Flood Risk Assessment

Site:
Wisteria Farm, Northgate, Pinchbeck, Spalding PE11 3TA

Applicant:
J.W.E Banks Ltd

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Introduction

Origin Design Studio Ltd have been appointed by J.W.E Banks Ltd to prepare a Flood Risk Assessment to accompany a planning application to South Holland District Council (SHDC) for a residential development.

The site is contained within all three flood zones, this is the basis upon which a Flood Risk Assessment is required. The approach to flood risk is set out in the National Planning Policy Framework (NPPF), refer to Appendix A with more local planning policy set out in the South East Lincolnshire Local Plan (SELLP), refer to Appendix B. This Flood Risk Assessment assesses the site in accordance with the policy requirements of the NPPF and the SELLP. The site is located in the district of Black Sluice Internal Drainage Board.

The Site

The site is located at Northgate, Pinchbeck, Spalding. The site is located at the end of a farm track access, approximately 50m north of Northgate. The site has a number of agricultural buildings on it. These include 3 barns, a red brick general purpose barn, a grain store and open side barn. To the south of the site is the historic farmhouse, Wisteria House. The site is surrounded by agricultural fields. To the west of the entrance track there is a foul sewer pumping station.



Figure 1 - Aerial Image of Site (www.google.com/maps)

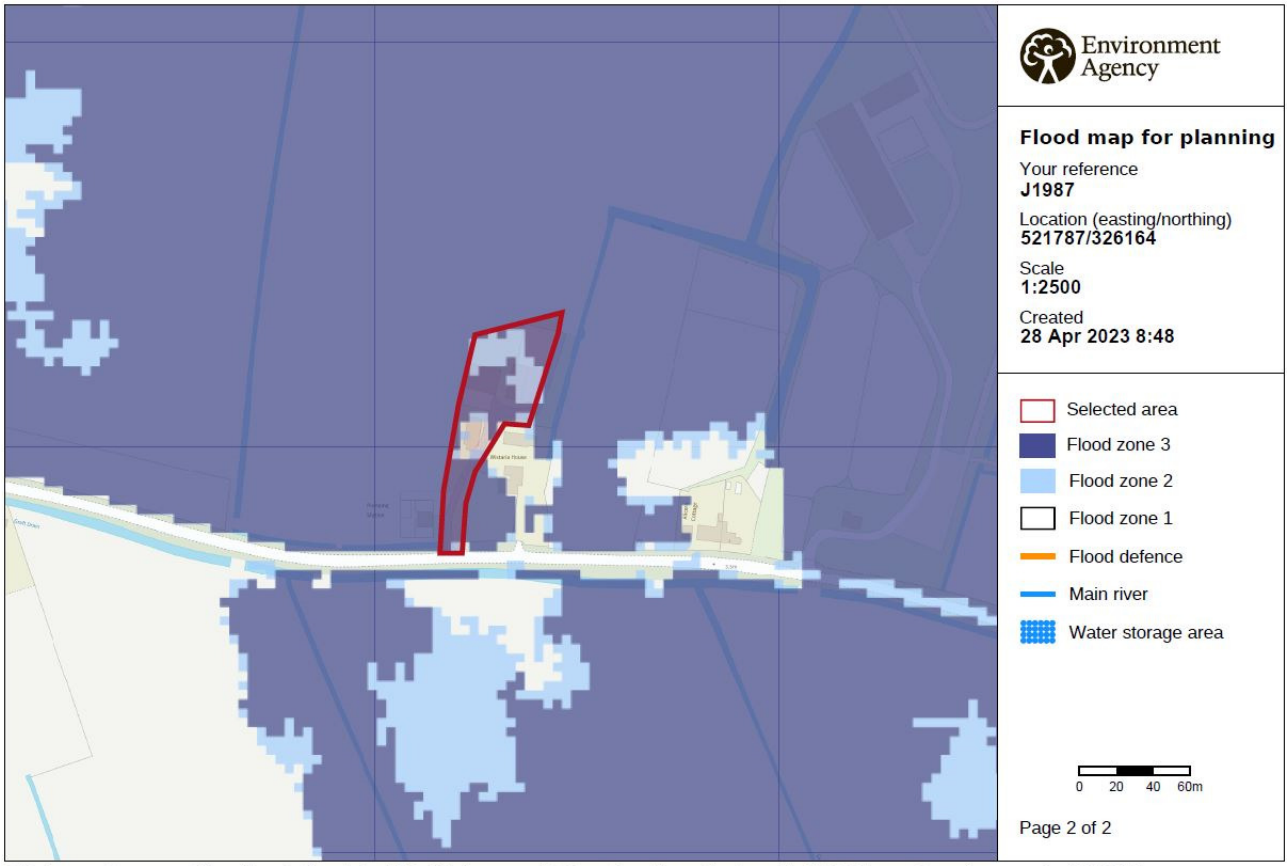
An application for the change of use of the existing agricultural buildings to form 3 dwellings was submitted to the local planning authority. This included the conversion of two of the existing three agricultural buildings. This was approved by SHDC November 2022, reference H14-0922-22.

Findings

Risk of Flooding from River and Seas

Flood Zone

The site is contained within a Flood Zone 1,2, & 3. Roughly 60% is contained in a Flood Zone 3, 30% in Flood Zone 2 and 10% in Flood Zone 1. Flood Zone 3 shows the area at risk of flooding for an undefended flood event with: a 1% or greater probability of flooding from rivers or 0.5% or greater probability of flooding from the sea.



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Figure 2 - Flood zone map (the site is marked with a red line).

Historic Flooding

The Environment Agency do not have any information about historical flooding near to the site, refer to Appendix E.

Sequential & Exception Test

The proposed development is residential and will result in 3No. two storey dwellings new build dwellings. Therefore, flood risk is considered on this basis.

Developments need a sequential test when the development is in flood zone 2 or 3 and a sequential test hasn't already been done for a development of the type planned on the proposed site.

The purpose of the sequential test is to direct development to land of lower flood risk. The sequential test compares the proposed development site with other available sites to find out which has the lowest flood risk.

The residential use is classified as “more vulnerable” in accordance with Table 2 – Flood Risk Vulnerability Classification.

Flood Zones	Flood Risk Vulnerability Classification				
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a †	Exception Test required †	✗	Exception Test required	✓	✓
Zone 3b *	Exception Test required *	✗	✗	✗	✓*

Key:

✓ Development is appropriate

✗ Development should not be permitted.

Figure 3 - Table 3 – Flood Risk Vulnerability and Flood Zone Compatibility (www.gov.uk)

In accordance with Table 3 where a site is located in a Flood Zone 3 with a vulnerability classification of “more vulnerable” development is considered to be compatible providing the exception test is satisfied. Therefore, the development will need to pass both a sequential test and exception test.

In this case the scheme should be viewed in light of an established fallback position under Class Q of the GPDO. The prior approval application for the permitted development right allowed for the conversion of two of the existing agricultural buildings to form 3 single storey dwellings, each with a ground floor level of +3.65mAOD.

Here the new build scheme is for 3No two storey dwellings and takes a sequential approach within the site. This involves siting the development where possible on land with lower flood risk within the

confines of the site. Differences in the approved scheme and the proposed scheme show that for the proposed scheme there is a decrease in ground floor accommodation and an increase in first floor accommodation and a reduction in the amount of development contained in flood zones 3. All of these aspects are considered to provide flooding betterment. On this basis it is considered that the sequential test is passed and the exception test is passed.

Site Levels

A topographical survey shows that levels on the road are +3.668mAOD. On the site the levels vary from around +3.50mAOD on parts of the track to +2.70mAOD at its lowest on land to the north of the existing agricultural buildings.

Calculating the Flood Level

Where possible all habitable floors should be above the flood level. Where the accommodation is proposed to be two storeys the 1 in 100/200-year flood level plus climate change will be used to ensure habitable floors are above the flood level. In the case where a single storey building is proposed habitable floors should be above the 1 in 1000-year flood level plus climate change. In both cases a safe point of refuge can be established and therefore provide protection to the inhabitants of the building.

In this case it is proposed to create a 3No. two-storey dwellings and therefore the 1 in 100/200 flood level plus climate change is to be used. To determine the flood level the fluvial and tidal sources will be looked at to determine the worst case and an appropriate floor level.

Tidal Flood Sources

The site is not at risk from tidal sources of flooding.

Fluvial Flood Sources

The site is at risk of fluvial flooding from main rivers. The main risk to the site is the River Glen located some 500m to the south of the site.

The site is protected by fluvial flood defences and these consist of earth embankments. They are in a fair condition and provide protection against flood event with a 1% chance occurring in any year. Some protection to the site is also provided by the raised road of North Gate.

Given the site is protected by adequate defences, namely the embankment of the river the site is at risk from a residual risk of breaching of these defences. For the purposes of the breach analysis for the River Glen it is assumed that North Gate does not offer protection to the site, where in reality it would do.

Data from the Environment Agency includes in channel data for the River Glen, refer to Appendix D. It does not contain Hazard mapping for modelled breaches or overtopping which may affect the site.

A simplistic breach model using the in-channel levels of the River Glen offer a basic way to establish a 1:100-year flood level including climate change for the site. The nearest levels for the River Glen are from node GLEN 8668, the corresponding flows are from node GLEN 8569. A topographical survey profiling the watercourse has not been undertaken of the River Glen however information available on OS maps suggest the embankment levels are around 5m. The simplistic model only considers an oncoming wave depth and assumes the land downstream of the breach to be taken down to 2.2m, which is the lowest level onsite in the basin of the roadside drain. The breach of the River Glen is discussed in this section.

Global warming is now recognised that it is likely to affect the frequency and severity of extreme events such as both tidal and fluvial flooding. The climate change allowances in the NPPF Guidance were updated on the 19th February 2016 and again on 17th December 2019. The site lies within the Welland Catchment and allowances for climate change should be made on the following basis. For a worst-case scenario, the site shall be considered to be in a Flood Zone 3a and the use classification is ‘more vulnerable’ therefore Peak River flows use the higher central and upper end to assess a range of allowances.

The adjustments for peak flows can be seen in the table below. For simplicity, for design a 26% increase to peak flow will be used to determine the 1 in 100-year flood level plus climate change and the design will be tested for sensitivity using a 53% increase to peak flows for the 1 in 100-year event.

River basin district	**Allowance category**	**Total potential change anticipated for the ‘2020s’ (2015 to 2039)**	**Total potential change anticipated for the ‘2050s’ (2040 to 2069)**	**Total potential change anticipated for the ‘2080s’ (2070 to 2115)**
Welland	Upper	22%	26%	53%

River basin district	Allowance category	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
	Higher	10%	10%	28%
	Central	5%	4%	17%

Figure 4 - Table 1 peak river flow allowances by river basin district (use 1961 to 1990 baseline)

A flow discharge curve can be established using the increase in flow to calculate and establish in-channel levels of the River Glen for the additional climate change scenarios.

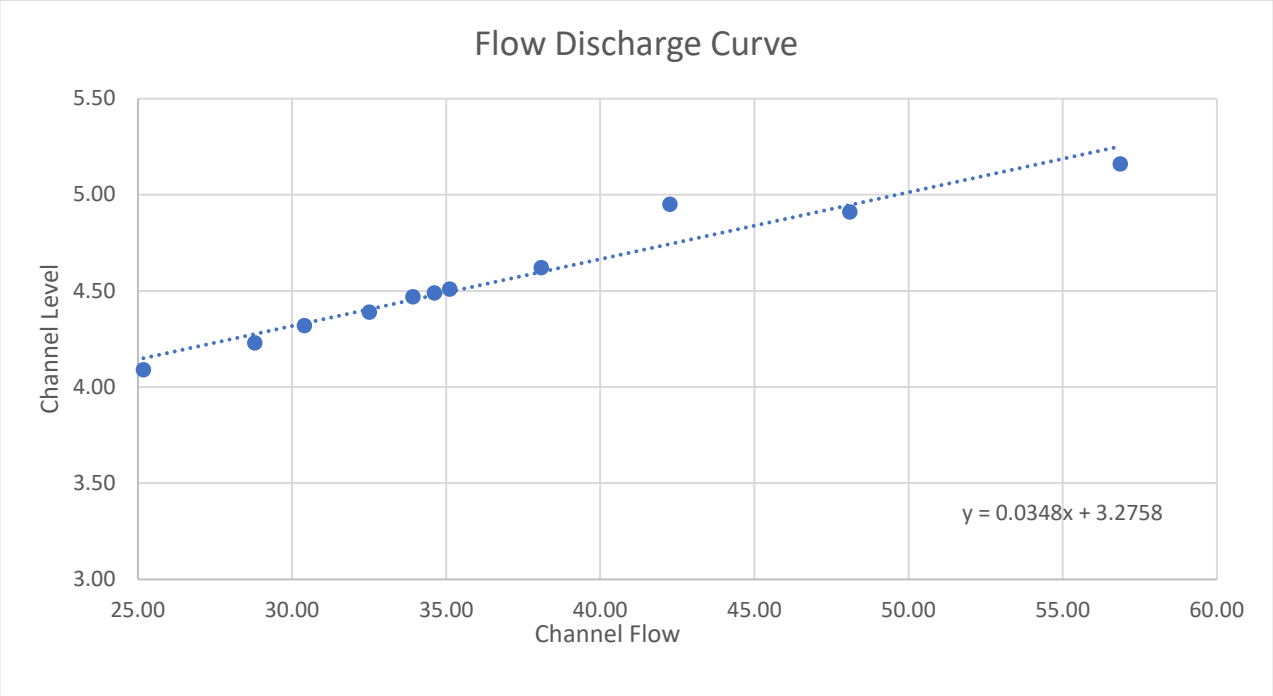


Figure 5 - Flow discharge curve for River Glen node 8668

Event & Climate Change (%)	Flow (m^3)	Level (m)
1% +26%CC	44.40	4.82
1% +53%CC	54.05	5.16

Figure 6 - Calculated Levels for Climate Change for Glen node 8668

Unusually the approach for establishing a growth curve/line results in reduced levels. For simplicity the worst-case level will be used in a breach analysis. This is from the 1 in 100-year level plus 20% climate change where the level is +4.95m in-channel. The distance from the flood source to the nearest dwelling within the Flood Zone will be used to establish the flood level for the site. A breach analysis using data from this node is contained in Appendix C and the on plain 1:100-year level including adjustment for climate change for the site is +0.361m above existing ground level. The resulting onsite level will be used for design and tested against the 1:100-year +53% climate change.

Using this in-channel level results in a flood level for the site to be +0.385m above existing ground level.

Risk of Flooding from Surface Water

The risk of flooding from surface water is very low on the site. The following map shows the Environment Agency's Risk of Flooding from Surface Water map:

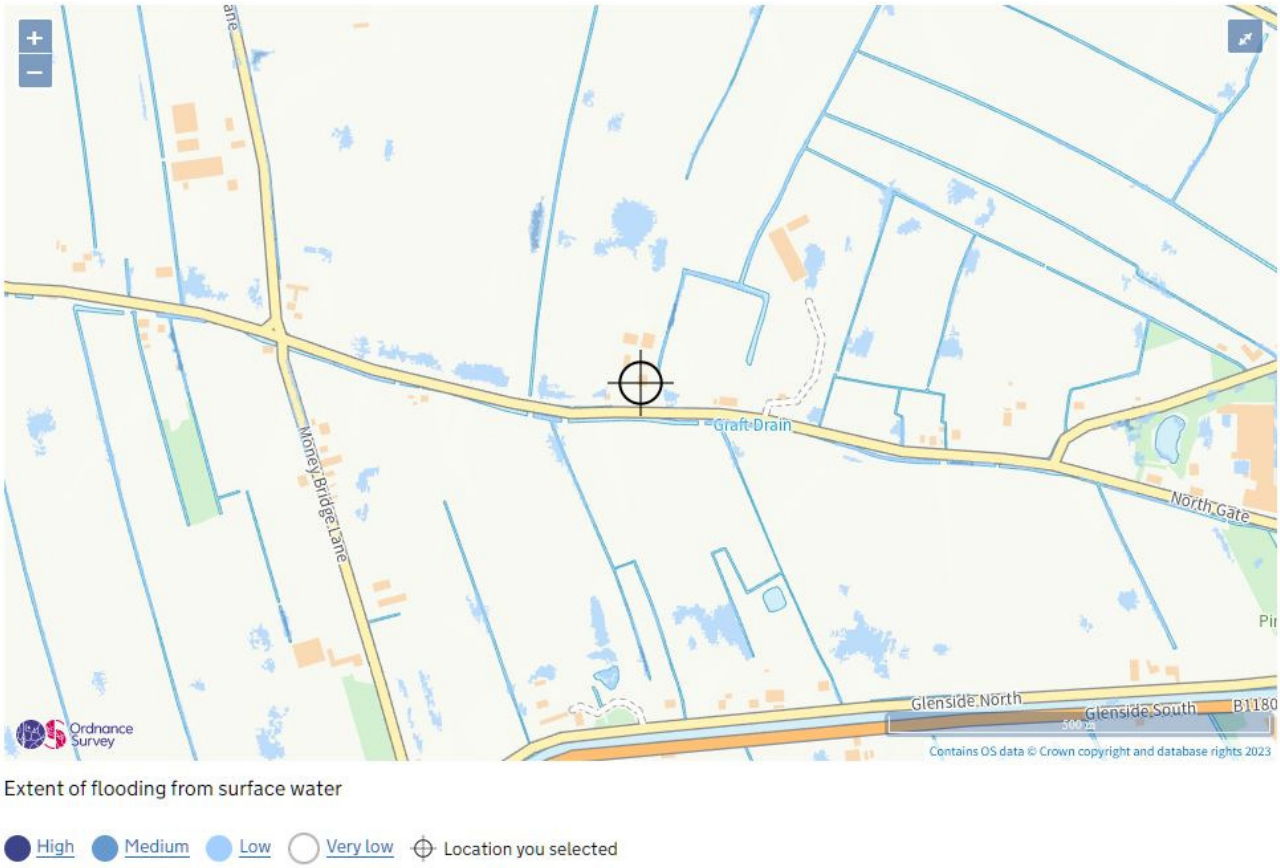


Figure 7 - Surface Water Flood Map (www.gov.uk)

The site does not suffer from surface water flooding. No further action is required.

Risk of Flooding from Reservoirs

There is no risk of flooding from reservoirs when river levels are normal or when there is flooding from rivers. The following map shows this on the Environment Agency's Risk of Flooding from Reservoirs map*:*

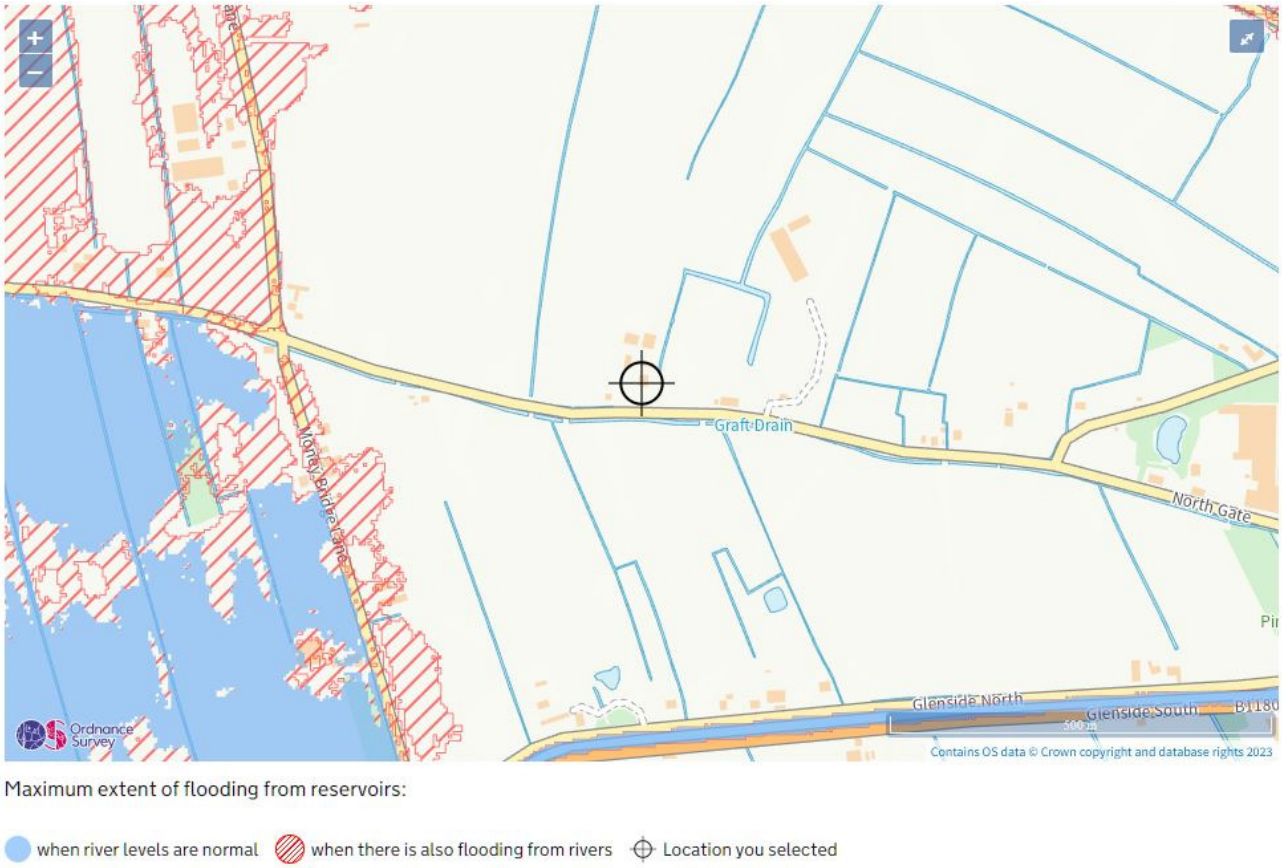


Figure 8 - Reservoir Flood Map (www.gov.uk)

No further action is required.

Risk of Flooding from Sewers

There are no known public surface water and foul water sewers that currently exist on the site that are known to suffer from sewer surcharging. All new infrastructures to service the dwellings shall be appropriately designed to the relevant standards to ensure failures do not present a problem.

Safe Access & Egress

The proposed ground floor level will be above the predicted worse case flood level and provide a safe refuge. The access track to North Gate may be passable allowing for safe passage along North Gate.

Setting the floor level

Standing advice requires finished floor levels (FFL) should be a minimum of whichever is higher of 300mm above the:

- Average ground level of the site
- Adjacent road level to the building
- Estimated river or sea flood level

In this case the calculated 1 in 100-year flood level plus climate change is +0.361m above ground level. The average ground level on site is taken to be 3.2m. This results in an onsite flood level of +3.561mAOD. A previous flood risk assessment for application reference H14-0922-22 established the proposed ground floor at +3.65mAOD. This is above the 1:100-year flood level plus 53% climate change level (+3.585mAOD) and is therefore considered to provide adequate protection for life and property. Tested against the predicted upper climate change it is considered that the above measures are suitable for providing sufficient freeboard, rather than using the standard advice above.

Conclusion

The proposed development is for 3No. two-storey dwellings. The site is contained within all 3 Flood Zones. A sequential approach onsite has been taken to limit development in Flood Zones 2 & 3.

The site is not at risk of tidal flooding but is at risk from fluvial flooding. The site is protected by adequate fluvial flood defences which are maintained by the Environment Agency. A residual risk to breaching of these defences exist.

The residential use falls within "more vulnerable" uses of land in Table 2 Flood Risk Vulnerability Classification and Table 3 shows that developments of this nature are appropriate in flood zone 3 subject to passing the Sequential Test and Exception Test.

In this case the proposed scheme should be viewed in the light of a fallback. It is considered the scheme provides a level of flooding betterment not available in the ‘Change of Use’ scheme. Therefore, it is considered this scheme passes the Sequential Test and Exception Test.

The predicted flood depth for the design event (1 in 100-year plus climate change) for the site is +0.361m. Based on average ground levels it is considered that the floor levels be set at no less than +3.65mAOD. Flood resilient construction to a height 300mm above the predicted flood depth shall also be installed.

At the detailed design stage of the development advice contained in “Improving the Flood Performance of New Buildings - Flood Resilient Construction” should be followed.

Further to this the property will register to Floodline to receive advance warning of potential flooding.

New foul and surface water drains will be designed to the relevant standards.

Appendices

Appendix A – National Planning Policy Framework

PLANNING AND FLOOD RISK

159. Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere.

160. Strategic policies should be informed by a strategic flood risk assessment, and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards.

161. All plans should apply a sequential, risk-based approach to the location of development – taking into account all sources of flood risk and the current and future impacts of climate change – so as to avoid, where possible, flood risk to people and property. They should do this, and manage any residual risk, by:

    a) applying the sequential test and then, if necessary, the exception test as set out below;
    b) safeguarding land from development that is required, or likely to be required, for current or future flood management;
    c) using opportunities provided by new development to reduce the causes and impacts of flooding (where appropriate through the use of natural flood management techniques); and
    d) where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking opportunities to relocate development, including housing, to more sustainable locations.

162. The aim of the sequential test is to steer new development to areas with the lowest risk of flooding. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower risk of flooding. The strategic flood risk assessment will provide the basis for applying this test. The sequential approach should be used in areas known to be at risk now or in the future from any form of flooding.

163. If it is not possible for development to be located in zones with a lower risk of flooding (taking into account wider sustainable development objectives), the exception test may have to be applied. The need for the exception test will depend on the potential vulnerability of the site and of the development proposed, in line with the Flood Risk Vulnerability Classification set out in Annex 3.

164. The application of the exception test should be informed by a strategic or site-specific flood risk assessment, depending on whether it is being applied during plan production or at the application stage. For the exception test to be passed it should be demonstrated that:

    a) the development would provide wider sustainability benefits to the community that outweigh the flood risk; and
    b) 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.

165. Both elements of the exception test should be satisfied for development to be allocated or permitted.

166. There planning applications come forward on sites allocated in the development plan through the sequential test, applicants need not apply the sequential test again. However, the exception test may need to be reapplied if relevant aspects of the proposal had not been considered when the test was applied at the plan-making stage, or if more recent information about existing or potential flood risk should be taken into account.

167. When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment[55]. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:

    a) within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;
    b) the development is appropriately flood resistant and resilient;
    c) it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;
    d) any residual risk can be safely managed; and
    e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan.

168. Applications for some minor development and changes of use[56] should not be subject to the sequential or exception tests but should still meet the requirements for site-specific flood risk assessments set out in footnote 55.

169. Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:

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[55] A site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.

[56] This includes householder development, small non-residential extensions (with a footprint of less than 250m2) and changes of use; except for changes of use to a caravan, camping or chalet site, or to a mobile home or park home site, where the sequential and exception tests should be applied as appropriate.

a) take account of advice from the lead local flood authority;
b) have appropriate proposed minimum operational standards;
c) have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and
d) where possible, provide multifunctional benefits.

Appendix B – South East Lincolnshire Local Plan

POLICY 4: APPROACH TO FLOOD RISK

Development proposed within an area at risk of flooding (Flood Zones 2 and 3 of the Environment Agency's flood map or at risk during a breach or overtopping scenario as shown on the flood hazard and depths maps in the Strategic Flood Risk Assessment) will be permitted, where:

1. It can be demonstrated that there are no other sites available at a lower risk of flooding (i.e. that the sequential test is passed). The sequential test will be based on a Borough or District wide search area of alternative sites within the defined settlement boundaries, unless local circumstances relating to the catchment area for the development justify a reduced search area, i.e. there is a specific need for the development in that location. The sequential test is not required for sites allocated in the Local Plan, minor development1or change of use (except for a change of use to a caravan, camping or chalet site, or to a mobile home or park home site).
2. It can be demonstrated that essential infrastructure in FZ3a & FZ3b, highly vulnerable development in FZ2 and more vulnerable development in FZ3 provide wider sustainability benefits to the community that outweigh flood risk.
3. The application is supported with a site-specific flood risk assessment, covering risk from all sources of flooding including the impacts of climate change and which:
    a) demonstrate that the vulnerability of the proposed use is compatible with the flood zone;
    b) identify the relevant predicted flood risk (breach/overtopping) level, and mitigation measures that demonstrate how the development will be made safe and that occupants will be protected from flooding from any source;
    c) propose appropriate flood resistance and resilience measures (following the guidance outlined in the Strategic Flood Risk Assessment), maximising the use of passive resistance measures (measures that do not require human intervention to be deployed), to ensure the development maintains an appropriate level of safety for its lifetime;
    d) include appropriate flood warning and evacuation procedures where necessary (referring to the County's evacuation routes plan), which have been undertaken in consultation with the authority's emergency planning staff;
    e) incorporates the use of Sustainable Drainage Systems (SuDS) (unless it is demonstrated that this is not technically feasible) and confirms how these will be maintained/managed for the lifetime of development (surface water connections to the public sewerage network will only be permitted in exceptional circumstances where it is demonstrated that there are no feasible alternatives);
    f) demonstrates that the proposal will not increase risk elsewhere and that opportunities through layout, form of development and green infrastructure have been considered as a way of providing flood betterment and reducing flood risk overall;
    g) demonstrates that adequate foul water treatment and disposal already exists or can be provided in time to serve the development;
    h) ensures suitable access is safeguarded for the maintenance of water resources, drainage and flood risk management infrastructure.

Development in all flood zones, and development over 1 hectare in size in Flood Zone 1, will need to demonstrate that surface water from the development can be managed and will not increase the risk of flooding to third parties.

Change of use of existing buildings will be supported providing they do not pose an increase in risk to people. Change of use that would result in self-contained ground floor residential accommodation in areas of hazard rating 'danger for some', 'danger for most' and 'danger for all' will not be supported. In these areas unrestricted access to a habitable room above the flood level and an emergency evacuation plan will be required.

Caravans, mobile homes and park homes intended for permanent residential use will not be permitted in areas at risk of flooding. Caravan, chalet, log cabin, camping and touring sites at risk of fluvial flooding where there is a 'danger for most' and 'danger for all' will not be permitted. Occupancy of caravan, chalet, log cabin, camping and touring sites at risk of tidal flooding will not be permitted to open between 1st November in any one year and the 14th March in the succeeding year.

No development will be permitted within a 50m buffer from the toe of the raised Witham Haven Banks (flood defences), as shown on the indicative Plan contained in Appendix 10, to allow access for construction and maintenance.

Flood risk management infrastructure shall be provided at the strategic level, where development opportunities allow, to reduce the hazard and probability of flooding.

Appendix C – Breach Analysis

River Glen - 1:100-year event + 20% Climate Change (worse than 26%)

Defence Crest Levels (h1)	5	m
Average Ground Level behind defences (h2)	2	m
1 in 100 year flood level plus climate change (h3)	4.7	m
Assumed length of breach (B)	40	m
Max head over breach (h)	2.7	m
Peak flow (Q) = $1.7xBxh^{3/2}$	301.7	m^3s^{-1}

Peak flow (Q)	301.7	m^3s^{-1}
Assuming Energy Grad (S)	0.001	-
Assume % obstructions to flow	0	-
Assuming mannings (n)	0.03	-

	Scenario					
	1	2	3	4	5	6
Distance from breach	0	250	500	625	750	1000
Perimeter of Flood Wave (Assumed Channel Width)	40	825.5	1611	2003.75	2396.5	3182
Effective perimeter (P)	40	825.5	1611	2003.75	2396.5	3182
Normal Depth y = $((Qn/(b \times S^{0.50}))^{0.6}$	3.257	0.530	0.355	0.311	0.279	0.236

Time to Reach Development

Distance from breach above plus 1.0m	1	251	501	626	751	1001
Perimeter of Flood Wave (Assumed Channel Width)	43.1	828.6	1614.1	2006.9	2399.6	3185.1
Normal Depth y = $(Qn/(bxS^{0.5}))^{0.6}$	3.112	0.528	0.354	0.311	0.279	0.236
Volume in Additional 1.0m	134.3	437.9	571.7	623.8	670.0	750.3
Speed to cover additional 1.0m (m/s)	2.25	0.69	0.53	0.48	0.45	0.40
Average time to reach radius (secs)	-	327.9	854.5	1164.9	1501.0	2240.7
Average time to reach radius (mins)	-	5.5	14.2	19.4	25.0	37.3

Glen River - 1:100-year event + 53% Climate Change

Defense Crest Levels (h1)	5.16	m
Average Ground Level behind defenses (h2)	2.2	m
1 in 100 year flood level plus climate change (h3)	5.16	m
Assumed length of breach (B)	40	m
Max head over breach (h)	2.96	m
Peak flow (Q) = $1.7xBxh^{3/2}$	346.3	m^3s^{-1}

Peak flow (Q)	346.3	m^3s^{-1}
Assuming Energy Grad (S)	0.001	-
Assume % obstructions to flow	0	-
Assuming mannings (n)	0.03	-

	Scenario					
	1	2	3	4	5	6
Distance from breach	0	100	200	250	500	600
Perimeter of Flood Wave (Assumed Channel Width)	40	354.2	668.4	825.5	1611.0	1925.2
Effective perimeter (P)	40	354.2	668.4	825.5	1611.0	1925.2
Normal Depth y = $((Qn/(b \times S^{0.50}))^{0.6}$	3.538	0.956	0.653	0.575	0.385	0.346

Time to Reach Development

Distance from breach above plus 1.0m	1	101	201	251	501	601
Perimeter of Flood Wave (Assumed Channel Width)	43.1	357.3	671.5	828.6	1614.1	1928.3
Normal Depth y = $(Qn/(bxS^{0.5}))^{0.6}$	3.381	0.951	0.651	0.574	0.385	0.346
Volume in Additional 1.0m	145.8	339.8	437.3	475.6	621.0	666.8
Speed to cover additional 1.0m (m/s)	2.37	1.02	0.79	0.73	0.56	0.52
Average time to reach radius (secs)	-	89.2	228.4	310.3	808.6	1041.6
Average time to reach radius (mins)	-	1.5	3.8	5.2	13.5	17.4

Appendix D – Topographical Survey

Appendix E – Environment Agency Flood Data