FLOOD RISK ASSESSMENT

PROPOSED ANAEROBIC DIGESTION PLANT
BARR FARM
MAIN ROAD
DEEPING ST. NICHOLAS
SPALDING
PE11 3BN

FLOOD RISK ASSESSMENT FOR PROPOSED AD PLANT
BARR FARM, DEEPING St. NICHOLAS, SPALDING. PE11 3BN

INTRODUCTION

The Government has placed increasing priority on the need to take full account of the risks associated with flooding at all stages of the planning and development process. This seeks to reduce the future damage to property and the risk to life from incidents of flooding. Their expectations relating to flooding are contained in the National Planning Policy Framework March 2012, (NPPF), which identifies how the issue of flooding is dealt with in the drafting of planning policy and the consideration of planning applications by avoiding inappropriate development in areas at risk from flooding and to direct development away from areas at highest risk.

Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere. Local plans should apply a sequential, risk-based approach to the location of development to avoid where possible flood risk to people and property and manage any residual risk, taking account of the impacts of climate change.

The Environment Agency's flood maps show areas that are at risk, from fluvial and tidal flooding. These maps show the limits of the flood plain of the area which could be affected by flood events, over topping or breaching of flood defences. They are based on the approximate extent of floods with a 1% annual probability of exceedance (1 in 100 year flood) for rivers and 0.5% annual probability of exceedance (1 in 200 years flood) for coastal areas under present expectations or the highest known flood. However they do not take into account of the presence of defences or the likelihood that flood return intervals will be reduced by climate change.

This Flood Risk Assessment has been prepared in support of the planning application and considers the risk of flooding from fluvial and tidal sources in accordance with National Planning Policy Framework (NPPF). It also considers the risks of localised flooding due to inadequate foul and surface water sewers, failure of reservoirs, water main pipe bursts, sewer blockages, pump failures or high ground water table etc.

APPLICATION SITE

The site is located at Barr Farm, Main Road, Deeping St. Nicholas, Spalding, PE11 3BN, within the South Holland District Council's administrative area. **Plan 1**

The Site would be classed as Non Major Development applying the Town & Country Planning (Consultation) (England) Direction 2009 as the site is to be developed is less than one hectare.

The National Grid Reference is TF 22378 17683.

This flood risk assessment has been prepared for a planning application covering an area of 3976m^2 comprising feedstock clamps, and the AD Plant. **Plan 2**

The National Planning Policy Framework Technical Guidance (NPPF TG) defines three levels of flood risk depending upon the annual probability of fluvial flooding occurring.

Zone 1 – Low Probability (<0.1%)

Zone 2 – Medium Probability (0.1 – 1.0%

Zone 3 – High Probability (>1.0%)

The proposed development site is shown to be within Flood Zone 3a 'High Probability' as detailed on the Environment Agency's Flood Zone Maps without defences, and as defined in Table 1 of NPPF TG.**Map1**

Table 1: Flood Zones Definition

Zone 3a - high probability
Definition This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.
Appropriate uses The water-compatible and less vulnerable uses of land (table 2) are appropriate in this zone. The highly vulnerable uses should not be permitted in this zone. The more vulnerable uses and essential infrastructure should only be permitted in this zone if the Exception Test is passed. Essential infrastructure permitted in this zone should be designed and constructed to remain operational and safe for users in times of flood.
Flood risk assessment requirements All development proposals in this zone should be accompanied by a flood risk assessment.
Policy aims In this zone, developers and local authorities should seek opportunities to: • reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage systems;

Applying the Flood Risk Vulnerability Classification in Table 2 of (NPPF TG), the proposed industrial use for the site is classified as "Less Vulnerable," Table 3 of NPPF TG states that such uses are permitted in Flood Zone 3a.

Table 2: Flood Risk Vulnerability Classification

Less vulnerable

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

From the topographic survey the road level on Main Road at the site entrance is at 2.80mODN with the proposed area for the proposal at a level averaging 2.10mODN. **Plan 3**

DRAINAGE AUTHORITIES

Environment Agency

The Environment Agency is responsible for reducing the risk of flooding from designated main rivers and from the sea.

The following potential sources of flooding affecting the development site have been identified as:

- From the River Welland
- Welland & Deepings Internal Drainage Board system

The Flood Zone Maps identify river catchments over 3 sq. km. These maps are a theoretical estimate of areas that could be inundated should no defence exist. In practice current standards of protection would result in flood envelopes substantially less than shown by these maps. The maps make no allowance for local, site specific features.

The flood zone maps show that the site of the proposed development is considered at risk from flooding. These maps indicate that the area would be flooded without flood defences, which are in place, (with an annual probability of more than 1% or a 1 in 200 or greater annual probability of flooding from the sea) (**Map 1).**

RIVER WELLAND

The Left bank of the River Welland is formed by an earth bank which is provided with a soak dyke on the landward toe. The right bank to the river is at a slightly lower level and of less proportions and this forms the embankment to the Cowbit Washlands which allows water to overtop to control the levels in the river from overtopping the left bank

which consequently controls the river levels downstream during a high flow event. Further upstream there is a similar controlling flood storage washlands at Crowland. The standard of protection provided by these defences is for the 1 in 100 year flood event.

The following is an abstract from Table 6R & 7R SHSFRA

	Chainage (km)	Peak 1 in 100 year fluvial Flood level (mODN)		Peak I in 1000year fluvial Flood Level (mODN)		Left Bank Defence Crest Level (mODN)
		2007	2115	2007	2115	
Little London Bridge	0.0	4.42	4.67	4.43	4.68	5.22
A!6 Road Bridge	2.4	4.50	4.67	4.51	4.67	5.98
Welland Farm	5.0	4.57	4.69	4.59	4.69	6.08

Taking the precautionary approach the Hazard Rating following a breach which in Flood Risk Assessment (FD 2320) Guidance for New Development Phase 2 R& D Technical Report these are classified as low <0.75, moderate 0.75 - 1.25, significant 1.25 - 2.50 and extreme >2.50 based upon an empirical measure of velocity and depth.

Flood Hazard value	Degree of flood hazard	Description	Indicative depth range
< 0.75	Low	Caution 'Flood zone with shallow flowing water or deep standing water'	Up to 0.25 m
0.75 – 1.25	Moderate	Danger for some (i.e. children) 'Danger: flood zone with deep or fast flowing water'	Up to 0.5 m
1.25 – 2.0	Severe	Danger for most 'Danger: flood zone with deep fast flowing water'	0.5 m to 3 m
> 2.0	Extreme	Danger for all 'Extreme danger: flood zone with deep fast flowing water'	0.5 m to over 3 m

HR = d x (v + 0.5) +DF

Where V = Flood flow velocity (m/sec)

D = Flood depth (m)

DF = A debris factor included to represent the greater damage, or risk of injury to people, that can occur if debris is swept along with the water. = 0.5 for depths <0.25 or 1.0 for depths

For the degree of Flood Hazard to be classified as low HR has to be <0.75

The updated South Holland SFRA carried out Mapping following a breach to the flood defences. With climate change up to year 2115 the maps show that the site is not within a Hazard Rating area, therefore the site is not subject to flooding following a breach to the flood defences.

Welland & Deepings Internal Drainage Board

The proposed development site is located within Catchment area of Welland & Deepings Internal Drainage Board. The Board is responsible to operate and maintain the arterial fluvial system.

The Board's Drain which serves the site is:-

South Drove Drain

This watercourse is one of the Boards main drains which flows north-westwards to Pode Hole pumping station which discharges into Vernatts Drain which flows by gravity to Surfleet Seas End where it discharges through pointing doors into the tidal River Welland. The design flood level in South Drove Drain at Pode Hole pumping Station is 1.20mODN.

South Holland District Council

In order to inform the process of risk assessment and site selection the District Council commissioned Haskoning UK Ltd Consultants to prepare a Strategic Flood Risk Assessment in December 2002.They have carried out an update of this report and this report was published in January 2010

This Flood Risk Assessment has taken the results of the updated South Holland Strategic Flood Risk Assessment (SHSFRA) into account in its findings.

It was found that the actual risk from primary sources of flooding (taken as being rivers and the sea) was assessed as being the product of:

- Medium probability (assigned because the standards of the primary defences are variable) and

- Low consequence (assigned because of the District's generally rural nature and because any urban flooding is likely to be shallow with minimal impact).

The findings reflect the considerable protection afforded to the area by coastal and tidal & fluvial flood defences and by the extensive well organised system of lowland IDB fluvial drainage.

The computer modelling used in the SFRA to produce the Hazard, depth and velocity maps simulated the spread of flood waters over the land and allowed for the presence of locally raised features such as road embankments etc. The maps produced by the Environment Agency took a more precautionary approach.

The potential flooding consequences shown on this map relate to flooding from the sea, main rivers and Internal Drainage Board systems taking into account the presence of current flood risk management measures such as flood defences.

The consequences designated as being an Actual Risk arise from direct overtopping of defences, where this would occur, together with assumed breach failure of some defences. Breach failure has been assumed to occur in places where the freeboard between Peak Sea or river water level and the defence crest level is less than the minimum desirable for structural security of the defence.

From the Actual Risk Extent District - Year 2115 1% Fluvial / 0.5% Tidal Event Probability, the Actual Peak Depth District - Year 2115 1% Fluvial / 0.5% Tidal Event Probability and Actual Flood Hazard District - Year 2115 1% Fluvial / 0.5% Tidal Event Probability maps from the update of strategic flood risk assessment for South Holland District Council, the site is not affected from any breach to the flood defences. **Map 4**, **Map 5 & Map 6**.

SEQUENTIAL APPROACH

When considering the sequential approach for flood risk from fluvial flooding in accordance with NPPF the site would fall into Zone 3a (High Probability) as defined in Table 1: Flood Zones, and illustrated on the Environment Agency's Flood Maps, if defences were not present.

The flood zones as detailed on the flood map show the area of land which theoretically would be inundated by floodwater during a flooding event from either tidal or fluvial sources without flood defences.

The Environment Agency categorise land into one of three Flood Zones.

- Flood Zone 1 is land outside the 0.1% floodplain (with a chance of flooding of less than 0.1 % chance in any given year);
- Flood Zone 2 is land that falls between the 1 in 100 year extent and the 1 in 1000 year extent (a chance of flooding between 1% and 0.1% in any given year);
- Flood Zone 3a is land which falls within the 1 in 100 year flood extent (has a 1 %chance of a flood occurring in any given year).

The Sequential Test is defined in NPPF with the principal aim of steering new development to areas of the lowest probability of flooding (Flood Zone 1). Where there are no reasonably available sites in Flood Zone 1 then decision makers should first consider Zone 2and then Zone 3a taking into account the flood risk vulnerability of land uses as categorised in Table 2 of NPPF.

The proposed commercial use development for the site falls within "Less Vulnerable" uses of land in Table 3 Flood Risk Vulnerability Classification and Table 1 shows that developments of this nature are appropriate in this zone. All development is permitted in Zone 1. Development in Zones 2 and 3 is restricted based on Table 3 of NPPF replicated below

TABLE 3: Flood risk vulnerability and flood zones 'compatibility'

Flood risk vulnerability classification (see table 2)		Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
Flood zone (see table 1)	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓	✓
	Zone 3a	Exception Test required	✓	×	Exception Test required	✓
	Zone 3b functional floodplain	Exception Test required	✓	×	×	×

The proposed site is shown on the flood maps to be within Flood Zone 3a and less vulnerable uses are permitted.

CLIMATE CHANGE

Global warming is now recognised that it is likely to affect the frequency and severity of extreme events as both tidal and fluvial flooding.

The annual sea rise due to climate change is given in the NPPF and the recommended contingency allowances are stated in Table 4.

TABLE 4: Recommended contingency allowances for net sea level rises

	Net sea level rise (mm per year) relative to 1990			
	1990 to 2025	**2025 to 2055**	**2055 to 2085**	**2085 to 2115**
East of England, east midlands, London, south-east England (south of Flamborough Head)	4.0	8.5	12.0	15.0
South-west England	3.5	8.0	11.5	14.5
North-west England, north-east England (north of Flamborough Head)	2.5	7.0	10.0	13.0

The effect of global warming on fluvial flood peaks is given in Table 5. It is expected that the overall effect up to 2025 will result in an increase of rainfall of 5%, 2025-2055 10%, 2055-2085 20% and2085-2115 of 30% with Peak River flows increasing by 20%.

Table 5: Recommended National Precautionary Sensitivity Ranges for Peak Rainfall Intensities. Peak River Flows, Offshore Wind Speeds and Wave Heights.

Parameter	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak rainfall intensity	*+5%*	*+10%*	*+20%*	*+30%*
Peak river flow	*+10%*	*+20%*		
Offshore wind speed	*+5%*		*+10%*	
Extreme wave height	*+5%*		*+10%*	

INFRASTRUCTURE

Surface Water Drainage

The rainwater falling onto the proposed impermeable feedstock clamps and the plant area will all be collected for re-use within the anaerobic digesters. In addition it is proposed to construct a lagoon within which the rainwater and small amount of leachate from the clamp will be stored. There will be no direct discharge from the site.

Foul Water

There is no requirement to provide foul water facilities as part of the proposal.

CONCLUSIONS

- The site does have the benefit of protection from tidal/fluvial flooding by existing defences which are properly maintained to a 1 in 200 /100year standard of protection from tidal/fluvial flooding.

- The proposal is for planning permission to construct an anaerobic digestion plant located adjacent to the proposed feedstock, which complies with prevailing local plan policies. The Sequential Test therefore passed.

- The maps indicating the actual risk of flooding contained in South Holland's Strategic Flood Risk Assessment 2010 show that the site is unaffected from flooding from a breach to the defences.

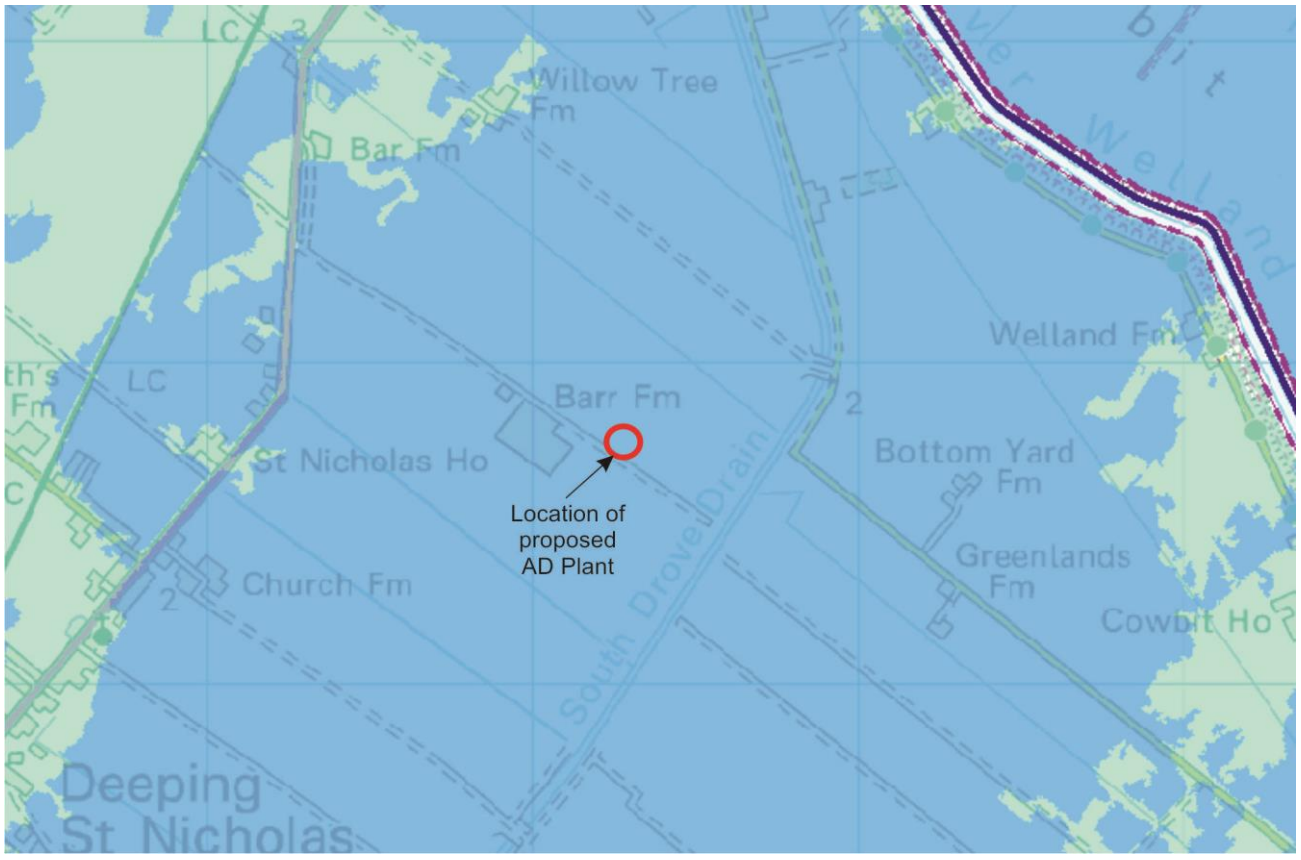
- The industrial use falls within the "Less Vulnerable" uses of land as defined in Table 2 NPPF for Flood Risk Vulnerability Classification and the proposed development use is appropriate in Flood Zone 3a.

- Flooding from other sources is unlikely to affect the site.

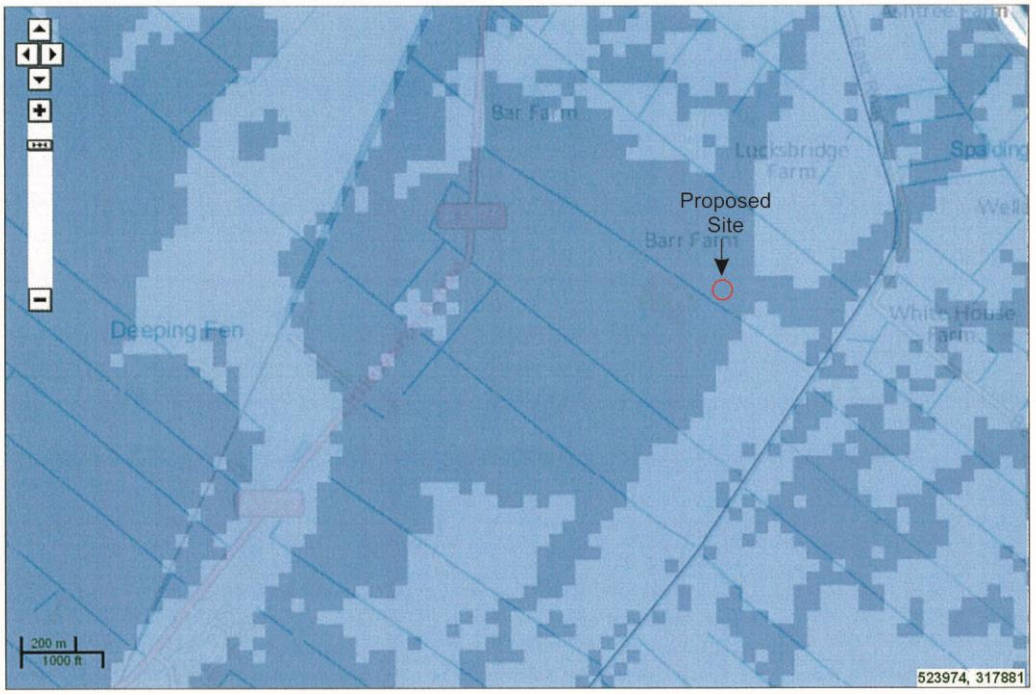
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APPENDICES

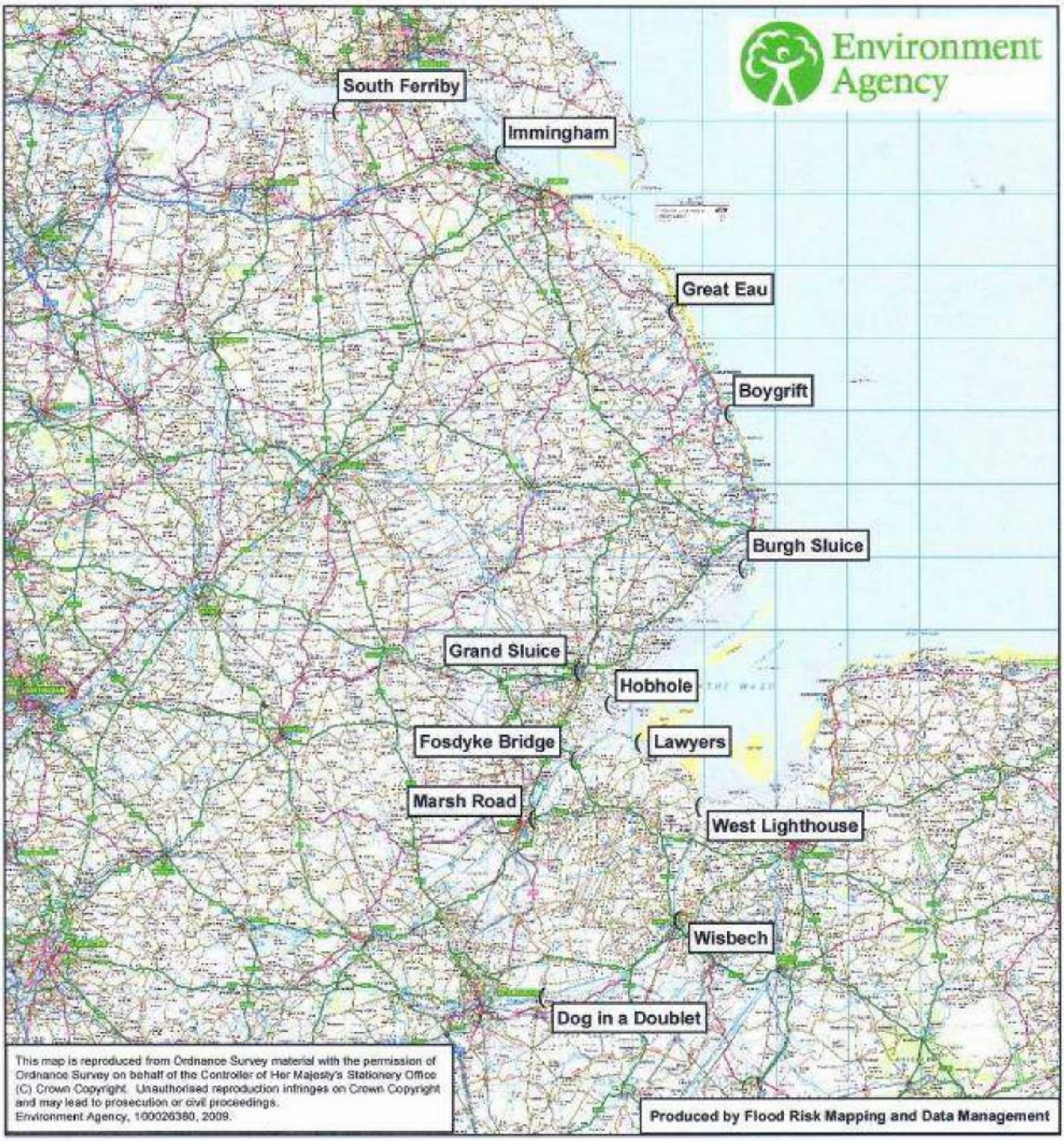
Map 1	Environment Agency Flood Plain Map.
Map 2	Environment Agency Risk of Flooding from Rivers and Sea Map.
Map 3	Northern Area Tidal Model Analysis 2006 Map
Map 4	Actual Risk Extent District - Year 2115 1% Fluvial / 0.5% Tidal Event Probability
Map 5	Actual Peak Depth Spalding - Year 2115 1% Fluvial / 0.5% Tidal Event Probability
Map 6	Actual Flood Hazard Spalding - Year 2115 1% Fluvial / 0.5% Tidal Event Probability
Plan 1	Site Location Plan
Plan 2	Site Layout Plan


Willow Tree Fm
Bar Fm
Welland Fm
Barr Fm
St Nicholas Ho
Location of proposed AD Plant
Bottom Yard Fm
Greenlands Fm
Church Fm
Deeping St Nicholas

MAP1


Bar Farm
Proposed Site
Barr Farm
Deeping Fen
200 m
1000 ft
523974, 317881

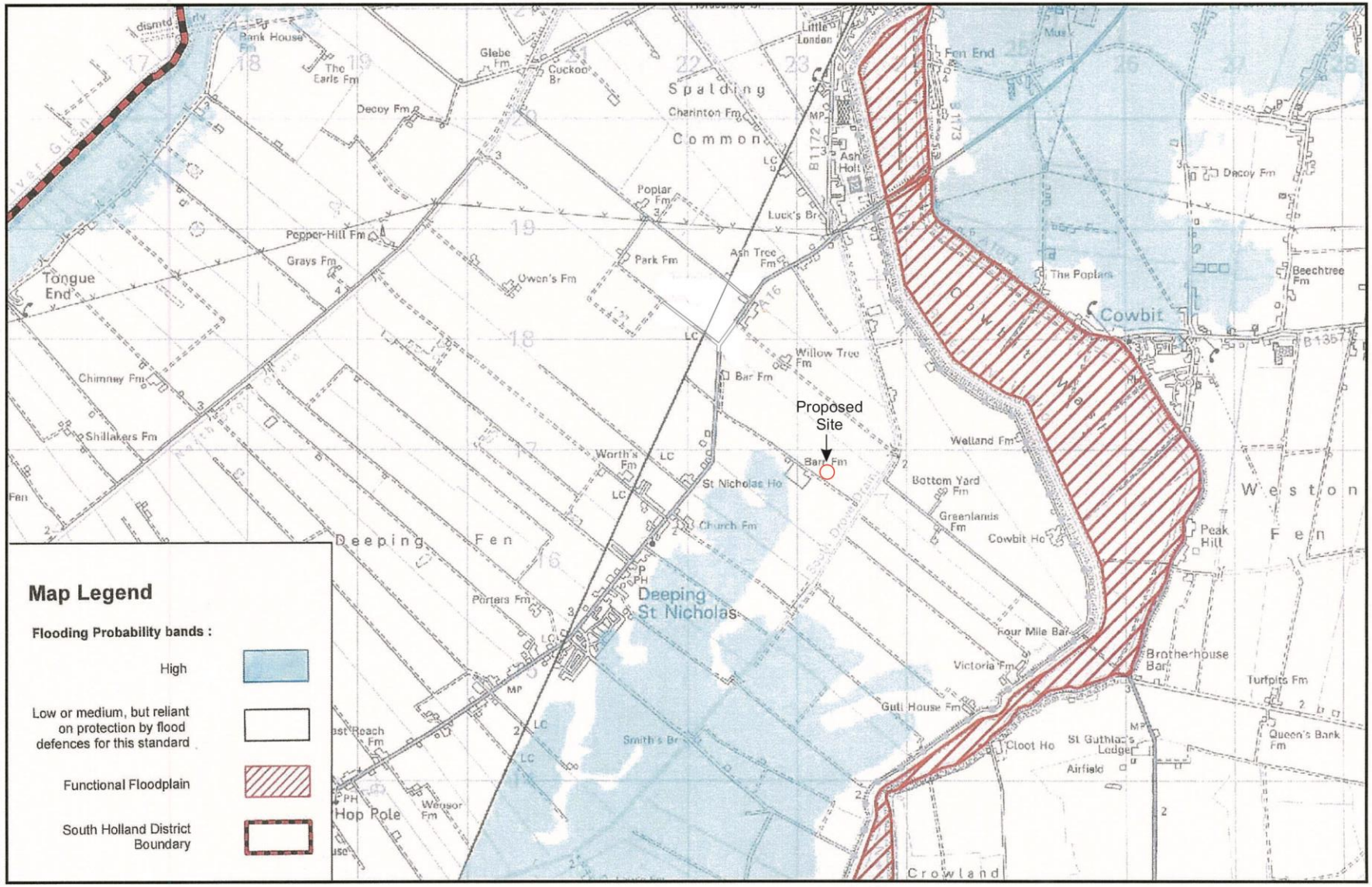
MAP 2



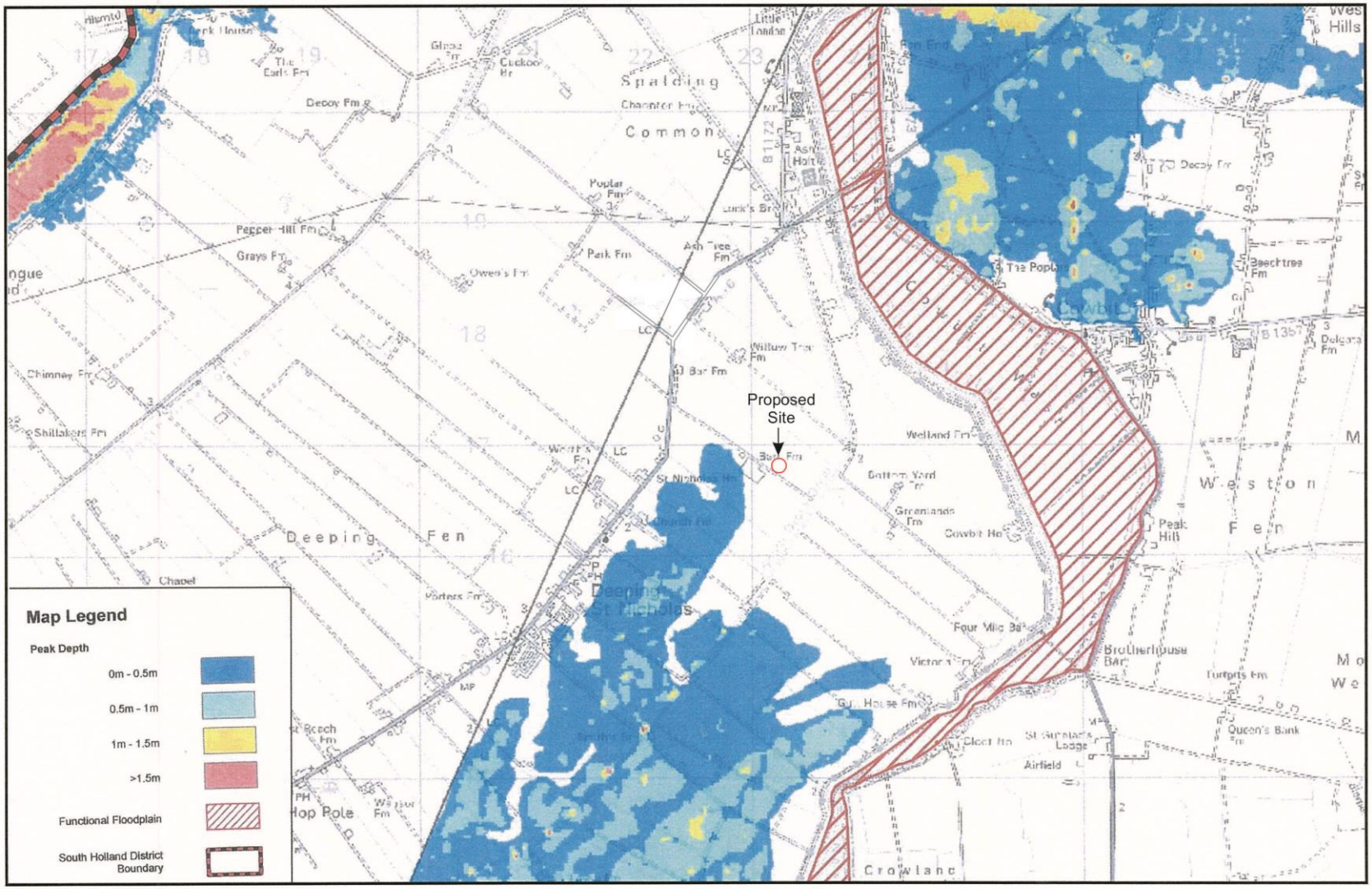
Tidal Levels mODN - based Northern Area Tidal Model Analysis 2006

Location	Easting	Northing	100% (1 in 1)	10% (1 in 10)	4% (1 in 25)	2% (1 in 50)	1% (1 in 100)	0.5% (1 in 200)	0.1% (1 in 1000)
South Ferriby	498772	421418	4.90	5.29	5.45	~	~	5.55	5.63
Immingham	521381	415464	4.08	4.49	4.65	4.76	4.88	5.05	5.34
Great Eau	545500	393800	3.80	4.19	4.34	4.46	4.57	4.69	4.96
Boygrift	553300	379800	3.84	4.24	4.41	4.53	4.65	4.77	5.05
Burgh Sluice	555190	358620	4.26	4.45	4.63	4.76	4.90	5.03	5.34
Hobhole	536610	339940	4.82	5.30	5.49	5.64	5.78	5.93	6.27
Lawyers	540750	334550	4.84	5.32	5.51	5.66	5.80	5.95	6.29
West Lighthouse	549150	325750	4.88	5.37	5.57	5.71	5.86	6.01	6.35
Grand Sluice	532400	344500	4.88	5.33	5.51	5.65	5.78	5.93	~
Fosdyke Bridge	531700	332200	4.91	5.38	5.56	5.71	5.85	5.99	~
Marsh Road	526000	324000	5.04	5.44	5.60	5.73	5.85	5.98	~
Wisbech	546100	310000	4.83	5.25	5.41	5.53	5.66	5.78	~
Dog in a Doublet	527300	299300	3.67	4.00	4.13	4.22	4.32	4.42	~

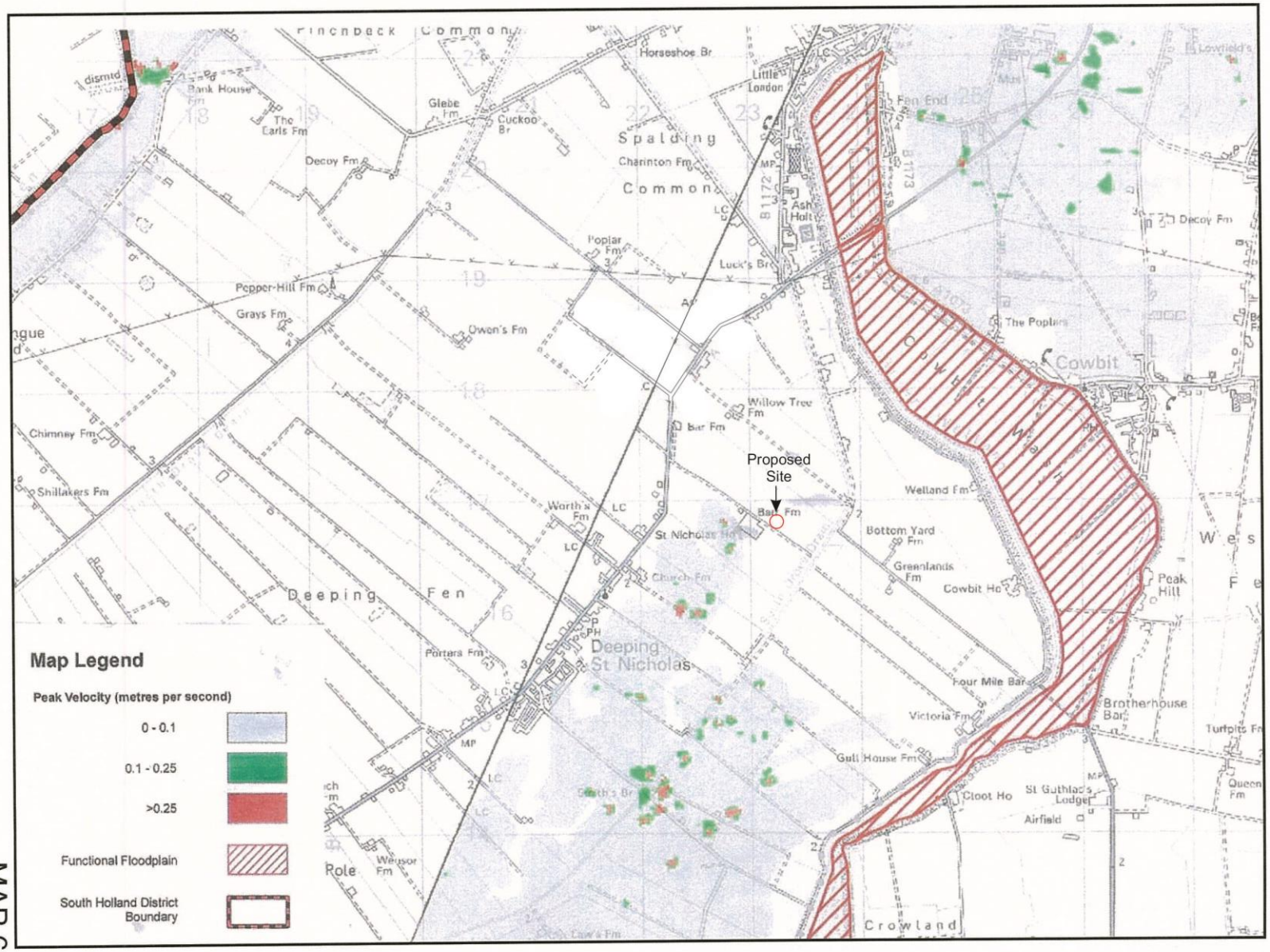
MAP 3


Proposed Site
Map Legend
Flooding Probability bands :
High
Low or medium, but reliant on protection by flood defences for this standard
Functional Floodplain
South Holland District Boundary
Spalding Common
Deeping Fen
Deeping St Nicholas
Tongue End
Cowbit
Weston Fen
Crowland
Hop Pole
Fen End
Bank House
The Earls Fm
Glebe Fm
Cuckoo Br
Decoy Fm
Charlton Fm
Little London
Ash Holt
Poplar Fm
Luck's Br
Pepper Hill Fm
Grays Fm
Owen's Fm
Park Fm
Ash Tree Fm
Willow Tree Fm
Bar Fm
Chimney Fm
Shillakers Fm
Worth's Fm
St Nicholas Ho
Church Fm
Porters Fm
Smith's Br
Wenzor Fm
Welland Fm
Bottom Yard Fm
Greenlands Fm
Cowbit Ho
Peak Hill
The Poplars
Beechtree Fm
Four Mile Bar
Victoria Fm
Brotherhouse Bar
Turfpits Fm
Guti House Fm
Cloot Ho
St Guthlac's Ledger
Airfield
Queen's Bank Fm
B1172
B1173
B1357

MAP 4

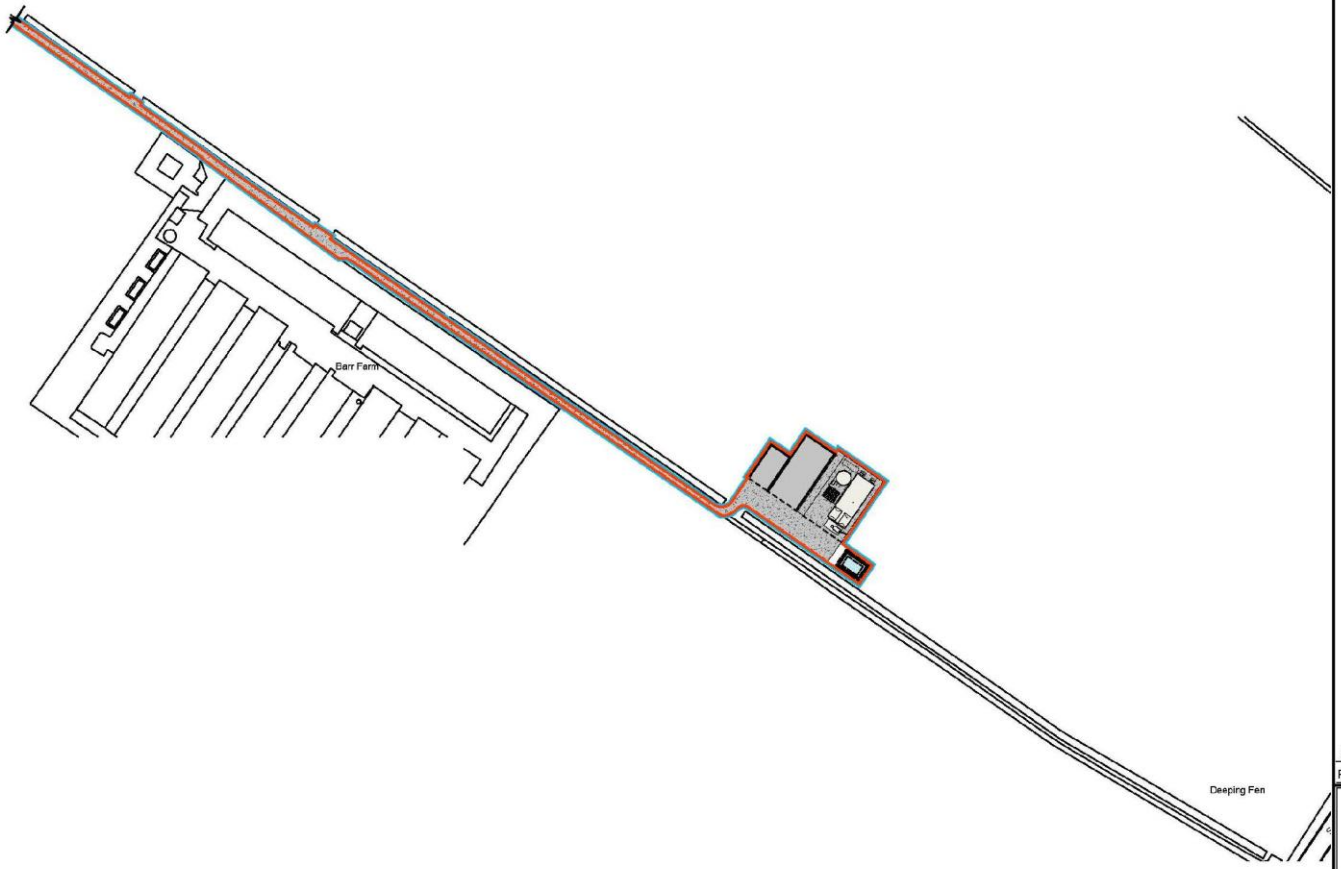

Proposed Site
Map Legend
Peak Depth
0m - 0.5m
0.5m - 1m
1m - 1.5m
>1.5m
Functional Floodplain
South Holland District Boundary
Spalding Common
Deeping Fen
Weston Fen
Crowland
Deeping St Nicholas
Hop Pole
Peck House
Decoy Fm
Pepper Hill Fm
Grays Fm
Owen's Fm
Park Fm
Ash Tree Fm
Poplar Fm
Bar Fm
Chimney Fm
Shillakers Fm
Chapel
Porters Fm
Wellband Fm
Greenlands Fm
Cowbit Hall
Peak Hill
Four Mile Bar
Brotherhouse Bar
Turnpits Fm
Queen's Bank
Airfield
Beechtree Fm
Delgara Fm
Willow Tree Fm
Bottom Yard
St Nicholas Church
Victoria Fm
Gt House Fm
Cloot Fm
St Guthlac's Lodge
Hills

MAP 5


Proposed Site
Map Legend
Peak Velocity (metres per second)
0 - 0.1
0.1 - 0.25
>0.25
Functional Floodplain
South Holland District Boundary
Spalding Common
Deeping Fen
Deeping St Nicholas
Cowbit
Crowland
Horseshoe Br
Little London
Fen End
Glebe Fm
Cuckoo Br
Decoy Fm
Charlton Fm
Ash Holt
Poplar Fm
Luck's Br
Pepper-Hill Fm
Grays Fm
Owen's Fm
Willow Tree Fm
Bar Fm
Chimney Fm
Shillakers Fm
Worth's Fm
St Nicholas Ho
Church Fm
Welland Fm
Bottom Yard Fm
Greenlands Fm
Cowbit Ho
Peak Hill
Porters Fm
Four Mile Bar
Victoria Fm
Brotherhouse Bar
Gull House Fm
Cloot Ho
St Guthlac's Lodge
Airfield
Queen Fm
Turfpits Fm
Weasor Fm
Role
The Poplars

MAP 6

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N

0 20 40 60 80 100m

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Rev.	By	Notes	Date
A	AB	Red & Blue lines amended	19/06/14

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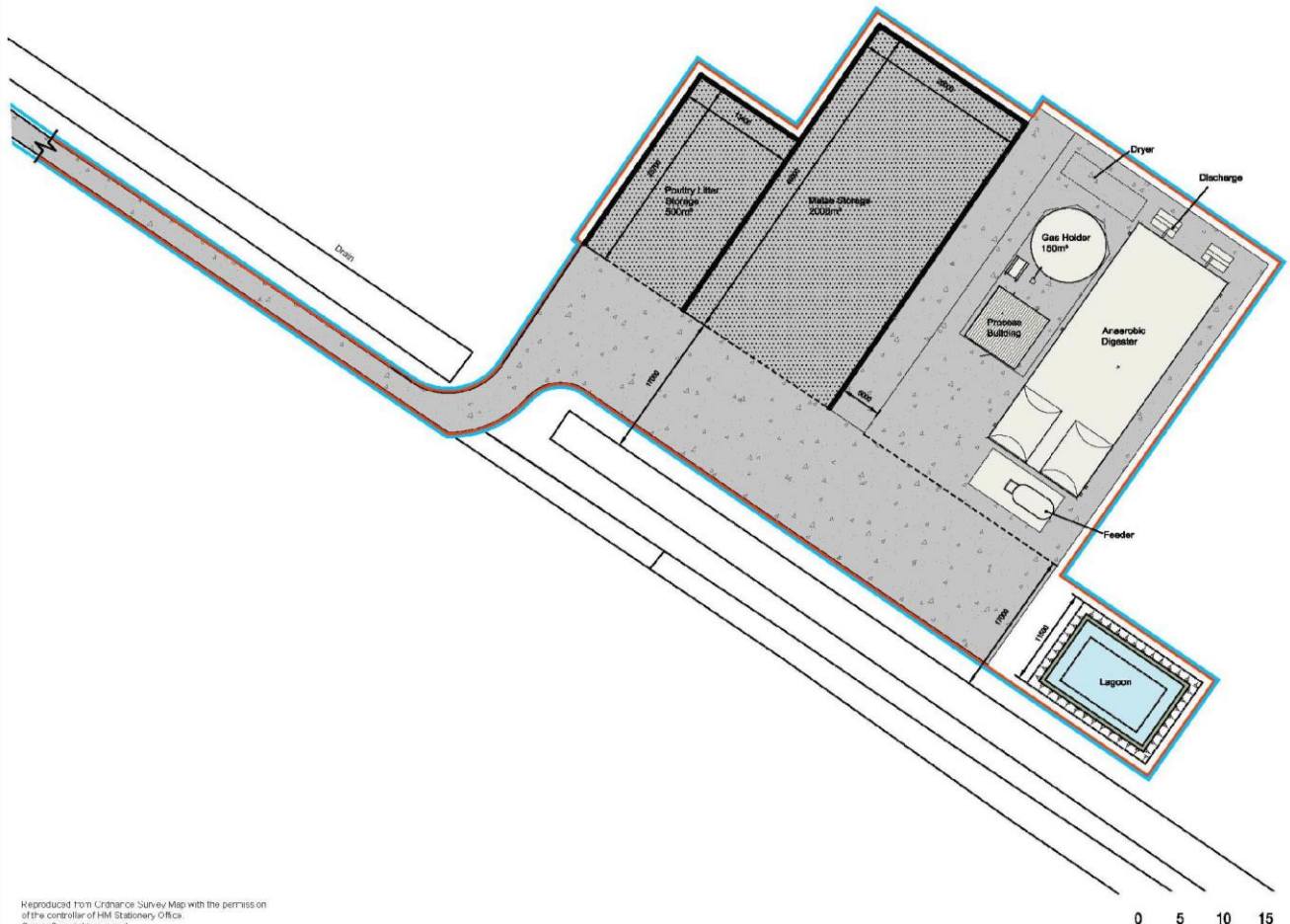
Drawing title: Location Plan

Drawing No.	Rev.	Drawn
739-15-SL01	A	AB
Scale	Date	Checked
1:2500 @ A3	10/06/14	LMS

All measurements should be checked against on site conditions and any discrepancies should be brought to the attention of the Robert Doughty Consultancy.

PLAN 1

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Rev.	By	Notes	Date
A	AB	Client amendments.	19/06/14

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Client: Mr R Turner		
Project: Barr Farm, Deeping St. Nicholas		
Drawing Title: Site Plan		
Drawing No: 739-15-SP01	Rev: A	Drawn: AB
Scale: 1:500 @ A2	Date: 12/06/14	Checked: LMS

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PLAN 2