped surface water system may be required to cater for the proposals. Any offsite works will need to be discussed and agreed with the relevant parties (including Highways Authority) during detailed design process.

7.11 The Flood Risk Assessment and Drainage Management Strategy has been prepared in consultation with the relevant interested parties and incorporates their comments where possible. The report is considered to be commensurate with the scale and nature of the development proposals and in summary, the development can be considered appropriate in accordance with the Planning Practice Guidance.
8.0 RECOMMENDATIONS

8.1 For ‘more vulnerable’ development located within Flood Zone 1, it is typical to set the Finished Floor Levels (FFL) of residential dwellings to a minimum of 150mm above the existing ground levels. By ensuring the FFLs are raised sufficiently above the external levels (following any re-grade) should mitigate any risk of flooding from a variety of sources, including groundwater and surface water run-off risks at the proposed development.

8.2 To minimise the flood risk to the neighbouring property and proposed dwellings it is proposed that the surface water run-off generated by the proposals be managed effectively with the peak rates of run-off being restricted in accordance with the NPPF and Non-Technical Standards for SuDS.

8.3 In accordance with LPA’s and TW requirements, Soakaway Testing to BRE365 may be required to be undertaken upon planning approval to evidence that discharge to ground will not be a viable solution, this can be via a standard condition (prior to commencement of work).

8.4 Detailed design will refine the drainage strategy once an outfall point is determined, along with confirming whether a full site gravity system can be achieved; it is likely that a pumped solution in part would be required for foul water connection to the public sewer network.

8.5 Early discussion with TW for any proposed works to the public sewer network is advised and will identify any additional considerations including access, points of connection and capacity constraints. Furthermore, consents with other land owners including Highway Authority will be required for any offsite works.

8.6 Consideration is recommended into the stormwater attenuation requirements due to restricting the surface water discharge from the site. The proposed onsite surface water drainage system will need to be sized to contain the 30yr return period event wholly below ground with overland run-off from storm events up to and including the 1 in 100yr return period storm event with a 40% allowance for climate change being contained onsite; the estimate of between 215m$^3$ and 305m$^3$ is required to store in the 1 in 30yr event.

8.7 It is important that should any drainage systems not be offered for adoption to either the Water Company or the Local Authority then an appropriate maintenance regime should be scheduled with a suitably qualified management company for these private drainage systems.
BIBLIOGRAPHY & REFERENCES

Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities
- Environment Agency/DEFRA 2016

Web-based References
Anglian Water - http://www.anglianwater.co.uk/
Bingmaps – http://www.bing.com/Maps/
Chronology of British Hydrological Events – www.dundee.ac.uk/
CIRIA – http://www.ciria.org/
Cranfield University – http://www.landis.org.uk/soilscape/
Environment Agency – www.environment-agency.gov.uk/
FloodProBE – http://www.floodprobe.eu/
Flood Forum – http://www.floodforum.org.uk/
Google Maps – http://maps.google.co.uk/
Streetmap – http://www.streetmap.co.uk/
Thames Water - https://www.thameswater.co.uk/
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Table 1: Flood zones
(Notes: These flood zones refer to the probability of river and sea flooding, ignoring the presence of defences)

<table>
<thead>
<tr>
<th>Zone 1 - low probability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition</strong></td>
</tr>
<tr>
<td><strong>Appropriate uses</strong></td>
</tr>
<tr>
<td><strong>Flood risk assessment requirements</strong></td>
</tr>
<tr>
<td><strong>Policy aims</strong></td>
</tr>
</tbody>
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<table>
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<tr>
<th>Zone 2 - medium probability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition</strong></td>
</tr>
<tr>
<td><strong>Appropriate uses</strong></td>
</tr>
<tr>
<td><strong>Flood risk assessment requirements</strong></td>
</tr>
<tr>
<td><strong>Policy aims</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Zone 3a - high probability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition</strong></td>
</tr>
<tr>
<td><strong>Appropriate uses</strong></td>
</tr>
<tr>
<td><strong>Flood risk assessment requirements</strong></td>
</tr>
<tr>
<td><strong>Policy aims</strong></td>
</tr>
<tr>
<td>- reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage systems;</td>
</tr>
</tbody>
</table>
- relocate existing development to land in zones with a lower probability of flooding; and
- create space for flooding to occur by restoring functional floodplain and flood flow pathways and by identifying, allocating and safeguarding open space for flood storage.

### Zone 3b - the functional floodplain

**Definition**
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 identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. But land which would flood with an annual probability of 1 in 20 (5%) or greater in any year, or is designated to flood in an extreme (0.1%) flood, should provide a starting point for consideration and discussions to identify the functional floodplain.

**Appropriate uses**
Only the water-compatible uses and the essential infrastructure listed in table 2 that has to be there should be permitted in this zone. It should be designed and constructed to:
- remain operational and safe for users in times of flood;
- result in no net loss of floodplain storage;
- not impede water flows; and
- not increase flood risk elsewhere.

Essential infrastructure in this zone should pass the Exception Test.

**Flood risk assessment requirements**
All development proposals in this zone should be accompanied by a flood risk assessment.

**Policy aims**
In this 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 appropriate application of sustainable drainage systems;
- relocate existing development to land with a lower probability of flooding.
Table 2: Flood risk vulnerability classification

<table>
<thead>
<tr>
<th>Essential infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk.</td>
</tr>
<tr>
<td>• Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations, and water treatment works that need to remain operational in times of flood.</td>
</tr>
<tr>
<td>• Wind turbines.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Highly vulnerable</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Police stations, ambulance stations and fire stations and command centres and telecommunications installations required to be operational during flooding.</td>
</tr>
<tr>
<td>• Emergency dispersal points.</td>
</tr>
<tr>
<td>• Basement dwellings.</td>
</tr>
<tr>
<td>• Caravans, mobile homes and park homes intended for permanent residential use.</td>
</tr>
<tr>
<td>• Installations requiring hazardous substances consent* (where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure, or carbon capture and storage installations that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as “essential infrastructure”)*.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>More vulnerable</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Hospitals.</td>
</tr>
<tr>
<td>• Residential institutions such as residential care homes, children’s homes, social services homes, prisons and hostels.</td>
</tr>
<tr>
<td>• Buildings used for dwelling houses, student halls of residence, annexing establishments, nightshuts and hotels.</td>
</tr>
<tr>
<td>• Non-residential uses for health services, nurseries and educational establishments.</td>
</tr>
<tr>
<td>• Landfill and sites used for waste management facilities for hazardous waste.</td>
</tr>
<tr>
<td>• Sites used for holiday or short let caravans and camping, subject to a specific warning and evacuation plan.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Less vulnerable</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Police, ambulance and fire stations which are not required to be operational during flooding.</td>
</tr>
<tr>
<td>• Buildings used for shops, financial, professional and other services, restaurants and cafes, hot food takeaways, offices, general industry, storage and distribution, non-residential institutions not included in “more vulnerable”, and assembly and leisure.</td>
</tr>
<tr>
<td>• Land and buildings used for agriculture and forestry.</td>
</tr>
<tr>
<td>• Waste treatment (except landfill and hazardous waste facilities).</td>
</tr>
<tr>
<td>• Mines and mineral processing (except for sand and gravel working).</td>
</tr>
<tr>
<td>• Water treatment works which do not need to remain operational during times of flood.</td>
</tr>
<tr>
<td>• Sewage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Water-compatible development</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Flood control infrastructure.</td>
</tr>
<tr>
<td>• Water transmission infrastructure and pumping stations.</td>
</tr>
<tr>
<td>• Sewage transmission infrastructure and pumping stations.</td>
</tr>
<tr>
<td>• Sand and gravel working.</td>
</tr>
<tr>
<td>• Docks, marinas and wharves.</td>
</tr>
<tr>
<td>• Navigation facilities.</td>
</tr>
<tr>
<td>• Ministry of Defence defence installations.</td>
</tr>
<tr>
<td>• Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a water-side location.</td>
</tr>
<tr>
<td>• Water based recreation (excluding sleeping accommodation).</td>
</tr>
<tr>
<td>• Lifeguard and coastguard stations.</td>
</tr>
<tr>
<td>• Amenities open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms.</td>
</tr>
<tr>
<td>• Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.</td>
</tr>
</tbody>
</table>
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Dear Megan

Thank you for your email.

We are unable to supply any modelled flood levels as the site is located in Flood Zone 1. Please find attached an extract from our flood map and surface water flood map.

I hope that we have correctly interpreted your request. Please refer to our Open Government Licence for the permitted use of the supplied data: [http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/](http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/)

Please be aware that many of our datasets are now available online. Simply visit [environment.data.gov.uk](http://environment.data.gov.uk)

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).

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

Yours sincerely

Dawn Cooper
Customers & Engagement Officer
Direct Dial: 020 302 59465

Environment Planning & Engagement Team
Environment Agency
Thames Area

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---

From: Megan Berry [mailto:meganberry@betts-associates.co.uk]
Sent: 20 March 2018 09:30
To: Enquiries_THM <enquiries_THM@environment-agency.gov.uk>
Subject: Flood Risk Advice

**F.A.O Flood Risk, Drainage and/or Planning department**
Please forward to the correct department/office

To whom it may concern,

Oxford Road, Bodicote.

Please could you confirm whether you have any information that you feel would be valuable to a Flood Risk Assessment and Drainage Management Strategy for the site above (see location plan attached), including details of historical flooding and any predicted flood water levels; this would be greatly appreciated. If there are any specific requirements that you require in a scope of works for this site please can you advise at this stage so that it can be fully incorporated into the proposals at an early stage.

Please do not hesitate to contact me on the details below to discuss further should you require additional information or clarification.

Kind Regards

Megan Berry  BSc(Hons)
Graduate Flood Risk Analyst

BETTS HYDRO
Specialists in Drainage and Flood Risk
Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire, CH5 2LY

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SUDS | STRUCTURAL SURVEYS | PARTY WALL DUTIES | INFILTRATION | GEO-TECHNICAL

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Flood Map for Planning

Long Term Flood Risk – Rivers or Sea
Long Term Flood Risk – Surface Water

Long Term Flood Risk - Reservoirs
This page has been left intentionally blank
Megan Berry

From: Megan Berry
Sent: 20 March 2018 09:30
To: 'DEVELOPER.SERVICES@THAMESWATER.CO.UK'
Subject: Flood Risk Advice
Attachments: LOCATION PLAN.pdf

F.A.O Flood Risk, Drainage and/or Planning department

Please forward to the correct department/office

To whom it may concern,

Oxford Road, Bodicote.

Please could you confirm whether you have any information that you feel would be valuable to a Flood Risk Assessment and Drainage Management Strategy for the site above (see location plan attached), including details of historical flooding and any predicted flood water levels; this would be greatly appreciated. If there are any specific requirements that you require in a scope of works for this site please can you advise at this stage so that it can be fully incorporated into the proposals at an early stage.

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Based on the Ordnance Survey Map with the Sanction of the controller of H.M. Stationery Office, License no. 100019345 Crown Copyright Reserved.
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This page has been left intentionally blank
Dear Megan
The site in question is remote from the South Oxford Canal which will not present any flood risk.

Regards
John

John Kearsey
Principal Water Engineer - South
Canal & River Trust

M 07710 796354

Please visit our [website](http://www.canalrivertrust.org.uk) to find out more about our 10 year strategy.

Hi John,

Please see below, can I leave this with you to respond to?

Many thanks

Lou

F.A.O Flood Risk, Drainage and/or Planning department

Please forward to the correct department/office

To whom it may concern,

*Oxford Road, Bodicote.*
Please could you confirm whether you have any information that you feel would be valuable to a Flood Risk Assessment and Drainage Management Strategy for the site above (see location plan attached), including details of historical flooding and any predicted flood water levels; this would be greatly appreciated. If there are any specific requirements that you require in a scope of works for this site please can you advise at this stage so that it can be fully incorporated into the proposals at an early stage.

Please do not hesitate to contact me on the details below to discuss further should you require additional information or clarification.

Kind Regards

Megan Berry  BSc(Hons)
Graduate Flood Risk Analyst

BETTS HYDRO
Specialists in Drainage and Flood Risk
Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire, CH5 2LY
CHESTER OFFICE - 01244 289041
meganberry@betts-associates.co.uk
www.betts-associates.co.uk

CIVIL | STRUCTURAL | GEO-ENVIRONMENTAL | HYDROLOGY | FLOOD RISK MANAGEMENT
SUDS | STRUCTURAL SURVEYS | PARTY WALL DUTIES | INFILTRATION | GEO-TECHNICAL

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Cadw mewn cysslitiad
Cofrestrwch i dderbyn e-gylchlythyr Glandŵr Cymru https://canalrivertrust.org.uk/newsletter
Cefnogwch ni ar https://www.facebook.com/canalrivertrust
Dilynwnch ni ar https://twitter.com/canalrivertrust ac https://www.instagram.com/canalrivertrust

Mae'r e-bost hwn a'i atodiadau ar gyfer defnydd y derbynnydd bwriedig yr e-bost hwn a'i atodiadau, ni ddylech gymryd unrhyw gamau ar sail y cynnwys, ond yn hytrach dylech eu dileu heb eu copio na'u hanfon ymlaen a rhoi gwybod i'r anfonwr eich bod wedi eu derbyn ar ddamwain. Mae unrhyw farn neu safbwynt a fynegir yn eiddo i'r awdur yn unig ac nid ydyn nhw reidrwydd yn cynrychioli barn a safbwyntiau Glandŵr Cymru.
Hello, I have received your emailed enquiry of 20th March.

You are probably aware that the site is shown to be in Flood Zone 1. Reference to the surface water flood risk maps show there may be a small risk of surface water flooding within the site.

We are not aware that the site has been affected by flooding. However, because of its current use and nature, we may not necessarily have been notified if it has.

Tony Brummell CEng FICE  
Building Control Manager

Cherwell and South Northants Building Control Service  
Place and Growth Directorate  
Cherwell and South Northants Councils

Direct Tel: 01327 322273  
tony.brummell@cherwellandsouthnorthants.gov.uk  
www.cherwell.gov.uk  |  www.southnorthants.gov.uk

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Dear Ms Berry,

Thank you for your request of 20 March 2018 in which you asked for the flood risk assessment and drainage management strategy for Oxford Road, Bodicote.

Your request is being considered and Oxfordshire County Council will respond within 20 working days in compliance with the Freedom of Information Act 2000. This means that the council will send a response to you by 19 April 2018.

Please note that there will be a fee payable for this information and we would be grateful if you notify us if you wish to proceed with your request.

If appropriate, the information requested can be made available in alternative formats, including other languages, Braille, large print, and audiocassette. If you require any of these formats then please let us know.

Please contact us if you have any have further enquiries about your request. We would be grateful if you could quote the reference number given at the top of this email.

Kind regards
Renata Malinowski

E&E Freedom of Information and Complaints Support Officer
Joint Commissioning and E&E
Email: E&E-FOI@oxfordshire.gov.uk and JointCommissioningFOI@oxfordshire.gov.uk

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APPENDIX E: LOCATION PLAN

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LOCATION PLAN
Oxford Road, Bodicote.

OS X (Eastings)     446170
OS Y (Northings)    238398
Nearest Post Code   OX15 4QL
Lat (WGS84)         N52:02:31 (52.042065)
Long (WGS84)        W1:19:42 (-1.328260)
Lat,Long            52.042065,-1.328260
Nat Grid            SP461383 / SP4617038398
mX                  -147861
mY                  6774022
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APPENDIX H: PFRA/SFRA PLANNING EXTRACTS

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PRELIMINARY FLOOD RISK ASSESSMENT

Oxfordshire County Council

Map 7: Areas Susceptible to Groundwater Flooding

Legend

- Surface water hotspots
- Areas Susceptible to Groundwater Flooding
  - >= 75%
  - >= 50% <75%
  - >= 25% <50%
  - < 25%

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This document is the property of Jeremy Benn Associates Ltd. It shall not be reproduced in whole or in part, nor disclosed to a third party, without the permission of Jeremy Benn Associates.
This document shows the spatial distribution of non-residential properties that may be affected by future surface water flooding in an event with a 1 in 200 chance of occurring in any given year. Non-residential properties are defined in the Environment Agency's PFRA and property count guidance, and include all industrial, commercial, retail, public buildings etc. Calculations for each 1km square were carried out using the Flood Map for Surface Water (1 in 200 >0.3m), Environment Agency's detailed method of counting (based on property outlines) and the National Receptors Database v1.1. The 1km squares are shaded from light to dark purple as the number of non-residential properties affected in each square increases. Also overlaid on the map are surface water flooding 'hot spots', or areas where the consequences of a surface water event are likely to be more severe. These have been defined as 1km grid squares where at least one of the three indicators is above the threshold given below (thresholds defined by Defra guidance):

- More than 200 people affected
- One or more critical services affected
- More than 20 non-residential properties affected

The maps show that:

- The main hotspots are in more urban locations due to the concentration of population, industrial and commercial buildings, and critical services.
- Several more rural communities have less people affected but will still experience an adverse impact, particularly those where local critical services are affected. More detail is given in the main report.

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Maps 6a to 6c show the spatial distribution of three receptors (people, critical services and non-residential properties) that may be affected by future surface water flooding in an event with a 1 in 200 chance of occurring in any given year.

This map shows the number of people affected, which can be considered an indicator of the consequences of flooding for human health. The number of people is defined by the Environment Agency guidance as the number of residential (housing) properties multiplied by 2.34.

Calculations for each 1km square were carried out using the Flood Map for Surface Water (1 in 200 >0.3m), Environment Agency’s detailed method of counting (based on property outlines) and the National Receptors Database v1.1.

The 1km squares are shaded from light to dark purple as the number of people affected in each square increases. Also overlaid on the map are surface water flooding ‘hot spots’, or areas where the consequences of a surface water event are likely to be more severe. These have been defined as 1km grid squares where at least one of the three indicators is above the threshold given below (thresholds defined by Defra guidance):

- More than 200 people affected
- One or more critical services affected
- More than 20 non-residential properties affected

The maps show that:
- The main hotpots are in more urban locations due to the concentration of population, industrial and commercial buildings, and critical services.
- Several more rural communities have less people affected but will still experience an adverse impact, particularly those where local critical services are affected.

More detail is given in the main report.
PRELIMINARY FLOOD RISK ASSESSMENT
OXFORDSHIRE COUNTY COUNCIL

Legend

- Number of properties affected by groundwater flooding:
  - 0 to 10
  - 11 to 20
  - 21 to 200

Map 3: Past flooding - Groundwater

Note: Points are an indication of the approximate location of the settlement affected, NOT the location of individual properties flooded.

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Explanatory note: Maps 6a to 6c show the spatial distribution of three receptors (people, critical services and non-residential properties) that may be affected by future surface water flooding in an event with a 1 in 200 chance of occurring in any given year.

This map shows the number of non-residential properties affected, which can be considered an indicator of the consequences of flooding for economic activity. Non-residential properties are defined in the Environment Agency’s PFRA and property count guidance, and include all industrial, commercial, retail, public buildings etc.

Calculations for each 1km square were carried out using the Flood Map for Surface Water (1 in 200 > 0.3m), Environment Agency’s detailed method of counting (based on property outlines) and the National Receptors Database v1.1.

The 1km squares are shaded from light to dark purple as the number of non-residential properties affected in each square increases.

Also overlaid on the map are surface water flooding ‘hotspots’, or areas where the consequences of a surface water event are likely to be more severe. These have been defined as 1km grid squares where at least one of the three indicators is above the threshold given below (thresholds defined by Defra guidance):

• More than 200 people affected
• One or more critical services affected
• More than 20 non-residential properties affected

The maps show that:
• The main hotspots are in more urban locations due to the concentration of population, industrial and commercial buildings, and critical services.
• Several more rural communities have less people affected but will still experience an adverse impact, particularly those where local critical services are affected. 

More detail is given in the main report.

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Explanatory note:
Maps 6a to 6c show the spatial distribution of three receptors (people, critical services and non-residential properties) that may be affected by future surface water flooding in an event with a 1 in 200 chance of occurring in any given year.

This map shows the number of people affected, which can be considered an indicator of the consequences of flooding for human health. The number of people is defined by the Environment Agency guidance as the number of residential (housing) properties multiplied by 2.34. Calculations for each 1km square were carried out using the Flood Map for Surface Water (1 in 200 >0.3m), Environment Agency's detailed method of counting (based on property outlines) and the National Receptors Database v1.1.

The 1km squares are shaded from light to dark purple as the number of people affected in each square increases. Also overlaid on the map are surface water flooding 'hot spots', or areas where the consequences of a surface water event are likely to be more severe. These have been defined as 1km grid squares where at least one of the three indicators is above the threshold given below (thresholds defined by Defra guidance):

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- More than 20 non-residential properties affected

The maps show that:
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PRELIMINARY FLOOD RISK ASSESSMENT

Map 4: Past flooding - Canal flooding in July 2007

OXFORDSHIRE COUNTY COUNCIL

Date:

Status:

Scale:

File Name:

AB 09/06/2011 FINAL N/A

Drawing Number: Map 4

Original @ A3

Not to scale

Legend

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PRELIMINARY FLOOD RISK ASSESSMENT
OXFORDSHIRE COUNTY COUNCIL

Map 3: Past flooding - Ground water

Legend

- Past flooding from groundwater
  - Number of properties
    - 0 to 10
    - 11 to 20
    - 21 to 200
  - Groundwater flooding locations (2001)

Note: Points are an indication of the approximate location of the settlement affected, NOT the location of individual properties flooded.

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OX10 6SL

0 5 10 20 25 Kilometers
PRELIMINARY FLOOD RISK ASSESSMENT

OXFORDSHIRE COUNTY COUNCIL

Legend

Number of properties flooded internally by 'surface water' (by settlement). Note: Points are an indication of the approximate location of the settlement affected, NOT the location of individual properties flooded.

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OX10 6SL

2007
Map 1: Past flooding - Surveys made in July

Number of properties flooded internally by 'drainage' and 'ordinary watercourse' (by parish)
PRELIMINARY FLOOD RISK ASSESSMENT

Map 7: Areas Susceptible to Groundwater Flooding

OXFORDSHIRE COUNTY COUNCIL

Legend
- Surface water hotspots
- Areas Susceptible to Groundwater Flooding

Proportion of each 1km square that is susceptible to groundwater emergence

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## SURFACE WATER RUN-OFF CALCULATION SHEET

### Development
- OXFORD ROAD BODICOTE
- HYD317

### Revision
- 1.0
- Completed by MB
- Date 13/04/2018
- Checked by DK

### Areas
- **Total Site**: 2.204 ha
- **Development Area (for SW Strategy)**: 1.806 ha
- **Existing Impermeable**: 0.430 ha
- **Existing Impermeable (for SW Strategy)**: 0.430 ha
- **Existing Pervious**: 1.774 ha
- **Existing Pervious (for SW Strategy)**: 1.376 ha
- **Proposed Impermeable (total)**: 0.878 ha
- **Proposed Impermeable (domestic only)**: 0.878 ha

### Catchment Characteristics
- **SAAR**: 700 mm
- **SPR**: 0.1 %
- **i_1**: 13.9 mm/hr
- **i_30**: 30.8 mm/hr
- **i_100**: 40.0 mm/hr

### Run-off Rates

#### Pre-development

<table>
<thead>
<tr>
<th>Event</th>
<th>Impermeable</th>
<th>Pervious</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1yr</td>
<td>16.6 l/s</td>
<td>0.6 l/s</td>
<td>17.2 l/s</td>
</tr>
<tr>
<td>30yr</td>
<td>36.8 l/s</td>
<td>1.7 l/s</td>
<td>38.5 l/s</td>
</tr>
<tr>
<td>100yr</td>
<td>47.8 l/s</td>
<td>2.3 l/s</td>
<td>50.1 l/s</td>
</tr>
<tr>
<td>50mm/hr</td>
<td>59.7 l/s</td>
<td>0.7 l/s</td>
<td>50.4 l/s</td>
</tr>
</tbody>
</table>

#### Post-development

- **Proposed Impermeable (total)**: 34.0 l/s
- **Proposed Impermeable (domestic only)**: 1 l/s

### Volumes

#### Pre-development

<table>
<thead>
<tr>
<th>Event</th>
<th>Impermeable</th>
<th>Pervious</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1yr</td>
<td>0.0 cu.m</td>
<td>19.3 cu.m</td>
<td>19.3 cu.m</td>
</tr>
<tr>
<td>100yr</td>
<td>97.8 cu.m</td>
<td></td>
<td>97.8 cu.m</td>
</tr>
</tbody>
</table>

#### Post-development

<table>
<thead>
<tr>
<th>Event</th>
<th>Impermeable (total)</th>
<th>100yr+CC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1yr</td>
<td>0.0 cu.m</td>
<td>0.0 cu.m</td>
</tr>
</tbody>
</table>

### Quick storage Estimates

<table>
<thead>
<tr>
<th>Return Period</th>
<th>low</th>
<th>high</th>
<th>mean</th>
<th>Imp. Area (ha)</th>
<th>Max. Discharge (l/s)</th>
<th>Rainfall</th>
<th>CC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1yr</td>
<td>65</td>
<td>108</td>
<td>86.5</td>
<td>0.878</td>
<td>7.9 •</td>
<td>FEH</td>
<td>0</td>
</tr>
<tr>
<td>30yr</td>
<td>215</td>
<td>305</td>
<td>260</td>
<td>0.878</td>
<td>7.9 •</td>
<td>FEH</td>
<td>0</td>
</tr>
<tr>
<td>100yr+CC</td>
<td>387</td>
<td>526</td>
<td>456.5</td>
<td>0.878</td>
<td>7.9 •</td>
<td>FEH</td>
<td>20%</td>
</tr>
<tr>
<td>100yr+CC</td>
<td>469</td>
<td>636</td>
<td>552.5</td>
<td>0.878</td>
<td>7.9 •</td>
<td>FEH</td>
<td>40%</td>
</tr>
</tbody>
</table>

* Based on a soil factor of 0.45
### Surface Water Run-off Calculation Sheet

**Development**
- OXFORD ROAD BODICOTE

**Project No.**
- HYD317

**Revision**
- 0.0

**Completed by**
- MB

**Date**
- 13/04/2018

**Checked by**
- DK

#### Areas

<table>
<thead>
<tr>
<th>Description</th>
<th>Area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Site</td>
<td>2.184</td>
</tr>
<tr>
<td>Development Area (for SW Strategy)</td>
<td>1.807</td>
</tr>
<tr>
<td>Existing Impermeable</td>
<td>0.044</td>
</tr>
<tr>
<td>Existing Impermeable (for SW Strategy)</td>
<td>0.044</td>
</tr>
<tr>
<td>Existing Pervious</td>
<td>2.140</td>
</tr>
<tr>
<td>Existing Pervious (for SW Strategy)</td>
<td>1.763</td>
</tr>
<tr>
<td>Proposed Impermeable (total)</td>
<td>0.904</td>
</tr>
<tr>
<td>Proposed Impermeable (domestic only)</td>
<td>0.904</td>
</tr>
</tbody>
</table>

#### Run-off Rates

**Pre-development**

<table>
<thead>
<tr>
<th>Rainfall Intensity (mm/hr)</th>
<th>1yr</th>
<th>30yr</th>
<th>100yr</th>
<th>QBar</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>6.1</td>
<td></td>
<td></td>
<td>0.7</td>
</tr>
<tr>
<td>1yr</td>
<td>1.7</td>
<td>3.8</td>
<td>4.9</td>
<td></td>
</tr>
<tr>
<td>30yr</td>
<td>0.6</td>
<td>1.7</td>
<td>2.3</td>
<td>0.7</td>
</tr>
</tbody>
</table>

**Post-development**

<table>
<thead>
<tr>
<th>Rainfall Intensity (mm/hr)</th>
<th>1yr</th>
<th>30yr</th>
<th>100yr+CC</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>6.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1yr</td>
<td>1.7</td>
<td>2.3</td>
<td>35.0</td>
</tr>
<tr>
<td>30yr</td>
<td>1.7</td>
<td>5.5</td>
<td>77.4</td>
</tr>
</tbody>
</table>

#### Quick Storage Estimates

<table>
<thead>
<tr>
<th>Return Period</th>
<th>low</th>
<th>high</th>
<th>mean</th>
<th>Imp. Area (ha)</th>
<th>Max. Discharge (l/s)</th>
<th>Rainfall</th>
<th>CC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1yr</td>
<td>174</td>
<td>268</td>
<td>221</td>
<td>0.904</td>
<td>0.7 *</td>
<td>FEH</td>
<td>0</td>
</tr>
<tr>
<td>30yr</td>
<td>437</td>
<td>589</td>
<td>513</td>
<td>0.904</td>
<td>0.7 *</td>
<td>FEH</td>
<td>0</td>
</tr>
<tr>
<td>100yr+CC</td>
<td>724</td>
<td>923</td>
<td>824</td>
<td>0.904</td>
<td>0.7 *</td>
<td>FEH</td>
<td>20%</td>
</tr>
<tr>
<td>100yr+CC</td>
<td>874</td>
<td>1097</td>
<td>986</td>
<td>0.904</td>
<td>0.7 *</td>
<td>FEH</td>
<td>40%</td>
</tr>
</tbody>
</table>

#### Catchment Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAAR</td>
<td>700 mm</td>
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<tr>
<td>SPR</td>
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</tr>
<tr>
<td>i_1</td>
<td>13.9 mm/hr</td>
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<tr>
<td>i_30</td>
<td>30.8 mm/hr</td>
</tr>
<tr>
<td>i_100</td>
<td>40.0 mm/hr</td>
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#### Volumes

**Pre-development**

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<th>Rainfall Intensity (mm/hr)</th>
<th>1yr</th>
<th>100yr</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>50</td>
<td>0.0 cu.m</td>
<td>0.0 cu.m</td>
<td>0.0 cu.m</td>
</tr>
<tr>
<td>1yr</td>
<td>0.7 cu.m</td>
<td>19.3 cu.m</td>
<td>19.3 cu.m</td>
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<tr>
<td>30yr</td>
<td>0.7 cu.m</td>
<td>77.4 cu.m</td>
<td>77.4 cu.m</td>
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**Post-development**

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<tr>
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<th>100yr+CC</th>
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<tbody>
<tr>
<td>50</td>
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<tr>
<td>1yr</td>
<td>35.0 l/s</td>
<td>130.6 l/s</td>
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<tr>
<td>100yr+CC</td>
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</tr>
</tbody>
</table>

#### Existing Impermeable

- Total Site: 2.184 ha
- Development Area (for SW Strategy): 1.807 ha
- Existing Impermeable: 0.044 ha
- Existing Impermeable (for SW Strategy): 0.044 ha
- Existing Pervious: 2.140 ha
- Existing Pervious (for SW Strategy): 1.763 ha
- Proposed Impermeable (total): 0.904 ha
- Proposed Impermeable (domestic only): 0.904 ha
Rainfall profile

Storm duration (mins) 360

FSR Data
Region England and Wales
M5-60(mm) 19.800
Ratio R 0.412
Peak Intensity (mm/hr) 13.930
Ave. Intensity (mm/hr) 3.553
Return Period (years) 1
Rainfall profile

Storm duration (mins) 360

FSR Data
Region England and Wales
M5-60(mm) 19.800
Ratio R 0.412
Peak Intensity (mm/hr) 30.824
Ave. Intensity (mm/hr) 7.863
Return Period (years) 30
Rainfall profile

Storm duration (mins) 360

FSR Data
Region England and Wales
M5-60(mm) 19.800
Ratio R 0.412
Peak Intensity (mm/hr) 40.019
Ave. Intensity (mm/hr) 10.209
Return Period (years) 100
ICP SUDS Mean Annual Flood

Input

<table>
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<tr>
<th>Return Period (years)</th>
<th>Soil</th>
<th>Area (ha)</th>
<th>Urban</th>
<th>SAAR (mm)</th>
<th>Region</th>
<th>Number</th>
<th>Region</th>
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</thead>
<tbody>
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<td>1</td>
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<td>1.807</td>
<td>0.000</td>
<td>700</td>
<td>6</td>
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Results  l/s

- QBAR Rural 0.7
- QBAR Urban 0.7
- Q1 year 0.6
- Q1 year 0.6
- Q30 years 1.7
- Q100 years 2.3
ICP SUDS Mean Annual Flood

Input

Return Period (years) 1 Soil 0.450
Area (ha) 1.807 Urban 0.000
SAAR (mm) 700 Region Number Region 6

Results l/s

QBAR Rural 7.9
QBAR Urban 7.9
Q1 year 6.7
Q1 year 6.7
Q30 years 18.0
Q100 years 25.3
Greenfield Runoff Volume

FSR Data

Return Period (years) 1
Storm Duration (mins) 360
Region England and Wales
M5-60 (mm) 19.800
Ratio R 0.411
Areal Reduction Factor 1.00
Area (ha) 1.807
SAAR (mm) 700
CWI 105.000
Urban 0.000
SPR 10.000

Results

Percentage Runoff (%) 5.00
Greenfield Runoff Volume (m³) 19.287
Greenfield Runoff Volume

FSR Data

<table>
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<tr>
<th>Parameter</th>
<th>Value</th>
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<tbody>
<tr>
<td>Return Period (years)</td>
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<tr>
<td>Storm Duration (mins)</td>
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<tr>
<td>Region England and Wales</td>
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</tr>
<tr>
<td>M5-60 (mm)</td>
<td>19.800</td>
</tr>
<tr>
<td>Ratio R</td>
<td>0.411</td>
</tr>
<tr>
<td>Areal Reduction Factor</td>
<td>1.00</td>
</tr>
<tr>
<td>Area (ha)</td>
<td>1.807</td>
</tr>
<tr>
<td>SAAR (mm)</td>
<td>700</td>
</tr>
<tr>
<td>CWI</td>
<td>105.000</td>
</tr>
<tr>
<td>Urban</td>
<td>0.000</td>
</tr>
<tr>
<td>SPR</td>
<td>10.000</td>
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</tbody>
</table>

Results

Percentage Runoff (%) 8.83
Greenfield Runoff Volume (m³) 97.833
APPENDIX J: IMPERMEABLE AREAS PLANS

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This drawing is not a drainage 'design' but a preliminary drainage strategy showing existing sewer locations. No hydraulic simulation or assessment of these proposals has been undertaken. Proposed points of connection to the existing system require invert levels to be accurately established. Refer to the proposed drainage plan.

Surcharging of the proposed outfall will require modelling to satisfy the requirements of United Utilities along with full hydraulic analysis.
**PRELIMINARY PROPOSED DRAINAGE PLAN**

**SITE:** OXFORD ROAD, BODICOTE

**DATE:** 06.04.18  
**REV:** 0

**FURTHER NOTES:**

This drawing is not a drainage 'design' it is a preliminary drainage strategy showing existing sewer locations. No hydraulic simulation or assessment of these proposals has been undertaken.

Proposed points of connection to the existing watercourse and sewer require invert levels to be accurately established. Refer to proposed drainage plan.

Surcharging of the proposed outfall will require modelling to satisfy the requirements of United Utilities along with full hydraulic analysis.

---

**Foul Water Sewer (public)**

**Surface Water Sewer (public)**

**Infiltration (1)**

**Surface Water (2)**

**Foul Water**

---

**TBC**

**E x i s t i n g D r a i n a g e**

---

**Footnotes:**

1. Review of the TW sewer records identify there to be limited public sewer infrastructure in proximity to the site however, the nearest foul water sewer (150mm dia.) is located north-east of site within Oxford Road. Due to the site being brownfield there is a possibility there is an existing connection, however further investigation is required to confirm the condition and capacity of the existing sewer network. Detailed design will be required to confirm feasibility based on the topographic levels following further detailed investigation. Consents and relevant agreements will be required from TW prior to commencement of works. Early consultation with TW is recommended to identify any additional constraints and their preferred point(s) of connection.

2. Based on the ground conditions identified by the online datasets it can be considered that infiltration may offer a part or fully viable drainage solution for the development site due to the permeable strata. Further investigation is recommended to take place promptly as infiltration would be the primary means of discharging surface water run-off. Should infiltration not be feasible for all of the site due to other constraints then the next outfall in the hierarchical approach is to discharge to the watercourse. At present, there are no watercourses suitable for outfall within close proximity of the site, therefore discharge to the sewer network (subject to the relevant consents/agreements) would be required to explore. Detailed design will be required to confirm the possibility of a site wide gravity connection following further investigations. If a gravity system is not feasible a pumped surface water system may be required to cater for the proposals.
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APPENDIX L: STORMWATER STORAGE ESTIMATES

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1 YEAR RETURN PERIOD STORM EVENT

Variables
- FSR Rainfall
- Return Period (years): 1
- Region: England and Wales
- Map: M5-60 mm
- Ratio R: 0.411
- Cv (Summer): 0.750
- Cv (Winter): 0.840
- Impermeable Area (ha): 0.878
- Maximum Allowable Discharge (l/s): 7.9
- Infiltration Coefficient (m/hr): 0.00000
- Safety Factor: 2.0
- Climate Change (%): 0

Results
Global Variables require approximate storage of between 65 m³ and 108 m³.
These values are estimates only and should not be used for design purposes.

30 YEAR RETURN PERIOD STORM EVENT

Variables
- FSR Rainfall
- Return Period (years): 30
- Region: England and Wales
- Map: M5-60 mm
- Ratio R: 0.411
- Cv (Summer): 0.750
- Cv (Winter): 0.840
- Impermeable Area (ha): 0.878
- Maximum Allowable Discharge (l/s): 7.9
- Infiltration Coefficient (m/hr): 0.00000
- Safety Factor: 2.0
- Climate Change (%): 0

Results
Global Variables require approximate storage of between 215 m³ and 305 m³.
These values are estimates only and should not be used for design purposes.
QUICK STORAGE ESTIMATES

100 YEAR RETURN PERIOD STORM EVENT + 20% CLIMATE CHANGE

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<th>Values</th>
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<td>Cv (Summer)</td>
<td>0.750</td>
</tr>
<tr>
<td>Cv (Winter)</td>
<td>0.840</td>
</tr>
<tr>
<td>Impervious Area (ha)</td>
<td>0.878</td>
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<tr>
<td>Maximum Allowable Discharge (l/s)</td>
<td>7.9</td>
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<tr>
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<tr>
<td>Climate Change (%)</td>
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Global Variables require approximate storage of between 387 m³ and 526 m³.
These values are estimates only and should not be used for design purposes.

100 YEAR RETURN PERIOD STORM EVENT + 40% CLIMATE CHANGE

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<td>Cv (Winter)</td>
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<tr>
<td>Impervious Area (ha)</td>
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<td>Infiltration Coefficient (m/hr)</td>
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<tr>
<td>Climate Change (%)</td>
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</table>

Global Variables require approximate storage of between 469 m³ and 636 m³.
These values are estimates only and should not be used for design purposes.
QUICK STORAGE ESTIMATES

OXFORD ROAD, BODICOTE

1 YEAR RETURN PERIOD STORM EVENT

<table>
<thead>
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<tr>
<td>Cv (Winter)</td>
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<tr>
<td>Immerseable Area (ha)</td>
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<tr>
<td>Maximum Allowable Discharge (l/s)</td>
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<tr>
<td>Infiltration Coefficient (m/hr)</td>
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<tr>
<td>Climate Change (%)</td>
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Results

Global Variables require approximate storage of between 174 m³ and 268 m³.
These values are estimates only and should not be used for design purposes.

30 YEAR RETURN PERIOD STORM EVENT

<table>
<thead>
<tr>
<th>Variables</th>
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<tbody>
<tr>
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<td>Cv (Winter)</td>
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<td>Immerseable Area (ha)</td>
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<tr>
<td>Maximum Allowable Discharge (l/s)</td>
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</tr>
<tr>
<td>Infiltration Coefficient (m/hr)</td>
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<tr>
<td>Safety Factor</td>
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<tr>
<td>Climate Change (%)</td>
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Results

Global Variables require approximate storage of between 437 m³ and 589 m³.
These values are estimates only and should not be used for design purposes.
QUICK STORAGE ESTIMATES

OXFORD ROAD, BODICOTE

100 YEAR RETURN PERIOD STORM EVENT + 20% CLIMATE CHANGE

Variables

<table>
<thead>
<tr>
<th>FSR Rainfall</th>
<th>Cv (Summer)</th>
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<tbody>
<tr>
<td>Return Period (years)</td>
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<td>Region</td>
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<tr>
<td>England and Wales</td>
<td>Maximum Allowable Discharge (l/s)</td>
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<tr>
<td>Map</td>
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<td>M5-60 (mm)</td>
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</tr>
<tr>
<td>Ratio R</td>
<td>Climate Change (%)</td>
<td>20</td>
</tr>
</tbody>
</table>

Results

Global Variables require approximate storage of between 724 m³ and 923 m³.
These values are estimates only and should not be used for design purposes.

100 YEAR RETURN PERIOD STORM EVENT + 40% CLIMATE CHANGE

Variables

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<tr>
<td>Region</td>
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<td>England and Wales</td>
<td>Maximum Allowable Discharge (l/s)</td>
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<td>Map</td>
<td>Infiltration Coefficient (m/hr)</td>
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<tr>
<td>M5-60 (mm)</td>
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</tr>
<tr>
<td>Ratio R</td>
<td>Climate Change (%)</td>
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</tr>
</tbody>
</table>

Results

Global Variables require approximate storage of between 874 m³ and 1097 m³.
These values are estimates only and should not be used for design purposes.
APPENDIX M: OVERLAND FLOOD FLOW ROUTING PLANS

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APPENDIX N: TYPICAL SUDS DETAILS

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INLET

INSPECTION

COVER

PERFORATED CONCRETE RINGS

HIGH VORDS MEDIA

CONCRETE FOOTING

CONCRETE CHAMBER

OIL & SEDIMENT COLLECTOR

WATER INFILTRATES TO SUB-SOIL

SOAKAWAY DETAILS (INCLUDING PRE-TREATMENT DEVICE)

SOAKAWAYS

TYPICAL SUDS DETAIL

DO NOT SCALE
PIPEWORK BENEATH STORAGE TO BE PERFORATED

PLAN

SECTION A - A'

ALL DIMENSIONS AND DEPTHS DEPENDENT ON REQUIRED VOLUME AND LOCAL GROUND CONDITIONS

BACKFILL, BUILD-UP AND SURFACING AS APPROPRIATE

100 MIN SAND

VENTING LAYER - MIN 150mm (SINGLE CLEAN STONE 25 - 40mm) CONTAINING VENTING DETAILS TO BE SUPPLIED BY SUPPLIER

GEOTEXTILE MEMBRANE COVERING TOP FACE OF CELLULAR BLOCKS

1040mm DEPTH

CELLULAR STORAGE BLOCKS

DISTRIBUTION LAYER (SINGLE CLEAN STONE 20 - 40mm)

FILLER TO PROVIDE PROTECTION FOR IMPERMEABLE MEMBRANE. MATERIAL AND THICKNESS TO BE CONFIRMED IN CONJUNCTION WITH GEO - MEMBRANE SUPPLIER

PERFORATED DISTRIBUTION PIPES WITH MIN 150mm SURROUND

IMPERMEABLE MEMBRANE TYPICALLY 0.5 - 4.5m

APPROX. FILL

SECTION B - B'

DO NOT SCALE
Dry Swale

Wet Swale

Typical SUDS Detail

Drainage and Infiltration Systems

Design and Construction

- 150mm Freeboard
- 150mm Sand or Gravel Layer
- Geotextile Filter
- 900mm Sand Filter Layer
- 75mm Turf or Grass Layer
- 50 to 100mm Drop at Edge of Hard Surface

- Sheet Flow from Hard Surface
-OPTIONAL V-Notch Weir (OR OTHER CONTROL DEVICE)

- Permanent Water Level
- Optional 150mm Sand or Gravel Layer

- Impermeable Soils
- Wetland Planting

- 50 to 100mm Drop at Edge of Hard Surface
- 1:4 or 1:3 Side Slope
- Grassed to Resist Erosion

- Geotextile Filter
- 300mm Pea Gravel Layer with Perforated Underdrains
- Perforated Pipe Underdrains to Outfall

- Sheet Flow from Hard Surface

- Drainage and Infiltration Systems

- Design and Construction
INLET FLOW SPREADER
GRASS CHANNEL
APPROPRIATE PRE-TREATMENT SYSTEM (eg SWALE, DETENTION BASIN, FOREBAY, SUMP OR PROPRIETY SYSTEM)
EMERGENCY SPILLWAY (WHERE REQUIRED)
EMBANKMENT OR BASIN EDGE
EROSION CONTROL
OUTLET STRUCTURE & FLOW CONTROL
PLAN VIEW
INLET
DESIGN LEVEL
EXTREME FLOOD LEVEL
INFILTRATION STORAGE
INFILTRATION BASINS
TYPICAL SUDS DETAIL

GEOMEMBRANE LINER BENEATH PRE-TREATMENT SYSTEM

300mm FREEBOARD TO EMERGENCY SPILLWAY OUTLET STRUCTURE & FLOW CONTROL
EROSION CONTROL (IF REQUIRED)

DO NOT SCALE

PRELIMINARY DRAWING
A109 BETTS
INFILTRATION BASINS
TYPICAL SUDS DETAIL
APPROPRIATE PRE-TREATMENT SYSTEM & FLOW CONTROL
EMERGENCY SPILLWAY
ELOW SPREADER
APPENDIX O: NOTES OF LIMITATIONS

The data essentially comprised a study of available documented information from various sources together with discussions with relevant authorities and other interested parties. There may also be circumstances at the site that are not documented. The information reviewed is not exhaustive and has been accepted in good faith as providing representative and true data pertaining to site conditions. If additional information becomes available which might impact our conclusions, we request the opportunity to review the information, reassess the potential concerns, and modify our opinion if warranted.

It should be noted that any risks identified in this report are perceived risks based on the available information.

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