GENERATOR GROUP LLP

BLOFIELD, NORWICH

FLOOD RISK ASSESSMENT

REPORT REFERENCE NO. N750-02 REV. A
PROJECT NO. N750
OCTOBER 2012
BLOFIELD, NORFOLK

FLOOD RISK ASSESSMENT

Ardent Consulting Engineers
Suite 4A
4th Floor Diamond House
36/38 Hatton Garden
LONDON
EC1N 8EB
Tel: 020 7430 1209
Fax: 020 7430 0318
enquiries@ardent-ce.co.uk

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LIST OF ACRONYMS

AWSL  Anglian Water Services Ltd.
BDC   Broadlands District Council
CFMP  Catchment Flood Management Plan
CfSH  Code for Sustainable Homes
DCLG  Department of Communities and Local Government
DEFRA Department of Food & Rural Affairs
EA    Environment Agency
FWMA  Flood & Water Management Act 2010
FRA   Flood Risk Assessment
IoH124 Institute of Hydrology Report 124
LDF   Local Development Framework
LLFA  Lead Local Flood Authority
LPA   Local Planning Authority
NCC   Norfolk County Council
NPPF  National Planning Policy Framework
PFRA  Preliminary Flood Risk Assessment
PPS25 Planning Policy Statement 25
PSTR  Private Sewer Transfer Regulations
SAB   SuDS Approval Body
SCC   Suffolk County Council
SFA   Sewers for Adoption
SFRA  Strategic Flood Risk Assessment
SPZ   Source Protection Zone
SuDS  Sustainable Urban Drainage System
This report was prepared for the exclusive use of the Client who is defined in this report. It should not be reproduced in whole or in part, or relied upon by third parties, without the express written authority of Ardent Consulting Engineers.
1. **INTRODUCTION**

1.1. Ardent Consulting Engineers has been commissioned by Generator Group to undertake a Flood Risk Assessment (FRA), for a proposed residential development in Blofield, Norfolk. In terms of development aspirations, it is the intention of the client to construct 105 residential units comprising houses and flats. This FRA has been written with specific reference to the requirements of the National Planning Policy Framework (NPPF).

1.2. A glossary of common Flood Risk Engineering terms is provided in Appendix A, to assist non-technical readers.

1.3. During the preparation of the FRA, consultation with Anglian Water Services Ltd. (AWSL), the Environment Agency (EA) and Norfolk County Council (NCC) has been undertaken, all of whom have been supportive of the proposals to address flood risk issues. Please refer to Appendix B for correspondence with the EA, Appendix C for correspondence with the ASWL and Appendix D for correspondence with NCC.

**Scope**

1.4. In accordance with the assessment criteria found in NPPF, this report and associated surface water drainage strategy will ultimately seek to;

- Ensure that flood mitigation is provided within the project site to avoid detrimental impacts to third parties;
- Ensure that the impact of climate change is assessed;
- Ensure impermeable areas within the development are minimised where practical; and
- Ensure the use of sustainable drainage systems (SUDS) is optimised in line with current best practice.
Site Location

Figure 1-1: Site Location Plan

1.5. The Site is located within the village of Blofield (circa 10km east of Norwich) approximately 250m south of the A47. As can be seen
from Figure 1-1 above, the Site is bound by Yarmouth Road to the north, Fox Lane to the west and by Lingwood Road and a small number of residential dwellings to the south. The south eastern boundary of the site is bordered by arable farmland and the north eastern boundary by the Norwich Camping and Leisure establishment.

1.6. The Site (circa 3.4 ha in total) is centred approximately at Ordnance Survey grid co-ordinates 633902mE, 309678mN.

**Development Proposals**

1.7. The current proposals are for 105 residential units with associated car parking and landscaping. A new vehicular access is proposed onto Yarmouth Road, with pedestrian and cycle access onto Lingwood Road. **Figure 1-2** below shows an extract of the current masterplan, which can also be found within **Appendix E**.

![Figure 1-2: Proposed Development Layout (Extract)](image)
2. **POLICY**

*National Planning Policy Framework (NPPF)*

2.1. As of 27th March 2012, the Department of Communities and Local Government (DCLG) published the National Planning Policy Framework (NPPF). The NPPF replaces the PPS25 in relation to management of surface water.

2.2. The NPPF requires that:

"...a site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall."

2.3. NPPF promotes the implementation of SuDS to manage surface water in a manner which mimics existing (pre-development) conditions.

2.4. The NPPF states that in accordance with the Flood and Water Management Act 2010, the SuDS Approving Body (SAB) in unitary or county councils should approve the drainage system before construction begins. The SAB will apply the National Standards which are discussed in more detail in paragraph 2.10 below.

*Flood and Water Management Act (2010)*

2.5. The Flood and Water Management Act 2010 implements Sir Michael Pitt’s recommendations following the review of the 2007 floods. The Act defines clearer roles, responsibilities and standards for the implementation of sustainable drainage (SuDS) in developments, by requiring drainage systems to be approved against a set of national standards (see below).

2.6. Once enacted, Schedule 3 of the Act advocates that the Lead Local Flood Authority (established at the county or unitary local authority level) will be required to establish SuDS Approval Bodies (SABs).
The date for enactment is pending supplementary legislative guidance.

**The Private Sewers Transfer Regulations (PSTR),**

2.7. The Private Sewer Transfer Regulations is a guidance document for ‘The Water Industry (Schemes for Adoption of Private Sewers 2011) Regulations.’

2.8. As of 1st October 2011, all privately owned sewers and lateral drains which connected in to an existing public sewer became the responsibility of the sewer undertaker - chiefly the water and sewerage company for the area.

**National Standards for Sustainable Drainage Systems**

2.9. The Draft National Standards were published in December 2011 for consultation and are expected to be formally released around April 2013. Where planning permission is required, applications for drainage approval and planning permission are likely to run in parallel.

2.10. In addition, the Local Planning Authority (LPA) may set local requirements for planning permission that have the effect of more stringent requirements than the National Standards

2.11. In lieu of the National SuDS standards, SuDS should be designed in accordance with Ciria 697 SuDS Manual (REF 08), which represents current best practice.

**SuDS Approval Bodies (SAB)**

2.12. NCC has not yet formed a SAB for the area, however consultation with NCC in the preparation of this report has been undertaken.

2.13. AWSL are anticipated to undertake a temporary SuDS adoption role, looking to adopt all SuDS features in the interim, with NCC to
become the SAB upon commencement of the National SuDS Standards.

**Code for Sustainable Homes (CfSH)**

2.14. The Code for Sustainable Homes (CfSH) and associated Technical Guidance is an assessment criterion which is compulsory on a number of social housing schemes and represents good practice on private units. Sur 1 is a mandatory part of CfSH which provides a detailed methodology for establishing if a surface water management system can be considered sustainable. It should be noted that the Sur 1 criteria is expected to be updated to reflect the National Standards for Sustainable Drainage.

2.15. Presently the Sur1 requirements can be summarised as follows:

- If there is no increase in impermeable area, then the Sur1 Mandatory requirements are met.

- If there is an increase in impermeable area, than the rate of surface water discharge will need to be flow matched to the 1 year and 100 year rates. If this would result in a rate of less than 5 l/s then this rate can be used as the minimum to avoid the increased risk of blockage associated with small diameter outfalls.

- If there is an increase in impermeable area, and therefore over the development lifetime the development would discharge (allowing for climate change) a greater volume of surface water runoff than the pre-development site for the 100 year 6 hour event; then this volume must be prevented from leaving the site via infiltration techniques. If however, ground conditions do not allow for the above to be satisfied, then the additional volume must be attenuated on site and discharged at either the 1yr, mean average flood flow rate (Qbar) or 2l/s/ha whichever is greater. However if this would result in a rate of less than 5 l/s then this rate can be used as the
minimum to avoid the increased risk of blockage associated with small diameter outfalls.

Partnership of Norfolk District Councils Strategic Flood Risk Assessment (SFRA) (Stage 2), Subsidiary Report C; Broadland District Council Area (December 2007)

2.16. A Stage 2 SFRA was carried out by Millard Consulting and published in December 2007 for the Broadland District Council area, one of a consortium of District Councils including North Norfolk District Council, the Broads Authority, Norwich City Council and South Norfolk Council. The particular Terms of Reference for the Stage 2 study were set out in the JBA Consulting “Stage 1 Inception Report and Terms of Reference for Stage 2” dated October 2006. The Stage 1 Study consisted of the compilation of a data inventory together with a review of the various planning and development related flood risk matters considered important to the five authorities. The Stage 1 Study also sets out a Scope for the Stage 2 work.

2.17. A level 2 SFRA predominantly permits the application of the Exception Test, by considering the detailed nature of flood hazard taking account of the presence of flood risk management measures.

2.18. The SFRA indicates the site to be wholly located within Flood Zone 1 (low risk), identified as comprising land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).

2.19. Environment Agency Flood Risk Mapping also confirms the Site to be located within Flood Zone 1, as shown in Figure 2-1 below. This has been confirmed by the Environment Agency, as shown in Appendix B.
2.20. The Broadland Rivers CFMP was published in December 2009 (REF X) by the EA; with the aim of providing a high level strategic plan through which the EA, can identify and agree policies for sustainable flood risk management over the next 50-100 years, working together with key decision-makers within the catchment.

2.21. Blofield is identified as being within the Fluvial/Tidal Rivers and Tidal Broads sub-area of the catchment. This sub-area has been allocated under flood risk management policy 3, applied to areas of low to moderate flood risk where the existing flood risk is generally being managed effectively.
Norfolk County Council Preliminary Flood Risk Assessment (PFRA) Report (July 2011)

2.22. The NCC PFRA was published in July 2011 by Norfolk County Council, to meet the legal requirements of the Flood Risk Regulations 2009 (FRR).

2.23. The PFRA was produced to comply with the Stage 1 requirement of the FRR 2009, that each LLFA compiles a Preliminary Flood Risk Assessment Report by 22nd June 2011. The intention of the PFRA was to provide a consistent high level overview of the potential risk of flooding from local sources such as surface water, groundwater and ordinary water courses.

Greater Norwich Development Partnership Stage 1, 2a & 2b Water Cycle Study

2.24. Scott Wilson has undertaken a Stage 1, 2a and 2b Water Cycle Study (REF x,x and X) on behalf of The Greater Norwich Development Partnership.

2.25. The reports collectively summarise the recommendations necessary to meet the planned growth throughout the district, including the general requirements for individual development sites.

Sequential Test

2.26. As shown Figure 2-1 above, the site is wholly located within flood zone 1 identified as comprising land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding in any year (<0.1%).

2.27. As the site is located within Flood Zone 1 it automatically satisfies the requirements of the sequential test, as outlined within the Technical Guidance of the NPPF.
3. SITE DESCRIPTION

3.1. The existing Site area can be considered greenfield and is predominantly arable farmland defined by hedgerows, with an orchard occupying a central portion of the Site.

3.2. Hedgerow flanks the proportion of the southern boundary adjacent to Lingwood Road with trees bordering the northern boundary adjacent to Yarmouth Road.

Topography

3.3. A topographical survey of the Site was produced by Survey Solutions in August 2012.

3.4. The Site generally falls from north to south, with levels ranging from 24.00m AOD (above Ordnance datum) in the north easternmost corner to 17.27m AOD in the south westernmost corner.

Figure 3-1: Northern Boundary/Yarmouth Road
3.5. Whilst the northern boundary of the site is generally at level with Yarmouth Road (see Figure 3-1 above), the southern boundary is raised by circa 1.2-1.5m above Lingwood Road, as shown in Figure 3-2 below.

![Figure 3-2: Southern Boundary/Lingwood Road](image)

3.6. The full topographic survey for the Site can be found in Appendix F.

**Hydrology**

3.7. The nearest designated watercourse to the site is the approximately 0.9km southwest of the Site Boundary, which is a tributary of the River Yare. As mentioned within paragraph 2.19 above, Environment Agency Flood Risk Mapping confirms the Site to be located within Flood Zone 1, identified as comprising land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).
3.8. There are no surface water features present within the site boundary.

**Ground conditions**

3.9. A geotechnical desk study and intrusive investigation (comprised of both trial pits and window sample boreholes) was undertaken by Card Geotechnics Limited in September 2012. The full interpretative report can be found in **Appendix G**.

![Figure 3-3: Superficial Deposits](image-url)
3.10. The onsite investigation encountered Topsoil, to a maximum depth of 0.6m below ground level (BGL), over the Happisburgh Glacigenic Formation (HGF), a secondary A aquifer of high vulnerability. The HGF was proven to a maximum depth of 7.0m and generally consisted of firm to stiff very sandy clay, with dense sand at depth. Softer clay was noted between 2.0m and 3.0m BGL. The indicative superficial deposits underlying the site are shown in Figure 3-3 above.

3.11. Groundwater was not encountered during the site investigation; however, water level monitoring from a nearby water abstraction borehole indicates that the groundwater is approximately 5.0m AOD.

3.12. Soil infiltration rates were calculated from the results of four soakage pits. One of the trial pits did not drain sufficiently to be refilled over the three day monitoring period. The remaining three pits drained but did not fully empty, therefore the results (REF: TP2, TP3 and TP4) have been extrapolated to give an indication of the permeability of the soil. The results are summarised in Table 3-1 below:

<table>
<thead>
<tr>
<th>Soakage Pit Reference</th>
<th>Soil infiltration Rates (m/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Test 1</td>
</tr>
<tr>
<td>TP2</td>
<td>8.7 x 10^{-7}</td>
</tr>
<tr>
<td>TP3</td>
<td>3.0 x 10^{-7}</td>
</tr>
<tr>
<td>TP4</td>
<td>9.9 x 10^{-7}</td>
</tr>
</tbody>
</table>

Table 3-1: Soakage Test Results

3.13. The geotechnical investigation concluded that the above soakage results suggest the underlying stratum is not considered suitable for near soakaways. The infiltration rates are suitable for permeable paving, this is covered further in the Surface Water Management section of the report.

3.14. A layer of sand was encountered at depth beneath the HGF clay and therefore further testing was carried out to investigate the use of deep bored soakaways. This testing involved 2 boreholes located
within the proposed Public Open Space (POS) within the centre of the site, one borehole was used to confirm groundwater levels, the other to carry out soakage testing.

3.15. The testing measured groundwater at 12.5m bgl, and confirmed the infiltration rate within the Happisburgh Glacigenic Formation has an infiltration rate of between $1.17 \times 10^{-5}$ m/s and $2.28 \times 10^{-5}$ m/s.

3.16. Groundwater source protection zones (SPZ) define the risk of contamination from any activities that might cause pollution in the area. According to information from the Environment Agency, the entire Site lies within a SPZ3, as shown in Figure 3-4.

![Figure 3-4: Groundwater Source Protection Zone Location](image)

**Existing Sewer Infrastructure**

3.17. According to AWSL sewer records there is no evidence of public surface or foul water sewers within the Site boundary. The nearest foul water sewers are located within the carriageways of Yarmouth Road and Lingwood Road.

3.18. Extracts from AWSL sewer records can be found in Appendix H.
3.19. ACE has obtained highway drainage records from NCC which also confirm there to be no surface water drains within the site boundary. The records do however identify the location of 225mm diameter surface water drains and associated gullies within Fox Lane and Danesbower Lane further south. There are also soakaways located within the southern highway verge of Lingwood Road associated with road gullies immediately south of the site boundary.

3.20. NCC highway drainage plans can be found in Appendix I.
4. SOURCES OF FLOODING

4.1. According to information provided by the EA and through a review of historic flood events within the SFRA, there is no recorded history of flooding on the Site.

4.2. The Technical Guidance of the NPPF requires flood risk from the following sources to be assessed:

- Fluvial Sources (river flooding);
- Tidal Sources (flooding from the sea);
- Groundwater Sources;
- Canals and Artificial Sources;
- Pluvial Sources (flooding resulting from overland flows); and,
- It also requires the risk from increases in surface water discharge to be assessed (surface water management).

Each of these sources is assessed separately below.

**Fluvial Flooding**

4.3. Based on a study of EA flood maps, through consultation with the EA and from a review of the SFRA it has been confirmed that the site is not at risk of flooding as a direct result of floodwater coming from a designated watercourse. The Site is therefore not affected by fluvial flooding.

**Tidal Flooding**

4.4. There are no known Tidal watercourses located in the vicinity of the Site, therefore the Site is not at risk of Tidal flooding.
**Groundwater**

4.5. No groundwater flooding has been recorded in the area and the geotechnical investigation work carried out to date has confirmed that groundwater levels in the area are 12.5m beneath ground level.

4.6. During construction appropriate measures will be undertaken to minimise the risk of pollution to groundwater sources, as well as to protect the Site and operatives during the construction phase.

**Pluvial Flooding**

4.7. Pluvial flooding occurs when natural and engineered drainage systems are unable to deal with the volume of rainfall, due to insufficient capacity in the receiving system.

4.8. A pre-development report was produced by Anglian Water in August 2012. This report identified the following:

"There have not been any instances of flooding in the vicinity of the Development Site that can be attributed to the public sewerage system."

4.9. The Site is therefore not considered to be at risk of pluvial flooding.

**Summary**

4.10. Based on the above desk based assessments and informed by the intrusive geotechnical investigations, site investigations and an assessment of topographic survey; it is considered that the Site can be safely operated under the assessment criteria of NPP, as shown in Table 4-1 below.
### SOURCE OF FLOODING

<table>
<thead>
<tr>
<th>SOURCE OF FLOODING</th>
<th>PATHWAY</th>
<th>RECEPTOR</th>
<th>RISK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluvial</td>
<td>No River</td>
<td>People Property</td>
<td>None</td>
</tr>
<tr>
<td>Tidal</td>
<td>No Seas</td>
<td>People Property</td>
<td>None</td>
</tr>
<tr>
<td>Groundwater</td>
<td>Through underlying strata when groundwater levels rise above surface levels – high levels of clay would not allow for significant groundwater egress</td>
<td>People Property</td>
<td>None (with suitable mitigation)</td>
</tr>
<tr>
<td>Canals and artificial sources</td>
<td>No Canals or Reservoirs</td>
<td>People Property</td>
<td>None</td>
</tr>
<tr>
<td>Pluvial</td>
<td>No sewers within site boundary.</td>
<td>People Property</td>
<td>None</td>
</tr>
</tbody>
</table>

**Table 4-1: Flood Risk Summary**
5. **SURFACE WATER MANAGEMENT**

5.1. The technical guidance of NNPF requires an assessment of surface water to be made as part of a site-specific FRA.

5.2. The NPPF states that, to allow for the predicted impacts of climate change on surface water runoff, the following increases to peak rainfall intensity should be allowed for:

- 1990 to 2025: + 5% (usually for temporary structures)
- 2025 to 2055: +10% (short lease uses)
- 2055 to 2085: +20% (usually commercial / industrial use)
- 2085 to 2115: +30% (usually residential use)

5.3. Under the NPPF an allowance of 30% for the effects of climate change would achieve the policy requirements for the proposed residential development.

**Existing Pre-development Discharge Rate**

5.4. The existing Site is undeveloped and does not positively drain to the public surface water sewer within the surrounding surface water network. Due to the topography of the site however, it is not unreasonable to assume that a proportion of surface water overland flows from the site, enters the road gullies within Lingwood Road.

5.5. Greenfield run-off rates for the undeveloped site (circa 3.4ha) have been calculated in accordance with IoH124, and in line with the recommendations within Ciria 697 SuDS Manual, using Microdrainage WinDes v12.0 modelling software. The resultant existing discharge rates are shown within Table 5-1 below.
<table>
<thead>
<tr>
<th>Storm Event</th>
<th>Greenfield Runoff Rate for 50ha (l/s)</th>
<th>Greenfield Runoff Rate for 2.5ha (l/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1 (1 in 1 year)</td>
<td>124.0</td>
<td>8.4</td>
</tr>
<tr>
<td>QBar (1 in 2.33 year)</td>
<td>142.0</td>
<td>9.7</td>
</tr>
<tr>
<td>Q30 (1 in 30 year)</td>
<td>342.0</td>
<td>23.2</td>
</tr>
<tr>
<td>Q100 (1 in 100 year)</td>
<td>506.0</td>
<td>34.4</td>
</tr>
</tbody>
</table>

Table 5-1: Greenfield Runoff Rates

5.6. Please refer to Appendix J for full Microdrainage WinDes v12.0 output.

**Review of Geotechnical Results**

5.7. As highlighted within Chapter 3 of this FRA, the infiltration rates achieved during shallow and deep bored testing are not suitable for the use of soakaways or swales. The infiltration rates achieved at a shallow depth are suitable for permeable paving, the calculations have been agreed in writing with the EA (the calculations are included in Appendix J).

**Sustainable Urban Drainage Systems (SuDS)**

5.8. Current legislation advocates that surface water run-off should be controlled as near to its source as possible through a sustainable approach to surface water management. Sustainable Drainage Systems (SuDS) are an approach to managing surface water run-off by mimicking natural drainage systems and managing surface water at the source rather than allowing to freely discharge through traditional piped systems.

5.9. SuDS involve a range of techniques including green roofs, grassed swales, permeable pavements, ponds, infiltration trenches, wetlands...
and soakaways. SuDS offer significant advantages over conventional piped drainage systems in reducing flood risk, by attenuating the rate and quantity of surface water run-off from a site, promoting groundwater recharge, absorbing diffuse pollutants and improving water quality. The EA has confirmed that all opportunities to utilise SuDS throughout the development proposals should be explored, and that the SuDS hierarchy should be implemented to inform the drainage strategy on site.

5.10. Table 5-2 below appraises the constraints and opportunities for the use of SuDS techniques within the Site and it adopts the hierarchical approach outlined in C697.

<table>
<thead>
<tr>
<th>Type:</th>
<th>Living Roofs (Source Control)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constraints:</td>
<td>Safety and maintenance implications, additional structural loading for intensive type roofs.</td>
</tr>
<tr>
<td>Opportunities:</td>
<td>Living Roofs are unlikely to be included as part of the residential aspirations for the site due to maintenance and structural loading implications.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type:</th>
<th>Infiltration Devices (Source Control)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constraints:</td>
<td>Poor infiltration rates achieved during geotechnical investigation.</td>
</tr>
<tr>
<td>Opportunities:</td>
<td>Not feasible.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type:</th>
<th>Permeable Paving (Source Control)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constraints:</td>
<td>Poor infiltration rates achieved but sufficient for permeable paving, NCC have confirmed permeable paving is not acceptable within adoptable estate roads.</td>
</tr>
<tr>
<td>Opportunities:</td>
<td>Opportunities to utilise permeable paving should be maximised as this would improve the water quality of the surface water discharge, and should retain the first 5mm of rainfall.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type:</th>
<th>Rainwater Harvesting (Source Control)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constraints:</td>
<td>The benefits of rainwater harvesting on a specific design storm event cannot be quantified, due to the seasonal availability of storage within the structure.</td>
</tr>
<tr>
<td>Opportunities:</td>
<td>Not considered as part of the surface water management strategy, may be included as part of the Code for Sustainable homes requirements.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type:</th>
<th>Rain Gardens (Source Control)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constraints:</td>
<td>Siting of rainwater gardens will be subject to detailed highway design.</td>
</tr>
<tr>
<td>Opportunities:</td>
<td>There is potential to use rain gardens to act as treatment for highway runoff however this will be subject to detailed design.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type:</th>
<th>Swales, filter strips etc... (Permeable Conveyance and Source Control)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constraints:</td>
<td>Steep site – swales and filter strips will not work well.</td>
</tr>
<tr>
<td>Opportunities:</td>
<td>Not considered feasible due to land increased land take and engineering required to address steep slopes.</td>
</tr>
<tr>
<td>Type:</td>
<td>Infiltration/Detention Basin/Pond (Site System)</td>
</tr>
<tr>
<td>------</td>
<td>------------------------------------------------</td>
</tr>
<tr>
<td>Constraints:</td>
<td>See Infiltration Devices above. Given the steep nature of the site, siting of larger features will be sensitive to ensure a practicable depth can be achieved.</td>
</tr>
<tr>
<td>Opportunities:</td>
<td>Large area of POS could be suitable for use as detention basin for heavy storm events</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type:</th>
<th>Wet Ponds, Bio-retention Ponds or Wetlands (Site system/end of pipe treatment)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constraints:</td>
<td>Given the steep nature of the site, siting of larger features will be sensitive to ensure a practicable depth can be achieved.</td>
</tr>
<tr>
<td>Opportunities:</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type:</th>
<th>Attenuation Tanks (end of pipe treatment)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constraints:</td>
<td>Limited positive environmental impact. Should attenuation be required this could be achieved by use of geo-cellular attenuation sited in parking areas with catchpits to minimise the ingress of silt.</td>
</tr>
<tr>
<td>Opportunities:</td>
<td></td>
</tr>
</tbody>
</table>

**Table 5-2: C697 SuDS Hierarchy Site Assessment**

5.11. After implementation of the C697 approach, it is considered that there are opportunities to utilise the following SuDS techniques across the development:

- Permeable paving in all unadoptable roads, shared parking areas and all residential drives.
- Bio-retention and Tree-Pit drainage systems to be used where feasible, subject to detail design.
- Detention Basin in central POS if feasible following detail design.
- Attenuation Tanks to be used where no other feasible options exist.

**SuDS Maintenance**

5.12. As part of the SuDS Adoption process, it will be necessary to provide an indication of the likely maintenance requirements associated with each of the SuDS components. From the previous section of this report, the key components of the surface water strategy have been identified as being the following:
- Permeable Paving
- Bio-retention areas/rain gardens
- Surface Water Pipes

5.13. **Tables 5-3 to 5-5** outline the typical maintenance requirements of the above components which have been informed by the guidance outlined within CIRIA C697. The guidance provided below would be supplemented by manufacturers specification and be dependent on the type of system involved.

<table>
<thead>
<tr>
<th>Maintenance schedule</th>
<th>Required Action</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular Maintenance</td>
<td>Brushing and vacuuming</td>
<td>3 times/year at end of winter, mid-summer, after autumn leaf fall, or as required based on site specific observations of clogging or manufacturers recommendations</td>
</tr>
<tr>
<td>Occasional Maintenance</td>
<td>Stabilise and mow contributing and adjacent areas</td>
<td>As required</td>
</tr>
<tr>
<td></td>
<td>Removal of weed</td>
<td>As required</td>
</tr>
<tr>
<td>Remedial Actions</td>
<td>RemEDIATE any landscaping which, through vegetation maintenance or soil strip, has been raised to within 50mm of the level of paving</td>
<td>As required</td>
</tr>
<tr>
<td></td>
<td>Remedial work to any depressions and rutting considered detrimental to the structural performance of the pavement or a hazard to users</td>
<td>As required</td>
</tr>
<tr>
<td></td>
<td>Rehabilitation of surface and upper sub-structure</td>
<td>As required (if infiltration performance is reduced as a consequence of significant clogging)</td>
</tr>
<tr>
<td>Monitoring</td>
<td>Initial inspection</td>
<td>Monthly 3 months after installation</td>
</tr>
<tr>
<td></td>
<td>Inspect for evidence of poor operation and/or weed growth. If required take remedial action</td>
<td>3-monthly, 48 hours after large storm</td>
</tr>
<tr>
<td></td>
<td>Inspect silt accumulation rates and establish appropriate brushing rates</td>
<td>Annually</td>
</tr>
<tr>
<td></td>
<td>Monitor inspection chambers</td>
<td>Annually</td>
</tr>
</tbody>
</table>

**Table 5-3: Maintenance Regime for Permeable Pavements**
### Table 5-4: Maintenance Regime for Bioretention areas

<table>
<thead>
<tr>
<th>Maintenance Schedule</th>
<th>Required Action</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular Maintenance</td>
<td>Litter and debris removal</td>
<td>Monthly (or more frequently for aesthetic reasons)</td>
</tr>
<tr>
<td></td>
<td>Mulching – remove and replace</td>
<td>Annually</td>
</tr>
<tr>
<td></td>
<td>Pruning and trimming of trees – recycle back in to mulch</td>
<td>2 years</td>
</tr>
<tr>
<td></td>
<td>Spiking, scarifying and thatch removal</td>
<td>3 years (when mulching)</td>
</tr>
<tr>
<td>Occasional Maintenance</td>
<td>Watering of Plants</td>
<td>As required</td>
</tr>
<tr>
<td></td>
<td>Weeding</td>
<td>As required (probably annually)</td>
</tr>
<tr>
<td>Remedial Actions</td>
<td>Removal of damaged or silt covered vegetation to a depth of 50mm below original design level</td>
<td>As required</td>
</tr>
<tr>
<td></td>
<td>Treatment of diseased trees</td>
<td>As required</td>
</tr>
<tr>
<td></td>
<td>Treatment and restoration of eroded areas</td>
<td>As required</td>
</tr>
<tr>
<td></td>
<td>Re-turfing</td>
<td>As required</td>
</tr>
<tr>
<td></td>
<td>Reinstatement of design levels, restoration or improvement of infiltration and silt removal</td>
<td>As required</td>
</tr>
<tr>
<td>Monitoring</td>
<td>Inspect inlets, outlets and overflows for blockages, and clear if required</td>
<td>Monthly/after large storms</td>
</tr>
<tr>
<td></td>
<td>Inspect infiltration surfaces for ponding. Record dewatering time of the facility to determine if maintenance is necessary</td>
<td>Monthly or when required</td>
</tr>
<tr>
<td></td>
<td>Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.</td>
<td>Half Yearly</td>
</tr>
<tr>
<td></td>
<td>Test planting soil for pH – if adjustment is necessary, amalgamate with appropriate substances</td>
<td>Annually</td>
</tr>
</tbody>
</table>

### Table 5-5: Maintenance Regime for Drainage Pipes

<table>
<thead>
<tr>
<th>Maintenance Schedule</th>
<th>Required Action</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular Maintenance</td>
<td>Remove sediment and debris from inspection chambers and hydrobrake chambers</td>
<td>Annually</td>
</tr>
<tr>
<td></td>
<td>Cleaning of gutters and any filters on downpipes</td>
<td>Annually</td>
</tr>
<tr>
<td></td>
<td>Remove any root ingress</td>
<td>As required</td>
</tr>
<tr>
<td>Occasional Maintenance</td>
<td>CCTV survey of drains to check alignment, cracking and joint displacement</td>
<td>10 year intervals</td>
</tr>
</tbody>
</table>
SuDS Adoption

5.14. In the preparation of this FRA, NCC’s Flood and Water Management Team has provided information to clarify the authority’s current position regarding the pending SuDS Approving Body & Adoption duties as outlined in The Flood And Water Management Act 2010 and the Government’s current consultation on implementation of these functions.

5.15. Where development proposals are in advance of the commencement of the authority’s SuDS duties, NCC has no function in the approval or adoption of any of the surface water drainage systems.

5.16. The National Standards for Sustainable Drainage Systems propose;

The SAB Approval will not be required for the first 12 months:

- for developments already granted Planning Permission before commencement
- for developments with one or more reserved matters where an application for approval of the reserve matter is made
- for which a valid Planning Application has been made before commencement

That proposed drainage systems do NOT comply with National Standards unless;

- Surface run-off is managed at its source
- Surface run-off is managed on the surface
- Public space is used and integrated with the drainage system, where it serves more than one property
- Design is cost-effective to operate and maintain over the design life of the development
• Design of the drainage system accounts for the likely impacts of Climate Change and changes to impermeable area over the life of the development

5.17. It is considered that the proposed surface water strategy demonstrates adherence to current best practice whilst acknowledging future SuDS legislation, in advance of the SAB formation and associated SuDS Guidance.

5.18. It is envisaged that all strategic SuDS features would be adopted by the SAB once this has been established. If no SAB has been established in the area then the SuDS would be maintained and operated by a private management company. The piped network would be adopted and owned by AWSL.

**Offsite Highways Drains**

5.19. NCC confirmed that under Section 115 of the Water Industry Act 1991, a Highway Authority cannot unreasonably refuse a Water Authority connection into their drainage network. It was agreed that ACE would need to demonstrate that sufficient capacity exists within the existing drainage network to accommodate flows from the development.

5.20. Plans received from NCC show Fox Lane and the western end of Lingwood Road drain to a highways drainage network which eventually outfalls to a watercourse south of Blofield.

5.21. NCC stated that highways drainage within the county is designed to operate without surcharge during a 1 in 1 year storm event, and without flooding during a 1 in 30 year storm event.

5.22. ACE commissioned a CCTV drainage survey of the existing highways drainage network in Blofield. The survey was carried out in October 2012 and confirmed the extent, pipe diameters and levels of the highways drainage network. The annotated survey drawings and photos are included in Appendix K.
5.23. The highways drainage network was modelled using windes, storms of varying duration representing 1 in 1 and 1 in 30 year events were simulated (see Appendix J for Windes Calculations).

5.24. During the 1 in 1 year storm event, some of the drains around Hunters Close surcharge due to the pipes being undersized. A drain at the junction of Pound Road and Church Road also surcharges, this is due to the upstream invert of the pipe being lower than the downstream invert.

5.25. During a 1 in 30 year storm event, flooding is experienced at the northern end of Hunters Close, this is due to the drains in the area being undersized.

5.26. A dummy network was added to the existing network to represent the site, including controls to limit the discharge to greenfield runoff rates.

5.27. There was no additional flooding or surcharging during a 1 in 1 or 1 in 30 year storm. A test was also carried out to determine how the network would cope with a 1 in 100+30% year storm event, whilst minor flooding of the network was experienced, the additional development flows do not increase this flooding.

5.28. NCC confirmed that the survey work and modelling carried out are sufficient to confirm that the highway drainage network is able to accommodate the development flows. NCC will therefore not oppose the new connection to their highway drainage network.

**Impermeable Areas**

5.29. Based upon measurements taken from the masterplan, the following breakdown of impermeable areas have been used to model the development catchments.
<table>
<thead>
<tr>
<th>Type</th>
<th>Percentage of Gross Area</th>
<th>Area (Ha)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private Driveways and Parking</td>
<td>11.7%</td>
<td>0.40</td>
<td>Permeable Paving – not included in modelling.</td>
</tr>
<tr>
<td>Roofs (Houses and Garages)</td>
<td>22.0%</td>
<td>0.75</td>
<td></td>
</tr>
<tr>
<td>Adoptable Estate Roads</td>
<td>12.5%</td>
<td>0.42</td>
<td></td>
</tr>
<tr>
<td><strong>Total Impermeable Areas</strong></td>
<td><strong>46.2%</strong></td>
<td><strong>1.57</strong></td>
<td></td>
</tr>
</tbody>
</table>

Table 5-6: Impermeable Area Breakdown

**Drainage Strategy**

5.30. All private areas of hardstanding such as parking courts and driveways will be constructed from permeable paving, draining directly to the subsoil. NCC has stated that they will not accept permeable paving within areas of adoptable estate road.

5.31. Roofs and adoptable estate roads will drain to a network of onsite sewers which will be offered to Anglian Water for adoption. The network will discharge to the Highway Drains at the southern end of Fox Lane.

5.32. The discharge from the site will be limited to greenfield run-off rates using a hydrobrake or similar control. Storage for storms up to and including the 1 in 30 year event are is to be provided within the drainage network. Storage for events exceeding 1 in 100 year probability will be provided offline.

5.33. To determine the maximum storage requirements for the development 1 in 100 year storms were modelled with a 30%
allowance for climate change, discharge rates were limited to the 1 in 100 year greenfield rates.

5.34. To estimate the storage requirements within the network, 1 in 30 year storms were modelled with the discharge limited to the 1 in 30 year peak greenfield rates. The results of the modelling demonstrated that 460m³ of total storage is required, 250m³ of which will be provided within the drainage network, whilst 210m³ is required offline.

5.35. The POS in the centre of the development is to be used as a detention basin to store rainfall in excess of the 1 in 30 year storm. Storms up to and including 1 in 30 year are stored within oversized pipes and chambers, approximately 350m of 600mm diameter pipe is required.

5.36. Due to the location of the POS and the steep slope of the site, a small area of buried storage is proposed in the parking area in the south west corner of the site (see Appendix L for Drainage Strategy).

5.37. Where feasible, run-off from the adoptable highways will pass through bio-retention tree-pits or rain gardens to provide treatment before entry into the drainage system. The retention basin will be planted and landscaped to maximise the ecological and amenity value of the space.
6. **FOUL WATER DRAINAGE**

6.1. Although not obligatory by NPPF, in accordance with EA requirements, this FRA has considered the disposal of foul water from the site.

*Existing drainage networks and capacity*

6.2. ACE commissioned AWSL to produce a pre-development report (August 2012), to evaluate the capacity of the existing foul water network and the potential impacts to the existing network, as a result of the increased flows from the new development.

6.3. The pre-development report confirms that the foul drainage from the development is in the catchment of Whitlingham Sewage Treatment Works and will have available capacity for an additional 105 units.

6.4. The sewerage system, at present, has available capacity for gravity flows from the proposed development site. The connection point will be to manhole 7503 in Lingwood Road, see Figure 6-1 below and see Appendix C and H.

*Proposed Strategy*

6.5. Given the average gradient of the site is 1:30 from northeast to southwest, the foul drainage network for the development will successfully drain via gravity to the above referenced manhole without the need for pumping or significant earthworks.
Figure 6-1 Proposed Foul Water Connection
7. CONCLUSIONS

7.1. Ardent Consulting Engineers has been commissioned by Generator Group to undertake a Flood Risk Assessment (FRA), for a proposed residential development in Blofield, Norfolk. This FRA has been undertaken to support an Outline Planning Application for 105 residential units comprising houses and flats.

7.2. The FRA has considered the current policy relating to flood risk, in particular the requirements of the National Planning Policy Framework and the Partnership of Norfolk District Councils Strategic Flood Risk Assessment (SFRA) (Stage 2), Subsidiary Report C; Broadland District Council Area (December 2007).

7.3. This assessment has been undertaken in consultation with Anglian Water Services Ltd. (AWSL), the Environment Agency (EA) and Norfolk County Council (NCC). All parties have been supportive of the proposals to address flood risk issues and the principles of the drainage strategy.

7.4. Environment Agency Flood Risk Mapping confirms the Site to be located within Flood Zone 1, identified as comprising land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%) i.e. low risk.

7.5. As the site is located within Flood Zone 1 it satisfies the requirements of the sequential test, as outlined within the Technical Guidance of the NPPF and the exception test is not required.

7.6. The SFRA identifies that the site is not deemed to be at risk of flooding from any sources and there has been no recorded history of flooding on Site.

7.7. Established by a desk based assessment of flood risk, it is considered that the Site can be safely operated under the assessment criteria of NPPF, and is not at risk of flooding from the
following sources: fluvial, tidal, groundwater, canals & artificial and pluvial.

7.8. The geotechnical investigation concluded that the underlying stratum is not considered suitable for near surface soakaways. But the EA have confirmed the soakage results are suitable for the use or permeable paving.

7.9. Opportunities to utilise SuDS across the development has been assessed adopting the hierarchical approach outlined within C697. Specific drainage proposals include permeable paving, Bioretention tree pits or rain gardens and a retention basin within the POS in the centre of the site.

7.10. The maintenance requirements of the key elements within the drainage strategy have been informed by CIRIA C697.

7.11. Following discussions with NCC it was agreed that the onsite drainage will discharge into the existing highway drains south west of the site. The discharge direction, therefore follows the natural slope of the site to maintain existing catchments. The discharge rate will be limited to greenfield run-off rates, as agreed with the EA.

7.12. In conclusion, this FRA demonstrates that the proposed development is not at risk of flooding and will not increase flood risk elsewhere, in accordance with the NPPF. The proposed drainage strategy utilises all opportunities to implement SuDS and is based upon the principles agreed with the EA.
**AEP: Annual Exceedance Probability**

The estimated probability of a flood of given magnitude occurring or being exceeded in any year. Expressed as, for example, 1 in 100 chance or 1 per cent.

**Attenuation (surface water)**

The reduction of a peak flow by restricting the rate at which water discharges. Attenuation usually refers to a design volume associated with a specific AEP event.

**Compensatory Floodplain Storage**

In order to maintain a similar flood flow profile post development, it is usual to offset any land raising within the 1% AEP + Climate Change floodplain, by lowering land elsewhere. The land lowered has to provide the same volume of floodplain and at the same vertical level.

**Climate Change**

Under PPS25 the predicted impacts of climate change need to be considered as part of an FRA, this is to protect the development over the lifetime of the development.

**Design flood level**

The maximum estimated water level during the design event, relates to a specific AEP i.e. 0.5% for tidal or 1% for fluvial Flood Zone 3.

**Flood Defences**

Flood defence infrastructure, intended to protect an area against flooding to a specified standard of protection, through the use of engineered embankments or walls.

**Flood Defence Level**

The level required to be achieved by flood defences, usually the design flood level with a freeboard allowance, to account for wave action and modelling uncertainty.

**Floodplain**

An area of land adjacent to a river or tidal water body that is predicted to become affected by water as the result of a defined flood event.

**Fluvial Flooding**

Flooding caused by a river overtopping its banks, as a result of high flows exceeding the rivers capacity.

**Flood Zone**

An area defined by the Environment Agency and/or SFR as being at risk from a specified flood event. The Flood Zone definitions ignore the benefits of flood defence structures.
**FLOOD RISK GLOSSARY**

<table>
<thead>
<tr>
<th>Flood Zone 1: Low Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>An area having a less than 0.1% AEP of flooding for both tidal and fluvial sources.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flood Zone 2: Medium Probability</th>
</tr>
</thead>
</table>
| An area having a fluvial AEP of between 1% and 0.1%.
Or a tidal AEP of between 0.5% and 0.1%. |

<table>
<thead>
<tr>
<th>Flood Zone 3(a): High Probability</th>
</tr>
</thead>
</table>
| An area having a fluvial AEP of between 5% and 1%.
Or, a tidal AEP of between 5% and 0.5%. |

<table>
<thead>
<tr>
<th>Flood Zone 3(b): The Functional Floodplain</th>
</tr>
</thead>
<tbody>
<tr>
<td>An area having an AEP of more than 5% for both tidal and fluvial sources.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flood Zone Map</th>
</tr>
</thead>
<tbody>
<tr>
<td>A map produce by the Environment Agency, or SFRA which designates the flood zones. Site specific FRA usually refine the detail of these maps to provide a more accurate prediction at the Site level.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Freeboard</th>
</tr>
</thead>
<tbody>
<tr>
<td>The difference between the Flood Defence level and the Design Flood level, usually 300mm for fluvial sources and 600mm for tidal sources. But local variations do occur.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Groundwater Flooding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caused by groundwater rising through permeable soil strata either into basements, or through the ground. Tends to occur at the bottom of a valley in large chalk catchments.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Greenfield Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two definitions of the greenfield rate are used interchangeably. C697 defines it as “The surface water runoff regime from a site before development, or the existing site conditions for brownfield redevelopment sites”. However common usage ignores the brownfield status.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pluvial Flooding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caused by overland run-off exceeding the capacity of natural and artificial drainage systems as a result of the volume of rainfall.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PPS25 Exception Test</th>
</tr>
</thead>
</table>
| PPS25 identifies a number of vulnerability classes within certain flood zones which will require the Exception Test.
The Exception Test can enable development within flood risk areas when taking account of the wider sustainability benefits of the site, i.e. to avoid economic or social blight on previously developed land. |
<table>
<thead>
<tr>
<th><strong>PPS25 Sequential Test</strong></th>
<th><em>The Flood Zones and Vulnerability Classifications are used</em></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Residual Risk</strong></td>
<td><em>The risk which remains following the use of all risk reduction, mitigation and management options. Or the risk beyond the design AEP event.</em></td>
</tr>
<tr>
<td><strong>Run-off</strong></td>
<td><em>The flow of water from an area as a result of a rainfall event.</em></td>
</tr>
<tr>
<td><strong>Tidal Flooding</strong></td>
<td><em>Caused by sea or estuarine levels rising beyond the level of the land or flood defences. Usually associated with significant offshore storm events.</em></td>
</tr>
<tr>
<td><strong>SFRA</strong></td>
<td><em>Strategic Flood Risk Assessment, usually undertaken on behalf of Local Authorities to inform their PPS25 Sequential Tests.</em></td>
</tr>
<tr>
<td><strong>SuDS</strong></td>
<td><em>Sustainable Drainage Systems, a sequence of drainage devices which promote a more natural run-off regime from developments. The use of SuDS can result in a reduction in the volume of water discharged to sewers and watercourses, therefore reducing the risk of Pluvial Flooding.</em></td>
</tr>
</tbody>
</table>
Dear Mr Brooks

**Blofield, Norfolk**

Thank you for your enquiry which was received on 18 June 2012 and payment of £60.00. Following internal consultations we are able to reply to your enquiry as below.

Please see attached map showing the Flood Zones (outlines) for the area of the site.

This area falls within Flood Zone 1 Fluvial.

Flood Zone 1, (i.e. a less than 0.1% annual probability of flooding).

The Flood Zone 2 outline shows a 1 in 1000 chance of flooding at a location in any one given year (i.e., a 0.1% annual probability of flooding).

The Flood Zone 3 fluvial outline shows a 1 in 100 chance of flooding at a location in any one given year (i.e., a 1% annual probability of flooding).

The Flood Zone 3 tidal outline shows a 1 in 200 chance of flooding at a location in any one given year (i.e., a 0.5% annual probability of flooding).

The flood outlines show areas of potential flooding as a direct result of floodwater coming from a watercourse. No direct effects of surface runoff or surface flooding are included. The Flood Maps show areas at risk of flooding, and not the risk to individual properties. This is because we do not hold data on individual properties.

We have checked our historic flooding database and have found no record of flooding in this area. This does not mean that the site has never flooded, only that no flooding has been reported to us in this location.

There are no Environment Agency maintained defences in this area.

We do not hold any modelled flood levels for this site.
The site overlies Crag with a high vulnerability due to the near surface sand and gravel deposits. There is a SPZ Zone 3 below the whole site. We would encourage the use of best practice in SUDS design, however, due to the potentially shallow groundwater table the use of deep soakaways would require consultation with us. Please contact David Seccombe (Groundwater & Contaminated Land Team Leader) 01473 706098.

We hold no records of any pollutions incidents within the vicinity of the site.

Any future planning application should demonstrate that there is sufficient capacity within the foul sewerage infrastructure including the waste water treatment works and foul sewer network to accommodate the foul flows from the proposed development. In this respect, we recommend that Anglian Water Services are contacted. Further guidance can be found within the greater Norwich Water Cycle Study.

A significant part of England (southern and eastern parts of England, including Norwich) is classified as being in an area of serious water stress. We consider it is particularly important that water efficiency measures are incorporated into this scheme. The applicant should consider the use of water efficient systems and fittings such as dual-flush toilets; water butts; water-saving taps and showers; and appliances with the highest water efficiency rating as a minimum. Greywater recycling and rainwater harvesting should also be considered where appropriate. Any submitted scheme should include detailed information (capacities, consumption rates, etc) on proposed water saving measures.

With new information becoming available on the impacts of climate change it is important that the new development is carried out in as sustainable manner as possible. This is in line with the objectives of the National Planning Policy Framework.

Development should also seek to minimise the use of resources and the production of waste by incorporating, for example, passive systems using natural light, air movement and thermal mass, as well as using energy produced from renewable sources.

We would also advise that as part of any landscaping proposals thought is given to maximise potential ecological enhancement. Issues that should be considered include the planting of only native species and use of low intensity/time of year mowing regimes. Green/brown roofs and walls may also be considered. As well as providing additional invertebrate and bird habitats, they can contribute to increasing the energy efficiency of buildings and assist in attenuating rain water flow.

Please note that the view expressed in this reply by the Sustainable Development Team is a response to a pre application enquiry only and does not represent our final view in relation to any future planning application made in relation to this site. We reserve the right to change our position in relation to any such application.

Please see the attached notice for details of the permitted use of the information provided.

If you have any specific requirements because of dyslexia, visual or other physical impairment etc, we will be able to supply the data in an alternative format.

Eastern Area - Iceni House
Cobham Road, Ipswich, Suffolk, IP3 9JD
General Enquiries: 03708 506506 Fax: 01473 724205
Weekday Daytime calls cost 8p plus up to 6p per minute from BT Weekend Unlimited.
Mobile and other providers’ charges may vary
Email: enquiries@environment-agency.gov.uk
Website: www.environment-agency.gov.uk
If we can be of any further assistance, please do contact the Corporate Services Team at the number below.

Yours sincerely

Nina Earrey
External Relations Officer
Corporate Services Team
01473 706720
Dear Phil,

Thank you for your e-mail and your invitation to attend the Developer Forum relating to the site at Blofield. Unfortunately I am unable to attend on the 16th. However, I have considered the site location and the proposal for 70-90 dwellings and have the following general advice:

Our Flood Zone maps show the site to fall within Flood Zone 1, the low risk flood zone, as defined within Table 1 of the NPPF Technical Guidance. The site is greater than 1 hectare in size. A Flood Risk Assessment (FRA) should therefore be submitted in support of any future planning application. This should assess the surface water management for the site to ensure that the development of the site will not lead to an increase in flood risk on or off-site. We would be happy to provide specific advice to the applicant regarding the scope of the required FRA if this would be helpful.

I would also highlight that the site falls on top of a principal aquifer and within a Source Protection Zone 3 designated to protect drinking water supplies. This means that any pollutants entering the groundwater below this site could contaminate the public water drinking supply. The time taken for contamination in the water to be abstracted is estimated to be more than 400 days. It should be ensured that adequate pollution control measures are in place. For residential development, best practice techniques should be installed. For example, oil interceptors on large car parking areas.

We would support the incorporation of green infrastructure into the site. Furthermore, we would advise that the development should utilize water saving techniques and this should be a consideration for any future planning application. Policy 3 of your Core Strategy requires that all developments reach Code for Sustainable Homes level 4 for water efficiency and those greater than 500 dwellings reach level 6 by 2015. We recommend that the developer seeks to reach high levels of water efficiency.

We also advise that Anglian Water should be consulted to confirm that there is sufficient capacity in the foul sewerage infrastructure, including at the waste water treatment works and within the foul water sewer, to accommodate the foul flows from this development. Should upgrades be required, the development should be planned/phaed in line with the upgrades.

Finally, it would appear from our maps that the current use of the site may be agricultural fields. However, this should be confirmed through any future planning application. Should it be considered that the site may be subject to land contamination associated with a previous use, this should be assessed. We recommend that as a minimum, a desktop study should be completed. If the desktop study identifies that contamination may be a problem, a full site investigation may also be required along with a risk assessment and remediation method statements.

I trust that the above comments are useful. We would be happy to provide further advice to the applicant if required.

Kind regards,

Jessica

Jessica Fraser (née Bowden)
Senior Planning Liaison Officer - Sustainable Places team
Anglian Eastern Area
Tel: 01473 706008
E-mail: jessica.bowden@environment-agency.gov.uk
Address: Iceni House, Cobham Road, Ipswich, Suffolk. IP3 9JD

-----Original Message-----
From: Phil Courtier
Sent: 01 August 2012 14:29
To: Bowden, Jessica R; Faulkner, Stephen; ken.hamilton@norfolk.gov.uk; Hazel Ellard; Stephen Chesney-Beales; David White; Stuart Moore; Bob Fell; John Walchester; Higgins, David; Nigel Harriss; Gareth Hughes

Cc: John Cutler

Subject: Developer forum regarding Garden Fm, Blofield

<<Red Line Plan.jpg>> We are in discussions with Iceni Projects Ltd regarding an outline proposal for approx. 70 - 90 dwellings on the 4.2ha site outlined in red on the attached image.

This proposal is at a relatively early stage but it would be helpful to have your comments/input into the preparation of the application. To this end I have arranged a developer forum for 10.30am on Thursday 16th August at Broadland DC offices, Thorpe Lodge. If you have attended one of these forums at BDC before you will know that this will consist of a brief presentation of the proposal from the agent which is followed by an opportunity for each attendee to offer comments on the scheme and to confirm the level of information required at the application stage.

Please confirm whether you wish to attend or not. In addition please feel free to forward this email to a colleague if you want someone else to attend.

I will be on leave on the 16th but Nigel Harriss, Area Planning Manager will chair the forum and if you need any more details in advance of the meeting please contact him direct.

Regards

Phil

The message is ready to be sent with the following file or link attachments:

Red Line Plan

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Jessica,

We spoke very briefly on Friday regarding the above site following on from your email correspondence to Broadland Council (attached).

I understand that your colleague Sarah is the best person to speak to regarding flooding / drainage matters, are you able to provide her contact details so I can give her a call to discuss?

Thanks,

Ben Brooks
Principal Engineer

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Sarah,

Once again, thanks for taking the time to discuss the above scheme with me earlier, as agreed I have recorded the main points of our discussion below.

Following the geotechnical investigation and discussions with Anglian Water, Broadlands Council and Norfolk County Council we are struggling to drain the site through conventional means.

The initial feedback from geotechnical investigation is that only half of the soakage tests were suitable for permeable paving, and none were suitable for soakaways. There are no Surface Water sewers in the area and the highway drains are expected to be running at full capacity. We have not identified any suitable watercourses or ditches in the area to date.

We discussed that deep-bore soakaways may be acceptable, subject to discussions with the groundwater protection team (you have kindly agreed to forward this email on to begin these discussions). A minimum clear distance between the water table (possibly 4-5m) and suitable pre-treatment would need to be provided, soakage testing would need to be carried out at the depth of the proposed soakaway.

Permeable paving with a half drain time slightly less than the 24 hours recommended in BRE 365 may be preferable to deep bore soakaways, subject to the sub-base being oversized to accommodate repeat storms. Ideally, if the roads and driveways could be drained via permeable paving or via other means, then the run-off from the roofs which is not expected to be contaminated could be drained to deep bore soakaways.

We also discussed that there may be difficulties in getting SABS to adopt deep-bore soakaways, as suggested I will get in touch with the SAB and discuss at an early stage.

Kind Regards,

Ben Brooks
Principal Engineer

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Dear Mr Brooks

RESIDENTIAL DEVELOPMENT (70-90 DWELLINGS). GARDEN FARM, BLOFIELD.

Thank you for your e-mail dated 20 August 2012 regarding the above site. In that regard, we are able to provide the following advisory comments:

Surface water drainage

It would be preferable if oversized permeable paving could be used to drain the entire site, if the infiltration rates are found to be sufficient to allow drainage through shallow infiltration. It would be acceptable for the half drain times to be longer than 24 hours if additional storage capacity is provided to accept subsequent rainfall events. The infiltration rates and half drain times should however be sufficient to enable it to be demonstrated that drainage through infiltration would be feasible and the surface water would drain away. If it is possible for the houses as well as the roads to be drained through permeable paving then this would be preferable to using deep bore soakaways.

Infiltration testing should be carried out across the site and the permeable paving should be sited where the infiltration rates are good enough to allow infiltration drainage. In areas with poor infiltration the water should be drained to permeable paving in areas of better infiltration, where the topography allows.

If there are areas of poor infiltration which cannot drain to areas of good infiltration then it may be acceptable for deep bore soakaways to be used, providing that it can be demonstrated that there will be no risk to the groundwater. Deep soakaways (including boreholes or other structures that bypass the soil layers) for surface water or effluent disposal are only acceptable if the developer can demonstrate the following:

- there are no other feasible disposal options such as shallow soakaways (for surface water) or drainage fields/mounds (for effluents) that can be operated
in accordance with current British Standards;
- the system is no deeper than is required to obtain sufficient soakage;
- pollution control measures are in place;
- a risk assessment demonstrates that no unacceptable discharge to groundwater will take place, in particular that inputs of hazardous substances to groundwater will be prevented; and
- that there are sufficient mitigating factors or measures to compensate for the increased risk arising from the use of deep structures;
- there is no direct discharge of pollutants to groundwater.

Mitigating factors for deep soakaways may include additional levels of effluent treatment but in all cases there must be evidence of a sufficient unsaturated zone with suitable geological properties to provide an effective attenuation layer below the base of the structure.

Provided the above points can be demonstrated, the deep bore soakaways should be designed using infiltration rates obtained by undertaking infiltration testing at the proposed depth of the deep bore soakaways. The deep bore soakaways should also drain at a sufficient rate to enable the storage features to half drain in 24 hours.

Sufficient storage should be provided for the 1 in 100 year rainfall event including climate change. In the 1 in 30 year rainfall event the water must be contained within the storage features. If there is any above ground flooding in the 1 in 100 year rainfall event including climate change then the FRA must detail the volume and depth of water that will flood, where the water will flow and where it will be stored to prevent properties flooding or the water flowing offsite.

We trust the above comments are useful. Should you have any further queries, please contact me on the number given below.

Yours sincerely

Mrs Jessica Fraser (née Bowden)
Senior Planning Liaison Officer

Direct dial 01473 706008
Direct e-mail jessica.fraser@environment-agency.gov.uk
Ben Brooks

From: Ben Brooks
Sent: 27 September 2012 11:16
To: sarah.palmer@environment-agency.gov.uk
Cc: Fraser, Jessica R; Edward Orr
Subject: RE: Blofield, Norfolk [Filed 27 Sep 2012 11:16]

Sarah,

Once again, thank you for taking the time to discuss our proposals a moment ago.

We will move forward with the proposed deep bored testing on the basis that 4.0m of unsaturated soil is ideally required at the base, the testing should be carried out in the location of the proposed soakaways and should be repeated several times.

I will wait to hear of any concerns with the permeable paving proposals, but provided additional storage is provided above the 1in100 year storm, a 72 hour half drain time should be acceptable.

Kind Regards,

Ben Brooks
Principal Engineer

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From: Fraser, Jessica R [mailto:jessica.fraser@environment-agency.gov.uk]
Sent: 20 September 2012 12:24
To: Ben Brooks
Subject: RE: Blofield, Norfolk [Filed 20 Sep 2012 15:54]

Hi Ben,

Thank you for your e-mail. I have forwarded it to Sarah in our Flood Risk team and a colleague in our Groundwater team. I am on leave for the next week but will be in touch on my return with comments on the submitted information. In the mean time, should you wish to discuss the matter further, please contact Sarah Palmer on 01473 706721.
Jessica,

Thanks for your response.

As discussed we are keen to discuss both the existing soakage testing results, together with the proposals for the new deep bored soakaway testing.

I have attached the results of the recent soakage testing, these demonstrate that the lowest infiltration value encountered was around 0.00068 m/hr. I have used this result to design a sample piece of permeable paving, 430mm depth of sub-base is required to store the 1 in 100 + 30% storm, whilst the 1 in 10 storm will half drain within 72 hours. I was keen to discuss whether this was acceptable and what mitigation (for example providing 600mm of sub-base depth) would be required.

The proposed method statement for the deep bored soakage testing is also attached, I need to confirm this testing will meet your requirements and clarify at what point this work will be required.

If you could pass this information on to Sarah Palmer so I can discuss further it would be much appreciated.

Kind Regards.

Ben Brooks
Principal Engineer

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Dear Mr Brooks,

Please find attached our comments to your e-mail regarding the site at Garden Farm, Blofield.

Kind regards,

Jessica

Jessica Fraser (née Bowden)
Senior Planning Liaison Officer - Sustainable Places team
Anglian Eastern Area
Tel: 01473 706008
E-mail: jessica.fraser@environment-agency.gov.uk
Address: Iceni House, Cobham Road, Ipswich Suffolk, IP3 9JD

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Dear Mr Brooks

RESIDENTIAL DEVELOPMENT (70-90 DWELLINGS). GARDEN FARM, BLOFIELD.

Thank you for your e-mail dated 19 September 2012. In that respect, we hope the following comments will be useful:

It is indicated consideration is being given to the potential for deep borehole soakaways to be installed to depth of 12 to 14m, within the Crag (sand) which is anticipated to be encountered at a depth of 5 to 7m below ground level (bgl). It is further indicated it is anticipated that groundwater in the Crag will be at approximately 18m bgl, and a soakage test borehole is to be installed with a response zone to target the anticipated soakaway horizon (currently assumed to be from 12m to 14m).

In that regard, it should be noted that where the permeability of superficial deposits may be quite low with limited soakage potential, it may still be possible, and is always preferable, for a greater number of shallower soakays to used, rather than deep bore soakaways, to achieve the same overall discharge capacity.

Therefore, given the Crag is expected to be at 5-7m bgl, the soakage test should be used to confirm the soakage potential for installation of borehole soakaways to the minimum depth possible, to maximise the depth of unsaturated zone remaining between the base of the soakaways and the top of the water table. Only if the infiltration rates obtained at this depth are not sufficient should deeper borehole soakway testing be undertaken and deeper deep bore soakaways be considered. In this case, please re-consult us for further guidance.

Also, given the topography of the site, there may be a considerable variation in the depth to groundwater across the site. The actual depth of the groundwater bgl should therefore be established in the area of the proposed soakaway(s).
In addition to the above, the half drain time for the permeable paving in the 1 in 100 year rainfall event including climate change should be modelled. This should be fast enough to ensure that the water would adequately drain away after a large rainfall event.

There should also be additional volume of surface water storage provided within the permeable paving to enable a subsequent rainfall event (for example a 1 in 10 year rainfall event) to be stored during the length of time it takes the 1 in 100 year rainfall event including climate change to half drain.

We trust that the above comments are useful.

Yours sincerely

Mrs Jessica Fraser (née Bowden)
Senior Planning Liaison Officer

Direct dial 01473 706008
Direct e-mail jessica.fraser@environment-agency.gov.uk
Jessica,

I have spoken to Richard to explain the history of the scheme and our proposed geotechnical investigation.

On the basis that the purpose of the investigation is to determine the feasibility of using deep bored soakaways to drain the site, the proposed testing should be sufficient. Ideally, the soakaways will be as shallow as possible and only receive water from roofs within the development. If roads and parking areas are to drain to the soakaway then a Class 1 Petrol Interceptor should be used to remove contaminants, and the soakaways should be as shallow as possible.

We intend to carry out the Geotechnical Testing on Monday and have a week to complete the work before the field is re-planted. I agreed with Richard that a planning condition would be required to ensure that acknowledges the need for further work and discussion following outline planning to ensure that the drainage regime is acceptable to the Environment Agency. I will therefore instruct the work as proposed, the FRA to accompany the Outline Planning application will include further details of the drainage proposals, including details of how the quality of the groundwater will be protected.

I have also spoken to Sarah Palmer regarding half drain times. Whilst I am not convinced that CIRIA document C697 refers to 1in100 year half drain times for soakaways (in section 4.7 – Infiltration Design it is stated that soakaways are commonly designed to 1in10 years, and that soakaways should be designed to half drain in 25 hours – there is no mention of 1in100 year storms or climate change in this section) I have carried out some additional modelling.

Using the worst soakage result encountered during testing, and a factor of safety of 2, the 1 in 100 + 30% storm will half drain from the permeable paving within 5 days, whilst the 1 in 10 event will half drain in less than 2 days.

The 1 in 100 + 30% storm requires a 316mm deep sub-base whilst the 1 in 10 year storm requires a 154mm deep sub-base.

If you can confirm you are happy with a 475mm deep sub-base for this site, we can move forward with the design.

I trust that the above is acceptable, if there are any problems please could you let me know by close of play tomorrow – I am on leave from tomorrow and the testing will be carried out in my absence. Could you please copy my colleague Nigel Thompson in on any future correspondence, Nigel will be handling the scheme whilst I am away.

Kind Regards,

Ben Brooks
Principal Engineer

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Dear Mr Brooks

RESIDENTIAL DEVELOPMENT (70-90 DWELLINGS). GARDEN FARM, BLOFIELD.

Thank you for your email sent to my colleague Jessica Fraser and received on 2 October 2012. We have consider the additional information you have provided and confirm that we are satisfied with the proposal and have no further comment at this time.

Yours sincerely

Mrs Jo Firth
Senior Planning Liaison Officer

Direct dial 01473 706016
Direct e-mail jo.firth@environment-agency.gov.uk

cc Mr Nigel Thompson
Sarah,

Thanks for taking the time to talk through the Blofield scheme with me a moment ago.

As discussed, the Deep Bored Soakage testing was not very successful and this option does not seem feasible.

The alternative is to discharge to the Highways Drainage network, Norfolk have agreed in principle following a survey of the network and modelling to demonstrate capacity exists.

We agreed that a discharge rate of 1 in 100 (greenfield) is acceptable for 1 in 100 + 30% events, however the 1 in 1 event should also be limited to 1 in 1 year flows (greenfield), and ideally the 1 in 30 year event to 1 in 30 year flows (greenfield). I will run a quick check to confirm this will not change our storage requirements, but this is something we will likely deal with at the detail design stage when the complete drainage network is modelled.

We also agreed the principles of a dry basin within the central POS, with a smaller area of cellular storage to deal with the network at a lower level than the POS was acceptable for storage of storms above 1 in 30, with storms up to 1 in 30 stored within the piped network.

Permeable paving will be used in all non-adoptable areas.

Kind Regards,

Ben Brooks
Principal Engineer

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Appendix C

Anglian Water Correspondence
23 October 2012

Dear Mr Thompson,

**Site: Proposed Development, BLOFIELD**

Thank you for your correspondence dated 09 October 2012 seeking our comments on the above proposed development.

From a water perspective I can advise that your site will benefit from the Heigham to Mousehold strategic water main. This strategic scheme has been designed to cater for the predicted housing growth in the area. All developments that benefit from this strategic water scheme will be required to make a contribution proportional to their flow demand. Contribution is based on a litre per second requirement. For this site it has been assumed that you will use 1.1206 litres per second. The cost of carrying out work is £65,079.00. The connection point for the site will be from the existing water main in Yarmouth Road.

From a wastewater perspective I can advise that we have assessed a gravity connection to manhole 7503 for 105 dwellings which we can confirm is acceptable. Should a pumped connection be required, Anglian Water will have to reassess this.

If any further information or assistance is required concerning this matter please contact me on 01733 414607.

Yours sincerely

Keith Simpson
Planning & Equivalence Team
Appendix D

Norfolk County Council Correspondence
Graeme,

Thanks for taking the time to discuss the above scheme with me a moment ago, I have recorded the main points of the conversation below.

- No SW Sewers or water courses in the area, poor infiltration rates from geotech investigation (not suitable for Soakaways), some highway drains but not sized to accept new development flows. Considering Deep Bore Soakaways on the site and wanted to discuss this with the Norfolk SAB.
- Lots of un-answered questions relating to where the extents of adoption would lie in this type of situation.
- Schedule 3 of the FWMA will not come into effect this year, more likely April or October next year.
- Based upon a review of available information you confirmed;
  - No IDBs nearby.
  - Site is in Total Aquifer Protection Zone (zone 3).
  - Drainage system to be designed to 1 in 100 + Climate Change.
  - The Ciria Manual should be the basis for the SuDS system design.
- You suggested a review of the Kent Soakaway Design Guide, which has information on Deep Bore Soakaways.
- We agreed the best way forward was for Ardent to produce some sketch plans showing proposals and organise a meeting with all drainage stakeholders to agree the details of the scheme and determine adoption responsibilities.

If you could send over the Norfolk SuDS guidance it would be much appreciated, I will be in touch in the next few weeks when I have developed the design a little.

Kind Regards,

Ben Brooks
Principal Engineer

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Dear Sir,

Sustainable Drainage Systems (SuDS) Approval

Norfolk County Council is providing this letter to clarify the authority’s current position regarding the pending SuDS Approving Body & Adoption duties as outlined in The Flood And Water Management Act 2010 and the Government’s current consultation on implementation of these functions.

Where development proposals are in advance of the commencement of the authority’s SuDS duties Norfolk County Council has no function in the approval or adoption of any of the surface water drainage systems. These Sustainable Drainage Systems duties were expected to commence on 1st October 2012 under Schedule 3 of the Flood And Water Management Act 2010 but are now subject to delay and DEFRA have not confirmed the revised date.

The National Standards for Sustainable Drainage Systems recently out for consultation (that Government should respond to in 2012) propose;

The SAB Approval will not be required for the first 12 months:

- for developments already granted Planning Permission before commencement
- for developments with one or more reserved matters where an application for approval of the reserve matter is made
- for which a valid Planning Application has been made before commencement

www.norfolk.gov.uk
That proposed drainage systems do NOT comply with National Standards unless:

- Surface run-off is managed at its source
- Surface run-off is managed on the surface
- Public space is used and integrated with the drainage system, where it serves more than one property
- Design is cost-effective to operate and maintain over the design life of the development
- Design of the drainage system accounts for the likely impacts of Climate Change and changes to impermeable area over the life of the development

We are happy to receive information on any major developments that may be captured by the requirement for SuDS approval or adoption on the commencement of new legislation. Thank you for your engagement with the authority on this matter and the wider considerations of the legislative changes to the approval of drainage systems for new developments.

Please use the email: suds@norfolk.gov.uk

Yours faithfully

Graeme Taylor, I.Eng.AMICE
Sustainable Drainage Systems Strategy Engineer
Flood & Water Management Team
Environment, Transport and Development
Direct dial telephone number: 01603 638082
Mobile telephone number: 07795 451315
E-mail: graeme.taylor@norfolk.gov.uk
Team E-mail: water.management@norfolk.gov.uk
    suds@norfolk.gov.uk

Norfolk County Council
General enquiries: 0344 800 8020 or information@norfolk.gov.uk
www.norfolk.gov.uk
Andy,

As discussed, we were proposing permeable paving for the estate roads as the only other options would be an upgrade of the surrounding highway drainage network or discharge to a deep-bored soakaway.

I understand the Norfolk County Highways will adopt soakaways, but will not adopt permeable paving, bio-retention, tree-pit drainage or deep bored soakaways.

In order to confirm that capacity exists within the adjacent highways drains, we would need to survey and model the route to the outfall and demonstrate no surcharge during a 1 in 1 year storm, with no flooding during a 1 in 30 year storm. Norfolk County Council cannot unreasonably refuse a connection into the highway drain from a sewer, provided there is capacity.

We will be carrying out the deep bored soakage testing over the next few weeks and will likely be in touch to discuss further when the results are available.

Kind Regards,

Ben Brooks
Principal Engineer

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Ben

I have been forwarded your email below, as the County Council's Assistant Engineer for estate development in Norfolk.

Whilst I have no objection in principle to new adopted roads being drained to soakaways. The County Council will not adopt new roads constructed with permeable paving.

If you wish to discuss your proposals for highway drainage further, do not hesitate to contact either Bryan Dye (bryan.dye@norfolk.gov.uk) or myself.

Andrew Willeard
Assistant Engineer - Estate Development

Environment, Transport & Development
Tel: 01603 228948
Fax: 01603 223128
Email: andrew.willeard@norfolk.gov.uk
Norfolk County Council
General Enquiries: 0344 800 8009 or information@norfolk.gov.uk
Website: www.norfolk.gov.uk

Hi Andrew

One for you.

Regards

Michelle.

Michelle Melton
Developer Services Officer
Developer Services
Environment, Transport and Development
Direct dial telephone number: 01603 223271
E-mail: michelle.melton@norfolk.gov.uk
Norfolk County Council
General enquiries: 0344 800 8020 or information@norfolk.gov.uk
Website: www.norfolk.gov.uk

Hi Michelle,
I wondered if you could help Ben with the details for the design of the footways.

Many Thanks

Mark Barber  
Highway Technician  
Environment, Transport and Development  
Direct dial telephone number: 01493 378226  
E-mail: mark.barber@norfolk.gov.uk  
Norfolk County Council

From: Ben Brooks [mailto:bbrooks@ardent-ce.co.uk]  
Sent: 27 September 2012 09:08  
To: Barber, Mark  
Subject: RE: Blofield, Norfolk

Thanks Mark,

Interesting to see that the highway in the area drains to soakaways.

We may be able to use some permeable paving within the adopted roads on the site – is there someone within Norfolk County Council I can discuss adoption of permeable paving with?

Kind Regards,

Ben Brooks  
Principal Engineer  
ARDENT CONSULTING ENGINEERS

Fourth Floor, Diamond House, 36-38 Hatton Garden, London, EC1N 8EB  
Tel: 020 74301209 - Fax: 020 74300318 - Web: www.ardent-ce.co.uk  
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From: Barber, Mark [mailto:mark.barber@norfolk.gov.uk]  
Sent: 25 September 2012 14:43  
To: Ben Brooks  
Subject: RE: Blofield, Norfolk
Hi Ben,

I have attached a summary of the drainage system around the Danesbower Lane area.

Green = 225mm
Red = 300mm
Yellow = 450mm (outfall in ditch)

I believe this is easier than sending all the info, as there are quite a few plans which are hand drawn. I do not have details for the area south east of Fox Lane.

hope this helps.

Mark

From: Ben Brooks [mailto:bbrooks@ardent-ce.co.uk]
Sent: 17 September 2012 12:40
To: Barber, Mark
Subject: Blofield, Norfolk

Mark,

Following recent discussions regarding Highway Drainage around Fox Lane, Blofield we have completed a topographical survey of the area (attached).

Unfortunately, during the survey we were unable to lift the covers of the majority of the highway drainage chambers due to damage / age / surfacing (see photos attached). I was wondering if you had a team that would be able to assist – our surveyors were concerned about forcing the covers with hydraulic lifting equipment and any damage this may cause to the covers or frames.

If you were able to assist or had any suggestions then this would be much appreciated, please feel free to call me to discuss if that would be of use.

Kind Regards,

Ben Brooks
Principal Engineer

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Ben

Apologies for not responding last night, I know you are keen to get on with this work.

The proposed scope of the survey stated in the letter from Hydro (dated 1 October 2012) should be sufficiently comprehensive to ensure that adequate information is provided to allow an assessment of the available capacity to be completed to our satisfaction. In order to ensure this occurs, it is clearly vital that any connections from side roads are identified, to allow an accurate assessment of the area being drained via this system to be made.

As previously stated, relevant permissions / requirements of the Streetworks Inspector will also be required.

Andrew Willeard
Assistant Engineer - Estate Development

Environment, Transport & Development
Tel: 01603 228948
Fax: 01603 223128
Email: andrew.willeard@norfolk.gov.uk
Norfolk County Council
General Enquiries: 0344 800 8009 or information@norfolk.gov.uk
Website: www.norfolk.gov.uk

---

Andrew,

As discussed earlier today, I attach the proposed scope for the highway drainage survey we are proposing at Blofield. If you could review the proposals and confirm you are happy with them we will instruct the work.

Please give me a call if you would like to discuss any element.

Kind Regards,

Ben Brooks
Principal Engineer

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Fourth Floor, Diamond House, 36-38 Hatton Garden, London, EC1N 8EB
Tel: 020 74301209 - Fax: 020 74300318 - Web: www.ardent-ce.co.uk

Follow us on: twitter
Hi Ben,

Thanks for the invite it would be a good opportunity to update our records. I will take advantage of the offer if work load allows. Have a good holiday.

Many Thanks

Mark Barber
Highway Technician
Environment, Transport and Development
Direct dial telephone number: 01493 378226
E-mail: mark.barber@norfolk.gov.uk
Norfolk County Council

---

Hi Ben,

Thanks for the invite it would be a good opportunity to update our records. I will take advantage of the offer if work load allows. Have a good holiday.

Many Thanks

Mark Barber
Highway Technician
Environment, Transport and Development
Direct dial telephone number: 01493 378226
E-mail: mark.barber@norfolk.gov.uk
Norfolk County Council

---

Mark,

We are in the process of organising a drainage survey of the highway drainage around Danesbower Lane discussed recently. The intention of the investigation is to determine the capacity of the sewer so the potential of a connection from our development can be explored. Liam Sellar from InSewer is proposing to be on site from the 10th to the 11th October.

I thought this might be of interest to you, whilst we would be happy to share the results with you, you may wish to attend during the survey.

I am on leave for a few weeks, however in my absence Nigel will be dealing with the Blofield scheme. Please feel free to speak to Liam directly if you are interested in attending.

Kind Regards,

Ben Brooks
Principal Engineer
ARDENT CONSULTING ENGINEERS

Fourth Floor, Diamond House, 36-38 Hatton Garden, London, EC1N 8EB
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Follow us on: twitter
Andrew,

Thanks for discussing the scheme with me a moment ago, as discussed I have set out the steps taken to demonstrate capacity within the Highways Drainage at Blofield below.

We recently received the results of the highway drainage survey carried out in Blofield, I have attached the sketch plan produced by the survey team.

Using the results of the survey, we have modelled the network in WinDes and simulated 1 in 1 and 1 in 30 year storm events (see calculations and drainage strategy drawing attached).

During the 1 in 1 year storm event, some of the drains around Hunters Close surcharge due to the pipes being undersized. A drain at the junction of Pound Road and Church Road also surcharges, this is due to the upstream invert of the pipe being lower than the downstream invert (manhole photos attached – see photo of HD10).

During a 1 in 30 year storm event, flooding is experienced at the northern end of Hunters Close, this is due to the drains in the area being undersized.

The greenfield run-off rate for the site at Lingwood Road was then calculated (see attached greenfield calculations). A dummy network was added to the existing network to represent the site, including a control to limit the discharge to the greenfield run-off rate. The 1 in 1 and 1 in 30 year storms were then re-simulated.

No additional flooding or surcharge was experienced within the network following the introduction of the development flows. Please note that a pump has been used to control the discharge, this represents the worst case rate of discharge from the site, in reality the discharge during a 1 in 1 or 1 in 30 year event would be considerable lower than this.

We agreed that Norfolk County Council cannot unreasonably refuse a new connection to their drains, providing it can be demonstrated that there is capacity in the drainage network. The attached survey, drawing and calculations demonstrate that there is capacity within the network, providing the development discharge is limited to greenfield run-off rates. If you could confirm that Norfolk County Council will not oppose a new connection to their drain at Fox Lane, we can complete the Flood Risk Assessment and Drainage Strategy for submission in support of the planning application.

If you have any discussions or wish to discuss, please do not hesitate to get in touch.

Kind Regards,

Ben Brooks
Principal Engineer

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Appendix E

Proposed Development Layout
Appendix G

Geotechnical Reports
17 October, 2012

Mr B Brooks
Fourth Floor
Ardent Consulting Engineers
Diamond House
36-38 Hatton Garden
London
EC1N 8EB

Dear Ben

Site at Blofield, Norfolk – Deep borehole soakage test

Further to our proposal dated 31 August 2012, we write to provide the findings of the deep borehole soakage test undertaken at the site in Blofield, Norfolk. The scope of works comprised the installation of a groundwater monitoring well and a soakage test well, and subsequent soakage testing. The findings of the works are presented below.

Methodology

The groundwater monitoring well (borehole BH1) was intended to be drilled to a maximum depth of 25m below ground level (bgl) and installed as a groundwater monitoring well in order to determine the groundwater level beneath the site and to confirm the presence and thickness of the sand layer within the underlying strata. The soakage test borehole (borehole BH2) was intended to be installed with the soakage test response zone at approximately 3m above the resting groundwater level, within the anticipated sand layer.

The boreholes were drilled on 10 and 11 October 2012 and logged and representatively sampled by a CGL engineer. The borehole logs are included in Appendix A with a location plan as Figure 1. Details regarding the actual borehole depths and installation of standpipes are presented below.

Selected soil samples were submitted for particle size distribution analysis; the results were not available at the time of writing, but will be provided under separate cover.

Permeability testing was undertaken in borehole BH2 on 12 October 2012. This comprised filling the borehole with clean water until the water level had settled at approximately the top of the slotted section of the standpipe (~7.0m bgl). Measurements of the water level were then taken at intervals until the water had drained below 75% of the effective depth. The test was repeated five times and the results are presented below.

Findings of the ground investigation

The ground conditions encountered during drilling generally corresponded with the findings from the previous CGL investigation undertaken in August 2012. Table 1 presents a summary of the ground conditions which have been encountered during both the current and previous phases of investigation.
Table 1: Summary of ground conditions

<table>
<thead>
<tr>
<th>Stratum</th>
<th>Depth to top of stratum (m bgf)</th>
<th>Typical thickness (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>[TOPSOIL]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soft to stiff light brown very silty slightly gravelly clay to clayey slightly gravelly silt. Gravel is rounded to subangular, fine to medium of flint, chalk and mudstone.</td>
<td>0.0</td>
<td>0.2-0.6</td>
</tr>
<tr>
<td>Soft to stiff light orange to orange brown very low to low strength slightly to very sandy CLAY with occasional gravel. Gravel is rounded to subangular, fine to coarse of flint, mudstone and chalk.</td>
<td>0.2-0.6</td>
<td>4.7-6.95</td>
</tr>
<tr>
<td>Very dense light yellow to dark yellow orange slightly gravelly SAND. Sand is coarse. Gravel is rounded to subangular, fine to coarse of flint.</td>
<td>5.1-7.95</td>
<td>19.1</td>
</tr>
<tr>
<td>[HAPPISBURGH GLACIGENIC FORMATION]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stiff to very stiff dark grey fissured silty CLAY.</td>
<td>19.1</td>
<td>Proven to 20.0m</td>
</tr>
</tbody>
</table>

Groundwater was encountered during drilling in borehole BH1 at a depth of 13.70m bgf and rose to 12.7m bgf after 30 minutes. In addition, stiff to very stiff dark grey fissured silty clay (interpreted to be the Crag Formation) was encountered at 19.1m bgf. Therefore, borehole BH1 was terminated at 20.0m bgf and installed with the response zone between 7.0m and 19.0m bgf.

On this basis, borehole BH2 was drilled to a depth of 10m bgf to allow the soakage test to be undertaken approximately 3m above the groundwater level. The sand layer within the Happisburgh Glacigenic Formation was encountered at between 6.9m and 10.0m bgf in borehole BH2 and therefore the soakage test response zone was installed from 7.0m to 10.0m bgf.

Findings of the soakage testing

During the soakage test visit, the groundwater level in borehole BH1 was measured at 12.5m bgf. Groundwater was also measured in the garden centre borehole at 18.17m bgf.

The results of the assessment of soakage testing undertaken in borehole BH2 are presented in Table 2, below and on Figure 2. The infiltration rates have been calculated in general accordance with BS 59301 and BRE 3652. The assessment has taken into account the volume of water within the standpipe and the estimated volume of water within the gravel filter pack around the standpipe within the borehole, assuming a porosity range for the gravel filter pack of between 25% or 35% porosity (based on established values for fine gravels3).

Table 2: BH2 soakage test results

<table>
<thead>
<tr>
<th>Estimated gravel filter pack porosity</th>
<th>Infiltration rate (m/s)</th>
<th>Test 1</th>
<th>Test 2</th>
<th>Test 3</th>
<th>Test 4</th>
<th>Test 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>25%</td>
<td></td>
<td>1.89x10⁻⁵</td>
<td>1.77x10⁻⁵</td>
<td>1.51x10⁻⁵</td>
<td>1.43x10⁻⁵</td>
<td>1.43x10⁻⁵</td>
</tr>
<tr>
<td>35%</td>
<td></td>
<td>2.28x10⁻⁵</td>
<td>1.42x10⁻⁵</td>
<td>1.82x10⁻⁵</td>
<td>1.76x10⁻⁵</td>
<td>1.72x10⁻⁵</td>
</tr>
</tbody>
</table>

3 Values modified from Domenico, P.A. and Schwartz, F.W. Physical and Chemical Hydrogeology, Wiley, (1990) as indicated in ConSim Version 2