CHAPTER 9: HYDROLOGY

INTRODUCTION

9.1 This hydrology, hydrogeological and geological assessment has been prepared by Parsons Brinckerhoff Ltd (PB) in accordance with Environment Agency guidance and UK best practice. PB is a leading international engineering, environmental, construction and management services company. Founded in 1885, the company now employs approximately 14,000 staff in 150 offices worldwide. PB has been part of the Parent Company, Balfour Beatty plc, since November 2009.

9.2 The purpose of this chapter is to provide an assessment of the potential hydrological, geological and hydrogeological effects associated with the proposed wind park at Heckington Fen, East Heckington, Lincolnshire.

9.3 With three turbine options available comprising Enercon E-82's, Vestas V90's and Nordex N90LS wind turbines, three turbine scenarios are currently being considered as follows:

Item	Specification		
	Scenario 1	Scenario 2	Scenario 3
Manufacturer	Enercon	Vestas	Nordex
Model	E-82	V90	N90LS
Number of Turbines	22	18	21
Total Rated Capacity	50.6MW	54MW	52.5MW

9.4 For the purposes of this chapter a worst case scenario has been assumed whereby the proposed development at the site would comprise a 604 hectare parcel of land with 22 no. E82 wind turbines.

9.5 This chapter details the current baseline conditions within and adjacent to the proposed site boundary. An assessment of effects has been undertaken for the construction, operation and decommissioning stages of the proposed wind park, identifying associated activities that have the potential to affect the existing baseline situation. An assessment of the significance of any impacts, as defined under the EIA regulations, along with any appropriate mitigation measures are also detailed.

9.6 A separate Flood Risk Assessment has also been undertaken in accordance with planning policy statement 25; Development and Flooding (see **Appendix 9.1**).

9.7 Effects on hydrology, hydrogeology and geology may result in secondary ecological effects on habitats or species. Effects on ecological receptors (non-avian) are considered in **Chapter 7: Ecology.**

9.8 Key Issues:

- The following potential issues will be addressed as part of this assessment. Effects on groundwater and surface water quality;
- Changes to natural drainage patterns;
- Effects on flow in surface waters;
- Effects on run-off rates and volumes
- Effects on erosion and sedimentation;
- Effects on fisheries and recreation;
- Effects on groundwater levels
- Effects on public and private water resources;
- Flood risk
- Pollution risk; and,
- Effects on local geology.

METHODOLOGY

Study and Site Areas

9.9 Studied Water courses are shown in **Figure 9.1**.

Approach and Methods

9.10 This assessment has involved the following:

- Consultation with relevant statutory and non-statutory bodies;
- Detailed desk studies and a site visit to establish the baseline conditions on the site;
- Evaluation of the potential impacts of the proposed wind park and the effect these could have on the current site conditions;
- Evaluation of the significance of these impacts by consideration of the sensitivity of the site, the potential magnitude of these effects and the probability of these effects occurring; and,
- Identification of possible measures to avoid and mitigate against any potential adverse impacts resulting from this development; and
- Evaluation of the residual significance of the potential effects following mitigation

Legislative Framework and Assessment Guidance

9.11 This assessment takes into account the legal framework under the Water Resources Act 1991, the Water Industry Act 1991[1], and the Framework Directive on Water Policy (Water Framework Directive) 2000/60/EC (WFD). The Department of Environment, Food and Rural Affairs (DEFRA) transposed the WFD into statute in December 2003 through publication of The Water Environment (Water Framework Directive) Regulations 2003 which came into force in 2004. The key objectives of the WFD relevant to this assessment are:

- To prevent deterioration and enhance the status of aquatic ecosystems; and
- To establish a framework for the protection of surface fresh water, coastal waters and groundwater.

[1] *These Acts consolidate numerous statutes that previously covered the water environment.*

National and Local Planning Policy

9.12 **PPS23 : Planning and Pollution Control** sets out the Governments core policies and principles regarding land use planning in relation to pollution, land, air, water , stating that;

> *'any consideration of the quality of land, air or water and potential impacts arising from development, possibly leading to impacts on health, is capable of being a material planning consideration, in so far as it arises or may arise from or may affect any land use".*[2]

9.13 **PPS25: Development and Flood risk** identifies that its key aim is to;

> *'ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development away from areas at high risk of flooding and to direct development away from areas at high risk. Where new development is, exceptionally, necessary in such areas, policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall.'*[3]

Regional Strategy

9.14 **Policy 32 : A Regional Approach to Water Resources and Water** details the regional approach to water resources and water quality. It sets out a number of key approaches of which most are not pertinent to a wind farm. Of relevance to the proposed development however are;

> *Protect and improve water quality and reduce the risk of pollution especially to vulnerable groundwater;*
>
> *Use sustainable drainage techniques wherever practical to help mitigate diffuse pollution and support groundwater recharge. These will be required where development is upstream of a designated conservation site of international importance or to improve water quality, where the need is demonstrated through water cycle studies;*

9.15 **Policy 35 : A Regional Approach to Managing Flood Risk** outlines that Local Development Frameworks should take into account potential impact of climate change and in particular should:

- Be informed by strategic flood risk assessments in order to evaluate actual flood risk
- Include policies which prevent inappropriate development either in, or where there would be an adverse impact on, the coastal and fluvial floodplain areas.
- Deliver a programme of flood management schemes that also maximize biodiversity, provide townscape enhancement and other public benefits; and
- Require sustainable drainage in all new developments where practicable.

9.16 Development should not be permitted if, alone or in conjunction with other new development it would

- Be unacceptable risk from flooding or create an unacceptable risk elsewhere
- Inhibit the capacity of the floodplain to store water
- Impede the flow of floodwater in a way which would create an unacceptable risk elsewhere
- Have a detrimental impact upon infiltration of rainfall to ground water storage;
- Other unacceptably increase flood risk; and
- Interfere with coastal processes.

9.17 However, such development may be acceptable on the basis of conditions or agreements for adequate measures to mitigate the effects on the overall flooding regime, including provision for the maintenance and enhancement of biodiversity. Any such measures must accord with the flood management regime for that location.

North Kesteven Local Plan

9.18 **Policy C10 Flood Risk** outlines that planning permission will be granted for proposals if they will not:

1. Be at an unacceptable risk of flooding
2. Unacceptably increase flood risk elsewhere
3. Affect the integrity of existing flood defences to the level where they would not provide an acceptable standard of safety over the lifetime of the development.

Priority will be given in permitting sites for development in descending order of the following flood zones:

- Flood Zone 1 – Little or no risk – annual probability of flooding less than 0.1%
- Flood Zone 2 – Low to medium risk – annual probability of river flooding 0.1% to 1.0%
- Flood Zone 3 – High Risk – Annual probability of river flooding 1.0% or greater

9.19 Where possible, new developments should result in the overall reduction of flood risk. All relevant planning applications must be accompanied by a flood risk assessment.

9.20 **Policy C14 Surface Water Disposal** seeks to ensure that development includes measures to safely manage surface water run-off and where feasible manage the increase in surface water runoff.

Lincolnshire Minerals Local Plan

9.21 The Lincolnshire Minerals Local Plan was adopted in 1991 and was due to be reviewed in 2001. The Plan will be replaced by a Minerals and Waste Development Framework and the relevant policies in the Plan have been saved in the interim. None of the saved policies are relevant for this proposed development.

9.22 **Table 9.1** below summarises the key documents, which have been taken into consideration during the assessment.

[2] *ODPM (2004). PPS23: Planning and Pollution Control. (Para 2).*

[3] *ODPM (2006) PPS25: Development and Floodrisk (Para 5)*

Table 9.1 Assessment and Mitigation Methodology Guidance

Topic	Sources of Information
Legislation	• Environmental Permitting Regulations (England and Wales) 2010 • The Water Framework Directive (200/60/EC) (WFD) • Water Resources Act 1991 • Water Industry Act 1991 • Environmental Protection Act 1990 • Environment Act 1995 • Land Drainage Act 1991 • EC Fisheries Directive (78/659/EEC) • Water Act 2003 • EC Dangerous Substances Directive (76/464/EEC) • Drinking Water Directive (98/83/EC) • Public Health Act 1936
Statutory Instruments	• Groundwater Regulations 1998 • UK Water Quality (Water Supply) Regulations 2000 • Private Water Supplies Regulations 1991 • Control of Pollution (Oil Storage) (England) Regulations 2001 • Water Environment (Water Framework Directive) Regulations 2003 • The Surface Waters (Abstraction for Drinking Water) (Classification) Regulations 1996
Environment Agency Policies	• Policy and Practice for the Protection of Groundwater
Government planning guidance (PPGs)	• Planning Policy Statement 23: Planning and Pollution Control • Planning Policy Statement 25: Development and Flood Risk
Environment Agency Pollution Prevention Guidelines	• PPG1 General guide to the prevention of pollution • PPG2 Above ground oil storage tanks • PPG3 Use and design of oil separators in surface water drainage systems • PPG4 Disposal of sewage where no mains drainage • PPG5 Works and maintenance in or near water • PPG6 Working at construction and demolition sites • PPG7 Refueling facilities • PPG8 Safe storage and disposal of used oils • PPG21 Pollution incident response planning
	• PPG26 Storage and handling of drums and intermediate bulk containers (IBCs) • Is Your Site Right? (replacement for PPG 11 Preventing Pollution of Industrial Sites)
Other Guidelines	• CIRIA C650 Environmental Good Practice on Site • CIRIA C522 Sustainable Urban Drainage Systems Design Manual for England and Wales • CIRIA C532 Control of Water Pollution from Construction Sites. • CIRIA R156 Infiltration Drainage – Manual of Good Practice • Groundwater Protection Code: Solvents (DEFRA) • Groundwater Protection Code: Use and construction of septic tanks and other non-mains sewerage • The Groundwater Regulations 1998: Code of Practice on Mineral Extraction • Environmental Impact Assessment: A Guide to Procedures, DETR 2000 • Environment Agency: Abstracting Water, A guide to getting your license
Catchment Management Plans	• Environment Agency. The Vale of White Horse Catchment Abstraction Management Strategy. March 2006.

Consultation

9.23 Consultations were undertaken by **ecotricity** with relevant consultees to determine their opinion on the geology, hydrology and hydrogeology of the site, the scope of potential effects, the assessment methodology and relevant information sources. Summaries of the consultation responses are listed below and copies are provided in **Appendix 2.1**.

9.24 **Environment Agency** (EA) - Consultation was carried out in the form of a predevelopment enquiry. In a letter dated 27th October 2010, the EA noted that the site lies within Flood Zone 3. Accordingly, the EA noted that any planning application will need to be supported by an appropriate Flood Risk Assessment (this has been undertaken and is reported separately).

9.25 **Black Sluice Internal Drainage Board (IDB) -** Consultation was undertaken with the Black Sluice IDB in September 2009. The Black Sluice IDB stated that the proposed wind turbines must be located 9m away from an IDB watercourse. The Black Sluice IDB also confirmed that their prior consent will be required under Byelaw 10 and Section 23(1) of The Land Drainage Act 1991 before any IDB watercourse or riparian/private watercourse is culverted, filled in or otherwise obstructed.

Baseline Studies

Desktop Survey

9.26 In order to gather baseline data, a desktop survey was undertaken in order to:

- Identify all watercourses, catchments and springs;
- Collect water quality information from the Environment Agency (EA);
- Identify all private drinking water abstractions and public water supplies within the vicinity of the wind farm site;
- Identify flooding risks;
- Identify morphological characteristics of watercourses;
- Collect information relating to recreation and fisheries;
- Collate flooding data for the immediate area and watercourses in the vicinity of the site; and,
- Collate soil, geological and hydrogeological information.

9.27 **Table 9.2** summarises the information sources used to inform the baseline assessment.

Table 9.2 Summary of Information Sources

Topic	Source of Information
Geology Bedrock and Superficial Geology	• British Geological Survey, Boston, Sheet 128 Solid and Drift Edition, 1:50 000 • British Geological Survey website, www.bgs.ac.uk • The Lincolnshire Minerals Local Plan
Soils	• National Soil Resources Institute, Soil Site Report www.landis.org.uk
Climate	• Met Office Average Rainfall data www.metoffice.gov.uk • National River Flow Archive Online Data: Station 30006 River Slea at Leasingham Mill (TF 088 485)
Conservation	• Defra and partners MAGIC GIS database www.magic.gov.uk
Surface Waters Surface Hydrology Water Quality Flow and Flooding	• Ordnance Survey 1: 25 000 Explorer Map, Boston, Sheet 261 • Environment Agency, www.environment-agency.gov.uk • Environment Agency, The Witham Catchment Abstraction Management Strategy March 2004
Groundwater	• Environment Agency, www.environment-agency.gov.uk
Private Water Supplies	• Local Authority North Kesteven District Council

Field Survey Techniques

9.28 A Site visit was undertaken by the PB Flood Risk team on 16th November 2010 as part of the Flood Risk Assessment (reported separately). This report refers to findings of this Site visit, where appropriate.

Assessment of Significance

9.29 The Environmental Impact Assessment: A Guide to Good Practice and Procedures[4] provides general guidance for the assessment of the significance of the potential impact of a project. The methodology used in this assessment has been adapted from this guidance with reference to the paper, Practical Methodology for determining the Significance of Impacts on the Water Environment[5] to establish a robust framework for the assessment of the potential significance of specific impacts on the hydrological, hydrogeological and geology resources. The significance of the potential impacts of the proposed wind farm has been classified by taking into account the following factors:

- Sensitivity of receptor; and
- Magnitude of effects which comments on how sensitivity and magnitude are classified in this assessment is listed in **Tables 9.3 and 9.4** respectively.

Sensitivity

9.30 The sensitivity of the receptors has been achieved by considering the possible interactions between impacts of the proposed development and the existing and future environment, as well as the capacity of the receptor to accommodate any impacts. As with the description of magnitude, where possible the sensitivity has been approximated through current guidance and designations. **Table 9.3** describes the categories of sensitivity and gives examples of attributes of the water environment that relate to generic sensitivity criteria.

[4] *Department of Communities and Local Government. June 2006. Consultation Document.*
[5] *Mustow, S.E and Burgess, P.F, "Practical Methodology for determining the Significance of Impacts on the Water Environment", Journal of Chartered Institution of Water and Environmental Management, Volume 19, June 2005 No. 2.*

Table 9.3 Definition of Sensitivity of the Receiving Environment

Sensitivity	Classification						
	Rarity/ Substitutability	**Surface water quality - EA General Quality Assessment (GQA)**	**Ground Water**	**Ecology/ Recreation/ Conservation**	**Flood risk**	**Abstractions/ Potable Water**	**Geology**
Very High	High quality and rarity, regional or national scale and limited potential for substitution/replacement	Class A Very Good	Principle aquifer with soils of high, intermediate or unclassified leaching potential; Groundwater aquifer vulnerability classed as high; WFD – Principal Aquifer	Site of Special Scientific Interest (SSSI) or Special Area of Conservation (SAC); Designated salmonid fishery and/or salmonid spawning grounds present; Watercourse widely used for recreation, directly related to watercourse quality (e.g. swimming, salmon fishery etc.) within 2km downstream[6]	Within Flood Zone 3 Active floodplain area (important in relation to flood defence); ≥1 in 75 chance of flooding	Abstractions for public drinking water supply; Within Source Protection Zone 1 or 2 of a groundwater abstraction point; Groundwater abstractions >1000m^3/day (within 2km of site); Surface water - large scale industrial agricultural abstractions >1000m^3/day within 2km downstream	Geology rare or regionally/nationally important
High	Receptor with a high quality and rarity, local scale and limited potential for substitution/ replacement or receptor with a medium quality and rarity, regional or national scale and limited potential for substitution/ replacement	Class B Good	Secondary aquifer with soils of high or unclassified leaching potential; Groundwater aquifer vulnerability classed as intermediate;	Designated salmonid fishery and/or cyprinid fishery[7]; Watercourse used for recreation, directly related to watercourse quality (e.g. swimming, salmon fishery etc.)	Within Flood Zone 3 Active floodplain area (important in relation to flood defence); ≤1 in 75 and ≥1 in 200 chance of flooding	Groundwater abstraction for private water supply >10 m^3/day or serves > 50 people; Within Source Protection Zone 3 of a groundwater abstraction point; Surface water abstractions for private water supply for more than 15 people; Groundwater abstractions 500-1000m^3/day (within zone of influence from development); Large scale industrial agricultural abstractions 500-1000m^3/day within 2km downstream	Geology rare or regionally/nationally important.
Medium	Receptor with a medium quality and rarity, local scale and limited potential for substitution / replacement or receptor with a low quality and rarity, regional or national scale and limited potential for substitution / replacement	Class C Fairly Good or Class D Fair	Principle aquifer with soils of low leaching potential or minor aquifer with soils of intermediate leaching potential; Groundwater aquifer vulnerability classed as low; WFD – Secondary Aquifer or Significant Drift Aquifer	Designated cyprinid fishery, salmonid species may be present and catchment locally important for fisheries; Watercourse not widely used for recreation, or recreation use not directly related to watercourse quality	Flood Zone 2 Medium Probability of Flooding (between 1 in 100 and 1 in 1000 annual probability of a river flooding)	Private water supplies present; Not within a Source Protection Zone of a groundwater abstraction point; Surface water abstraction for private water supply; Groundwater abstractions 50-499m^3/day; Industrial/agricultural abstractions 50-499m^3/day within 2km downstream	Geology typical of wider area and no rare or vulnerable formations present.
Low	Receptor with a low quality and rarity, local scale and limited potential for substitution/replacement. Environmental equilibrium is stable and is resilient to changes that are greater than natural fluctuations, without detriment to its present character	Class E Poor or Class F Bad	Secondary aquifer with soils of low leaching potential, or non aquifer; Groundwater aquifer vulnerability not classified; WFD – Unproductive Aquifer	Fish sporadically present or restricted, no designated fisheries; Not used for recreation; Receptor heavily engineered or artificially modified and may dry up during summer months	Flood Zone 1 Low Probability of Flooding (less than 1 in 1000) probability of a site flooding in any year.	No drinking water supplies; Not within a Source Protection Zone of a groundwater abstraction point; Groundwater abstractions <50m^3/day; Industrial/agricultural abstractions < 50m^3/day within 2km downstream	Geology typical of wider area and no rare or vulnerable formations present.

[6] 2km is judged to provide a suitable area within which any effects from the development will be established
[7] Coarse fish such as carp, roach, bream etc

Magnitude of Effect

9.31 The magnitude of potential effects of the development have been characterised in terms of their duration, reversibility and scale as well as the likelihood of the impact occurring. Where possible attributed grades and hierarchal designations have been used to approximate magnitude and provide consistency and objectivity. **Table 9.4** below provides characterisations for degrees of magnitude according to certain criteria as well as providing specific examples in the context of impacts to the water environment.

Table 9.4 Magnitude of Effect

Magnitude	Criteria	Description and example
Major / Extreme	Results in loss of attribute	*Fundamental (long term or permanent) changes to the geology, hydrology, water quality and hydrogeology* • Loss of EC designated Salmonid fishery • Loss of designated species/habitats • Change in water quality status of river reach • Compromise employment source • Loss of flood storage/increased flood risk • Pollution of public or private drinking water source
Moderate	Results in effect on integrity of attribute or loss of part of attribute	*Material but non-fundamental and short to medium term changes to the geology, hydrology, water quality and hydrogeology* • Loss in productivity of a fishery • Contribution of a significant proportion of the effluent in the receiving water, but insufficient to change its water quality status; • Reduction in the economic value of the feature.
Minor	Result in minor effect on attribute	*Measurable but non-material and transitory changes to the geology, hydrology, water quality and hydrogeology* • Measurable change in attribute, but of limited size and/or proportion
Negligible	Results in an effect on attribute but of insufficient magnitude to affect the use / integrity	*No perceptible changes to the geology, hydrology, water quality or hydrogeology* • Discharges to watercourse but no loss in quality, fisheries productivity or biodiversity • No significant effect on the economic value of the receptor • No increase in flood risk • No pollution of private or public drinking water resources
Insignificant	No effect identified	No effect identified

Significance Criteria

9.32 The sensitivity of the receiving environment together with the magnitude of the effect defines the significance of the effect prior to application of mitigation measures outlined in **Table 9.5,**

Table 9.5 Significance Criteria

		Sensitivity of Receptor			
		Low	Medium	High - Very High	
Magnitude of Impact	No change	Insignificant	Insignificant	Insignificant	
	Minimal change	Negligible -Minor	Minor	Minor - Moderate	
	Very Low - Low	Minor	Minor - Moderate	Moderate	
	Medium	Minor - Moderate	Moderate	Moderate - Major	
	High - Very High	Moderate	Moderate - Major	Major	Extreme

Extreme: These effects, if adverse, represent key factors in the decision making process. They are generally, but not exclusively associated with sites and features of national importance and resources/features which are unique and which, if lost, cannot be replaced or relocated.

Major: These effects are likely to be important considerations at a regional or district scale, but, if adverse, are potential concerns to the project, depending upon the relative importance attached to the issue during the decision making process.

Moderate: These effects, if adverse, while important at a local scale, are not likely to be key decision making issues. Nevertheless, the cumulative effect of such issues may lead to an increase in the overall effects on a particular area or a particular resource.

Minor: These effects may be raised as local issues but are unlikely to be of importance in the decision making process. Nevertheless, they are of relevance in the detailed design of the project.

Negligible: Effects which are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.

Insignificant: No effect identified

9.33 Potential effects, prior to application of mitigation measures, are therefore concluded to be of **extreme, major**, **moderate**, **minor, negligible** or **insignificant**. The shaded boxes in **Table 9.5** represent effects considered to be significant in terms of the Environmental Impact Assessment (England and Wales) Regulations 1999. Following the application of mitigation measures, the magnitude of change needs to be re-established and the significance values reassessed. In this assessment, it has also been established whether the identified effects are:

- Direct, indirect, secondary and cumulative;
- Positive or negative;

- Short, medium or long-term; and,
- Permanent or temporary.

9.34 The significance criteria listed in **Table 9.5** have been used to determine the residual significance of each identified potential effect.

BASELINE

9.35 This section presents the information gathered on the existing topographical, geological, hydrological and hydrogeological conditions at the proposed site and its immediate surroundings.

Topography and Land Use

9.36 The site for the proposed wind park covers a total area of approximately 604 hectares and is located approximately 12km to the west of Boston in Lincolnshire. Review of the Ordnance Survey map indicates that topography of the development site is predominately flat lying at less than 5m Above Ordnance Datum (AOD). The topography of the surrounding land is generally flat.

9.37 The site comprises land from Six Hundreds Farm and is currently utilised as arable land with small corpse in field corners. A gas valve compound is situated within the site boundary to the north-western area, but is not located over a developable area. The site and surrounding area is covered by a network of drainage channels which carry water to Head Dike located adjacent to the northern site boundary and to Skerth Drain located approximately 600m east of the site boundary. A number of access tracks cross the site providing access to Six Hundreds Farm and the fields.

9.38 The site is surrounded on each boundary by further agricultural land scattered farmsteads and small villages / hamlets. Six Hundreds Farm is located within the site boundary and developable area. The nearest residential properties beyond the site boundary are at Home farm to the south and Mill Green Farm to the north. The proposed developable area of the site however is located approximately 1km from these properties.

Solid Geology

9.39 According to the British Geological Survey (BGS) sheet for the area (Boston, sheet 128 Solid and Drift Edition, 1:50 000), the solid geology beneath the site comprises grey shelly mudstone of West Walton and Oxford Clay formations (part of the Ancholme Group) which lie over the Lincolnshire Limestone Formation comprising oolitic and shell-detrital limestone from the Jurassic age.

9.40 According to the Lincolnshire Minerals Local Plan, there are no mineral workings within 1km of the Site. Between 1972 and 1984 the area encompassing the Site was granted an exploration licence for oil and gas which permitted drilling to a depth of 350m and undertaking magnetic and seismic surveys. Exploration license were permitted for 3 years within a renewable period of 1 year for the ensuing 3 years. The Lincolnshire Mineral Local Plan does not provide any information indication if any explorations were undertaken.

9.41 The BGS holds records of the following boreholes drilled in the vicinity of the site area:

Table 9.6 Borehole records

Borehole ref. TF14SE2 – c.0.01km south of site		
Description	**Thickness (m)**	**Depth (m)**
Soil	0.3	0.3
Silt	2.4	2.7
Sand, gravel	1.5	4.0
Clay	58.8	62.8
Borehole ref. TF14SE4A – c.0.1km south west of site		
Description	**Thickness (m)**	**Depth (m)**
Soil, grey sand, sand and gravel	1.1	1.1
Grey clay	72.1	73.2
Alternating limestone and brown clay	18.2	94.5
Mottled clay, grey clay & stone beds, soft brown clay	14.3	108.8
Very hard limestone with thin seams of grey clay	2.7	111.6
Hard sandy clay – light grey	7.0	118.6
Hard limestone, hard limestone with seams of grey clay, very hard grey limestone	13.4	132.0
Hard grey clay	2.7	134.7
Blake shale	3.4	138.1
Borehole ref. TF15SE28 – c.3.9km north of site		
Description	**Thickness (m)**	**Depth (m)**
Made ground	0.7	0.7
MARINE OR ESTUARINE ALLUVIUM; silty clay, dark bluish grey, firm becoming soft;	2.0	2.7
Peat, very dark reddish brown	0.8	3.5
Silty clay, as above	0.2	3.7
TILL; pebbly clay, dark grey, stiff, with some chalk granules and trace flint pebbles	6.7	10.4
ANCHOLME CLAY GROUP; silty clay, very dark grey, hard	1.0+	11.4

Superficial Geology and Soils

9.42 According to the BGS sheet for the area (Boston, sheet 128 Solid and Drift Edition, 1:50 000), the superficial deposits beneath the site comprise Barroway Drove Beds, older marine deposits and saltmarsh deposits between 10 and 20m in depth.

Soils

9.43 According to the National Soil Resources Institute Soils Site Report for location 520328E, 345228N, the site area is underlain by deep stoneless clayey soils which are calcareous in places. Land associated with these soils tends to be flat with low ridges giving a complex soil pattern. Major land

uses are indicated as winter cereals and some sugar beet, potatoes, cereals and field vegetables. This corresponds with the current site use.

9.44 The hydrology of the soil type is classified seasonally waterlogged by fluctuating groundwater and have relatively slow lateral saturated conductivity. The report describes the underlying rock type as marine alluvium.

9.45 **Table 9.7** lists key characteristics of the soil associations identified.

Table 9.7 General Characteristics of Site Soils[8]

	Key	Comments
Hydrology of Soil Type (HOST) Class	9	Soils seasonally waterlogged by fluctuating groundwater and with relatively slow lateral saturated conductivity.
Pesticide Leaching Risk	H1vi	Slowly permeable soil: groundwater at very shallow depth (60cm).
Pesticide Runoff Risk	S3m	Soils with moderate run-off potential and moderate adsorption potential.
Groundwater Protection Policy (GWPP) Leaching	H1	Soils of high leaching potential, which readily transmit liquid discharges because they are either shallow, or susceptible to rapid bypass flow directly to rock, gravel or groundwater.

Hydrogeology

9.46 The strata underlying the Site is classified by the EA as a unproductive strata which comprise rock layers or drift deposits with low permeability and have negligible significance for water supply or river base flow.

9.47 The boreholes presented in **Table 9.6** state do not indicate that water was struck.

9.48 The EA defines Groundwater Source Protection Zones around groundwater sources (e.g. boreholes) used for public water supply[9]. These zones constitute the catchment area of the groundwater source and show the risk of contamination from activities which may cause pollution in the area of the groundwater source. The zones are split into four: Zone 1 (Inner Protection Zone), Zone 2 (Outer Protection Zone), Zone 3 (Total Catchment) and Zone of Special Interest.

9.49 According to EA information, the site does not lie within a currently designated Groundwater Source Protection Zone.

Hydrology

9.50 The numerous drainage channels across the Site flow to Head Dike located adjacent to the northern Site boundary and to Holland Dike which forms the eastern Site boundary. These Dikes subsequently feed Skerth Drain situated approximately 600m east of the Site and South Forty Foot Drain located approximately 1km to the South. South Forty Foot Drain joins the River Witham at Boston and forms the Haven approximately 12km east of the Site boundary.

Water Resources

Water Quality

9.51 The EA classify rivers in terms of biological and chemical parameters. The gradings are given in **Table 9.8**.

Table 9.8 EA River Quality Classification

Classification	Biological Description	Chemistry likely uses and characteristics
A - very good	Biology similar to that expected for an unpolluted river	All abstractions. Very good salmonid fisheries. Cyprinid fisheries. Natural ecosystems.
B – good	Biology is a little short of an unpolluted river	All abstractions. Very good salmonid fisheries. Cyprinid fisheries. Ecosystems at or close to natural.
C - fairly good	Biology worse than expected for unpolluted river	Potable supply after advanced treatment. Other abstractions. Good cyprinid fisheries. Natural ecosystems, or those corresponding to good cyprinid fisheries.
D – fair	A range of pollution tolerant species present	Potable supply after advanced treatment. Other abstractions. Fair cyprinid fisheries. Impacted ecosystems.
E – poor	Biology restricted to pollution tolerant species	Low grade abstraction for industry. Fish absent or sporadically present, vulnerable to pollution.** Impoverished ecosystems. **
F – bad	Biology limited to a small number of species very tolerant of pollution	Very polluted rivers which may cause nuisance. Severely restricted ecosystems.
		*providing other standards are met. **where the grade is caused by discharges of organic pollution.
Information from the EA website www.environment-agency.gov.uk		

9.52 The River Slea, between the Boiling Wells and Ruskington Beck, (upstream grid reference: 504470, 345280 and downstream grid reference: 510660, 349680), approximately 10km north west of Site, has been designated by the EA as General Quality Assessment (GQA) Grade B Good quality for both Chemistry and Biology in 2008. Between 2003 and 2008 the GQA for both Chemistry and Biology have maintained at Grade B.

9.53 The River Witham, between Bardney and Dogdyke, (upstream grid reference: 511280, 368510 and downstream grid reference: 520920, 355490), approximately 10km to the north of the site, has been designated by the EA as General Quality Assessment (GQA) Grade C Fairly Good quality

[8] *Information from National Soil Resources Institute (2010) Environmental Soils Site Report for location 359500E 150400N, 2kmx2km*
[9] *EA website www.environment-agency.gov.uk*

(Chemistry) and Grade A Very Good quality (Biology) in 2008. The Biology GQA has increased from Grade C in 2003 – 2004 to Grade B in 2005 - 2007

Public Water Supplies

9.54 The proposed wind park site lies within the Witham Catchment Abstraction Management Strategy (CAMS) area. The site does not lie within a Groundwater Management Unit (GWMU) as designated by this strategy. Abstraction for public water supply accounts for the largest number of licences (36%) taken primarily from the confirmed Lincolnshire Limestone aquifer. Agriculture accounts for 23% of licences with 16% used for spray irrigation.

9.55 There are no public water supply abstractions within a 2km radius of the Site.

9.56 The EA has 4 no. records of licenses to abstract either surface water within a 3km radius from the centre of the site. All abstractions are for the purpose of spray irrigation and are abstracted from Heckington Head Dyke, riparian Drain "4" and I.D.B. Drain Heckington. The nearest abstraction is from Head Dyke located adjacent to the northern Site boundary. There are no records of any groundwater abstractions within a 3km radius.

Private Water Supplies and Abstractions

9.57 The BGS Geo-index website indicates there are 3no. water well within 1km of the site boundary. The nearest water well located just within the southern site boundary at Rectory Farm and is indicated to be a 30m+ well although it is unclear as to whether this is a productive well. The remaining two water wells are located approximately 200m and 950m south of the site boundary.

9.58 According to North Kesteven District Council, there are no private water supply abstractions within a 4.8km radius of the centre of the site area.

Wastewater Infrastructure

9.59 The site is crossed by numerous surface water drainage channels and culverts. Two pumping stations are located on the Holland Dike located adjacent to the north eastern site boundary.

9.60 Foul water is not generated at the site.

9.61 According to data from the EA, there are no sewage treatment works within 5km of the site boundary.

Fluvial Flooding

9.62 The EA defines a floodplain as that area that would normally be affected by flooding if a river rises above its banks. An area of floodplain is then further classified based on the probability or likelihood of flooding in any one year. These classifications are presented in **Table 9.9** below.

Table 9.9 EA Flood Classifications

Classification	Description
Significant	The chance of flooding in any year is greater than 1.3% (1 in 75)
Moderate	The chance of flooding in any year is 1.3% (1 in 75) or less, but greater than 0.5% (1 in 200)
Low	9.63 The chance of flooding in any year is 0.5% (1 in 200) or less
Information from the EA website www.environment-agency.gov.uk	

9.64 From the EA website, the site is shown to lie within significant risk Flood Zone 3 where the annual probability of flooding is considered to be greater than 1.3% (1 in 75). Further detail obtained directly from the EA during the PB Flood Risk Assessment (FRA) confirms that the site is located within the high risk Flood Zone 3a (as defined in PPS25) where the annual probability of fluvial flood risk is greater than 1% (1 in 100) in any one year (whilst ignoring the presence of defences). The EA have however confirmed that the site is not located within the functional floodplain, Flood Zone 3b.

9.65 A Flood Risk Assessment (FRA) has been undertaken by PB and is reported separately.

Fisheries and Recreation

9.66 According to the Witham Catchment Abstraction Management Strategy document, the fish population in the CAMS area varies due to the changes in gradient and habitat throughout the region. The upper reaches accommodate fish such as brown trout, grayling, barbel, chub and dace whilst the lower, more sluggish rivers support coarse fish such as roach, common bream and pike. Brown trout are rare in Lincolnshire due to habitat degradation, as such this species are afforded support under the Agency's remit of maintaining, developing and improving fisheries and protecting biodiversity.

9.67 From the EA Where to Go Fishing Guide, (Waterscapes) coarse fishing takes place on Clay Dike located approximately 1.2km east of the Site boundary at the nearest point.

9.68 Annual monitoring for fish populations takes place on South 40 Foot drainage channel. The Summary Report 2010 provided by the EA identified that the system is highly managed with the main channel being very uniform and of poor habitat diversity. Land drainage demands are identified to be the major factor limiting the environmental stability of the system.

Conservation

9.69 A scheduled monument site is located approximately 550m to the west of the Site boundary. There are no Special Areas of Conservation, Special Protection Areas or Sites of Special Scientific Interest and no National or Local Nature Reserves located within 1km of Site boundary.

Climate

9.70 Rainfall data from the National River Flow Archive shows that the average annual rainfall (1961 – 1990) at the River Slea at Leasingham Mill (TF 088 485, Station 30006), located approximately 10km west of the Site, was 601mm.

9.71 Additionally average monthly rainfall data provided by the Met Office, from a monitoring point at Waddington, approximately 30km north-west of the site is presented in **Table 9.10** below.

Table 9.10 Met Office recorded Monthly Average Rainfall Results

Month	Waddington 1971-2000 Average Rainfall (mm)	Waddington 1961-1990 Average Rainfall (mm)
January	52.4	48.9
February	37.8	37.9
March	47.4	48.5
April	44.4	46.7
May	47.7	49.5
June	55.3	52.6
July	44.5	52.7
August	57.6	62.3
September	51.1	46.7
October	53.4	47.1
November	52.1	54.5
December	55.1	53.3
Year	598.7	600.7

9.72 From the data obtained, comparing the 1961-1990 data to the 1971-2000 data the general trend appears to be that levels of annual rainfall in the wider area have increased slightly. However, this does not account for local variances.

Sensitivity of Receptors

9.73 On the basis of the baseline surveys and available information, **Table 9.11** below identifies the sensitivity of receptors as defined in **Table 9.3** with justification for their categorisation. Where there is uncertainty on level of sensitivity, the most conservative level has been awarded.

Table 9.11 Sensitivity of Receptors

Receptor	Sensitivity	Comment
Geology	LOW	Geology typical of wider area and no rare or vulnerable formations present.
Groundwater	LOW	The strata underlying the Site is classified by the EA as a unproductive strata which comprise rock layers or drift deposits with low permeability and have negligible significance for water supply or river base flow. From boreholes in the vicinity of the site, groundwater does not appear to be at shallow depth in the surrounding area.
Flooding	HIGH	The site lies within significant risk flood zone 3a.
Fisheries and Recreation	LOW	There are no known nearby water bodies used for fishery or recreation purposes within a 1km radius of the site.
Water Quality River Witham, local surface water system	LOW	The nearest classified river is located over 10km distant. There are numerous drainage channels across the Site which flow into the local surface water system. The most significant water body in the immediate surrounds is the South Forty Foot Drain located approximately 1km to the south which subsequently flows to the River Witham (classified as Grade A 10km to the north).
Abstractions	MEDIUM	There are no public water supply abstractions within a 2km radius, however there is a surface water abstraction for spray irrigation located adjacent to the northern Site boundary. The site does not lie within a designated Groundwater Source protection Zone.

ASSESSMENT OF EFFECTS

Potential Effects

9.74 This section details the various potential effects that may occur as a result of the development, followed by an assessment of the potential effects for each phase of the development:

- Construction;
- Operation; and
- Decommissioning.

9.75 Due to the nature of the site and the work to be undertaken, many effects will be similar for each phase of development (construction, operation and decommissioning). These are summarised below:

Surface Runoff and Downstream Flooding

9.76 The development of the wind farm at the site will increase the impermeable area. The circular foundations for each of the 22 turbines are approximately 219m^2, however, apart from the base of the turbine which has a diameter of 4.3m with a 1m flange around it (6.3m), the majority of the foundation will be buried below ground. This will reduce the exposed impermeable area for each turbine to 31.17m^2 resulting in an overall increase in impermeable area by approximately 735.8m^2 (based on 22 no. exposed turbine foundations each of 31.17m^2 and a single substation building measuring approximately 10m x 5m i.e. 50m^2). Access tracks, crane pads and the temporary construction compound will comprise crushed aggregate permeable material. The majority of the site will remain unsurfaced and is proposed to remain in arable use. A series of surface water drains are located across the site and surrounding fields which take site derived surface run-off into the surrounding water environment. Excavations can result in exposure of bare ground and frequently require overpumping operations to remove groundwater ingress or precipitation capture. The increase in hardstanding areas and soil compaction may cause an increase in the rate of surface runoff entering field drains in the site. In addition, movement of construction traffic may lead

to compaction of the soils, reducing soil permeability even further, which could lead to changes in the runoff. Significant increases in runoff may lead to changes in the flow pattern within a receiving watercourse, which could alter the river morphology downstream of the site, increase the risk of flooding and affect ecology. The magnitude of change prior to mitigation would be **very low-low** and would occur during both construction and operation.

Existing Abstractions

9.77 There are no public water supply abstractions within a 2km radius of the Site, however from EA information and the BGS website, there are small scale agricultural surface water abstractions located in the immediate vicinity of the Site. These may be influenced by surface water runoff and infiltration of unmitigated runoff / through flow which may impact the quality of water abstracted for domestic, agricultural and industrial use. The magnitude of change prior to mitigation would be **very low-low** and would occur during both construction and operation.

Impediment to Flows

9.78 Water crossings associated with access tracks can impede flows and tracks can alter the drainage if inadequately designed and installed. This can lead to higher water levels upstream, increased flood risk and localised erosion both upstream and downstream. In addition some of the smaller drainage ditches on the Site may be intercepted by proposed tracks. The magnitude of change prior to mitigation would be **very low-low** and would occur during both construction and operation.

Erosion and Sedimentation

9.79 Potential runoff from excavations, exposed soil, dewatering and stripping of topsoils may lead to erosion and transport of sediments into watercourses and surface field drains. Sedimentation of watercourses can affect flood storage capacity, water quality and ecology of aquatic fauna and flora. Sediment can settle in slower moving stretches of a watercourse and alter the river morphology. The soils may contain significant amounts of stored fertilisers and the release of such substances to watercourses may significantly alter the pH and nutrient levels in watercourses, leading to reduced water quality and effects on ecology. The magnitude of change prior to mitigation would be **very low-low** and would only occur during construction.

Groundwater and Drainage

9.80 During construction some excavations required for turbine bases may necessitate temporary sub-surface water control, such as physical cut-offs or de-watering. Cut-offs divert flow away from the excavation, while dewatering temporarily lowers the water table in the vicinity of the excavation. Localised changes to soil interflow patterns are therefore likely to arise, including drying of the topsoils and underlying superficial geology. Permanent changes may arise from the removal or deactivation of the existing piped drainage system and the construction of drainage channels, which are backfilled with sand and can act as drainage conduits. Groundwater abstraction may be required for on-site dust suppression and would be temporary.

9.81 The magnitude of change prior to mitigation would be **minimal** and would only occur during construction.

Chemical Pollution and Disposal of Foul Water

9.82 Potential causes of chemical pollution include the spillage or leakage of chemicals, cement washings, fuel or oil during use, disposal or storage on site. Spillages of concrete and cement may occur during cement pumping operations into turbine bases. Oils and fuels may contain List I substances (Groundwater Regulations 1998) such as mineral oils and hydrocarbons.

9.83 During construction there will be a requirement to provide temporary sanitation facilities for site workers. These will be provided with integral foul water collection tanks, however spillage of foul water may occur should these temporary facilities be emptied in an unsatisfactory manner. Foul water from sanitation facilities may contain faecal coliforms and the List II substance Ammonia (Groundwater Regulations 1998). An uncontrolled release of these aforementioned pollutants may adversely affect water quality of watercourses and cause contamination of underlying soils. The magnitude of change prior to mitigation would be **very low-low** and would occur during both operation and construction.

Geology

9.84 The local geology is unlikely to be significantly affected by the proposed development and the site is representative of the surrounding area. Stone required from the construction of the access tracks on agricultural land would be sourced from local distributors where possible. The magnitude of change prior to mitigation would be **minimal** and would only occur during construction.

Construction Effects

9.85 Due to the increased activity and nature of construction works, the most significant phase in terms of the potential effects is the construction period. This section lists the activities on site that have the potential to affect the hydrological and hydrogeological regime on site, including potential effects on groundwater and surface water regimes.

9.86 **Temporary Construction Compound** – A temporary compound (40m x 40m) will provide a designated area for sanitation facilities and storage of materials (including fuels, oils and lubricants) in addition to acting as a potential maintenance area. This is proposed to be located adjacent to the existing Six Hundreds Farm buildings located on-Site and be constructed of crushed aggregate on a fibrous, permeable material.

9.87 **Access Tracks** – The total length of new access tracks associated with the wind farm is approximately 10,665m. In the absence of existing site roadways, the tracks leading to the turbines will be 5.5m in width and 350mm depth and will be made of crushed aggregate on a fibrous, permeable material. Potential impacts from the tracks include:

- Erosion and sedimentation;
- Increase in rate of runoff;
- Changes to soil interflow patterns; and
- Chemical pollution.

9.88 **Crane Pads** – It is proposed to construct a crane pad hardstanding area associated with each turbine, each of which would measure 20m x 40m and 350mm deep constructed of crushed aggregate on a fibrous, permeable material. Potential impacts include:

- Erosion and sedimentation;
- Increase in rate of runoff;
- Changes to soil interflow patterns; and

- Chemical pollution.

9.89 **Cable Runs** – Associated cables will be trenched alongside the proposed access tracks where possible from the substation/construction compound, giving an approximate total length of 10.665km. The trenches will measure 0.6m x 1.2m deep and the cables will be laid using the most appropriate solution available at the time of installation. General effects due to cabling may include:

- Erosion, sedimentation and fertiliser run-off;
- Increase in rate of runoff; and,
- Changes to soil interflow patterns.

9.90 **Turbine Construction** – All turbines will be located in the superficial deposits beneath the Site (Barroway Drove Beds, older marine deposits and saltmarsh deposits) between 10 and 20m in depth with the Ancholme mudstones below. The circular turbine foundations are comprised of a concrete slab measuring 16.7m diameter and 2.85m deep, giving an area of 219m^2 and an approximate volume of 624m^3. The generic pile option for the E82 turbine is driven piles consisting of 16 square piles (600mmx600mm) estimated to extend to a maximum depth of 20mbgl. From the information obtained, it is therefore considered that the piles will be predominantly within the superficial deposits. Potential effects on the site geology would be limited to the excavation of underlying ground (to at least 2.85m) for the turbine bases. It is assumed that any extra material required for construction (including access roadways) will be brought on site from off-site sources. Should concrete batching be undertaken on site, this would be in a designated area specifically designed to ensure full containment of effluent and waste materials. Construction of turbine bases may therefore result in the following effects:

- Erosion and sedimentation;
- Increase in rate of runoff;
- Changes to soil interflow patterns;
- Chemical pollution;
- Groundwater abstraction; and,
- Disruption of the geology.

Operational Effects

9.91 Access tracks, drains, turbine bases, crane hardstanding areas, cabling and the substation would be retained on site during the operational phase of the wind farm. The sections below list the potential effects that may occur during the operational phase.

9.92 **Access Tracks** - Should ruts form in access tracks these could form preferential flow paths with increased risk of erosion.

9.93 **Maintenance -** Engineers would be required to visit the site approximately every 6 months to undertake maintenance and repair of the turbines and infrastructure. Pollutants associated with these activities (i.e. fuel, oil, lubricants) would be brought on site as required and would not remain on site once the visit is over. Whilst spillages of the substances could take place during the visit, all health and safety procedures and environmental best practice would be followed during these visits.

9.94 **Hardstanding Areas** - The turbine bases and wind farm infrastructure may result in localised alterations to the natural flow pathways in the soil and underlying geology. There could be lower groundwater recharge in areas of hardstanding and access tracks, and greater recharge in areas of permeable soil surfaces. However, these effects would be minor and localised.

9.95 **Turbine Bases -** Alkaline leaching into the groundwater could occur as a result of sulphate attack of the concrete in the turbine foundations. It is considered that such leaching would be minimal and very localised.

9.96 It should be noted that a fair proportion of the site would remain unsurfaced and hence there would continue to be a large amount of natural soakaway direct to the underlying ground. It is therefore considered that there would be minimal risk of increased surface run off to Site drainage channels and water courses and hence the identified water courses are unlikely to be affected by the development.

Decommissioning

9.97 The wind farm is expected to be operational for at least 25 years. Following this period, if the operational period is not extended, the wind farm will be decommissioned and the site reinstated as approved by the appropriate authority, and in agreement with the landowners.

9.98 Potential effects of the decommissioning phase are expected to be similar to those of the construction phase and have not been assessed further here.

MITIGATION

9.99 Mitigation measures have been divided into **design measures** (those incorporated into the design stage to minimise potential impacts), **general measures** (generic methods that will be implemented on site) and **construction measures** (mitigation for specific construction activities).

Design Measures

9.100 Design mitigation has influenced the location of turbines and associated infrastructure to avoid effects on sensitive areas, steep gradients and watercourses. In particular, the impacts described above may affect existing surface water drains and features. During the design phase the following measures were implemented to protect the hydrological features of the site:

- access track design and turbine locations have avoided water crossings where possible; and
- Deep excavations (up to 2.85m depth) would be associated with construction of turbine bases. These will be located within the underlying superficial deposits with the exposed impermeable area reduced by covering the foundations with soil.

General Measures

9.101 Construction method statements would be produced and would incorporate best working practices and measures from EA's Pollution Prevention Guidelines. The method statements would include the following:

- A series of method statements relating to activities which have the potential to affect surface water and groundwater resources and outlining preventative measures;

- An incident plan outlining actions to be taken in the event of accidental chemical or foul water spills, localised flooding and erosion. The plan would include the implementation of contingency planning provision, spill kits and staff and contractor training procedures; and
- A surface run-off and monitoring plan to be agreed with the EA.

9.102 During the tender process, the expected level of environmental control will be included in tender documents so that all contractors allow for mitigation measures in their costs and method statements.

9.103 During construction of the wind farm the Construction Project Manager will ensure that the proposed mitigation measures are put in place and carried out in such a manner as to minimise or prevent effects on surface water and groundwater. In addition to generic mitigation techniques such as the adoption of spill response measures, a number of targeted mitigation measures are available to control pollution.

9.104 In addition to the measures proposed below, a Water Users Management Plan will be designed to ensure relevant users of abstractions are aware of construction activities within the catchment of the spring supply. **ecotricity** will agree detailed mitigation measures for specific water users, this will comprise either provision of an alternative supply should surface and groundwater be influenced or connection to alternative supply.

9.105 Water sampling and quality assessment will be carried out at regular intervals during the construction phase of the wind farm. This will be agreed with the Local Authority and EA. Immediate action will be taken should the samples not meet the agreed standards.

9.106 Surface water drains would be regularly inspected for any sedimentation or blockages.

Construction Measures

9.107 A full soil investigation (including analytical testing for pH and sulphate concentrations) will be undertaken by the appointed contractors prior to construction to ensure that the most appropriate concrete and foundation materials are used. This will be done in accordance with the BRE Special Digest 1:2005 “Concrete in Aggressive Ground” (or similar appropriate guidance) to determine the Design Sulphate Class and the ACEC (Aggressive Chemical Environment for Concrete).

9.108 The following measures provide mitigation proposals for specific construction activities:

9.109 **Access Tracks** - Where additional impervious areas are required, the following measures are proposed:

- The access track would be constructed of crushed aggregate, an inert material appropriate to withstand the expected traffic loading, on a fibrous permeable material. This will also maximise infiltration through the track, minimising surface runoff and reducing the potential for erosion;
- The aggregate will be screened to avoid the build up of sludge;
- Vehicles and machinery would be restricted to the access tracks;
- Tracks would have adequate cross fall to allow rainwater to be shed. Lateral drains will intercept flow along the road; and
- Prior to track construction, site operatives will identify areas which concentrate water flow. These sections will be spanned with plastic pipes to ensure hydraulic conductivity under the road, and reduce water flow over the road surface during heavy rain.

9.110 **Turbine Construction and Crane Hardstanding Areas** – from boreholes in the vicinity of the site, groundwater does not appear to be at shallow depth in the surrounding area. Therefore it is considered that there is likely to be minimal impact upon groundwater flow, soil interflow and drainage patterns as a result of the proposed construction of the turbines. Notwithstanding the above during this construction, the following measures are proposed:

- Where drainage into the excavated turbine footings occurs, a wall or plank support will be provided where saturated soils are being dewatered to prevent slumping of excavation walls and reduce volume of water requiring settlement;
- Construction activities will be scheduled to minimise the area and period of time that stockpiles would be exposed;
- Silt fences and mats will be used to control silt levels in runoff. To avoid silt directly entering the site surface water drains, runoff will be controlled and directed to buffer zones and silt fences and passed through a suitable filter medium such as straw bales or geotextiles;
- Silt water generated during construction activities will be collected and treated with a suitable method to be confirmed with the EA. This may involve the use of a settlement pond or tank, or a grassed area. Alternatively filtration systems can be constructed on site or mobile commercial ‘siltbuster’ units brought on site. These systems avoid further loss of habitat occurring as a result of excavated settlement lagoons;
- Particular attention will be paid to identify runoff and drainage pathways. Flocculants to aid settlement will be retained on site for emergency measures and all pollution control will be subject to consultation with the EA and Natural England;
- Where possible, water will be prevented from entering excavations by using cut-off ditches or walls; and,
- Exposed ground and soil stockpiles will be minimized. Where present, they will be seeded or covered and silt fences constructed to intercept small erosive channels (runnels).

9.111 **Cabling** - To minimise impediment of soil interflow and excavation activities, cables will be laid adjacent to access tracks as far as practicable. Typically, drainage channels will be on the upslope side, and cables on the downslope side.

9.112 **Temporary Construction Compound** - A temporary compound will be provided during construction to provide a designated area for temporary sanitation facilities and storage of materials (including fuels, oils and lubricants) in addition to acting as a potential maintenance area. It is proposed that this be located adjacent to the existing Six Hundred Farm buildings.

9.113 The following measures will be implemented to avoid chemical pollution on the site:

- A dedicated secure storage area for all materials, including waste, will be created within the temporary construction compound. Clear warning signs will be displayed at all access points;
- Oils, fuels and lubricants will be stored in above ground storage tanks and containers that have been manufactured under a quality assurance system complying with relevant British Standards. The storage will be in line with the EA's Pollution Prevention Guidelines, PPG2 Above Ground Oil Storage Tanks and in compliance with the Control of Pollution (Oil Storage) (England) Regulations 2001;

- Storage tanks, containers and ancillary equipment will be placed within oil and watertight secondary containment such as a bund. The secondary containment system will provide storage of at least 110% of the tanks maximum capacity;
- Secondary containment will be secured to avoid unauthorised access and vandalism;
- Containers will be clearly labelled with the nature of contents and any hazards they could pose;
- Within the construction compound a dedicated handling area will be constructed which would be isolated from surface water drainage systems, have an impermeable base and be bunded and secured;
- Where possible, re-fuelling of vehicles and machinery would be carried in the dedicated handling area;
- Where possible, standing machinery would have drip trays placed underneath to prevent oil and fuel leaks resulting in pollution;
- A contingency plan will be produced detailing site drainage and a list of contacts in the event of a spillage in line with PPG 21 Pollution Incident Response Planning. Spillages will be reported to the site manager immediately. A stock of absorbent materials will be stored on site to deal with spillages, and staff will be trained in their appropriate use; and,
- Training of staff in the correct use and storage of all oils and chemicals on site.

Operational Measures

9.114 The effects identified for the operational phase are similar to those associated with the construction phase; however these effects are less severe due to the reduced activity on site. Therefore, pollution prevention measures detailed in the construction mitigation section above will also be adhered to during the operational phase. The contingency plan will be updated to ensure that it is specific to the risks and appropriate procedures should a spillage occur during the operational phase.

9.115 Additional mitigation measures that will remain in place throughout the lifetime of the wind farm would include those outlined in the following section.

9.116 **Chemical Pollution:** Engineers would be required to visit the site to undertake maintenance and repair of the turbines and infrastructure. Pollutants associated with these activities (i.e. fuel, oil, lubricants) would not remain on site once the visit has been completed. Whilst spillages of these substances could take place during the visit, all health and safety procedures and environmental best practice would be followed during these visits. Sulphate resistant concrete would be used, subject to a geotechnical survey, to prevent alkaline leaching from buried structures.

9.117 **Foul Water:** No additional sanitation facilities will be present on site during the operational phase.

9.118 **Flow Patterns on Site:** Given that there is likely to be minor impact upon the drainage patterns, erosion and run-off on the site from the proposed turbine construction, it is not considered necessary to implement any specific drainage solutions with respect to the site. If the EA consider that drainage solutions are required we would recommend that a suitable SUDS solution may be appropriate.

Decommissioning

9.119 Mitigation measures for decommissioning activities are assumed to be similar to the proposed mitigation techniques for construction activities and are therefore not discussed separately here.

STATEMENT OF RESIDUAL SIGNIFICANCE

9.120 Taking into account the proposed mitigation measures, no significant environmental impacts have been identified during the course of this review.

9.121 The effects on geology, hydrology and hydrogeology from the proposed development have been assessed as **not significant** in identified aspects (see Table 9.12). Impacts of moderate significance or greater are considered significant in terms of the EIA Regulations, and therefore with mitigation the potential effects are not considered to be significant.

REFERENCES

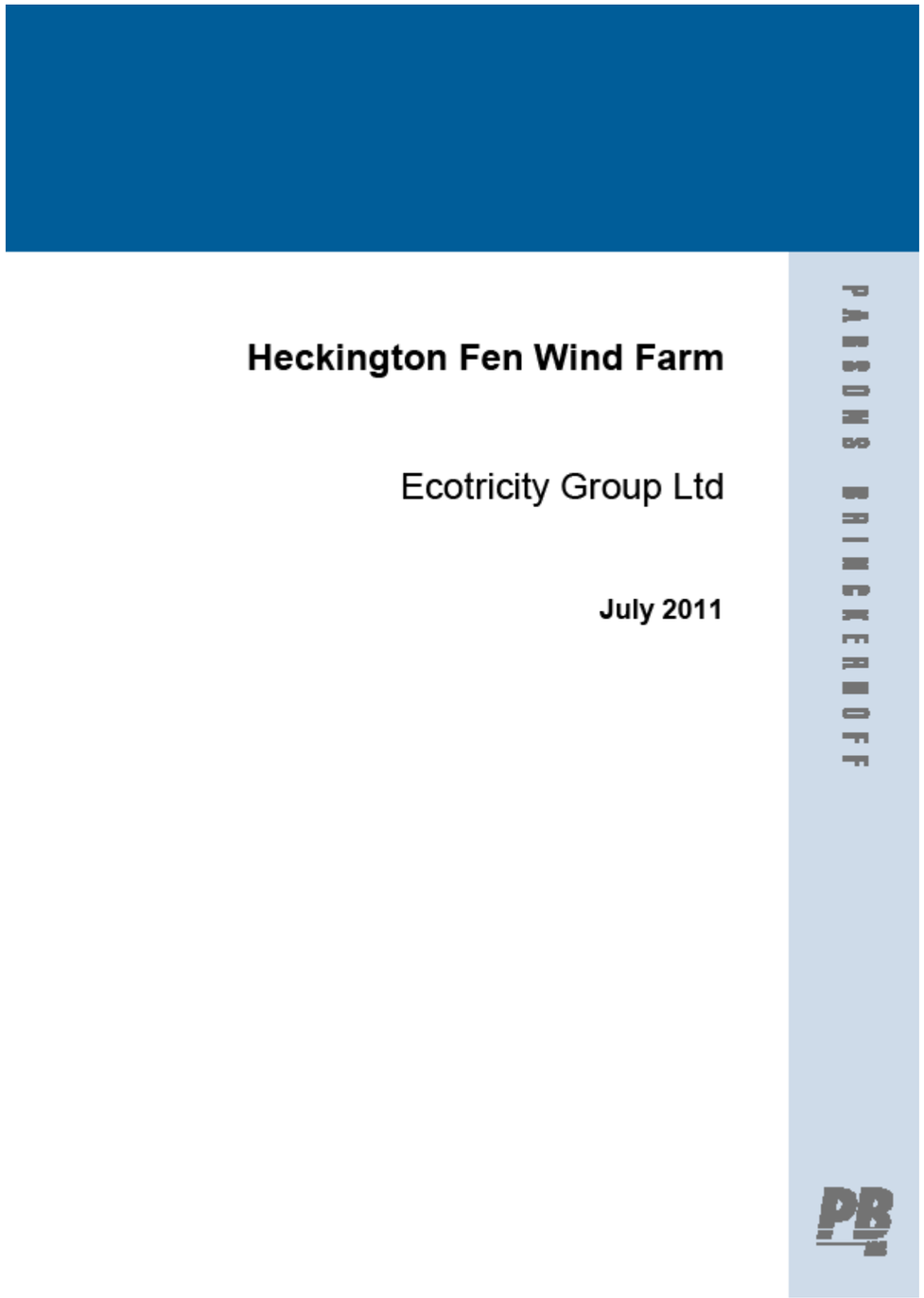
- Environment Agency, www.environment-agency.gov.uk
- British Geological Survey website, www.bgs.ac.uk
- British Geological Survey, Wells, Boston, Sheet 128 Solid and Drift Edition, 1:50 000
- National Soil Resources Institute, Soilscapes Viewer Report www.landis.org.uk
- Met Office Average Rainfall data www.metoffice.gov.uk
- National River Flow Archive Online Data, http://www.ceh.ac.uk/data/nrfa/index.html
- Ordnance Survey 1: 25 000 Explorer Map, Boston, Sheet 261
- North Kesteven District Council
- Natural England, www.naturalengland.org.uk
- Environment Agency, Where to Go Fishing, (Waterscapes).

Table 5.11 Significance of Effects

Stage of development	Feature (Receptor)	Sensitivity of receptor	Description of Potential Effect	Before Mitigation		Summary of Mitigation	After Mitigation					
				Magnitude of change	Significance before mitigation		Magnitude of change	Positive / Negative	Direct / Indirect / Secondary / Cumulative	Short / medium / long term	Permanent / Temporary	Residual Significance
Geology/Groundwater												
Construction/ Operation	Geology	Low	Disruption of local geological features from deep (2.85m) turbine excavations and maximum 20m	Minimal change	Negligible - Minor	The excavations and piles are predicted to be within the topsoil and superficial geology. No mitigation required.	Minimal change	Negative	Direct	Long term	Permanent	Negligible - Minor
Construction/ Operation	Groundwater	Low	Chemical pollution: Leaching of hydrocarbons, chemicals and cement to groundwater.	Very low-low	Minor	Oil/ chemicals stored in 110% bund, drip trays, refuelling within designated area. Provision of spill kits on site and trained staff. Temporary sanitation facilities maintained by licensed operators.	Minimal change	Negative	Direct	Short term	Permanent	Negligible-Minor
Abstractions												
Construction/ Operation	Groundwater	Low	Potential for leaching of concrete. Spillages and leakages during storage or routine maintenance.	Very low-low	Minor	Very small amounts of chemicals will be present on site during maintenance visits only. Operational phase will comprise small-scale routine activities.	Minimal change	Negative	Direct	Short term	Permanent	Negligible-Minor
Flooding												
Construction/ Operation	Surrounding land	High	Development (land take) and increased hardstanding may exacerbate flooding in downstream areas.	Very low-low	Moderate	Land use will remain largely rural. Use of sustainable urban drainage systems (SUDS) where appropriate.	Minimal change	Negative	Indirect	Medium term	Temporary	Minor-Moderate

Stage of development	Feature (Receptor)	Sensitivity of receptor	Description of Potential Effect	Before Mitigation		Summary of Mitigation	After Mitigation					
				Magnitude of change	Significance before mitigation		Magnitude of change	Positive / Negative	Direct / Indirect / Secondary / Cumulative	Short / medium / long term	Permanent / Temporary	Residual Significance
Water Quality												
Operation	Local drainage channels, South Forty Foot Drain, River Witham	Low	Spillages and leakages during storage or routine maintenance.	Very low-low	Minor	Very small amounts of chemicals will be present on site during maintenance visits only. Operational phase will comprise small-scale routine activities.	Minimal change	Negative	Direct	Short term	Temporary	Negligible-Minor
Construction	Local drainage channels, South Forty Foot Drain, River Witham	Low	Sediment entrained runoff from excavations and infrastructure construction reaching off-site surface water courses. Risk to downstream resources.	Very low-low	Minor	During construction, use of silt traps, pumping water to natural soakaways and/ or use of mobile siltbuster units, use of silt fences, mats and/ or geotextiles around construction activities	Minimal change	Negative	Direct	Short term	Temporary	Negligible-Minor
Fisheries and Recreation												
Operation/ Construction	Local drainage channels, South Forty Foot Drain, River Witham	Low	As water quality above.	Minimal	Negligible - Minor	As water quality above.	Minimal change	Negative	Direct	Short term	Temporary	Negligible - Minor
Decommissioning	Effects arising from decommissioning are anticipated to be similar to the construction effects as described above.											

APPENDIX 9.1: FLOOD RISK ASSESSMENT



Heckington Fen Wind Farm

3511012A

Prepared for
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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

Parsons Brinckerhoff was commissioned by Ecotricity to prepare a site specific Level 2 FRA to support the proposed Heckington Fen Wind Farm. The FRA was conducted in accordance with PPS25 and provided a qualitative assessment of flood risk to the development proposals and to people and property elsewhere as a result of the planned development.

The Heckington Fen Wind Farm is located in the Lincolnshire Fens between Boston and Sleaford. The development proposals comprise the construction of wind farm consisting of a maximum of 22 wind turbines, an electrical substation and associated infrastructure. The site boundary encompasses approximately 600 hectares (ha) of agricultural land, although the proposed wind turbines occupy approximately only half of this area to the north of the site.

Site topography ranges from approximately 3m Above Ordnance Datum (AOD) in the south of the site to approximately 0.6m AOD in the north-east of the site. A network of land drains within the site aid with the discharge of surface water runoff.

The greatest source of flooding to the proposed development has been identified to be fluvial flood risk from the surrounding watercourses. The site is located within the high risk Flood Zone 3a where the annual probability of fluvial flood risk is greater than 0.1% (1 in 100) in any one year. Based on hydraulic modelling of adjacent watercourses, the maximum water level during a 1 in 100 year event would be approximately 2.84m AOD. During a more extreme 1 in 1000 year event, the maximum water level is predicted to be approximately 3.02m AOD. The maximum flood depths during these events in the lowest parts of the site would be approximately 2.24m during the 1 in 100 year event and 2.42m during the 1 in 1000 year event.

Overland flow could pose flood risk to the development if the land drainage network was to reach capacity and/or the pumping stations which manage water in the drainage channels were to fail. However, it is considered unlikely that the resultant flood depth would be greater than the predicted fluvial flood depth as discussed above.

The proposed wind turbines and electrical substation compounds are estimated to remove up to 1538m^3 of flood water storage during a 1 in 100 year event. However, considering the size of the site and existing flood plain, this loss of flood storage is not considered to pose any significant increase in flood risk to the site or to people and property elsewhere. The proposed wind turbines and electrical substation are also not considered to have significant effect on the ability of flood waters to pass through the site.

Within the wind turbines, it is proposed that the electrical components are situated above the level of the 1 in 1000 year plus climate change flood level to prevent damage from the potential ingress flood waters. Similarly, the electrical substation will be built on ground above the level of the 1 in 1000 year plus climate change flood level.

New access tracks serving the wind turbines and the substation compound will be constructed of permeable compacted hardcore. Surface water will infiltrate through the crushed aggregate as per the current situation. Surface water run off from the substation will be managed to ensure no increased flood risk to the site or surrounding land, either through infiltration to the ground or direct discharge to a drainage ditch at an attenuated rate.

New or improved culverts will be required to enable the proposed access tracks to traverse the network of land drains which pass through the site. Prior consent for these works will be obtained from the Black Sluice Internal Drainage Board and the culverts will be designed to maintain existing flow conditions.

SECTION 1

INTRODUCTION

1 INTRODUCTION

1.1 Project Background

1.1.1 Parsons Brinckerhoff Ltd (PB) has been commissioned by Ecotricity to prepare a site specific Flood Risk Assessment (FRA) to support the Heckington Fen Wind Farm proposal. A description of the development proposals is provided in Section 1.3.

1.1.2 Review of indicative flood maps available from the Environment Agency (EA) website indicates that the proposed development site is located within the high risk Flood Zone 3. Review of standing advice provided by the EA states that a FRA will be required to support the planning application for all developments in Flood Zone 3.

1.1.3 The FRA will be conducted in accordance with Planning Policy Statement 25: Development and Flood Risk (PPS25) as a 'Level 2' FRA which provides a predominantly qualitative analysis of flood risk to support the planning application. PPS25 states that a Level 2 assessment should confirm the sources of flooding which may affect the site; qualitatively assess the risk of flooding to the site and to adjacent sites as a result of development; review the availability and adequacy of existing information; and discuss possible measures which could reduce flood risk to acceptable levels.

1.2 Consultation

1.2.1 Scoping opinions were sought from North Kesteven District Council (NKDC) in September 2010 and response regarding flood risk was received from the EA in October 2010. The EA advises that the FRA should consider:

- Whether the site falls within the coastal flood hazard area;
- The risk to the site from the Head Dyke Main River;
- How surface water will be managed on the site;
- Whether the proposed development will obstruct flood flows;
- How critical equipment will be designed to continue operating in flood conditions.

1.2.2 PB undertook further consultation directly with the EA in October and November 2010. The EA confirmed that the site is in an area of high fluvial flood risk, designated as Flood Zone 3a, and provided information regarding current and future flood levels. The EA also confirmed that the site is not at risk from tidal flooding.

1.2.3 Consultation was undertaken with the Black Sluice Internal Drainage Board (IDB) in September 2009. The Black Sluice IDB stated that the proposed wind turbines must be located 9m away from an IDB watercourse. The Black Sluice IDB also confirmed that their prior consent will be required under Byelaw 10 and Section 23(1) of The Land Drainage Act 1991 before any IDB watercourse or riparian/private watercourse is culverted, filled in or otherwise obstructed.

1.2.4 A copy of all consultation is provided in Appendix C.

1.3 The Development Proposals

1.3.1 The Heckington Fen Wind Farm development proposals comprise of the construction of a wind turbine farm located near East Heckington, Lincolnshire. In summary, the development will include:

- The construction of a maximum of 22 no. type E82 2.3MW wind turbines, with a base diameter of 4.3m with a 1m flange around (6.3m in total);
- The construction of a network of permeable crushed aggregate access tracks to connect to the existing access road, with a total length of approximately 10.6km;
- The construction of a 132kV electricity sub-station comprising a permeable compound with a footprint of approximately 120m^2, plus a sub-station building of approximate dimensions 10m x 5m.

1.3.2 A plan of the development proposals and turbine foundation design is provided in Appendix A.

SECTION 2

ASSESSMENT METHODOLOGY

2 ASSESSMENT METHODOLOGY

2.1 Flood Risk Assessment Overview

2.1.1 The assessment has been conducted in accordance with PPS25. The document provides guidance on how new developments must take into account flood risk, including making allowance for climate change impacts. PPS25 introduces the Sequential Test approach to flood risk, with the aim to steer development to areas with the lowest flood risk probability. If, after the Sequential Test has been applied, the development cannot be located in a low risk area, the Exception Test can be conducted through an appraisal of risk and implementation of appropriate reduction and management measures.

2.1.2 PPS25 Table D1 sets out the Flood Zones and appropriate land uses based on a vulnerability classification. Table D2 sets out the Flood Risk Vulnerability Classification for different types of development. Table D3 then sets the Flood Risk Vulnerability against Flood Zone Compatibility, and indicates whether a particular type of development is appropriate for each case and if the Exception Test is required. Tables D1, D2 and D3 are reproduced in Appendix B of this report.

2.1.3 The methodology adopted in this Level 2 FRA comprises:

- Review of available flood risk data (including the EA indicative flood risk maps, the North Kesteven Strategic Flood Risk Assessment (SFRA) and EA flood risk data) to identify existing flood risk from fluvial, tidal, groundwater and overland flow sources;
- Consideration of existing ground conditions on site to determine groundwater levels and soil permeability through review of information available from the EA and the British Geological Survey (BGS);
- Review of the development proposals in terms of flood risk vulnerability and flood zone compatibility, as defined by PPS25;
- Consideration of how the development proposals may affect flood risk to the site and surrounding land;
- Development of mitigation measures to manage flood risk to the development proposals or an increase in flood risk to surrounding land, if deemed required.

2.2 Definition of Flood Risk

2.2.1 Flood frequency is identified in terms of the return period and annual probability. For example, a 1 in 100 year flood event has a 1% annual probability of occurring. Table 2.1 below provides a conversion between return periods and annual flood probabilities.

Table 2.1 Flood probability conversion table

Return Period (years)	2	5	10	20	50	100	200	1000
Annual Flood Probability (%)	50	20	10	5	2	1	0.5	0.1

2.3 Flood Zones

2.3.1 PPS25 identifies Flood Zones in relation to flood risk. The zones refer to the probability of river (fluvial) and sea (tidal) flooding, whilst ignoring the presence of defences. Table 2.2 below summarises the relationship between Flood Zone category and the identified flood risk.

Table 2.2 Flood Zones

Flood Risk Area	Identification	Annual Probability of Fluvial Flooding	Annual Probability of Tidal Flooding
Zone 1	Low Probability	<0.1%	<0.1%
Zone 2	Medium Probability	1% – 0.1%	0.5% – 0.1%
Zone 3a	High Probability	>1%	>0.5%
Zone 3b	Function Flood Plain	>5%	>5%

2.4 Indicative Flood Risk Maps

2.4.1 The EA prepare indicative flood maps which highlight areas considered likely to flood from fluvial and tidal sources during different return periods. NKDC has also recently published their SFRA which identifies areas considered likely to flood from fluvial and tidal sources, as well as highlights potential risks from groundwater, surface water, sewers and artificial sources (such as reservoirs and canals).

2.5 Flood Hazard Mapping

2.5.1 Flood hazard maps have been prepared as part of the North Kesteven SFRA. This mapping was developed using the definitions of hazard zones identified in "Flood Risk in Assessment Guidance for New Development, Phase 2 R&D Technical Report FD2320 (Environment Agency, 2006)", using a matrix of flood flow velocities and depth to define categories of hazard.

2.6 Potential Sources of Flooding

2.6.1 In accordance with PPS25, the following sources of flooding will be considered in this assessment:

- Fluvial flood risk from nearby watercourses;
- Tidal flood risk from the North Sea and nearly watercourses;
- Overland surface water flooding from adjacent sites;
- Site generated surface water runoff;
- Surcharging of sewers; and
- Groundwater flooding.

2.7 Review of Relevant Planning Policy

North Kesteven Local Plan

2.7.1 The North Kesteven Local Plan was adopted in September 2007 with the purpose of controlling development in the District. Under the provisions of the Planning and

Compulsory Purchase Act 2004, the North Kesteven Local Plan expired in September 2010. However, the Secretary of State has directed that all policies in the North Kesteven Local Plan are saved beyond the expiry of the plan.

2.7.2 Policy C10 of the plan contains the following guidance regarding flood risk:

- Planning permission will be granted for proposals only if they will not be at an unacceptable risk of flooding, not unacceptably increase flood risk elsewhere, and not affect the integrity of existing flood defences to the level where they would not provide an acceptable standard of safety over the lifetime of the development.
- Priority will be given in permitting sites for development in ascending order of flood zones from Flood Zone 1 to Flood Zone 3.
- Where possible, new developments should result in the overall reduction of flood risk and all relevant planning applications must be accompanied by a flood risk assessment.

SECTION 3

SITE DESCRIPTION

3 SITE DESCRIPTION

3.1 Site Description

3.1.1 The proposed Heckington Fen Wind Farm is located in the Lincolnshire Fens at approximate OS Grid Reference TF205450, 20km inland from the Wash Estuary and 12km west of Boston. The site location is illustrated in Figure 3.1 below. A detailed map of the site highlighting key topographical and surface water features is provided in Appendix A of this report. A site visit was undertaken on 16 November 2010 for site familiarisation.

3.1.2 The site occupies approximately 600 ha of relatively flat low-lying agricultural fenland, surrounded on all sides by further agricultural land. Topographic data obtained from Ordnance Survey maps and LiDAR data provided by the Black Sluice IDB indicates that levels within the site boundary range from approximately 3m Above Ordnance Datum (AOD) in the south to a minimum of 0.6m AOD in the north east.

Figure 3.1 Site Location

3.1.3 The wind turbines are to be constructed within the northern half of the site to maintain a 1km buffer between the turbines and the properties on the southern site boundary.

3.1.4 The site is currently used for arable farming. The derelict Six Hundreds Farm is located in the centre of the site and comprises a disused farmhouse plus associated outbuildings. A below ground gas main runs north-south through the site and is identifiable on site by a line of marker posts. A gas valve compound that serves the gas main is located in the north-west of the site and is to remain unaffected post-development.

3.2 Surface Water Features

3.2.1 The proposed site is characteristic of the Lincolnshire Fens, with a network of open drainage channels criss-crossing the site. The location surface water features is highlighted on the map contained in Appendix A.

3.2.2 The site is bound to the north, east and west by drainage channels and to the south by the A17 principal road. Site photographs are included in Appendix F and show typical examples of the existing drainage channels which range from small field drains to larger open channels. Named drains within the site boundary include the Labour in Vain Drain in the west of the site and Holland Dyke on the eastern site boundary.

3.2.3 The Labour in Vain Drain, Holland Dyke, an un-named drainage channel that runs north-south through the site and the drainage channels which form the northern and western site boundaries are understood to be in IDB ownership. A plan of those drains identified to be in IDB ownership in provided in Appendix A.

3.2.4 During the site visit it was noted that many of the shallower drainage channels were either dry or at very low water levels. A significant volume of water was present in the larger drainage channels to north and east of the site (as shown in the site photographs) and the water level on the day of the site visit was estimated to be approximately 2-3m below ground level.

3.2.5 An EA Main River, known as Head Dyke–Skerth Drain, flows parallel to the north and east site boundaries. Flow from Head Dyke–Skerth Drain is pumped into the South Forty Foot Drain to south-east of the site. The South Forty Foot Drain is a major drainage channel that discharges into the Wash through the Black Sluice Pumping Station in Boston.

3.2.6 The network of smaller drainage channels which pass through the site discharge into the larger channels which form the site boundary, which in turn are pumped into the Head Dyke–Skerth Drain at Heckington Pumping Station and Trinity College Pumping Station. The plan provided in Appendix A shows the location of these pumping stations. Through consultation with the IDB it was confirmed that the land drainage system and pumping stations are designed to have sufficient capacity for an approximate 1 in 50 year event.

3.2.7 During the site visit it was noted that the water level within Head Dyke-Skerth Drain is maintained at a higher level than that in the IDB drainage channels to the north and east of the site. The water level in Head Dyke–Skerth Drain was estimated to be approximately level with adjacent ground level within the site boundary. Head Dyke–Skerth Drain is flanked by flood defences on both sides in the form of earth bunds.

3.3 Groundwater Conditions and Hydrogeology

3.3.1 Data obtained from the British Geology Society (BGS) indicates that the solid geology beneath the site comprises grey shelly mudstone of West Walton and Oxford Clays formations which lie over the Lincolnshire Limestone Formation. This is confirmed by the National Soil Resources Institute Soils Site Report which states that the site area is underlain by deep stoneless clayey soils which are calcareous in places. Using the Hydrology of Soil Type (HOST) index, the site is classified as Type 9, defined as 'soils seasonably waterlogged by fluctuating groundwater and with relatively slow lateral saturated conductivity'. This was confirmed during the site visit when standing water was observed in a number of locations despite no significant rainfall events in the preceding 5 days.

3.3.2 The site is not located in a Source Protection Zone, as defined by the EA, and the aquifer beneath the site is classified by the EA as an unproductive strata with low permeability and with negligible significance for water supply or river base flow.

3.3.3 BGS records of three boreholes in the vicinity of the site, which were taken to a maximum depth of 453m, have no record of groundwater being struck.

SECTION 4

EXISTING FLOOD RISK

4 EXISTING FLOOD RISK

4.1 Fluvial Flood Risk

4.1.1 The EA has confirmed that the majority of the site is located within the high risk Flood Zone 3a due to the risk of fluvial flooding from the adjacent Head Dyke–Skerth Drain watercourse. The extent of the flood plain within the vicinity of the site is illustrated in Figure 4.1 below.

Figure 4.1 Extract of EA Flood Map. © Environment Agency copyright and database rights 2010.

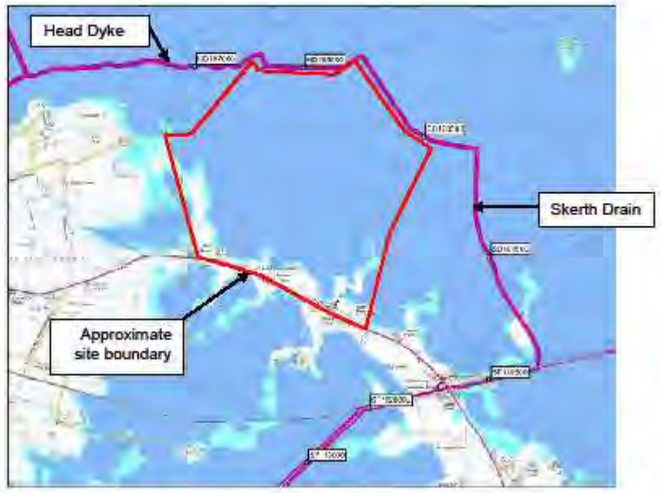


Figure 4.2 - Extract of EA Flood Map. © Environment Agency copyright and database rights 2010.

4.1.2 Figure 4.2 illustrates identified flood risk within the site boundary. The dark blue areas denote the extent of the high risk Flood Zone 3 in which the annual probability of fluvial flooding is greater than 1% (1 in 100 year). The light blue areas denote the extent of the medium risk Flood Zone 2 in which the annual probability of fluvial flooding is between 1% (1 in 100 year) and 0.1% (1 in 1000 year). The unshaded areas indicate those areas deemed to be at low flood risk where the annual probability of flooding in less than 0.1% (1 in 1000 year). As demonstrated in Figure 4.2, the northern half of the site which will accommodate the proposed wind turbines is located almost entirely within the high risk Flood Zone 3. The EA has confirmed that the site is not located in the functional floodplain, Flood Zone 3b.

4.1.3 The EA have provided hydraulic modelling data of the South Forty Foot Drain and its tributaries (dated May 2009). Table 4.1 shows the flood heights at a number of node points along Head Dyke-Skerth Drain for the existing 1 in 10 year event, 1 in 100 year event and 1 in 1000 year event. The model also provides predictions for future flood levels when the potential effects of climate change are considered. Detailed output from the model is provided in Appendix C.

Table 4.1 Flood Levels from EA South Forty Foot Drain Model

Node Label	Location	Annual Exceedance Probability (AEP) – Maximum Water Levels (m AOD)				
		10% AEP	1% AEP	0.1% AEP	1% AEP + CC	0.1% AEP + CC
HD107000	Adjacent to Five Willow Bridge to north west of the site.	2.29	2.84	3.02	2.90	3.04
HD105500	On northern site boundary	2.31	2.82	2.98	2.87	3.00
SD103500	Adjacent to Trinity College Pumping Station on north-eastern site boundary	2.27	2.79	2.92	2.83	2.95
SD101500	On Skerth Drain approximately 500m to the east of the site.	2.31	2.74	2.89	2.79	2.87

4.1.4 The model estimates that the maximum water levels within Head Dyke-Skerth Drain within the vicinity of the site are approximately 2.84m AOD during a current 1 in 100 year event (1% AEP) and 3.02m AOD during a current 1 in 1000 year event (0.1% AEP).

4.1.5 Site topography ranges between a minimum of approximately 0.6m AOD in the north-east of the site to approximately 3m AOD in the south of the site. A flood level of 2.84m AOD during a 1% annual probability flood event would submerge the lowest parts of the site by a maximum of approximately 2.24m. During a 0.1% annual probability event with a predicted flood level of 3.02m, the lowest parts of the site would be submerged by a maximum of approximately 2.42m. However, the values shown in Table 4.1 are the predicted height of flow in the watercourse and may not accurately represent the flood level on the site in the event of a breach or overtopping of the flood defences.

4.1.6 The Head Dyke-Skerth Drain watercourse is flanked on both sides by an earth embankment, providing flood protection to the site. The EA states that these defences are in fair to good condition and, at minimum, provide protection against a 1 in 10 year (10% annual probability) flood event. With reference to Table 4.1, this suggests that flood protection is provided to a minimum level of approximately 2.30m AOD.

4.2 Flood Hazard Mapping

4.2.1 Flood Hazard Mapping was undertaken as part of the North Kesteven 'Level 2' SFRA for the Lower Witham Fens. An Isis Tuflow hydraulic model was used to assess fluvial flood hazard resulting from likely breaches in the Lower Witham, River Slea / Kyme Eau and South Forty Foot Drain to identify degrees of flood hazard in the area. A hazard map showing the output from this model is provided in Appendix D. The proposed development site is identified as being in an area of Low Hazard.

4.3 Tidal Flood Risk

4.3.1 The site is 20km inland and there are no tidal watercourses within the vicinity of the site. The site is therefore not deemed to be at risk of tidal flooding, as confirmed by the EA.

4.3.2 The South Forty Foot Drain, which receives flow from the site and surrounding land, has a pumped discharge into the Haven which is a tidally influenced tributary of the Wash. The pumping station can discharge at all stages of the tide cycle and is not affected by the tidal range.

4.4 Flood Risk from Overland Flow

4.4.1 For the purpose of this FRA, flood risk from overland flow is defined as flooding from surface water runoff, surcharging of the sewerage network or overland flow from artificial sources, such as canals and reservoirs.

4.4.2 During normal rainfall conditions surface water runoff from the site and surrounding land is not considered to pose significant flood risk to potential development due to the arable and flat nature of the site and surrounding land. Whilst the impermeable nature of the underlying geology will mean that surface water will not infiltrate easily, the land drainage network will collect surface water runoff and discharge it to Head Dyke-Skerth Drain via pumping stations.

4.4.3 The IDB confirm that the pumping stations are designed to have capacity for a 1 in 50 year event. However, there is a residual flood risk to the site if flow exceeds the capacity of the pumping stations or if there is mechanical or electrical failure of the pumping stations. Any overland flow surcharging from the drainage channels will follow natural topography and flow to the lowest ground in the north east of the site.

4.4.4 Overland flow as a result of pump failure or system capacity could pose flood risk to the proposed wind farm development. Whilst it is not possible to quantify the likely depth of flood waters, it is considered unlikely that the resultant flood depth would be greater than the predicted fluvial flood depth as predicted in Section 4.1 above.

4.4.5 There is no known risk of flooding on the site arising from reservoirs or canals. The rural nature of the site suggests that there are no significant flood risks from surcharging of adjacent sewers.

4.5 Groundwater Flood Risk

4.5.1 Groundwater flooding occurs when the normal water table rises above the ground level and flows or ponds on the ground surface. The North Kesteven SFRA reports that the flooding archive contains only one groundwater flooding incident in the North Kesteven District, in February 2007 in Sleaford, approximately 12km to the west of the site.

4.5.2 Given the impermeable nature of the ground and predicted significant depth to the groundwater table, the likelihood of groundwater flooding is considered negligible.

4.6 Potential Effects of Climate Change

4.6.1 There is an increasing body of scientific evidence that the global climate is changing as a result of human activity. For the UK, projections of future climate change indicate that more frequent short-duration, high-intensity rainfall events and more frequent

periods of long-duration rainfall could be expected and that sea levels will continue to rise.

4.6.2 The EA hydraulic model for Head Dyke–Skerth Drain, as summarised in Table 4.1, provides predictions for future flood levels when the potential effects of climate change are considered. The model estimates that the maximum water levels within Head Dyke-Skerth Drain within the vicinity of the site will be approximately 2.90m AOD during a 1 in 100 year plus climate change event (1% AEP + CC) and 3.04m AOD during a 1 in 1000 year plus climate change event (0.1% AEP + CC).

4.6.3 In the lowest areas of the site where topography drops to approximately 0.6m AOD, the site could experience a maximum flood depth of up to 2.30m during a 1 in 100 year plus climate change event and a maximum flood depth of up to 2.44m during a 1 in 1000 year plus climate change event. The frequency at which the site would experience flooding could also increase.

4.7 History of Flooding

4.7.1 The EA have confirmed they hold no records of flooding in the vicinity of the site.

4.8 Summary of Existing Flood Risk

4.8.1 The greatest risk of flooding to the proposed Heckington Fen Wind Farm site has been identified to be fluvial flood risk from the adjacent Head Dyke-Skerth Drain Main River to the north and east of the site. The EA has confirmed that the site is located in the high risk Flood Zone 3a.

4.8.2 Hydraulic modelling data supplied by the EA estimates a maximum water level in Head Dyke-Skerth Drain within the vicinity of the site of 2.84m AOD during a current 1 in 100 year event and 3.02m AOD during a current 1 in 1000 year event. Site topography ranges between a minimum of approximately 0.6m AOD in the north-east to approximately 3m AOD in the south. The maximum flood depths during these events would therefore be approximately 2.24m during the 1 in 100 year event and 2.42m during the 1 in 1000 year event.

4.8.3 Climate change is predicted to increase the intensity and duration of rainfall events. The hydraulic modelling data supplied by the EA predicts that the flood level in Head Dyke-Skerth Drain within the vicinity of the site will rise to approximately 2.90m AOD during a 1 in 100 year plus climate change event and 3.04m AOD during a 1 in 1000 year plus climate change event. During these events, the maximum flood depth in the north-east of the site would be 2.30m and 2.44m respectively.

4.8.4 It is important to note that the fluvial flood values are based on the predicted height of flow in the Head Dyke-Skerth Drain watercourse and may therefore not accurately represent the flood level on the site in the event of a breach or overtopping of the flood defences.

4.8.5 The IDB advise that the land drainage systems and associated pumping stations are designed to have capacity for a 1 in 50 year event. Overland flow as a result of pump failure or system capacity would follow natural topography to the north-east of the site and could pose flood risk to the proposed wind farm development. Whilst it is not possible to quantify the likely depth of flood waters, it is considered unlikely that the resultant flood depth would be greater than the predicted fluvial flood depth as discussed above.

4.8.6 The assessment has identified no significant flood risks from tidal or groundwater sources.

SECTION 5

POST DEVELOPMENT FLOOD RISK

5 POST DEVELOPMENT FLOOD RISK

5.1 Flood Storage

5.1.1 Construction in Flood Zone 3a could displace volume available for flood water storage, potentially increasing flood risk and flood extents elsewhere.

5.1.2 The elements of the proposed wind farm which have the potential to displace flood waters in Flood Zone 3a are the sub-station compound and the turbine masts. The proposed access tracks will be built flush with existing ground levels and hence will not reduce available flood storage,

5.1.3 The sub-station is to be located in an area of the site which is above the 1 in 1000 year flood level (0.01% annual probability) and its construction will have not reduce flood storage in all events up to this magnitude. Each wind turbine base has a diameter of 4.3m plus a 1m flange (6.3m in total) and will displace 31.2m^3 per metre of flood depth, totalling 686.4m^3 per metre flood depth for all 22 turbines.

5.1.4 Considering a predicted flood depth of 2.84m AOD during the current 1 in 100 year event and assuming a worst case scenario based on the lowest levels of the site, the construction of the turbine masts could displace up to approximately 1,538m^3 of flood storage. When considering this volume of lost flood storage in relation to the extent and depth of the flood plain across the c.600 ha site, this loss of flood storage is not considered to pose any significant increase in flood risk to the development or to people and property elsewhere.

5.1.5 For operational and safety reasons (as discussed in Section 5.5 below) it is recommended that the substation compound is constructed to the south of the site where flood risk and flood depths are less. This recommendation will also reduce the volume of flood storage lost within the site boundary.

5.2 Flood Flow Conveyance

5.2.1 No turbine will be located within 9m of existing land drain or watercourses, as required by the IDB, and the works require no alteration or diversion to the alignment of the existing land drains. The proposed development will therefore have no adverse impact on flow through the internal land drainage system.

5.2.2 A number of new access tracks are proposed which will require the construction of new culverts or amendment to existing culverts, as shown in a plan of the proposed access tracks contained in Appendix B. Where possible, the proposed access tracks will be built over existing farm tracks and will use existing culverts. Land Drainage Consent will be obtained for the construction of any new culverts and the culverts will be designed in consultation with the IDB to ensure no adverse impact to flow.

5.2.3 The Black Sluice IDB provides the following guidance on culverting and it is recommended that these requirements are met during the detailed design of the proposed development:

- "the Board will only consent to the culverting if the size of pipe will place no restriction on the flow of water in that watercourse, and where appropriate there are no environmental damages."

- "the applicant will, except in the circumstances of short lengths for access purposes, need to provide a short environmental assessment to demonstrate that there will be no loss of wildlife habitat."

5.2.4 During an extreme flood event, the proposed development is not predicted to have any significant impact on flood flow conveyance through the site. In particular, the circular form of the turbine bases and the wide spacing between the turbines will have little effect on overland flow paths.

5.3 Surface Water Runoff

5.3.1 The proposed development includes a network of new access tracks as illustrated in Appendix A. The access tracks will be constructed of crushed aggregate on a fibrous, permeable material. Surface water will infiltrate through these surfaces as per the current situation with no increase in surface water runoff.

5.3.2 The total impermeable plan area of the turbine masts is 686m^2, based on 22 turbines with a base diameter of 4.3m plus a 1m flange around the base. Rainfall onto the turbine masts will shed to the ground surrounding the turbines and drain as per the current situation with no increase in surface water runoff.

5.3.3 The proposed electrical substation compound, which contains electrical connection equipment required for the wind turbine development, has a footprint of approximately 120m^2. The majority of the substation compound comprises a crushed aggregate surface which will enable surface water to infiltrate as per the current situation.

5.3.4 Surface water discharge from the sub-station building, with approximate dimensions 10m x 5m, will be managed in a method agreeable with the IDB to ensure no increased flood risk to the site or surrounding land. Surface water will be managed either be through infiltration to the ground or, more likely considering ground conditions, direct discharge to a drainage ditch at an attenuated rate if deemed required.

5.4 Construction Flood Risk

5.4.1 During the construction period, a crane pad measuring approximately 20m x 40m will be provided next to each turbine and a construction compound measuring approximately 40m x 40m will be provided within the site boundary. The crane pads and construction compound will be constructed of compacted hardcore and hence remain permeable. Surface water will therefore infiltrate through these surfaces as per the current situation with no predicted increase in flood risk to the site or to people and property elsewhere.

5.4.2 It is recommended that the contractor prepares a flood emergency and contingency plan, monitors flood warnings posted by the EA or registers for early warning notices.

5.5 Operational Flood Risk

5.5.1 The wind farm will be an unmanned site and access is only required for routine testing and maintenance approximately every 6 months. The risks to people during an extreme flood event will be managed by controlling site access. The residual flood risk is considered to be negligible.

5.5.2 All turbines will be of a type that will allow partial submersion up to the design flood level. The transformer is to be located within the turbine tower and the turbines will be

water resistant with access hatches raised approximately 3m above ground level to minimise the risk of water ingress during a flood event.

5.5.3 The electricity sub-station will form part of the E-On Central Networks Primary Network and as such the flood protection must be designed in accordance with the E-On Central Networks Primary Network Design Manual, an extract of which is provided in Appendix D. In accordance with this manual, the substation is to be located in an area of the site that has a ground level above the 1 in 1000 year plus climate change flood event, estimated to be a maximum of 3.04m AOD.

5.6 Summary of Post Development Flood Risk

5.6.1 The construction of the turbine masts and substation compound has the potential to displace up to approximately 1,538m^3 of flood storage during a 1 in 100 year event. When considering this volume in relation to the extent and depth of the flood plain across the c.600 ha site, this loss of flood storage is not considered to pose any significant increase in flood risk to the development or to people and property elsewhere.

5.6.2 No turbine will be located within 9m of existing land drain or watercourses, as required by the IDB, and the works require no alteration or diversion to the alignment of the existing land drains. Any new culverts or amendments to existing culverts required to provide access to the turbines will be designed and constructed in accordance with IDB requirements. The proposed development will therefore have no adverse impact on flow through the internal land drainage system

5.6.3 The proposed access tracks, substation compound, crane pads and construction compound will be constructed on compacted hardcore and will therefore remain permeable. Rainfall onto the turbine masts will shed to the surrounding ground to drain as per the existing situation. There is therefore no predicted increase in surface water runoff that would have significant effect on flood risk to the site or to people and property elsewhere.

5.6.4 Surface water discharge from the sub-station building, with approximate dimensions 10m x 5m, will be managed in a method agreeable with the IDB to ensure no increased flood risk to the site or surrounding land.

5.6.5 The wind turbine towers will be water resistant with access hatches raised approximately 3m above ground level to minimise the risk of water ingress during a flood event. The electrical substation compound will be constructed on land above the 1 in 1000 year plus climate change flood event, estimated to be a maximum of 3.04m AOD.

5.6.6 The above assessment demonstrates that the development proposals will not significantly increase flood risk to the site or elsewhere and will be designed to ensure resilience to existing flood risk whilst allowing for potential climate change effects.

SECTION 6

SEQUENTIAL TEST AND EXCEPTION TEST

6 SEQUENTIAL TEST AND EXCEPTIONTEST

6.1 The Sequential Test

6.1.1 PPS25 recommends that the risk-based Sequential Test should be applied by the Local Planning Authority when considering applications for new development. Its aim is to steer new development to areas at the lowest risk of flooding (Flood Zone 1). Where this is not possible, higher risk flood zones can be considered, but in the context of Flood Risk Vulnerability Classification and the possible application of the Exception Test.

6.1.2 With reference to Table D2 of PPS25, the development proposals are considered to be 'Essential Infrastructure' as they comprise electricity generating equipment which will be connected to the national grid. As demonstrated in Section 4, the development proposals are located within the high risk Flood Zone 3a. With reference to Table D3 of PPS25, essential infrastructure will only be permitted in Flood Zone 3a if the Exception Test is passed and if the development proposals can be designed and constructed to remain operational and safe for users in times of flood.

6.2 The Exception Test

6.2.1 PPS25 states that to pass the Exception Test, it must be demonstrated that:

- The development provides wider sustainability benefits to the community that outweigh the flood risk;
- The development should be located preferably on developable, previously-developed land; and
- A Flood Risk Assessment demonstrates that the development will be safe, without increasing flood risk elsewhere.

6.2.2 The development proposals will increase the generation of renewable energy in the region, hence contributing to the Government's renewable energy targets. Ecotricity undertook wide scale investigation to seek potential sites for wind energy development. A computerised GIS (Geographical Information System) approach was used to identify areas within the district at a strategic level that might be suitable as a potential wind energy site, using the following criteria:

- Suitable wind speed regime;
- Designated ecological areas;
- Designated landscape areas;
- Cultural heritage features;
- Residential housing buffer of 650m;
- Aviation and telecommunications constraints; and
- Proximity of local grid.

6.2.3 The investigation identified Heckington Fen as a suitable site for wind energy development, taking into account the above strategic factors. Full justification of the site selection is provided in the Environmental Statement.

6.2.4 It has been identified in Section 5 of this FRA that the development proposals will not significantly increase flood risk to the site or elsewhere and will be designed to ensure resilience to existing flood risk whilst allowing for potential climate change effects.

SECTION 7

CONCLUSIONS

7 CONCLUSIONS

7.1 Summary of Existing Flood Risk

7.1.1 Through review of indicative EA flood maps, flood hazard maps, the SFRA and consultation with the EA and IDB, it was identified that the site is located within the high risk Flood Zone 3a where the annual probability of flood risk is greater than 1% (1 in 100 year) from fluvial sources.

7.1.2 Hydraulic modelling data supplied by the EA estimates a maximum water level in Head Dyke-Skerth Drain within the vicinity of the site of 2.84m AOD during a current 1 in 100 year event and 3.02m AOD during a current 1 in 1000 year event. Site topography ranges between a minimum of approximately 0.6m AOD in the north-east to approximately 3m AOD in the south. The maximum flood depths during these events would therefore be approximately 2.24m during the 1 in 100 year event and 2.42m during the 1 in 1000 year event.

7.1.3 The IDB advise that the land drainage systems and associated pumping stations are designed to have capacity for a 1 in 50 year event. Overland flow as a result of pump failure or system capacity would follow natural topography to the north-east of the site. Overland flow could pose flood risk to the proposed development, although it is considered unlikely that the resultant flood depth would be greater than the predicted fluvial flood depth as discussed above.

7.1.4 The assessment has identified no significant flood risks from tidal or groundwater sources.

7.2 Summary of Post Development Flood Risk

7.2.1 It has been estimated (based on a maximum flood depth within the lowest part of the site) that the construction of the turbine masts has the potential to displace up to approximately 1,538m^3 of flood storage during a 1 in 100 year event. When considering this volume in relation to the extent and depth of the flood plain across the c.600 ha site, this loss of flood storage is not considered to pose any significant increase in flood risk to the development or to people and property elsewhere.

7.2.2 No turbine will be located within 9m of existing land drain or watercourses, as required by the IDB, and the works require no alteration or diversion to the alignment of the existing land drains. Any new culverts or amendments to existing culverts required to provide access to the turbines will obtain Land Drainage Consent and be designed and constructed in accordance with IDB requirements. The proposed development will therefore have no adverse impact on flow through the internal land drainage system.

7.2.3 During an extreme flood event, the proposed development is not predicted to have any significant impact on overland flow conveyance through the site. In particular, the circular form of the turbine bases and the wide spacing between the turbines will have little effect on overland flow paths.

7.2.4 The proposed access tracks, substation compound, crane pads and construction compound will be constructed on compacted hardcore and will therefore remain permeable. Rainfall onto the turbine masts will shed to the surrounding ground and drain as per the existing situation. There is therefore no predicted increase in surface

water runoff that would have significant effect on flood risk to the site or to people and property elsewhere.

7.2.5 Surface water discharge from the sub-station building, with approximate dimensions 10m x 5m, will be managed in a method agreeable with the IDB to ensure no increased flood risk to the site or surrounding land. Surface water will be managed either be through infiltration to the ground or, more likely considering ground conditions, direct discharge to a drainage ditch at an attenuated rate if deemed required.

7.2.6 To manage flood risk during construction, it is recommended that the contractor prepares a flood emergency and contingency plan, monitors flood warnings posted by the EA or registers for early warning notices.

7.2.7 The wind turbine towers will be water resistant with access hatches raised approximately 3m above ground level to minimise the risk of water ingress during a flood event. The electrical substation compound will be constructed on land above the 1 in 1000 year plus climate change flood event, estimated to be a maximum of 3.04m AOD.

7.2.8 This Flood Risk Assessment demonstrates that the development proposals will not significantly increase flood risk to the site or elsewhere and will be designed to ensure resilience to existing flood risk whilst allowing for potential climate change effects.

SECTION 8

REFERENCES

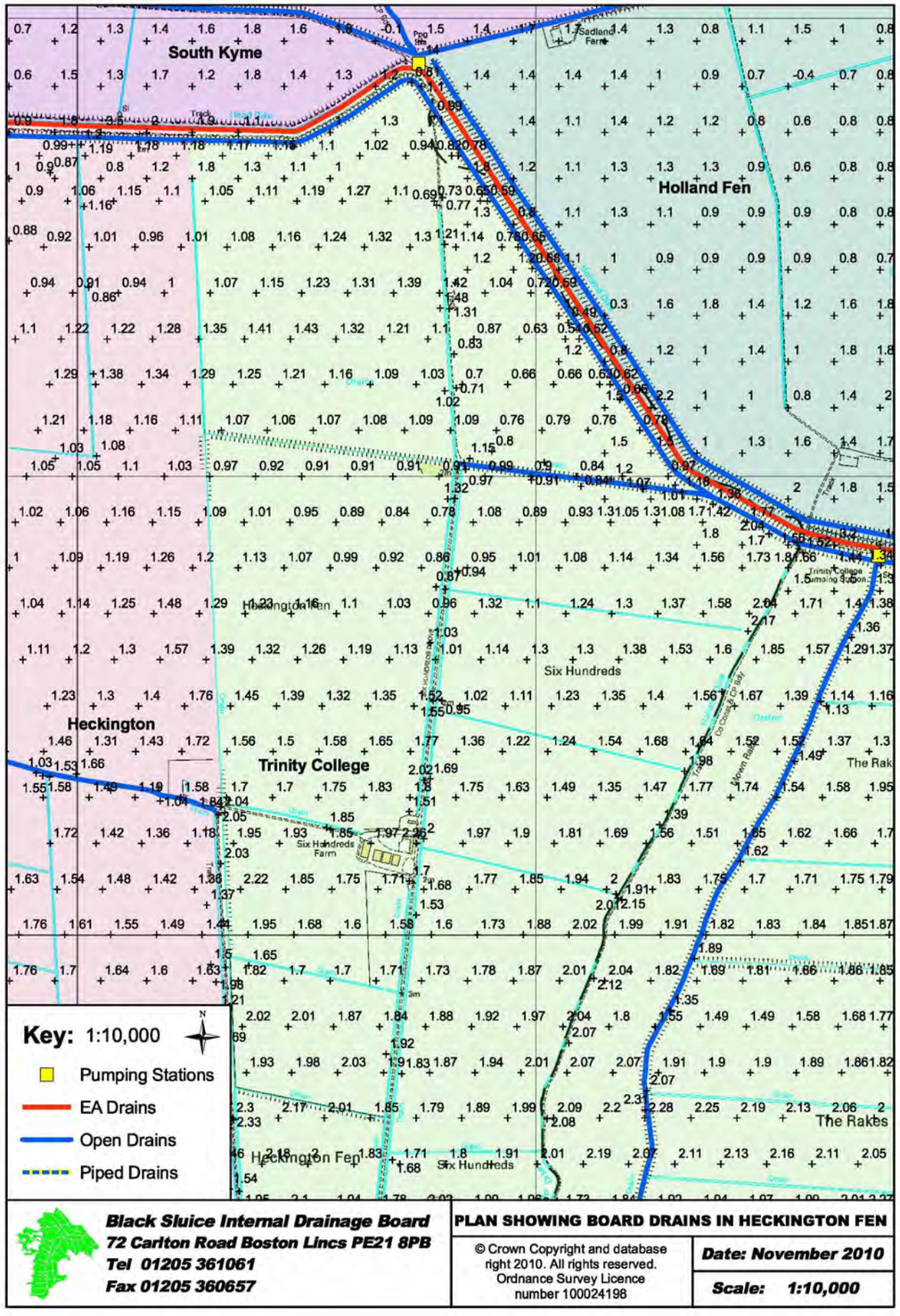
SECTION 8
REFERENCES

8 REFERENCES

1. Environment Agency Standing Advice. Flood Risk Assessment and other general advice for applicants and agents. http://www.environment-agency.gov.uk/research/planning/93498.aspx. Accessed November 2010.
2. Environment Agency indicative flood maps for the Heckington Fen. http://www.environment-agency.gov.uk/homeandleisure/floods/31650.aspx. Accessed November 2010.
3. Planning Policy Statement 25: Development and Flood Risk. Communities and Local Government. March 2010.
4. North Kesteven Strategic Flood Risk Assessment. 2009.
5. E-ON Central Networks Primary Design Manual. July 2007

APPENDIX A

EXISTING SITE AND PROPOSED DEVELOPMENT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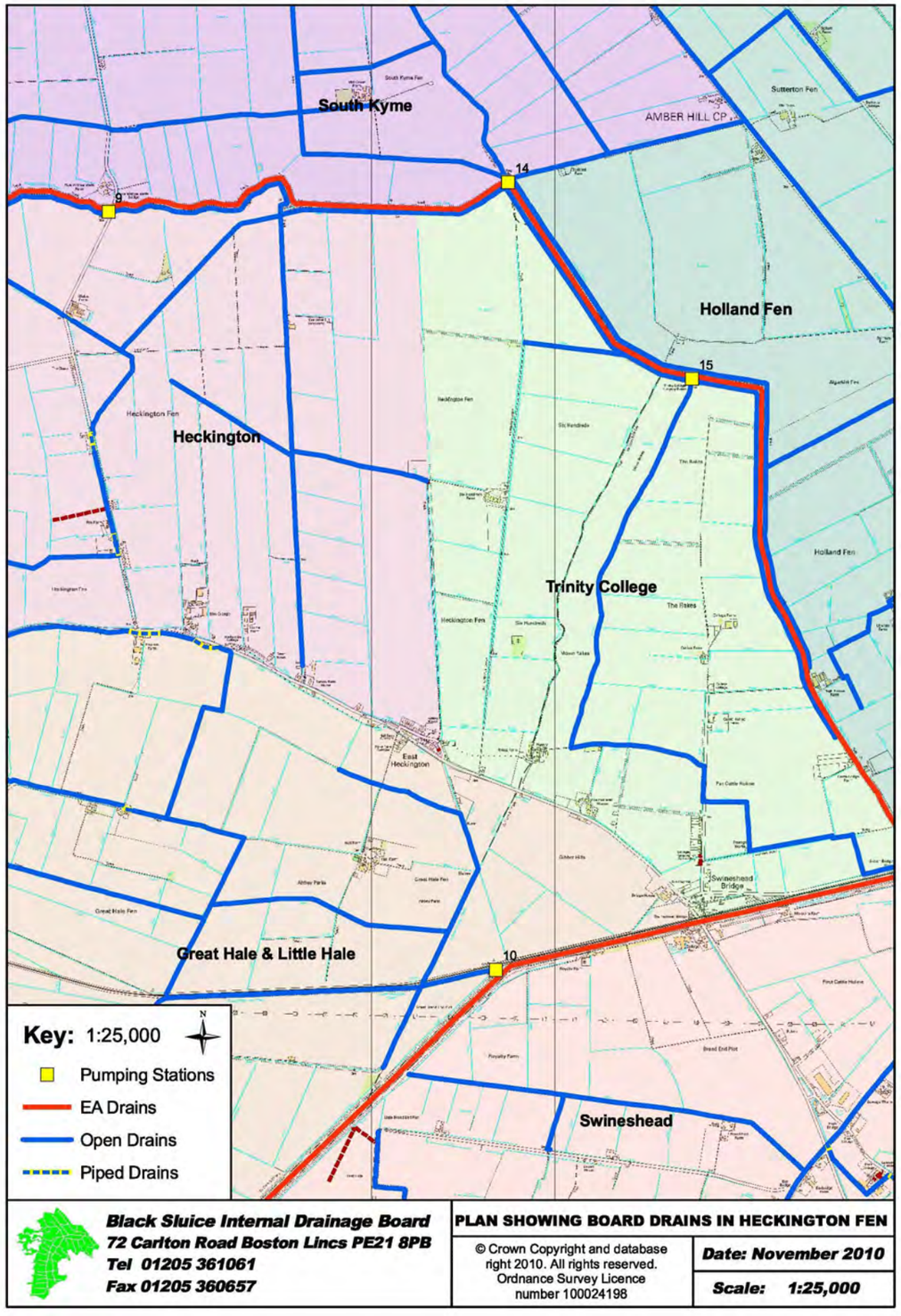
Holland Fen
Heckington
Trinity College
Six Hundreds
Heckington Fen
The Rakes
Key: 1:10,000
Pumping Stations
EA Drains
Open Drains
Piped Drains
Black Sluice Internal Drainage Board
72 Carlton Road Boston Lincs PE21 8PB
Tel 01205 361061
Fax 01205 360657
PLAN SHOWING BOARD DRAINS IN HECKINGTON FEN
© Crown Copyright and database right 2010. All rights reserved. Ordnance Survey Licence number 100024198
Date: November 2010
Scale: 1:10,000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Holland Fen
Heckington
Trinity College
Great Hale & Little Hale
Swineshead
Key: 1:25,000
Pumping Stations
EA Drains
Open Drains
Piped Drains
Black Sluice Internal Drainage Board
72 Carlton Road Boston Lincs PE21 8PB
Tel 01205 361061
Fax 01205 360657
PLAN SHOWING BOARD DRAINS IN HECKINGTON FEN
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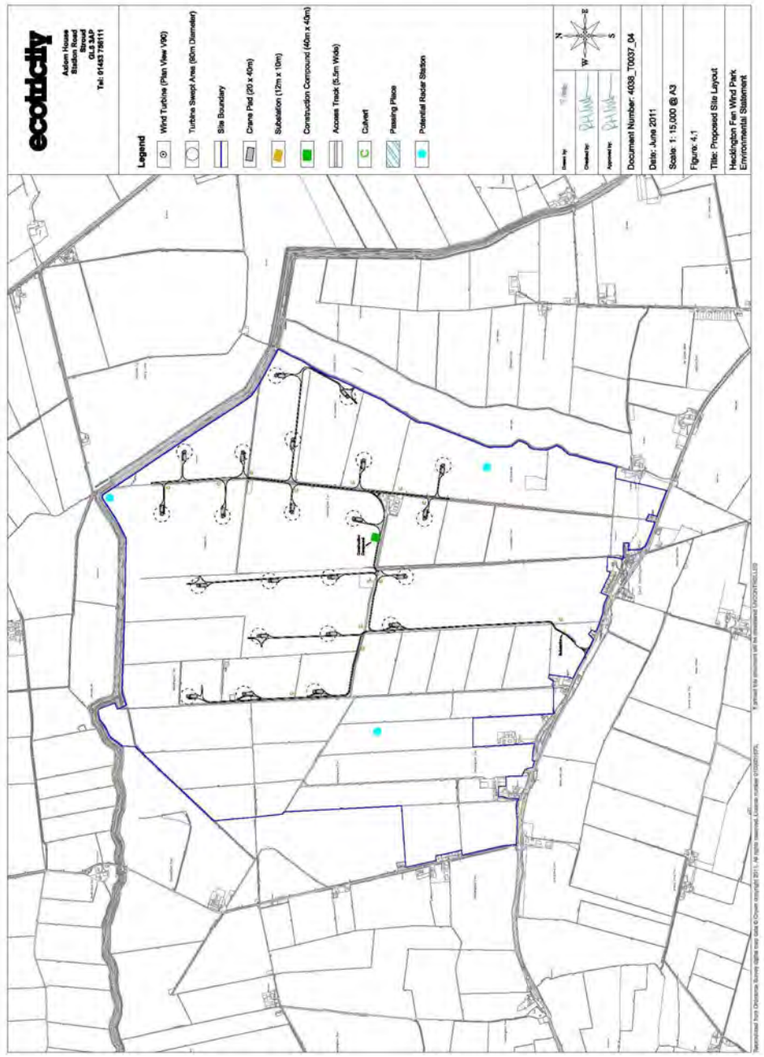
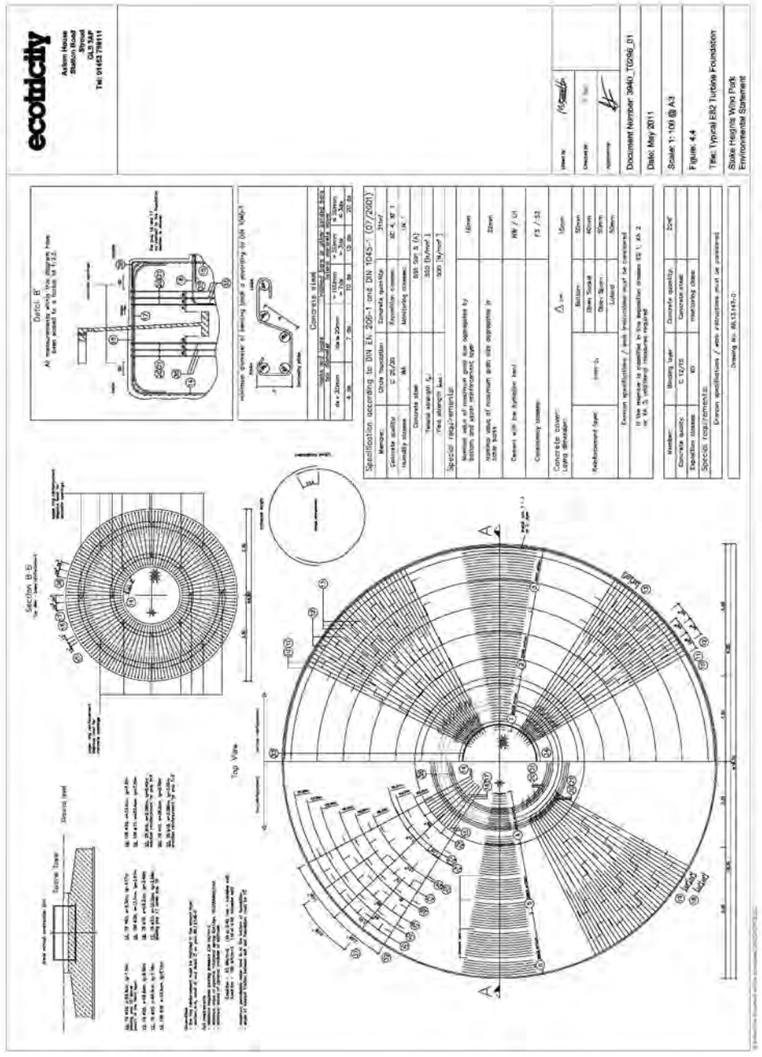
Date: November 2010
Scale: 1:25,000


ecotricity
Legend
Wind Turbine (Plan View VR0)
Turbine Sweep Area (80m Diameter)
Site Boundary
Crane Pad (20 x 40m)
Substation (12m x 10m)
Construction Compound (40m x 40m)
Access Track (5.5m Wide)
Culvert
Fencing Piece
Potential Radar Station
Document Number: 4038_T0037_04
Date: June 2011
Scale: 1: 15,000 @ A3
Figure: 4.1
Title: Proposed Site Layout
Heckington Fen Wind Park
Environmental Statement


ecotricity
Document Number: 3840_T0096_01
Date: May 2011
Scale 1:100 @ A3
Figure: 4.4
Title: Typical ESE Turbine Foundation
Stoke Heights Wind Park
Environmental Statement

APPENDIX B

PLANNING POLICY STATEMENT 25: DEVELOPMENT AND FLOOD RISK

Table D.1: Flood Zones

(Note: These Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences)

Zone 1 Low Probability

Definition

This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).

Appropriate uses

All uses of land are appropriate in this zone.

FRA requirements

For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a FRA. This need only be brief unless the factors above or other local considerations require particular attention. See Annex E for minimum requirements.

Policy aims

In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage techniques.

Table D.1: contd.

Zone 2 Medium Probability

Definition

This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% – 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% – 0.1%) in any year.

Appropriate uses

The water-compatible, less vulnerable and more vulnerable uses of land and essential infrastructure in Table D.2 are appropriate in this zone.

Subject to the Sequential Test being applied, the highly vulnerable uses in Table D.2 are only appropriate in this zone if the Exception Test (see para. D.9.) is passed.

FRA requirements

All development proposals in this zone should be accompanied by a FRA. See Annex E for minimum requirements.

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 techniques.

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 in Table D.2 are appropriate in this zone.

The highly vulnerable uses in Table D.2 should not be permitted in this zone.

The more vulnerable and essential infrastructure uses in Table D.2 should only be permitted in this zone if the Exception Test (see para. D.9) is passed. Essential infrastructure permitted in this zone should be designed and constructed to remain operational and safe for users in times of flood.

FRA requirements

All development proposals in this zone should be accompanied by a FRA. See Annex E for minimum requirements.

Table D.1: contd.

Zone 3a High Probability *(continued)*

Policy aims

In this zone, developers and local authorities should seek opportunities to:

i. 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 techniques;
ii. relocate existing development to land in zones with a lower probability of flooding; and
iii. create space for flooding to occur by restoring functional floodplain and flood flow pathways and by identifying, allocating and safeguarding open space for flood storage.

Zone 3b The Functional Floodplain

Definition

This zone comprises land where water has to flow or be stored in times of flood

Local planning authorities should identify in their SFRAs areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. But land which would flood with an annual probability of 1 in 20 (5%) or greater in any year, or is designed to flood in an extreme (0.1%) flood, should provide a starting point for consideration and discussions to identify the functional floodplain.

Appropriate uses

Only the water-compatible uses and the essential infrastructure listed in Table D.2 that has to be there should be permitted in this zone. It should be designed and constructed to:

- remain operational and safe for users in times of flood;
- result in no net loss of floodplain storage;
- not impede water flows; and
- not increase flood risk elsewhere.

Essential infrastructure in this zone should pass the Exception Test.

FRA requirements

All development proposals in this zone should be accompanied by a FRA. See Annex E for minimum requirements.

Policy aims

In this zone, developers and local authorities should seek opportunities to:

i. 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 techniques; and
ii. relocate existing development to land with a lower probability of flooding.

Table D.2: Flood Risk Vulnerability Classification

Essential Infrastructure	• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. • Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. • Wind turbines.
Highly Vulnerable	• Police stations, Ambulance stations and Fire stations and Command Centres and telecommunications installations required to be operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and park homes intended for permanent residential use. • Installations requiring hazardous substances consent.[19] (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as 'Essential Infrastructure'[20]).
More Vulnerable	• Hospitals. • Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. • Buildings used for: dwelling houses; student halls of residence; drinking establishments; nightclubs; and hotels. • Non–residential uses for health services, nurseries and educational establishments. • Landfill and sites used for waste management facilities for hazardous waste.[21] • Sites used for holiday or short-let caravans and camping, **subject to a specific warning and evacuation plan**.

Table D.2: contd.

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).
Water-compatible Development	• Flood control infrastructure. • Water transmission infrastructure and pumping stations. • Sewage transmission infrastructure and pumping stations. • Sand and gravel workings. • Docks, marinas and wharves. • Navigation facilities. • MOD defence installations. • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping accommodation). • Lifeguard and coastguard stations. • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, **subject to a specific warning and evacuation plan.**

Notes:

1) This classification is based partly on Defra/Environment Agency research on Flood Risks to People (FD2321/TR2)[22] and also on the need of some uses to keep functioning during flooding.
2) Buildings that combine a mixture of uses should be placed into the higher of the relevant classes of flood risk sensitivity. Developments that allow uses to be distributed over the site may fall within several classes of flood risk sensitivity.
3) The impact of a flood on the particular uses identified within this flood risk vulnerability classification will vary within each vulnerability class. Therefore, the flood risk management infrastructure and other risk mitigation measures needed to ensure the development is safe may differ between uses within a particular vulnerability classification.

Table D.3[23]: Flood Risk Vulnerability and Flood Zone 'Compatibility'

Flood Risk Vulnerability classification (see Table D2)		Essential Infrastructure	Water compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone (see Table D.1)	Zone 1	✔	✔	✔	✔	✔
	Zone 2	✔	✔	Exception Test required	✔	✔
	Zone 3a	Exception Test required	✔	✗	Exception Test required	✔
	Zone 3b 'Functional Flood plain'	Exception Test required	✔	✗	✗	✗

Key:

✔ Development is appropriate

✗ Development should not be permitted

APPENDIX C

CORRESPONDENCE

creating a better place

Environment Agency

Department of Energy & Climate Change
Development Consents and Planning
Reform Team
3 Whitehall Place
London
SW1A 2AW

Our ref: AN/2010/110565/01-L01

Date: 27 October 2010

FAO: William Long

Dear Sir/Madam

Electricity act 1989 – section 36 application for a 64.4MW onshore wind farm (28 turbines)
Six Hundred Farm, Six Hundred Drove, East Heckington, Lincolnshire

Thank you for referring the Scoping Opinion regarding the above proposal, which was received on 29 September 2010.

The Environment Agency has inspected the submitted information and wishes to make the following comments:

Flood Risk
The proposed development site is shown to be in Flood Zone 3. Consequently the Environmental Statement for this proposal needs to contain a Flood Risk Assessment (FRA). In particular this should consider:

- Whether the site falls within the coastal flood hazard area, as shown on our Coastal Hazard Maps.
- The risk to the site from the Head Dyke Main River in accordance with Annex E of Planning Policy Statement 25 (PPS25).
- How surface water will be managed on the site. This will need to consider whether roads, tracks or substations will have an impact on the current surface water regime.
- Whether the proposed development will obstruct flood flows and divert water elsewhere.
- How critical equipment, such as substations, will be designed to continue operating in flood conditions. For example, these could be designed and built to be safely above the predicted flood level.

Please note that this site falls within the district of the Black Sluice Internal Drainage Board. Therefore, we recommend that they are contacted on 01205 361061 to discuss this proposal and its potential impacts on their system.

Surface Water Management
The applicant should refer to the attached Surface Water Guidance Sheets for advice on how to compile a surface water drainage scheme for a development of this nature. For further information the applicant should contact Steven Coe in our Development and Flood Risk team on 01522 785343 who may be able to offer further advice/assistance.

Flood Defence Consent
Under the terms of the Water Resources Act 1991 and the Land Drainage Byelaws the prior written consent of the Environment Agency is required for any proposed works or structures in, under, over or within 9 metres measured horizontally from the foot of any bank of the landward side, or where there is no bank, within 9 metres measured horizontally from the top edge of the batter enclosing a Main River.

Coastal Hazard Maps
Our Coastal Hazard Mapping and the up to date levels, which can be used in the FRA, can be obtained by contacting our Corporate Services Team on 01522 785031, by e-mailing custanno.lincoln2.an@environment-agency.gov.uk or writing to Corporate Services at the address on page 1. Please note that there may be a charge for this information.

Should you require any additional information, or wish to discuss these matters further, please do not hesitate to contact me on the number below.

Yours faithfully

Dean Rezzougui
Planning Liaison Officer

Direct dial 01522 785882
Direct fax 01522 512927
Direct e-mail dean.rezzougui@environment-agency.gov.uk

Waterside House, Waterside North, Lincoln, LN2 5HA.
Customer services line: 08708 506 506
Email: enquiries@environment-agency.gov.uk
www.environment-agency.gov.uk

Cont/d..

End

Bennett, Charles

From: Coe, Steven [steven.coe@environment-agency.gov.uk]
Sent: 29 October 2010 16:32
To: Bennett, Charles
Subject: RE: Heck Farm Wind Farm

Charles,

The windfarm site is shown not be at risk of coastal flooding as shown on our Coastal Hazard Maps. The main source of flood risk to focus on would then be from the Head Dyke/Skerth Drain. Our External Relations team has received your data request and is looking into the information that we have. If we have no data available for the Skerth Drain I have asked them to provide some levels for the South Forty Foot Drain which is to the south of the A17. Levels in the Skerth Drain will be similar to those in the South Forty Foot as they are connected.

The site is in Flood Zone 3a and not in a functional floodplain.

Once you have received the level data from us please feel free to give me a call to discuss the next step if you wish.

regards
Steve Coe
Development and Flood Risk Engineer (Lincolnshire)
Tel: 01522 785343

From: Bennett, Charles [mailto:charles.bennett@pbworld.com]
Sent: 29 October 2010 14:49
To: Coe, Steven
Subject: Heck Farm Wind Farm

Dear Steven,

Thank you for your guidance earlier this afternoon regarding the flood risk at the proposed Heck Farm Wind Farm site.

I would be very grateful if you could confirm the following:
(i) the flood risk to the proposed Heck Farm Wind Farm site is due to a fluvial flood risk.
(ii) the site is situated in Flood Zone 3a, in an area not designated as the Functional Floodplain.

For clarity, the site is located at OS Landranger Reference TF205450, as shown on the attached location plan.

Thanks for your help,
Charles

Charles Bennett
Civil Engineer, Resource and Energy Ventures

Parsons Brinckerhoff
Queen Victoria House, Redland Hill, Bristol BS6 6US, UK
44-(0)117-933-9300; fax 44-(0)117-933-9253
charles.bennett@pbworld.com; www.pbworld.co.uk

Think before you print.

1

Bennett, Charles

From: Brown, Eleanor M [eleanor.brown@environment-agency.gov.uk]
Sent: 23 November 2010 10:05
To: Bennett, Charles
Subject: CCN-2010-25663 Flood risk data for Heckington Fen
Attachments: CCN-2010-25663 Heckington Fen.pdf

Dear Mr Bennett

Thank you for your request for information about the risk of flooding at Heckington Fen, East Heckington, Lincolnshire.

I hope the attached information meets your requirements. If you have any questions, however, please contact this office using the telephone/e-mail details below.

With regards

Eleanor Brown

Flood Risk Mapping & Data Management Team Member 2
Anglian Region, Northern Area.

Sustainably reducing the risk of flooding and its impact on people, property and the environment

Telephone : 01522 785028
Internal : 7 50 5028
Post : Environment Agency, Waterside House, Waterside North, Lincoln LN2 5HA
Internet : www.environment-agency.gov.uk

1

Environment Agency

Mr Charles Bennett
Parsons Brinckerhoff
Charles.bennett@pbworld.com

Our ref: CCN-2010-25663

Date: 23 November 2010

Dear Mr Bennett

Basic Flood Risk Assessment Data Request a site near the A17, East Heckington, Lincolnshire

Thank you for your request of 29 October 2010 to use Environment Agency data, Product 3, in the development of the Flood Risk Assessment (FRA) for the above site. The information is attached.

If you have requested this information to help inform a development proposal, then you should note the detail in the attached advisory text on the use of Environment Agency Information for Flood Risk Assessments / Flood Consequence Assessments.

Flood Map
The attached map includes the current Flood Map for your area. The Flood Map indicates the area at risk of flooding, **assuming no flood defences exist**, for a flood event with a 0.5% chance of occurring in any year for flooding from the sea, or a 1% chance of occurring for fluvial (river) flooding. It also shows the extent of the Extreme Flood Outline which represents the extent of a flood event with a 0.1% chance of occurring in any year, or the highest recorded historic extent if greater.

The Flood Map only indicates the extent and likelihood of flooding from rivers or the sea. It should also be remembered that flooding may occur from other sources such as surface water sewers, road drainage, etc.

Fluvial Flood Levels
The fluvial flood levels for the model nodes shown on the attached map are set out in the table below. They are measured in metres above Ordnance Datum Newlyn (mODN).

These levels are taken from the South Forty Foot Drain Model (May 2009) and are the most up-to-date currently available. We aim to review our models on a regular basis, so if you are using these levels more than twelve months from the date of this letter, please contact us again to check that they are still valid.

Contd.../

Waterside House, Waterside North, Lincoln, LN2 5HA
Customer services line: 08708 506 506
Email: enquiries@environment-agency.gov.uk
www.environment-agency.gov.uk

Weekday Daytime calls cost 8p plus up to 6ppm from BT Weekend Unlimited. Mobile and other providers' charges may vary

			Annual Exceedance Probability – Maximum Water Levels (mODN)					
Node Label	Easting	Northing	10% (1 in 10)	5% (1 in 20)	1% (1 in 100)	0.1% (1 in 1000)	1% (1 in 100) inc Climate Change	0.1% (1 in 1000) inc Climate Change
HD107000	518706	346772	2.29	2.59	2.84	3.02	2.90	3.04
HD105500	520031	346763	2.31	2.58	2.82	2.98	2.87	3.00
SD103500	521492	345923	2.27	2.55	2.79	2.92	2.83	2.95
SD101500	522284	344470	2.31	2.58	2.74	2.89	2.79	2.87
SF113000	520067	341973	2.35	2.65	2.88	2.97	2.91	2.98
SF112000u	520815	342640	2.37	2.66	2.85	2.97	2.91	2.94
SF110500	522287	342977	2.28	2.56	2.80	2.85	2.78	2.91

Please note that these levels are "in-channel" levels and therefore may not represent the flood level on the floodplain, particularly where the channel is embanked or has raised defences.

Fluvial Defence Information
The fluvial defences protecting this site consist of earth embankments. They are in fair to good condition and provide protection against a flood event with a 10% chance of occurring in any year (1 in 10). We inspect these defences regularly to ensure that any potential defects are identified early.

Tidal Flood Levels
Please find attached available **tidal** flood levels as requested. These levels have an assessment date of 2006, which should be used in any consideration of future increases due to climate change. The levels are in metres above Ordnance Datum Newlyn (mODN) and are valid for 12 months from the date of issue.

Tidal Defence Information
The tidal defences protecting this site consist of earth embankments. They are in good condition and provide protection against a flood event with a 0.67% chance of occurring in any year (1 in 150). We inspect these defences regularly to ensure that any potential defects are identified early.

History of Flooding
With regards to the history of flooding I can advise that we do not have any records of flooding in this area. It is possible that other flooding may have occurred that we do not have records for, and other organisations, such as the Local Authority or Internal Drainage Boards, may have records.

Land Drainage
The information provided is limited to flood risk from the sea and rivers with catchment areas greater than $3km^2$. The property is in an area of extensive land drainage which may pose an additional risk of flooding. Further information should be sought from the Black Sluice Internal Drainage Board (tel: 01205 361061).

This information is provided subject to the enclosed notice, which you should read.

If you have any queries or would like to discuss the content of this letter further please contact Eleanor Brown using the telephone/email details below. Please quote our CCN reference number in all correspondence where data is referenced, including the Flood Risk Assessment.

Yours sincerely

FOR John Ray
Flood Risk Mapping & Data Management Team Leader

Direct dial 01522 785028
Direct fax 01522 785018
Direct e-mail eleanor.brown@environment-agency.gov.uk

Enc.
FRA Advisory Text
Basic FRA Map
Tidal Flood Levels
Standard Notice (Commercial)

Use of Environment Agency Information for Flood Risk Assessments / Flood Consequence Assessments

Important

If you have requested this information to help inform a development proposal, then you should note the following: In England, you should refer to the Environment Agency's Flood Risk Standing Advice and PPS25 and its associated Practice Guide for information about what flood risk assessment is needed for new development in the different flood zones. These documents can be accessed via:
http://www.environment-agency.gov.uk/research/planning/82587.aspx
http://www.communities.gov.uk/publications/planningandbuilding/pps25floodrisk
http://www.communities.gov.uk/publications/planningandbuilding/pps25practiceguide

You should also consult the Strategic Flood Risk Assessment produced by your local planning authority.

In **Wales**, you should refer to TAN15 for information about what flood consequence assessment is needed for new development in the different flood zones
http://new.wales.gov.uk/topics/planning/policy/tans/tan15?lang=en

You should also refer to any Strategic Flood Consequence Assessment produced by your local planning authority.

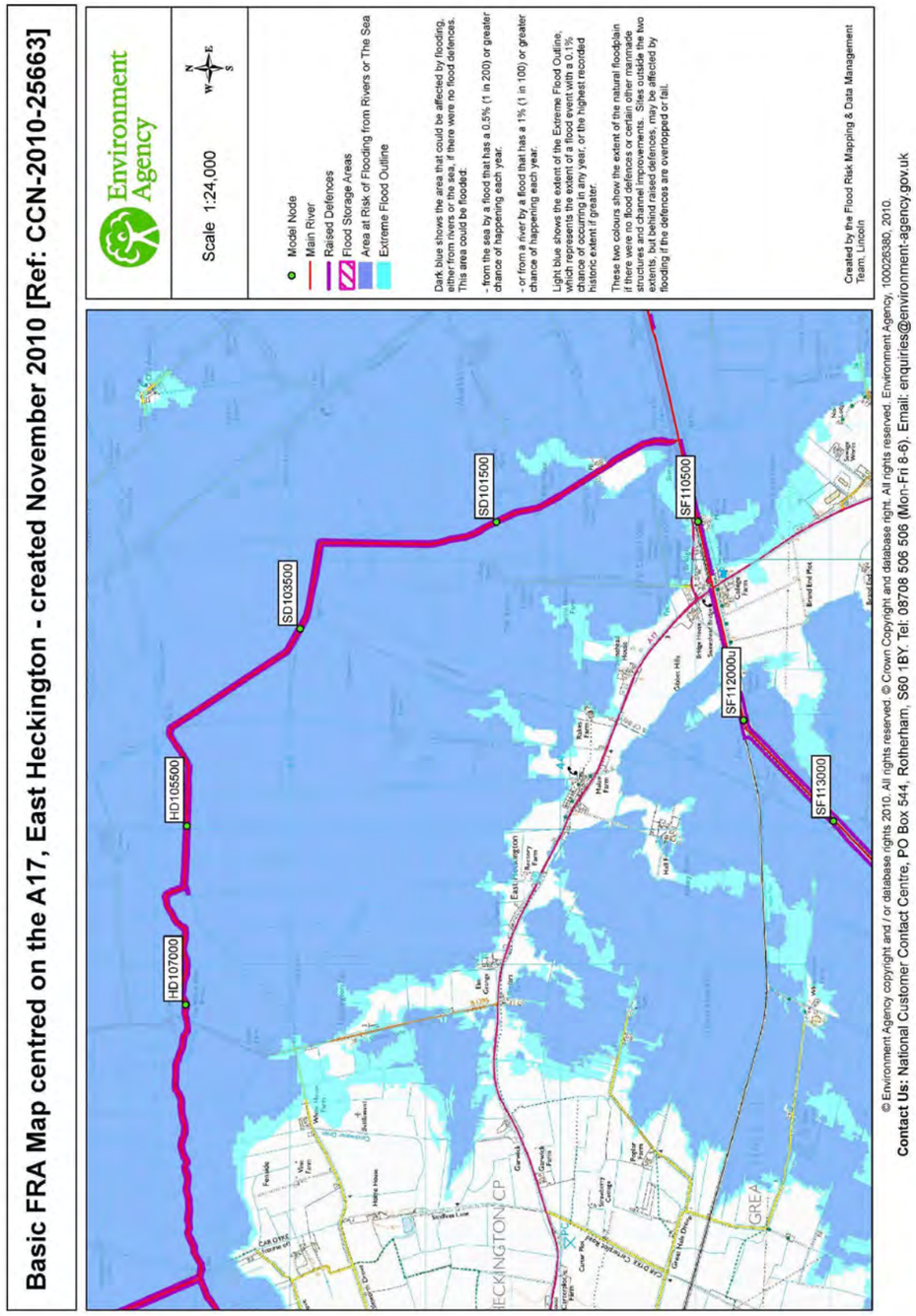
In both **England and Wales** you should note that:

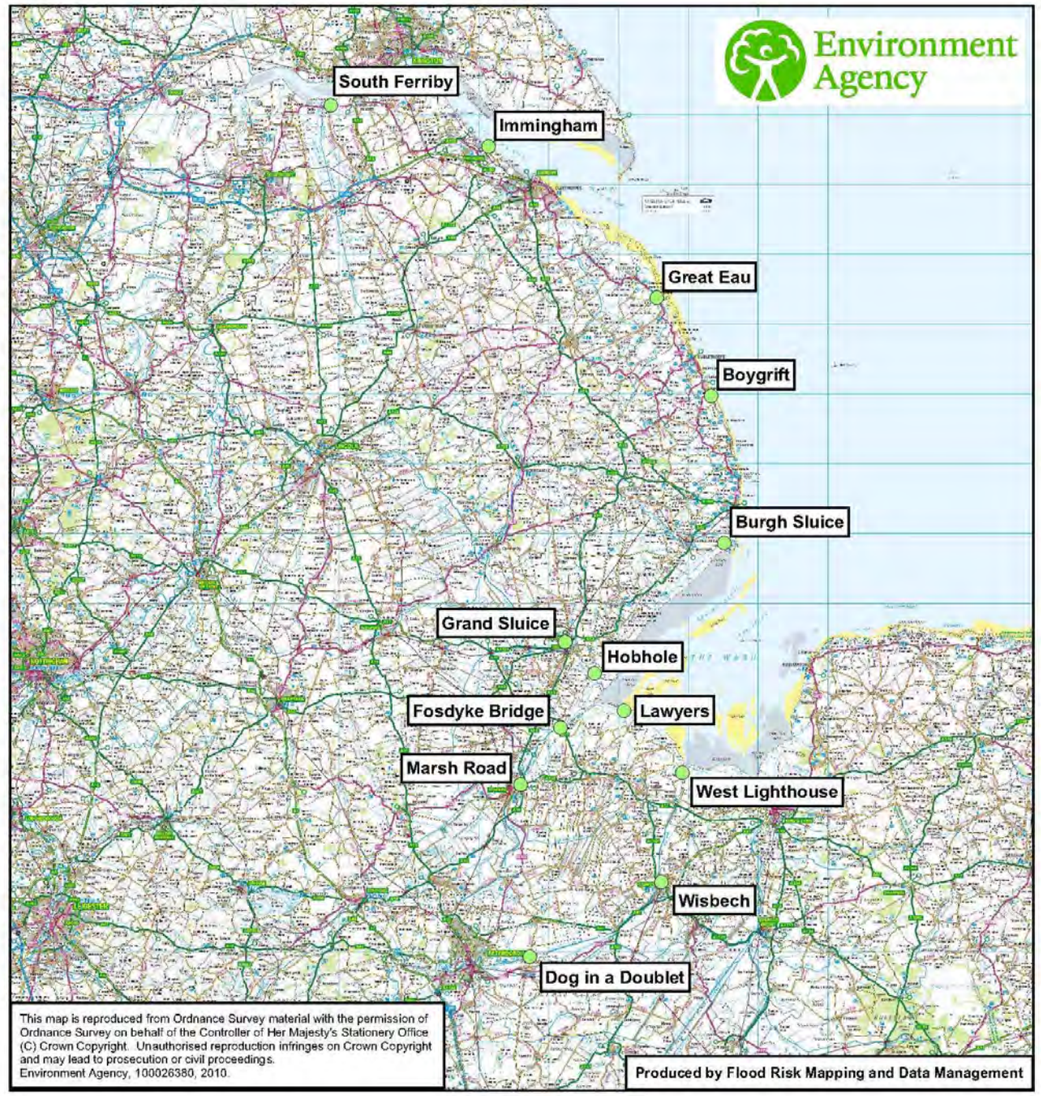
1. Information supplied by the Environment Agency may be used to assist in producing a flood risk or flood consequence assessment (FRA/FCA) where one is required, but does not constitute such an assessment on its own.

2. This information covers flood risk from main rivers and the sea, and you will need to consider other potential sources of flooding, such as groundwater or overland runoff. The information produced by the local planning authority referred to above may assist here.

3. Where a planning application requires a FRA/FCA and this is not submitted or deficient, the Environment Agency may well raise an objection.

4. For more significant proposals in higher flood risk areas, we would be pleased to discuss details with you ahead of making any planning application, and you should also discuss the matter with the local planning authority.





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	~

2010

Standard Notice – Commercial

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- detriment to the environment, including the risk of reduced future enhancement, or
- being prejudicial to the effective management of information held by the Agency, or
- damage to the Agency's reputation

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5. Intellectual Property Rights

No Intellectual Property Rights are transferred or licensed to you save those which are expressly provided in this agreement

6. Assignment

You may not transfer or in any other way make over to any third party the benefit of this agreement either in whole or in part

7. Waiver

Failure by either of us to exercise or enforce any rights available to it, or any forbearance, delay or grant of indulgence, will not be construed as a waiver of rights under this agreement or otherwise

8. Entire agreement

This agreement constitutes the entire agreement between us and supersedes all oral or written agreements, representations, understandings or arrangements (whether previous, contemporaneous or future) relating to its subject matter. You agree to waive any right to rescind this agreement by virtue of any misrepresentation and not to claim damages for any misrepresentation that is not fraudulent

9. Severance

If any part of the agreement is found by a court of competent jurisdiction or other competent authority to be unenforceable, then that part will be severed from the remainder of the agreement which will continue to be valid and enforceable to the fullest extent permitted by law

10. Variation and Termination

This agreement may not be amended, modified, varied or supplemented but it may if both of us agree be terminated or replaced by a new agreement

11. Relationship of Parties

We are not in a partnership or joint venture, nor is either of us the agent of the other or authorised to act on behalf of the other

12. Rights Of Third Parties

No third parties shall have rights to enforce any part of this agreement under the Contracts (Rights of Third Parties) Act 1999

13. Governing Law

This agreement shall be governed and construed in accordance with English law

Contact: enquiries@environment-agency.gov.uk 08708 506506

Bennett, Charles

From: Ian Watts [ian.watts@blacksluiceidb.gov.uk]
Sent: 30 November 2010 17:02
To: Bennett, Charles
Subject: RE: FAO Ian Watts. Heckington Fen Wind Farm
Attachments: Heckington Fen 2.pdf; Heckington Fen 1.pdf; Catchment info linked to PS database.pdf; BSIDB A4 catchment map.pdf; image001.jpg

Dear Charles

Following our recent conversation regarding the above site, please find attached plans showing the Board Watercourses within the vicinity of the site, additionally there is a Catchment Map for the whole area and an associated table giving some flood risk information for the relevant areas. Unfortunately no fluvial modelling has been carried out on the site area so I cannot provide any predicted water levels for the 1 in 100 year event, etc.

The proposals lie within two pump catchments Trinity College (Pumping Station No.15) and Heckington Fen (No.9) these discharge into the Head Dyke / Holland Dyke which becomes the Skerth Drain. This in turn then discharges into the EA South Forty Foot Drain. The Environment Agency should be approached for details of these Watercourses.

The second plan shows land levels based on LIDAR data – these should be used as a guide only and their accuracy cannot be guaranteed.

If you have any queries with regards to the above data, or require any further information, then please do not hesitate to contact me.

Best regards

Ian Watts

Engineering Team Leader

Black Sluice I.D.B.
72 Carlton Road
Boston
Lincs. PE21 8PB

Tel: 01205 361061
Fax: 01205 360657

E-Mail: ian.watts@blacksluiceidb.gov.uk
Web: www.blacksluiceidb.gov.uk

From: Jill Himsworth **On Behalf Of** Temp User
Sent: 19 November 2010 15:46
To: Ian Watts
Subject: FW: FAO Ian Watts. Heckington Fen Wind Farm

From: Bennett, Charles [mailto:charles.bennett@pbworld.com]
Sent: 19 November 2010 14:23
To: Temp User
Subject: FAO Ian Watts. Heckington Fen Wind Farm

1

Dear Ian,
I am working on behalf of Ecotricity to investigate flood risk at Heckington Fen as part of a planning application for a proposed Wind Farm. This follows on from earlier work to install a wind monitoring mast at the site, for which you provided guidance (your reference – IW/AS/NK/0628/09).
A location map of the development is provided below and a plan of the proposed development is attached.

We seek guidance on the following issues:

- The current drainage regime of the land, in particular the points of discharge from the land drainage into Head Dyke / Skirth Drain.
- Protection against flooding to the relevant pumping stations and watercourses.

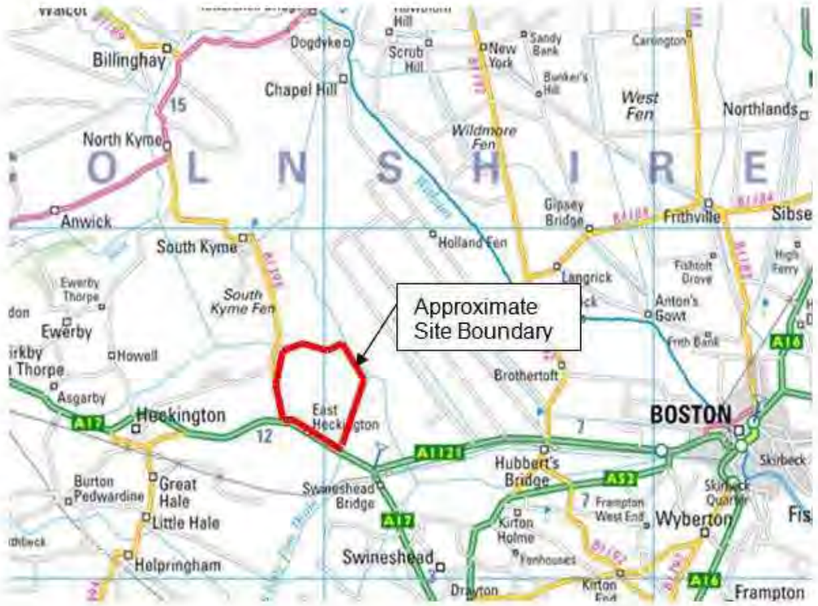
With reference to Appendix C of the North Kesteven SFRA it is stated that Head Dyke / Skirth Drain has a standard of protection of less than 1 in 10 years. Any further information on this would be greatly appreciated.

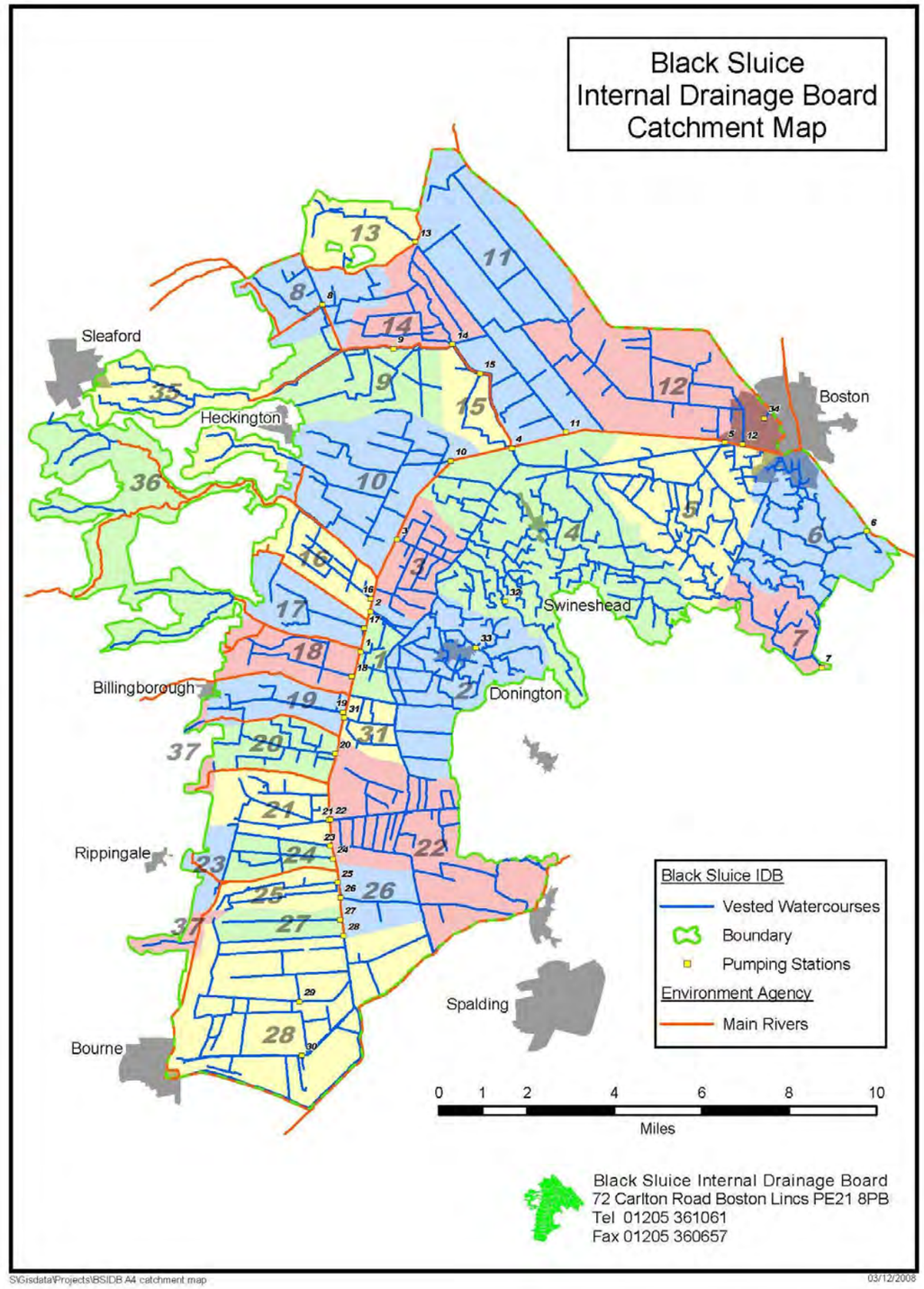
Many thanks for your assistance,
Charles

Charles Bennett
Civil Engineer, Resource and Energy Ventures

Parsons Brinckerhoff
Queen Victoria House, Redland Hill, Bristol BS6 6US, UK
44-(0)117-933-9300; fax 44-(0)117-933-9253
charles.bennett@pbworld.com; www.pbworld.co.uk

Think before you print.



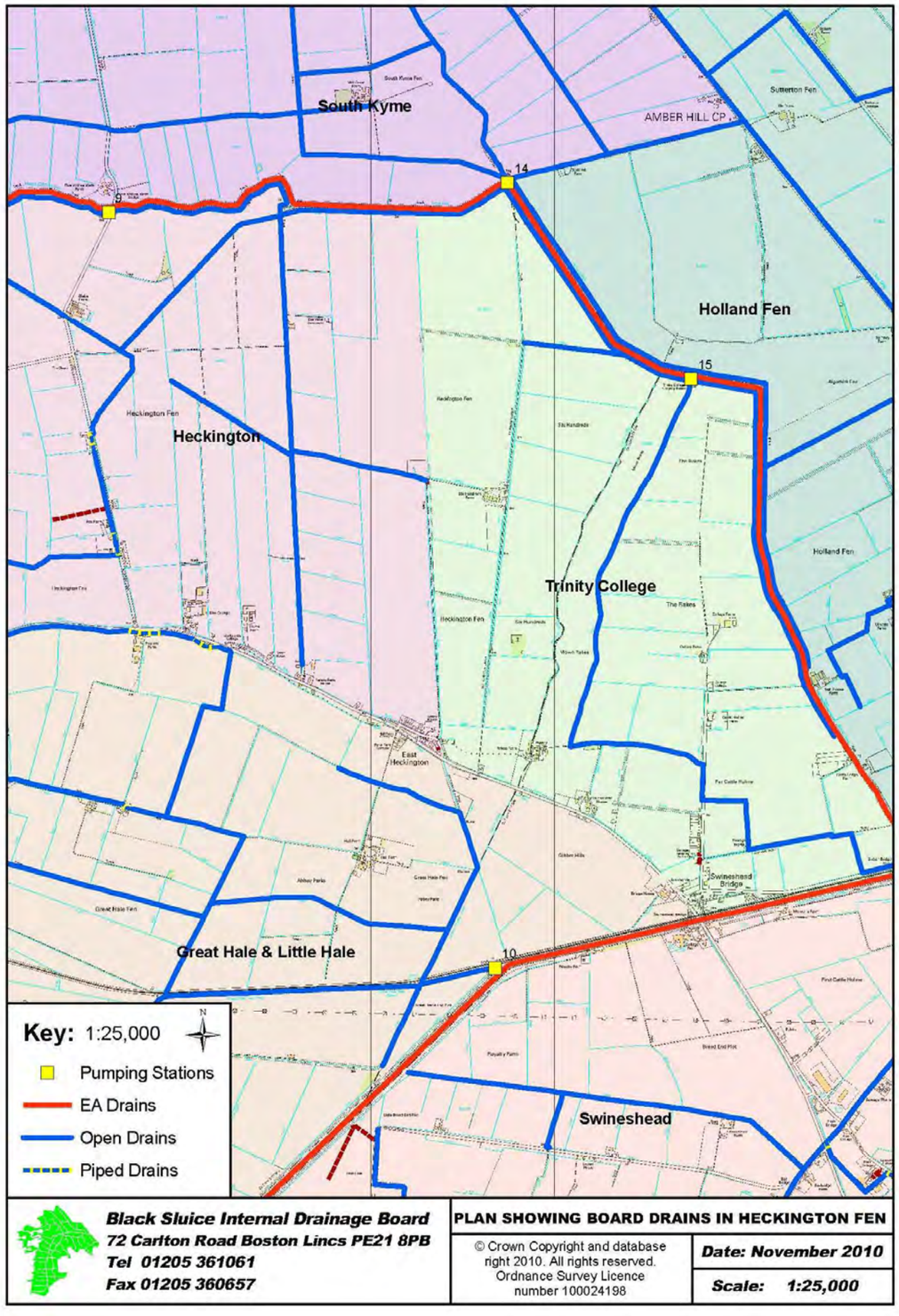


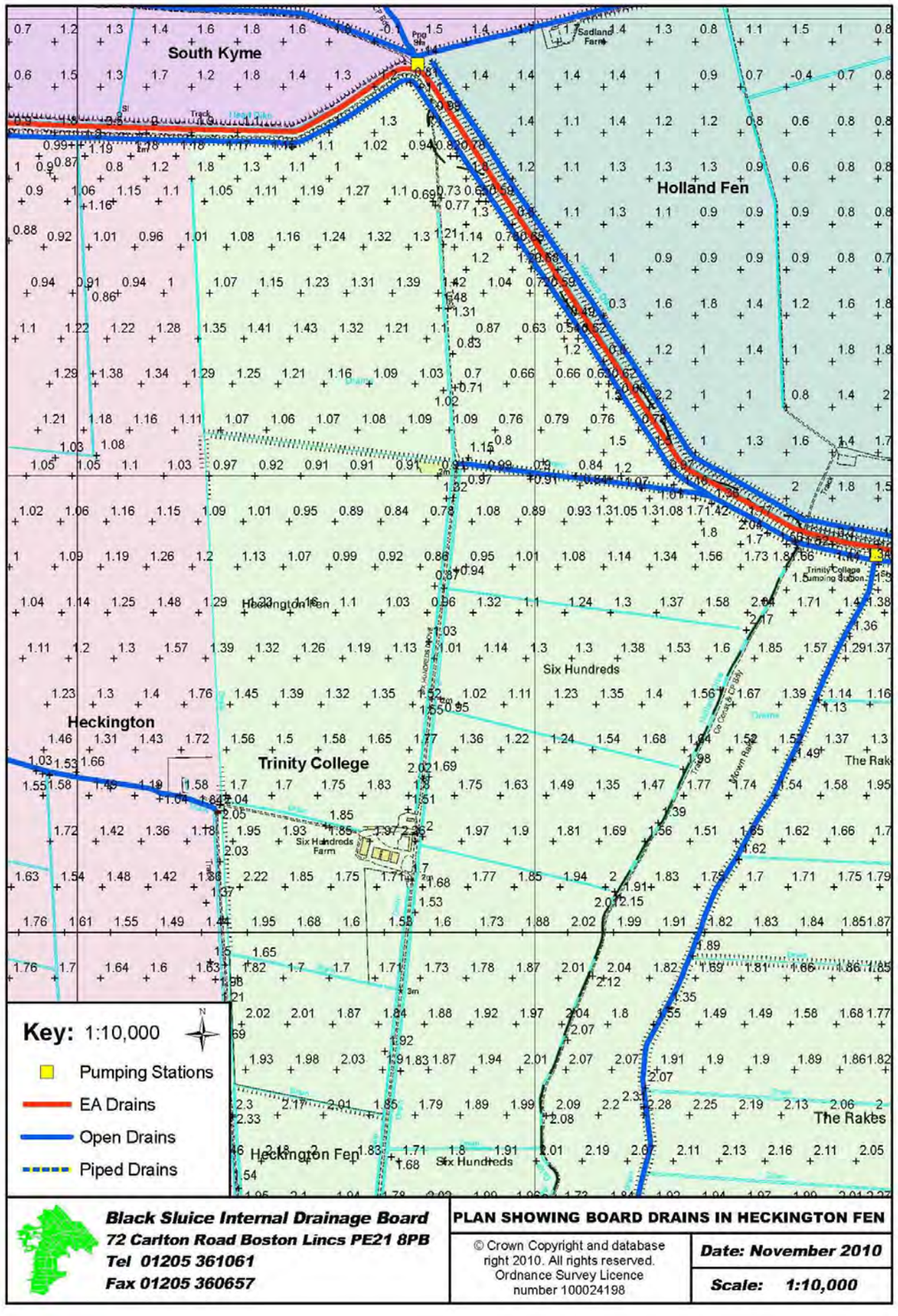
Black Sluice Internal Drainage Board
Flood Risk Information

	Catchment / Pumping Station	Area Hectares	P Station Capacity litre/sec	Maximum Design W.Level	Highest known W.Level	Highest W.Level telemet98	Lowest Land Level	Lowest Property Level
1	DONINGTON MAL. H.	365	566	Zero	0.83	0.8	1.5	2.00
2	DONINGTON N. INGS	2,262	3058	Zero	0.9	0.35	1.7	
3	BICKER FEN	848	1416	-0.30	0.65	0.53	1.4	
4	SWINESHEAD	4,824	6795	-0.15	0.9	0.33	1.35	
5	FRAMPTON & KIRTON	2,509	3695	-0.30	0.65	0.31	1.1	
6	WYBERTON MARSH	1,982	2803	zero	0.9	0.55	2.1	
7	KIRTON MARSH	774	934	+0.60	1.25	0.8	1.5	
8	EWERBY	1,141	2237	-0.30	-0.08	-0.08	0.75	
9	HECKINGTON	1,577	2661	-0.60	-0.13	-0.13	0.85	1.71
10	GREAT HALE	2,363	3482	-0.30	0.9	0.68	1.7	
11	HOLLAND FEN	3,505	4841	-0.60	0.63	-0.08	1	
12	BOSTON WEST	2,902	3907	-0.30	0.8	-0.01	1.3	
13	DAMFORD	893	1189	Zero	0.01	-0.5		
14	SOUTH KYME	1,101	1302	-0.60	-0.22	-0.36		
15	TRINITY COLLEGE	609	1133	-0.60	-0.24	0.35	0.85	
16	HELPRINGHAM	814	1331	Zero	1.1	0.91	1.5	2
17	SWATON	851	1133	0.15	1.35	0.9	1.75	2.3
18	HORBLING	886	1331	Zero	0.9	0.6	1.6	
19	BILLINGBOROUGH	775	934	Zero	1.2	0.68	1.4	
20	SEMPRINGHAM	824	1189	Zero	1	0.71	1.4	2
21	DOWSBY FEN	1,003	1699	Zero	0.45	0.15	1.3	
22	GOSBERTON	2,885	3992	Zero	0.9	0.5	1.5	
23	DOWSBY LODE	355	1019	0.6	1.8	1.2	2.1	
24	RIPPINGALE	496	1019	Zero	1.1	0.65	1.6	
25	DUNSBY	568	651	-0.6	0.8	0.35	1.25	2
26	PINCHBECK	655	906	0.6	0.9	0.6	1.9	2.7
27	HACCONBY	503	850	-1	1	0.7	1.5	
28	BLACK HOLE	4,150	5776	-0.6	0.01	0.01	0.3	
29	DYKE FEN	1,862	2660	-1.2	-0.01	-0.9	0	
30	TWENTY	607	849	-1.2	-0.6	-0.6	0	
31	QUADRING	400	566	Zero	1	0.6	1.4	2
32	BICKER EAU	365	450	1.4	1.7	1.7	2.8	
33	DONINGTON WYKES		421	1.2	1.5	1.22	2.2	
34	ALLAN HOUSE		90	1.2	1.4	1.2	2.1	
35	KIRKBY LA THORPE	1,339	GRAVITY					
36	SCREDINGTON	2,691	GRAVITY					
37	WESTERN VILLAGES	373	GRAVITY					
	TOTALS	47,223	66885					

Notes:
1. [ ] indicates a subcatchment to a larger catchment and not included in the Total.
2. A blank space indicates no value at present.
3. All levels are metres Ordnance Datum Newlyn (mODN)
4. The Board's drainage system is designed to provide approximately 1.00m freeboard to lowest land in 1:10 year flows.
5. Catchment Nos 5, 6 & 12 have been modelled and shown to cope with 1:100 year flows without flooding to property.

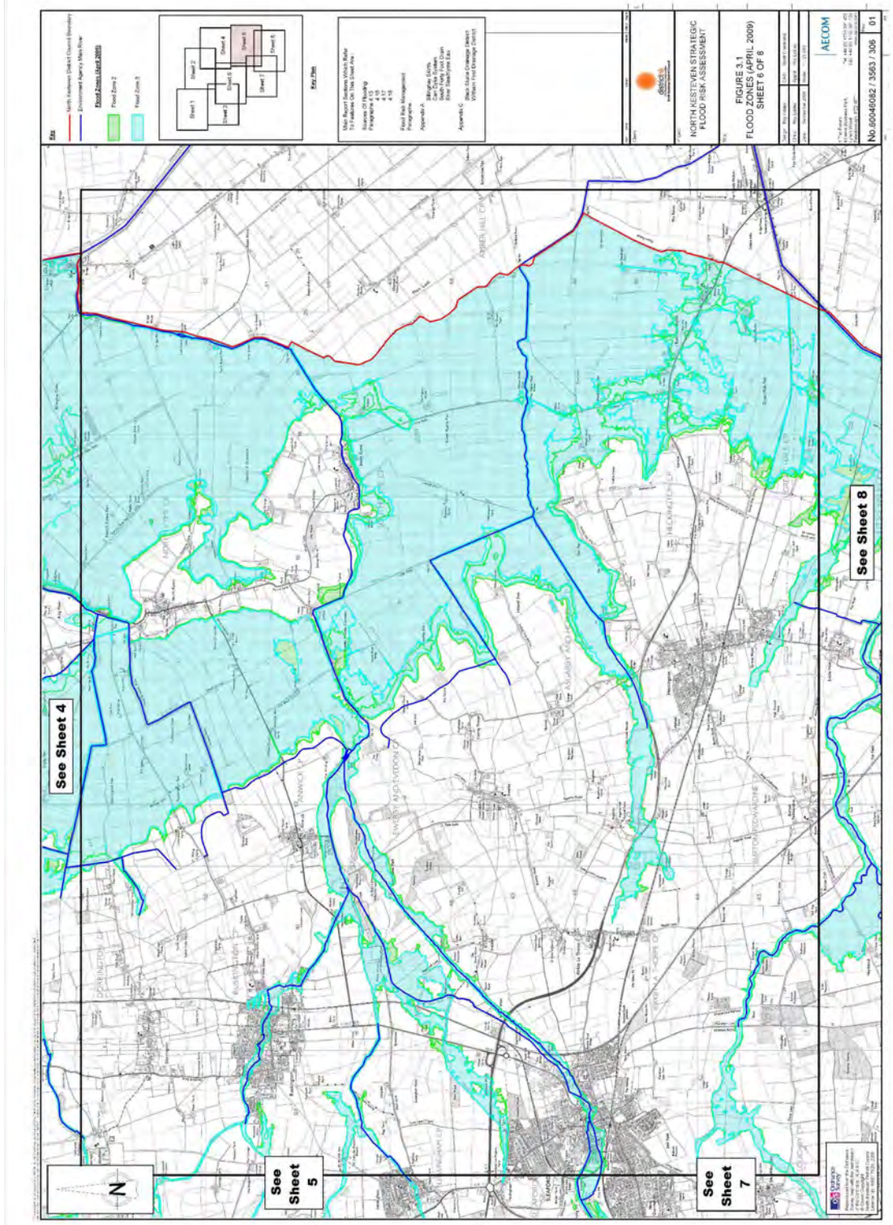
S:\Engineers\Catchment info linked to PS database.xls
Flood Risk Info 16/09/2008





APPENDIX D

EXTRACTS FROM NORTH KESTEVEN DISTRICT COUNCIL STRATEGIC FLOOD RISK ASSESSMENT


See Sheet 4
See Sheet 8
See Sheet 5
See Sheet 7
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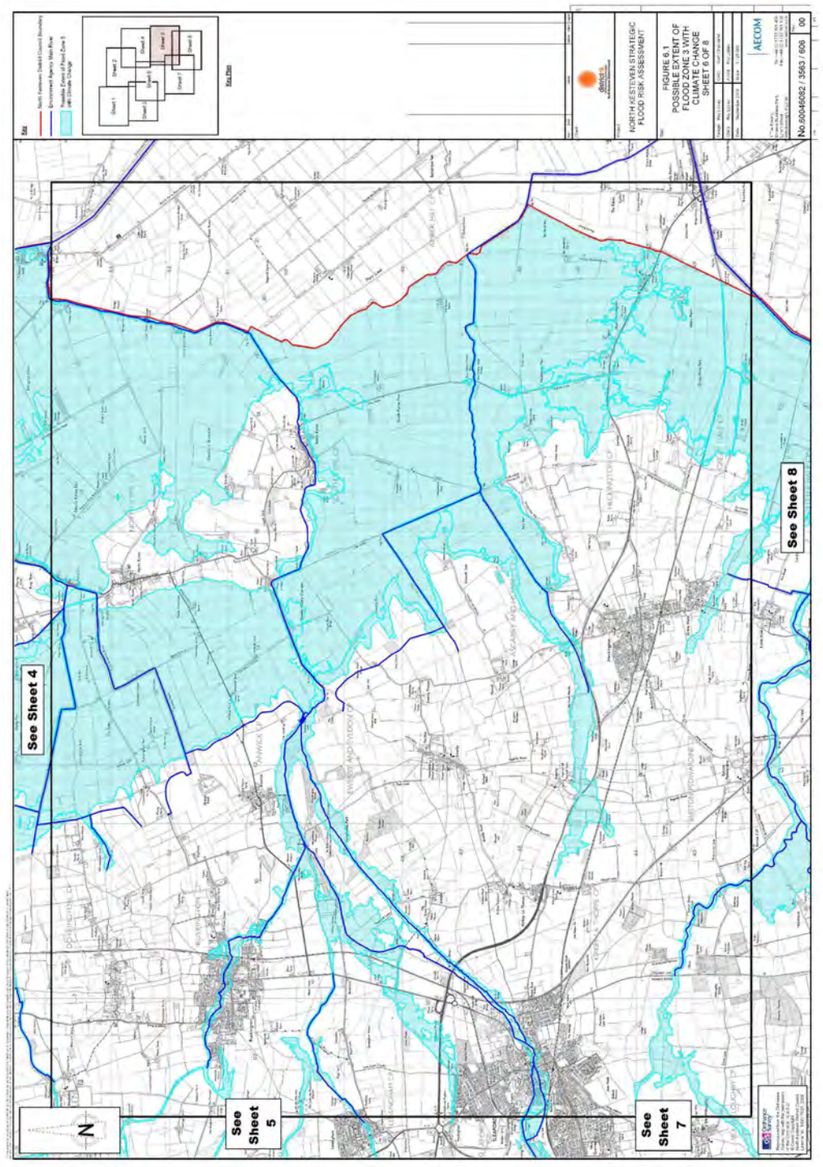
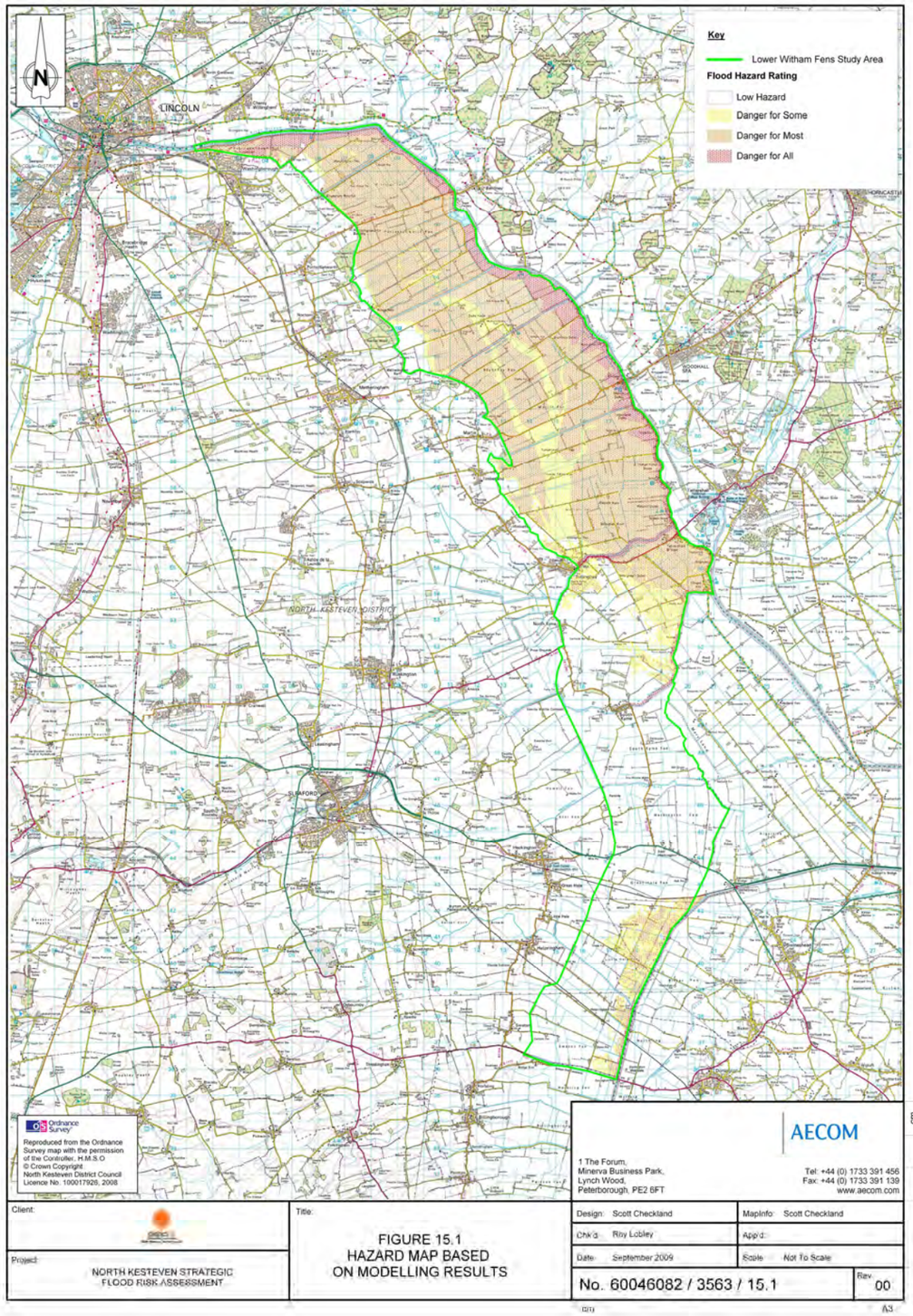
NORTH KESTEVEN STRATEGIC FLOOD RISK ASSESSMENT
FIGURE 3.1 FLOOD ZONES (APRIL 2009) SHEET 6 OF 8
AECOM


See Sheet 4
See Sheet 8
See Sheet 5
See Sheet 7
N
NORTH KESTEVEN STRATEGIC FLOOD RISK ASSESSMENT
FIGURE 6.1 POSSIBLE EXTENT OF FLOOD ZONE 3 WITH CLIMATE CHANGE SHEET 6 OF 8
AECOM



APPENDIX E

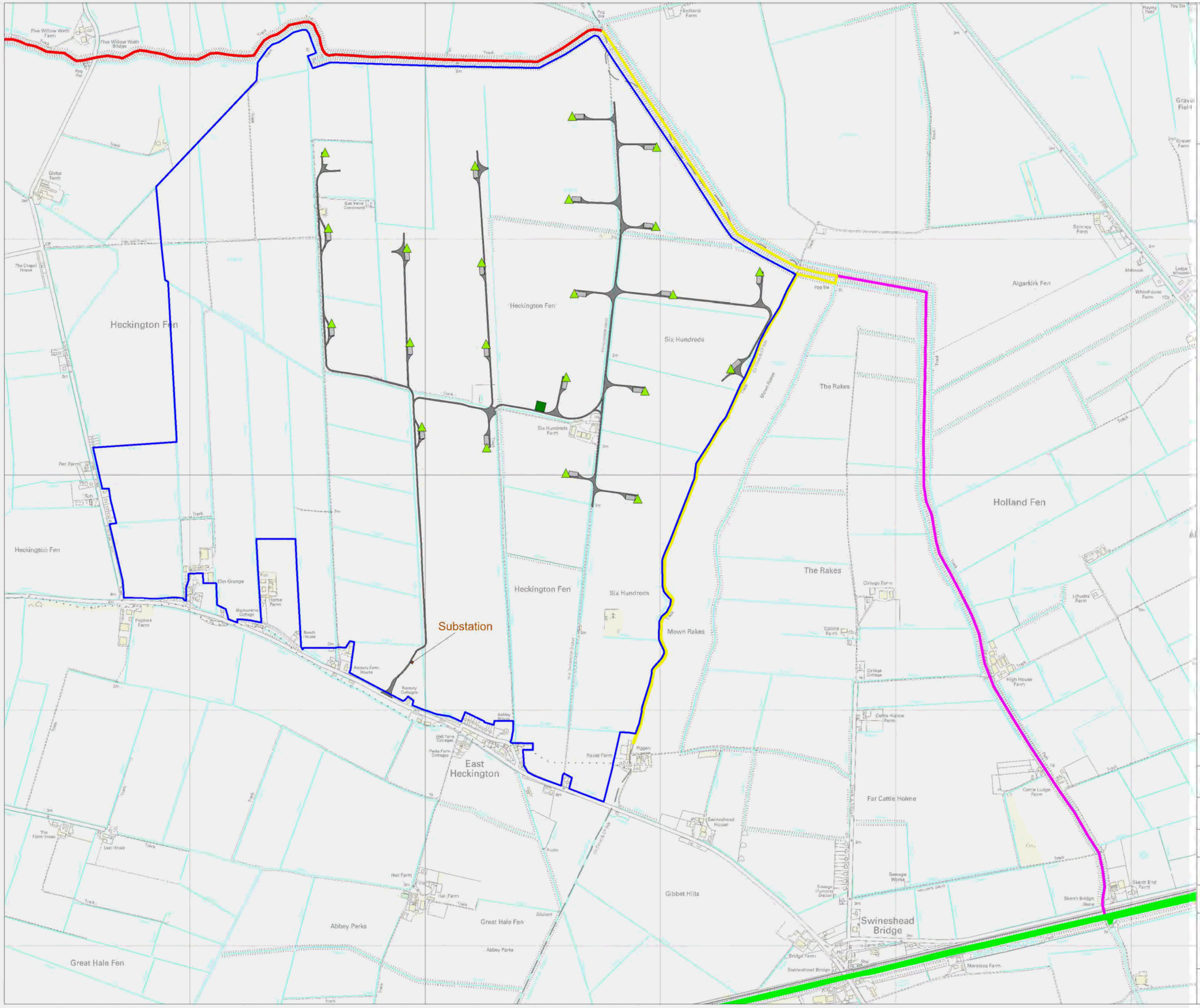
SITE PHOTOGRAPHS

Figure 1 Typical small field drainage channel. Depth approx2m below ground level

Figure 2 Labour In Vain Drain

Figure 3 Embanked protection between Head Dyke (on the left) and the proposed site (on the right)

Figure 4 Head Dyke along the north of the proposed site.



ecotricity

Axiom House
Station Road
Stroud
GL5 3AP
Tel: 01453 756111

Legend

- Turbine Location
- Site Boundary
- Access Track
- Crane Pad
- Substation
- Temporary Construction Compound
- Head Dike
- Holland Dike
- Skerth Drain
- South Forty Foot Drain

Drawn by	
Checked by	R Steele
Approved by	RHW

N W E S

Document Number: 4038_T0361_02

Date: July 2011

Scale: 1: 15,000 @ A3

Figure: 9.1

Title: Studied Watercourses

Heckington Fen Wind Park
Environmental Statement