Sizewell B Emergency Response Centre

Planning Statement Supporting Reference - Flood Risk Assessment

EDF Energy

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Summary

Atkins Limited has been commissioned to undertake a Flood Risk Assessment on behalf of EDF Energy for a site near Leiston in Suffolk. This site is associated with an existing rail head, where EDF are proposing to construct an Emergency Response Centre (ERC) for its power station at Sizewell. This site will provide a safe and dry storage facility for an emergency response associated with Sizewell B.

Executive summary

Site Name and Address	Sizewell crossing railhead King George's Avenue Leiston Suffolk		
Grid Ref	645,749 262,322	**Size**	2.5 hectares
Current Use	Industrial Currently an offloading and storage area	**Proposed use**	Other To be an emergency control centre for Sizewell B and house emergency plant and equipment
Flood Zone	Flood Zone 1	Sequential test	The proposed development is located in flood zone 1. The site is inherently at a low risk of flooding.
Vulnerability	Highly Vulnerable		
Compatible Development	Exception Test		
Exception test	Not required		The exception test is not required for this site.

Other

This flood risk assessment has identified that the greatest risk of flooding will be from rainfall. There are no fluvial or coastal risks of flooding.

Surface water ponding and overland flooding have not been specifically identified as a high risk to this site, although this source of flooding presents the greatest relative risk. The proposed development will increase the area of impermeable surface and mitigation measures are required to limit offsite discharges to the current Greenfield value. It is considered this value will be in the order of 2 l/s/ha.

It is recommended that infiltration drainage be used to minimise the additional runoff from the site.

1. Introduction

1.1. Background

Following the Tohuku earthquake in Japan on the 11th of March 2011, a review of the UK's nuclear industry has been carried out by the Office for Nuclear Regulation (ONR) using the lessons learnt from the Tokyo Electric Power Company (TEPCO) Fukushima-Daiichi station. This review concluded that there were no fundamental safety weaknesses in the UK's nuclear industry, but concluded that using the lessons learnt from the event the industry can be made even safer.

The final review from the ONR was issued in September 2011 and identified a number of areas for improvement in the UK nuclear industry. Subsequently, an independent review of the lessons from the event was carried out by EDF Energy. A key recommendation of the study was the provision of an Emergency Response Centre (ERC) that would enhance the emergency response capability at Sizewell B. The requirements for the centre have been developed by EDF Energy in response to the recommendations from the ONR.

Atkins Ltd have been appointed by EDF Energy to progress the design and engineering of the ERC for Sizewell B. As part of this instruction, Atkins have prepared an application for a full grant of planning permission for the ERC. This technical Report supports the application for planning permission and should be read in conjunction with the suit of documents that accompany the application for planning permission and in particular with the Planning Statement that summarises the case for the proposed development.

1.2. Site Location

The ERC is proposed for the existing railhead site east of Leiston as shown on the Site Location Plan - A4010 that accompanies the application for planning permission, National Grid Reference 645740, 262326. The rail head is located a short distance outside the development boundary for Leiston approximately 2km from the Sizewell Nuclear Power Station Complex to the east. The site is accessed via King George's Avenue and is owned by EDF Energy Nuclear Generation Limited (EDF Energy NGL). The site is currently used for open storage and as a railhead.

Directly to the west of the site lie the EDF Energy Sports and Social Club with its associated sports pitches and an arable field. Further west is Leiston Community High School and residential areas with the centre of Leiston approximately 1km west of the site. North of the site is King George's Avenue that runs east-west from the centre of Leiston, joining Sizewell Gap Road to the east of the site. North of King George's Avenue is open countryside made up of arable fields. To the west of the arable land on the north eastern edge of Leiston is Sizewell Crossing Industrial Estate with several large scale industrial buildings.

Rail lines serving the railhead run to the north west of the site. East of the site is more arable land and Crown Farm Cottage. South of the site is Crown Land Cottages and more open farmland.

The site is located outside of the Suffolk Coasts and Heaths Area of Outstanding Natural Beauty (AONB) and is approximately 300 metres from the Leiston-Aldenburgh Site of Special Scientific Interest (SSSI) and Sandlings Special Protection Area (SPA).

1.3. Site Description

The site is approximately 2.5 hectares and rectangular in shape adjoining the north east side of the rail lines that run from the northwest to the southeast. A topographical survey of the site Plan Number A4012 accompanies the application for planning permission.

The site is predominantly made up of hard standing used for open storage and as the off-loading area for the railhead. A transformer storage building approximately 8 metres square and 8.6 metres high is located centrally on the eastern boundary of the site and an overhead crane services the rail head. At the northern end of the site adjoining King George's Avenue the site widens with an area of mature planting, screening the railhead facility from King George's Avenue. The site also widens at its southern end with a further area of mature planting and scrub. The eastern boundary is made up of mature and semi mature planting and scrub encroaches onto the site in various locations.

1.4. Description of Development

The proposals are to construct an ERC. The ERC will comprise a storage facility for essential plant and materials and a control centre for emergency operations on the main Sizewell B facility. This facility will incorporate back-up plant and equipment storage and office space associated with EDF Energy's enhanced emergency arrangements for the nuclear power plant.

The design is for the facility to withstand extreme natural hazards and therefore remain operational. The architects have included timber effect cladding and a curved green roof for the building and are designing the ERC based on predictions for events such as earthquakes, extreme flooding and extreme high winds. This includes sourcing expertise from those countries which frequent such events and building in accordance with the international codes of practice.

The hazards that the facility will be required to be designed for are:-

- Earthquakes (Seismic);
- Extremes of Temperature, minimum of -17°C and maximum of 36°C;
- Extreme High Winds, up to 135mph three second gusts;
- Extreme Snow Loads, up to 543mm of snow with drifting also considered;
- Extreme Rainfall, up to 100mm in one hour and 200mm in one day;
- Extreme flooding and tidal/storm surge; and,
- Electrical Storms.

The proposed ERC is sited in the southern portion of the site parallel to the site boundary on its eastern edge. Details of the location and design of the building can be found on Plan Numbers A4013, A4014, A4015 and A4016 that accompany the application for planning permission. The ERC would be a conjoined pair of buildings, of approximate overall dimensions 90 metres by 14 metres and a height of approximately 8.5 metres above existing ground. The building would have an eaves height of 7.75 metres to the front (east) and 6.33 metres to the eaves at the rear of the building.

The building would have a concrete masonry construction at ground floor level. Above ground floor level the building would be faced in a cladding material to replicate a timber finish and would have a curved 'green' roof planted with sedum. To allow flexibility and resilience there is proposed to be a series of large sectional doors servicing each of the central bays. These doors will be accessed from the west elevation of the building. Door openings are as wide and high as possible within the structural constraints to give maximum flexibility for access and for future use.

To the south of the ERC would be a back-up generator and substation compound and separate refuse store and oil store. To the north of the building, between the ERC and existing storage building would be a substation and vehicle refuel area. To the front (west) of the ERC would be an area of replacement hardstanding, beneath which would be four new underground water tanks.

The proposed development has been designed to reduce its impact on the environment and surrounding landscape, through the use of the green low profile roof, renewable technologies (such as rainwater harvesting) and improved landscape perimeter.

Figure 1. Artists impression of the ERC building

1.5. FRA Planning Context

A FRA should consider all types of flooding to satisfy the following three key objectives:

- To assess flood risk to the proposed development and to demonstrate that any residual risks to the development and its users would be acceptable;
- To assess the potential impact of the proposed development on flood risk elsewhere and to demonstrate that the development would not increase flood risk elsewhere; and,
- To satisfy the requirements of the National Planning Policy Framework (NPPF).

Flood risk should be considered alongside other spatial planning issues such as transport, housing, economic growth, natural resources, regeneration, biodiversity, the historic environment and the management of other hazards. A FRA should be carried out to an appropriate degree at all levels of the planning process. It should assess the risks of all forms of flooding to and from development, taking into account climate change over the design life of the development, and should inform the application of the sequential approach if appropriate.

This report forms a Level 2 assessment as described in CIRIA publication c624, 'Development and Flood Risk'. Hence this report provides a qualitative assessment of the risks arising to the site as a result of both its location and development proposals.

2. Policy Context

2.1. National Planning Policy Framework

The NPPF replaced the previous planning system in March 2012. This replaced Planning Policy Statement 25 (PPS 25) which had set out Government policy on development and flood risk. PPS 25 aimed to ensure that flood risk was taken into account at all stages of the planning process, to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas of highest risk. Where new development was thought necessary in areas of flood risk, PPS 25 aims to make it safe, without increasing flood risk elsewhere, and, where possible, reduce flood risk overall.

PPS 25 promotes a sequential risk-based approach to determine the suitability of land for development in flood risk areas. The application of the sequential test is described in Section 7 of this report.

Although PPS 25 is now obsolete the new NPPF retains the key elements of PPS 25 as an interim measure pending a wider review of support and guidance.

Appendix D specifies more detailed requirements of the FRA by size and zone.

2.2. Strategic Flood Risk Assessment

The Suffolk Coastal and Waveney District Strategic Flood Risk Assessment (SFRA) from 2009 was reviewed as part of this FRA. The SFRA notes the presence of some formal flood defences in the general flood cell. The preliminary assessment indicated that, "*any new allocations for housing development at Leiston could reasonably be accommodated outside flood zones 2 and 3*". The mapping indicated that, "*the entirety of the area is located outside the Environment Agency mapped and PPS25 defined flood zones 2 and 3*".

Catchment wide strategies were suggested for sustainable drainage, with the implementation of strategic flood storage areas in Leiston to reduce flood risk to towns and villages. A restriction of greenfield runoff rate was also recommended for developments in Leiston to ease surface water flooding and drainage capacity exceedance.

The SFRA also notes that a number of roads in Leiston are regularly flooded, and that any culverted waterways should be deculverted to increase capacity and reduce flooding. Where a development allocation uses road crossing culverts for access they should be improved by the developer to increase capacity, including an allowance for climate change.

Figures B32 to B38 from that work indicates the site to be outside of flood zones 2 and 3.

2.3. Flood Risk and Return Period

Flood Risk includes the statistical probability of an event occurring and the scale of the potential consequences. The risk is estimated from historical data and expressed in terms of the expected frequency (or 'return period') of a flood of a given magnitude. The 10-year, 50-year and the 100-year floods have a 10%, 2% and 1% chance respectively of occurring in any given year (this is termed the Annual Exceedance Probability, AEP), however over a longer period the probability of flooding is considerably greater.

For example, for the 100-year return period flood:

- There is a 1% chance of the 100-year flood occurring or being exceeded in any year;
- a 26% chance of it occurring or being exceeded in a 30-year period; and,
- a 51% chance of it occurring or being exceeded in a 70-year period.

2.4. Environment Agency Flood Risk Classification

The site lies inside the Environment Agency's indicative flood zone 1. The figure below (Figure 2) is an extract from the Environment Agency's flood zone map (note this map assumes no flood defences are present). The Environment Agency flood map is used as the starting point for all FRAs.

The site lies within Flood Zone 1

Figure 2. Environment Agency flood zone map

2.5. Vulnerability Classification

The vulnerability of the development or land use must be taken into account as the consequences of flooding may not be acceptable for particular types of development. The NPPF technical guidance defines the Flood Risk Vulnerability classification (table D.1 – see Appendix D) for the proposed use of the development site.

As a command centre designed to be operational during flooding the site falls within the Highly Vulnerable 'classification which includes police stations and installations requiring hazardous substances consent.

The site is categorised as Highly Vulnerable

2.6. Compatibility

The NPPF flood risk vulnerability and flood zone 'compatibility' table (see Table 1) indicates that development is appropriate for the site. This is based on the site being in flood zone 1 and classified as highly vulnerable.

Flood Risk Vulnerability classification		Essential Infrastructure	Water compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	Zone 1	✔	✔	✔	✔	✔
	Zone 2	✔	✔	Exception test required	✔	✔
	Zone 3a	Exception test required	✔	✗	Exception test required	✔
	Zone 3b	Exception test required	✔	✗	✗	✗
Key: ✔ ✗		Development is appropriate Development should not be permitted				

Table 1. Flood risk vulnerability and flood zone 'compatibility'

The ERC development is appropriate for this site

2.7. Environment Agency Standing Advice

For applications greater than 1ha in Flood Zone 1, the Local Planning Authority should consult the Environment Agency with a FRA containing a surface water drainage strategy setting out how the surface water from the site will be managed.

The applicant is referred to the Environment Agency web site for FRA guidance note 1. FRA guidance notes are available at http://www.environment-agency.gov.uk/research/planning/93498.aspx. This document is appended to this report as Appendix C.

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3. Sources of Flooding

The NPPF states that all types of flooding should be considered in the development framework. The extent to which these should be considered will vary and depend on whether they are considered as significant at the spatial planning scale and in setting constraints on development in certain areas.

This section of the report identifies those sources of flooding that require further consideration.

3.1. History of Flooding

No data has been obtained to demonstrate that the site itself has been flooded previously.

Following heavy rainfall in 1993, runoff from fields and impervious areas resulted in flooding within Leiston, although there are no records of the site itself as having flooded. The SFRA noted that Leiston could benefit from strategic flood storage areas.

The SFRA indicates that the following properties in Leiston were affected by recent notable flooding. These do not include area near to the proposed site.

Flood Event Year	Locations Affected
1993	Carrs Cottages, 13 &14 Archway Cottages, 165 &167 Carr Ave, 103 &105 New bungalows 17, 21, 23 & 25 Haylings Rd. White Horse Hotel, Engineers Arms Valley Rd, Carr Avenue, Abbey Rd, Haylings Rd, Main St.
2000	15 Haylings Rd, Carr Cottages, 39 Cross St, Barclays Bank, Baker Bros, The Library, The Film Theatre Valley Rd, Cross Street, Valley Rd and Main Street, High Street

Table 2. Historical flood events in Leiston

The site is reasonably well elevated – it is approximately 15m above sea level, and approximately 5m higher than the Sizewell B site. The site is safe from even the most extreme tidal flood levels predicted by the Environment Agency.

The storm surge that struck the east coast of England and the southwest coast of the Netherlands during the night of Saturday 31 January, 1953 caused the worst natural disaster in northern Europe over the past two centuries. Sea levels of 4.61m AOD and 3.98m AOD were recorded at Lowestoft and Harwich respectively[1].

Data on the 1953 floods shows the proposed building is outside the zone affected by that event. This is one of the factors that contributed to the selection of the site, as the purpose of the building is to be unaffected by natural events such as extreme flooding.

3.2. Flooding from Rivers

The site is not at risk from fluvial flooding. There are no main rivers or ordinary watercourses in the immediate vicinity of the site, the nearest fluvial floodplain is some 1000m away.

The flooding extent is shown on the Environment Agency floodplain map although this assumes no defences are present (see Figure 3).

[1] Risk Management Solutions (2003), 1953 UK Floods – 50 year retrospective

3.3. Flooding from the Sea

This site will not be affected by flooding from the sea. The SFRA considered the impact of tidal flooding in the locality and tested the effect of breach in the tidal defences. No impact was found on the site.

Extreme tide levels around the UK have been published by the Environment Agency[2]. The study, from 2011, provides predicted tide levels for coastal chainage 4194 (nearest to the site), with a 1 in 200 year tide of 3.13m AOD. These are tabulated below in Table 3.

The data indicates a 1 in 10,000 year tide level of 4.18m AOD. This compares to the typical site level of 15m AOD. Hence the site is located more than 10m vertically above the extreme tide.

Comparison with data for the 1953 coastal event also indicates no risk to the site of coastal flooding. Peak tide levels between 4.61m AOD and 3.98m AOD were recorded at Lowestoft and Harwich respectively. Again, the site is located on land sufficiently elevated above the worst known flood event.

Tidal return period	Tide level mAOD
1	1.99
2	2.13
50	2.79
100	2.95
200	3.13
250	3.19
500	3.35
1,000	3.53
10,000	4.18

Table 3. Extreme tide levels

Figure 3. Flood outline form 1953 event

[2] Environment Agency (February 2011), Coastal flood boundary conditions for UK mainland and islands – Design Sea Levels, SC060064/TR2

3.4. Flooding from Groundwater

Groundwater flooding can lead to high levels of infiltration to sewers, soakaways and underground services, reducing their capacity to remove surface water runoff.

3.4.1. Geology

The BGS map indicates the solid Geology at the site to comprise the Crag Group – Sand described as a suite of shallow-water marine and estuarine sands, gravels, silts and clays. The sands are characteristically dark green from glauconite but weather bright orange with haematite 'iron pans'.

The Crag Group is overlain by superficial deposits of the Lowestoft Till Formation described as an extensive sheet of chalky Till, together with outwash sands and gravels, silts and clays. The Till is characterised by its chalk and flint content. The carbonate content of the Till matrix is about 30%.

The typical lithology of unweathered Lowestoft Till is olive-grey (dark olive-grey when wet), sandy, silty clay with scattered lithic clasts. The matrix consists largely of reconstituted Kimmeridge Clay and other Mesozoic argillaceous rocks (Perrin et al., 1973, 1974). In its unweathered state, the Lowestoft Till is cohesive, with a low permeability. Where weathered, the Till is rust-brown and is generally more friable and permeable than unweathered Till. Depending on the degree of weathering, the Till may be completely decalcified, the chalk having been removed by solution; where this is the case, the dominant clasts are flints or flint fragments. The depth of weathering is variable, with profiles extending to as much as 3 m below its top (Arthurton et al., 1994).

For further details refer to the ‘Ground Conditions’ report (document reference: 5112116/08/006).

3.4.2. Hydrogeology

The Environment Agency website indicates the site is underlain by a designated principal aquifer, the Crag Group: these are layers of rock or drift deposits that have high inter-granular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.

The Crag Group at the site is overlain by superficial deposits in the form of the Glacial Till of the Lowestoft Formation. The Environment Agency Website indicates that the superficial deposits are a Secondary A aquifer which are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

Where the Crag Group deposits are a significant thickness, non-water bearing and of a low permeability, they can effectively act as aquiclude, preventing any percolating groundwater from directly reaching the Principal aquifer.

Environment Agency information also shows that the site does not lie within a designated groundwater Source Protection Zone. There is a groundwater source protection zone (SPZ) located approximately 3km west of the site.

A standpipe installed during a site investigation, in 2011, recorded ground water at 7.90m below ground level on completion of its installation during the summer. There are no other records available from which to comment on this reading. It could be assumed that this reading is low due to the seasonality of the record. For further details refer to the ‘Ground Conditions’ report (document reference: 5112116/08/006).

However, the ground water table is well below ground level and hence flooding from groundwater is unlikely to be an issue.
It is concluded that there are no risks of flooding from groundwater on this site.

3.5. Flooding from Rainfall

Flooding from rainfall is that caused by overland flow / runoff after rainfall onto the site or locally. There are no known risks of flooding from the land on this site although overland flow could provide a pathway for flooding.

Whilst any new surface water drainage will be designed to carry the 1 in 30 year storm, there is a flood risk from rainfall on the site and a failure of the surface water drainage system to cope with intense deluges. This is discussed in Section 4.4.

3.6. Flooding from Sewers

Flooding from surface water, foul and combined sewers has not been reported to be a problem at the proposed development site. There are no sewers on the site; hence there are no records of sewer flooding occurring.

However, without adequate site drainage, surface water flooding could be a risk. New arterial sewers will be required to collect foul and surface water discharges from the new buildings. Whilst these could be connected into the existing sewer networks serving the Leiston community to the west of the site, the proposals are for stand-alone solutions. It is proposed that foul water drains to a new septic tank at the southern end of the site which will be emptied by tanker at regular intervals. Surface water drainage is described further in Section 5.1.

3.7. Flooding from other sources

There are no formal flood defences around the site or protecting it from afar. Therefore, failure of defences is not a flood risk issue.

There are no culverted watercourses or other water related infrastructure that could impact on the flood risk of the site.

4. Assessment of Actual Flood Risk

4.1. Data Collection

The previous section identified those sources of flooding requiring further consideration. This section details the investigations undertaken to assess the flood risk posed by those sources. The primary source of flood risk for consideration at the ERC was rainfall.

The following information was collected for the FRA:

- the Environment Agency Flood Map covering the site and adjacent areas. The map indicates an area with a 1% chance of fluvial flooding and 0.5% chance of tidal flooding in any given year in the absence of flood defences;
- SFRA for Suffolk coastal areas;
- details of the proposed development;
- topographic survey of existing ground levels at the proposed development site;
- search for records of historic flooding;
- Ground Conditions Report (reference: 5112116/08/006); and,
- design tidal water levels for by the Environment Agency for present day.

4.2. Topography

Plan number 5112116/A4012 that accompanies the application for planning permission shows the topographical survey of the existing site. This was surveyed by Atkins in March 2012.

The 2.5 hectare site is some 450m long and 60m wide. Ground levels across the site are reasonably flat and generally between 14.7m AOD and 15.3m AOD, with the higher ground to the western boundary. The existing hard standing area lies at around 15m AOD.

4.3. Climate Change

The NPPF states that climate change should be considered for the life time of the proposed development. The design life of the ERC development is 100 years. The official advice by Defra (August 2011)[3] on for climate change replaces Defra's supplementary advice note to Operating Authorities of October 2006. This guidance is based on the UKCP09 research and is different from the guidance in the NPPF, now considered out of date.

Climate change has been taken into account by applying change factors in line with the guidance for the site. These quantify the potential change (as mm or % depending on the variable) to the baseline. It is recommended that options are developed that plan for the change factor covering the whole of the decision lifetime. Rather than base options solely on the change factor, upper and lower bound estimates can be used to refine the options to prepare for a wider range of future change.

For the ERC site at Leiston, the relevant climate change factors are listed below.

[3] Environment Agency (August 2011), Adapting to Climate Change – advice for flood and coastal erosion management authorities

4.3.1. Change to extreme rainfall

It is recommended that projection of future rainfall for events more common than a 1 in 5 year event is derived from the UKCP09 data. For events more extreme than this the England wide dataset is recommended – as tabulated in Table 4.

	Total potential change anticipated for		
	2020's	2050's	2080's
Upper end estimate	+10%	+20%	+40%
Change factor	+5%	+10%	+20%
Lower end estimate	+0%	+5%	+10%
The 2020's cover the period 2015 to 2039; the 2050's the period 2040 to 2069; and the 2080's the period from 2070 to 2099. For changes beyond the 2080's it is recommended that the 2080's changes are used.			

Table 4. Climate change impacts on extreme rainfall intensity

No allowance for climate change should be applied to calculated greenfield peak rates of runoff from the site for any region.

4.3.2. Change to relative mean sea levels

Projections of relative mean sea levels for any location around the whole UK coast are provided within UKCP09. Relative sea level rise projections account for future land level movements. They also, for the first time, account for regional oceanographic effects. These regional effects arise from the difference in change in sea level for the region immediately surrounding the UK compared to the global mean.

The change factor and the lower end estimate can be taken directly from the UKCP09 user interface for the relevant location. See Table 5.

	Sea Level Rise (compared to 1990)			
	at 2025	at 2050	at 2080	at 2100
Change factor	Use UKCP09 relative sea level rise medium emission 95% projection for the project location available from the user interface.			
	177mm	337mm	564mm	738mm
Lower end estimate	Use UKCP09 relative sea level rise low emission 50% projection for the project location available from the user interface.			
	119mm	224mm	372mm	483mm

Table 5. Climate change impacts on sea level

The upper end estimates and H++ limits are defined on a countrywide scale in terms of an annual increase. These are tabulated below in Table 6.

	Rate of Sea Level Rise			
	up to 2025	2026 to 2050	2051 to 2080	2081 to 2115
H++ scenario	6 mm/yr	12.5 mm/yr	24 mm/yr	33 mm/yr
Upper end estimate	4 mm/yr	7 mm/yr	11 mm/yr	15 mm/yr

Table 6. H++ limits and upper end estimates for sea level

Thus the 1 in 10,000 year tide, in the year 2100, is predicted to be 4.918m AOD, with an H++ limit of 5.957m AOD. Both remain much lower than ground levels on the site.

The impact of climate change on storm surge or wave climate has not been considered as part of this FRA, as the site is located 1900m from the coastline and has ground levels of typically 15mAOD.

4.4. Assessment of Flood Risk from Rainfall

Rainfall can lead to local ponding of surface water and then overland flow onto, across and out of the site. Development in areas where sheeting flow occurs could alter drainage paths and lead to runoff being concentrated in areas susceptible to flooding.

The site lies at a level of 14.5m AOD to 15.0m AOD, with a nominal fall from north west to south east. Beyond the south-eastern boundary, ground levels drop down towards 12m AOD. Given the surrounding vegetation, topography and geology, overland flow from the west, south and east will be limited and negligible.

Surface water runoff is possible from the highway and access to the north, off King George's Avenue. The road drops from 15.5m AOD to 14.5m AOD from 50m either side of the site entrance. The highway shows no sign of any formal drainage with no road gullies or grips into drainage ditches. It is therefore possible that overland flow could enter the site from the road network.

The 2012 topographic survey indicates ground levels of between 14.78m AOD and 14.70m AOD across the access road inside the entrance. Road levels are 14.65m AOD and below. This implies that surface water would preferentially drain along the road and only when sheeting flow over 100mm deep occurs would some flow into the site.

There are no low lying features indicated on the existing site survey, nor proposed in the development. As such, rainfall onto the site will pass across it, rather than be retained on it.

Rainfall depths for the site were derived from the Flood Estimation Handbook[4], using the DDF model. Whilst the 1 in 10,000 year rainfall is included in the table below, the model is not suited to the prediction of such extreme rainfall and the estimates should be treated with caution.

Duration	Rainfall return period							
hours	10	20	50	100	200	500	1,000	10,000
0.25	16	21	29	36	46	62	78	169
0.5	20	25	34	42	53	71	89	187
1	24	30	40	49	61	81	101	205
1.5	27	33	44	54	67	88	108	216
2	29	35	47	57	71	93	114	225
4	34	42	55	67	81	105	128	246
5	36	44	58	70	85	110	133	253
10	44	53	67	81	98	125	150	276
12	46	55	70	84	101	129	154	282
24	54	65	81	97	115	145	172	305

Table 7. Rainfall depths (mm)

It should be noted that the designs functional requirements require consideration of rainfall under two scenarios: 100mm per hour and 200mm per day. The table above indicates that these rainfalls are approximately the 1 in 1,000 year and 1 in 1,600 year return periods respectively. The management of these extreme events will be considered during the detailed design phase.

[4] Institute of Hydrology (1999) Flood Estimation Handbook

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5. Control of Flood Risk

5.1. Mitigation Measures

The proposed ERC development has the potential to increase the amount of impermeable surface within the site, which will lead to an increase in surface water runoff if not mitigated for. However, the site is already moderately paved and the change in runoff will be relatively small.

The developed rate of run-off into a watercourse, or other receiving water body, up to and including the 1 in 100 year event, should be no greater than the existing rate of run-off for the same event, or restricted to a limit set by the Environment Agency or Water Authority. The purpose of this is to retain a natural flow regime in the receiving watercourse and not increase peak rates of flow.

For this site, a 100 year Greenfield runoff rate of 12.7 l/s/ha has been calculated, using the ADAS 345 method. This is based on a WRAP class 3. The site appears to be on the border of WRAP classes 1 and 3 and hence the Greenfield runoff rate could be much lower at 2.5 l/s/ha. The Institute of Hydrology method (IoH 124) suggests between 13.8 l/s/ha and 1.6 l/s/ha for the same event. Thus a lower discharge limit of 2l/s/ha serves as a useful indicator for this FRA and mitigation for an increase in runoff (to be confirmed for detailed design through ground investigation tests).

The existing site currently provides approximately 0.5ha of impermeable area (paved and roof area) leaving 2ha of permeable area (vegetated areas and granular surfacing). Assuming 100% runoff from the impermeable areas, and 10% to 37% runoff from the permeable areas (based on soil WRAP class 1 or 3) the volume of site runoff for a 100 year 15 minute storm (36mm) would be between 252 and 446m^3.

The proposed site layout has the potential to increase the impermeable area with a new building and additional paved area for vehicle access, with a total impervious area of approximately 0.92ha. This is an increase in impermeable area of 4200m^2. This could raise the discharge volume to between 388m^3 to 542m^3. Hence a long term storage requirement of between 95m^3 and 136m^3 could be required.

However, the site is already a developed plot and restriction to full Greenfield runoff is not appropriate, other than for the additional development burden. The proposed increase in impermeable area is 0.42ha. The current runoff from that area, at a 100 year greenfield rate of 2 l/s/ha, is a flow of less than 1l/s, which compares with a potential peak flow from that area of 218l/s (average flow of 168l/s) in the developed scenario. Attenuation storage would be required to restrict the discharge from the additional impermeable areas to the greenfield runoff limits. This will also need to accommodate the 20% increase in rainfall predicted under the climate change scenario. In this instance, the rainfall depth from the 15 minute 100 year storm rises from 36mm to 43.2mm.

No other mitigation measures are specifically required for this site. The proposed development neither impacts on the existing flood risk of its neighbours, nor is at risk itself.

5.1.1. Use of Sustainable Drainage Systems (SuDS)

The ground investigation data available notes a groundwater table some 8m below ground level at the site. With a superficial geology of Crag Group – Sand, the site would appear suitable for infiltration drainage through soakaways or infiltration ponds.

It is thus recommended that the surface water drainage is designed to include sustainable techniques for much of the site runoff so mitigating against the increase in runoff caused by the additional impermeable areas. This could be located on the area to the south of the proposed commercial vehicle turning circle, and be designed as an amenity feature with ecological gain.

The building design include for a green roof to hold surface water and minimise runoff. Surface water will be collected by varying the gradient of the new hard standing to allow the surface water to drain away from the building. It is intended that this will be in a similar way to the present state. Soakaways are to be provided to return much of the surface water to ground with a design standard of 1 in 30 year storm. The exact capacity will depend on the results from the ongoing ground investigation and available space.

5.2. Management of Flood Risk

The site is not specifically protected from flooding, other than by its location. The proposed building is to be located on higher ground and away from the road. This will position the infrastructure in the least risk area.

Surface water drainage will be installed which discharges to 1 or more soakaways. The soakaways are being designed to handle a 1 in 30 year storm. Overflows from the soakaways will direct water towards the existing natural drainage paths, taking water offsite to the south and east.

5.3. Resilience and Resistance

Neither the proposed building, nor the site, is deemed to be at risk from extreme flooding, as defined in the NPPF. As such adding flood resistance and resilience measures to the building is not of immediate importance. However, given the need for the premises to remain operational in almost the worst possible conditions, it is recommended that some consideration be made towards adding flood resilience into the works.

Flood resilience measures are aimed at enabling the operational requirement of the infrastructure to become fulfilled immediately after, if not during, flooding, whilst accepting (accommodating) flood water onto the site. Flood resistance measures seek to prevent floodwater from entering the building or site.

For this proposed ERC site at Leiston, the flood hazard safety case will consider the impacts of 1 in 10,000 year flooding and design rainfall of up to 100mm per hour or 200mm a day. It is suggested that resilience measures are considered during the detailed design stage, and could include raised electrical sockets, and off-the-ground storage facilities for sensitive equipment.

The design of the drainage infrastructure will be of key importance, as surface water provides the primary source of flood risk. Any infiltration or storage features should be specified with the safety case in mind.

5.4. Off Site Impacts

5.4.1. Fluvial Risk

The proposed development will have no impact on fluvial flood risk elsewhere. The Surface water drainage scheme will be designed to prevent additional flows into the receiving watercourses.

5.4.2. Coastal Risk

The proposed development will have no impact on coastal flood risk elsewhere.

5.4.3. Groundwater Risk

The proposed development will have no impact on flood risk from groundwater sources elsewhere. It is considered that surface water drainage could be discharged to ground via soakaways or infiltration drainage although this is to be tested during a future ground investigation.

5.4.4. Surface Water Flood Risk

Surface water runoff from the site will be controlled such that it does not add to any overland flow arising from areas outside of the site boundary. There will be no impact on the risk of flooding elsewhere from overland flow across the site.

Site drainage of surface water will be designed to incorporate sustainable techniques where possible. Given the local geology and proposed site layout, infiltration ponds and soakaways appear viable. A green roof is proposed to help reduce the additional runoff caused by the new building

5.4.5. Sewer Risk

Site drainage of surface water is covered in Section 5.4.4 above. There will be no additional burden on the existing public sewer network, with all foul and surface water being held on site.

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6. Residual Flood Risk

6.1. Extreme Event

The residual risks of the extreme event (1 in 1000 year as defined in the NPPF) are of deeper flooding and higher velocities across the site. Such risks will only arise from surface water flooding, with all other sources of flood risk having no impact on the site, even in this event.

With suitable drainage infrastructure, flood resilience measures, and consideration of the nuclear design safety case, the site will remain safe during the extreme event. The residual risk of flooding from all sources is low.

6.2. Risk of Breach

There are no raised defences protecting the proposed ERC site. As such, risk of breach or defence failure is not an issue for this FRA.

6.3. Access and Egress Conditions

Access and egress from the site will be via King George's Avenue to the north, with the current access leading south of that road to the proposed site car parking and building.

Surface water flooding on King George's Avenue could lead to sheeting flow along that road, with no gullies present along the verges. Extreme rainfall could lead to some surface water entering the site. The current ground levels indicate this would mostly shed to the permeable ground on the east of the driveway.

With the site access and hard standing areas surrounded by permeable surfacing and green areas, the depth of any surface water flooding will be minimal. Access and egress conditions will be affected by direct rainfall, but depths of water will be nominal. The area of greatest relative risk will be access along King Georges Avenue; however we don't perceive that works will be required to manage this risk.

6.4. Management over Development Lifetime

There are no development - lifetime management issues for this site, although it is recognised that flood risk will increase with time in line with climate change.

The site will be available for use at least until Sizewell B is decommissioned. The building will have a 100 year design life.

6.5. Flood Warning and Evacuation

Although flood risk cannot be fully mitigated, it can be managed so that the impacts of such a flood event are less severe. Those attending the site will be made aware of the residual risk. No flood warning systems are considered necessary for this site, nor are any flood-focussed emergency evacuation plans

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7. Application of Flood Risk Policy

7.1. Policy Context

The broad aim of the NPPF is to reduce the number of people and properties within the natural and built environment at risk of flooding. To achieve this aim, planning authorities are required to ensure that flood risk is properly assessed during the initial planning stages of any development.

Responsibility for this assessment lies with developers and they must demonstrate the following:

- whether the proposed development is likely to be affected by flooding;
- whether the proposed development will increase flood risk to adjacent properties; and,
- that the measures proposed to deal with any flood risk are sustainable.

The developer must prove to the Local Planning Authority and the Environment Agency that any existing flood risk or flood risk associated with the proposed development can be satisfactorily managed.

7.2. Sequential Test

The NPPF states that the risk-based Sequential Test should be applied at all stages of planning. Its aim is to steer new development to areas at the lowest probability of flooding. Development should be directed to flood zone 1 wherever possible, and then sequentially to flood zones 2 and 3, and then to the areas of least flood risk within flood zones 2 and 3. Appendix D.3 includes some extracts from the NPPF on this subject.

The sequential approach has been applied to the layout and design of this particular development proposal. Fundamentally, the site has been chosen because of its distance from sources of flooding (river and the coastline). The location is a result of a comprehensive review of available sites, using the criterion that ensures the chosen location is:

- accessible to Sizewell B power station;
- accessible from the existing road network;
- available for use;
- has sufficient space;
- minimises visual and environmental impact;
- avoids internationally designated sites for nature conservation; and,
- makes use of previously developed land.

The land is previously developed land already owned by EDF Energy. The proposed site at the rail head in Leiston better met the requirements for the building compared to other sites considered. The Planning Statement (document reference 5112116/08/002) provides details regarding the site selection process.

Within the proposed site, the proposed building itself is located off the road on an area of land marginally higher than the rest of the site.

7.3. Exception Test

The exception test should only be applied after the application of the Sequential test. For this site and proposed development, the Exception test is not required. Appendix D.4 includes some extracts from the NPPF on this subject.

7.3.1. Sustainability Benefits

Existing wildlife habitats on the site will be assessed and protected where appropriate. A green (sedum) roof and external materials that reduce visual impact are proposed for the new building.

The design team are also considering the use of recycled aggregates for certain elements of the facility however due to the nature of the hazards that the building may have to withstand, conventional construction materials will mostly be used as they provide greater reinforcement. Although many conventional materials such as steel and concrete will be used, it is currently proposed that the appearance of the outside of the building will be designed using materials that have a natural variation e.g. a green roof & an external cladding material to appear like timber.

The current proposals allow for a design that reduces the visual impact of the building from the surrounding landscape & particularly for the east where the AONB (Area of Outstanding Natural Beauty) lies.

During the construction phase, there may be opportunities for local business to benefit.

The development is informed by the Suffolk Coastal SFRA. Rain water runoff from the site will be attenuated using SuDS. The design team are considering the use of rain water harvesting to provide a source of water for toilet flushing.

7.3.2. Developable Land

The proposed development is on previously developed land that was previously used by EDF Energy as part of the rail head facility. The site currently comprises large areas of paved hard standing, permeable hard standings for vehicles and a small building.

7.3.3. Safe from Flood Risk

This flood risk assessment has demonstrated that the site will be safe from flooding, and will not increase the risk of flooding in the vicinity. With appropriate drainage design the proposed development can also reduce overall flood risk to the locality.

8. Conclusions & Recommendations

8.1. Conclusions

This FRA has concluded that:

- the proposed development site at the Sizewell railhead is at a low risk of flooding from all sources;
- the primary source of flood risk will be from direct rainfall;
- the proposed use and site location are compatible in terms of flood risk; and,
- the proposed development will have no negative impact on flood risk elsewhere.

8.2. Recommendations

The investigations carried out for this FRA have led to the following recommendations:

- It is recommended that infiltration tests (soakaway tests) are undertaken to check the viability of sustainable drainage on the site; and,
- That the drainage strategy incorporates surface water attenuation for any discharge to sewer or local surface water feature, this will be informed by the ongoing ground investigation.

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Appendices

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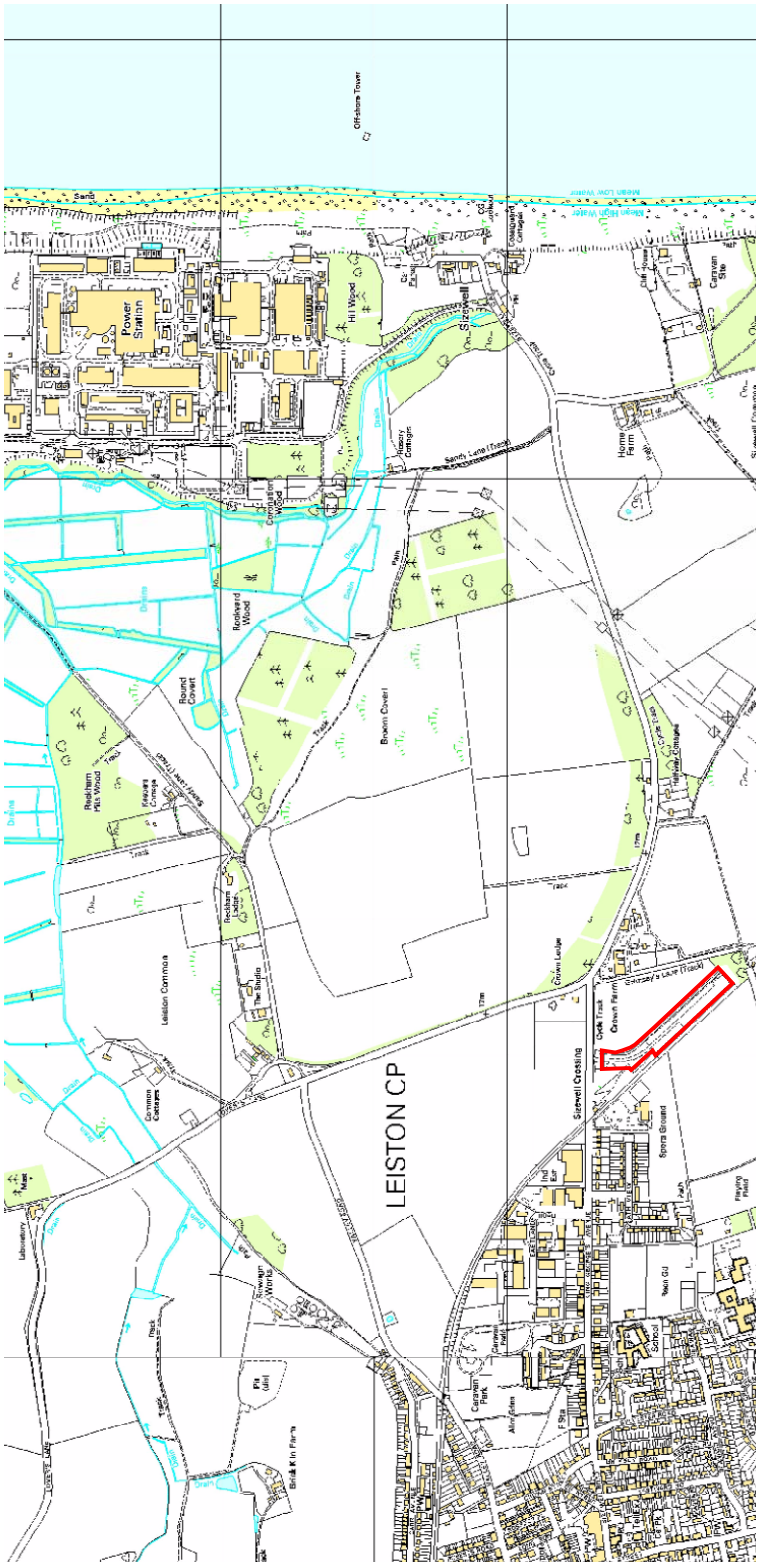
Appendix A. PLANS

A.1. Location Plan



Appendix B. TECHNICAL

None included in this FRA

Appendix C. FRA GUIDANCE

Note that the detail and technical complexity of a flood risk assessment will reflect the scale and nature of the proposed development.

For further details of assessment requirements view http://www.environment-agency.gov.uk/research/planning/93498.aspx

Flood Zone	Development Area	Specification of Requirements
1	Greater than 1.0 Hectares	Focus: Management on the flood management of surface water run-off. It is particularly for larger developments which have the potential to generate large volumes of surface water run-off. For sites between 1-5ha in Flood Zone 1, it is recommended that the FRA is agreed with the Environment Agency at ore-application stage enabling a 'letter of compliance' to be issued prior to submission to the planning authority. Include: Flood risk assessment for this scale of development will be a relatively minor nature and may even take the form of a short written statement. - Location Plan- must include geographical features, street names, and other water bodies - Plan of site showing existing site, development proposals and proposed flood protection measures. - Site levels related to ordinance survey datum

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Appendix D. EXTRACTS FROM NATIONAL PLANNING POLICY FRAMEWORK

D.1. Flood Zones

The Flood Zones defined below in Table 8-1 (NPPF table 1) are the starting point for the sequential approach. Zones 2 and 3 are shown on the Environment Agency indicative flood zone map with Flood Zone 1 being all the land falling outside Zones 2 and 3.

PPS 25 Zone	Definition
Zone 1 Low Probability	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%). This is regarded *as little or no risk* and presents no constraint to planning.
Zone 2 Medium Probability	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. This is regarded as *low to moderate risk* by PPS25 and is suitable for most development, but not essential civil infrastructure such as hospitals.
Zone 3 a High Probability	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. This is regarded as *high risk* by PPS25, and for developed areas suggests that development is possible as long as there are adequate defences over the lifetime of the development.
Zone 3 b Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone (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, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes).

Table 8-1: flood risk vulnerability classification

D.2. Vulnerability

New developments should be categorised according to the table below (NPPF table 2), where land uses are different from those included in the table, a risk- based approach should be adopted to ensure that any increase in risk to life is kept to an absolute minimum.

Vulnerability category	Description
Essential Infrastructure	- Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk, and strategic utility infrastructure, including electricity generating power stations and grid and primary substations.
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.
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. - Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less Vulnerable	- 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 plants. - Sewage treatment plants (if adequate pollution control measures are in place).

Table 8-2 - flood risk vulnerability

D.3. Sequential Test

See http://www.environment-agency.gov.uk/static/documents/Utility/SequentialTestProcess_v3.1.pdf

Development should be directed to Flood Zone 1 wherever possible, and then sequentially to Flood Zones 2 and 3. The Flood Zone definition and Flood Risk Vulnerability compatibility are shown in Table 9 3 (NPPF Table 3).

Flood Risk Vulnerability classification		**Essential Infrastructure**	**Water compatible**	**Highly Vulnerable**	**More Vulnerable**	**Less Vulnerable**
Flood Zone	**Zone 1**	✔	✔	✔	✔	✔
	Zone 2	✔	✔	Exception test required	✔	✔
	Zone 3a	Exception test required	✔	✗	Exception test required	✔
	Zone 3b	Exception test required	✔	✗	✗	✗
Key: ✔ ✗		Development is appropriate Development should not be permitted				

Table 8-3 - Flood Risk Vulnerability and Flood Zone 'Compatibility'

D.3.1. Demonstrating the flood risk Sequential Test

For Planning Applications the approach below is used by Local Planning Authorities (LPA) to apply the Sequential Test to planning applications located in Flood Zones 2 or 3. The approach provides an open demonstration of the Sequential Test being applied in line with NPPF and flood risk Practice Guide. Close working between LPA development control and forward planning departments will be required to implement the Sequential Test effectively.

Paragraph 101 of the NPPF states that "the aim of the Sequential Test is to steer development to areas with the lowest probability of flooding. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower probability of flooding."

Note: the Sequential Test does not apply to Change of Use applications.

D.3.1.1. Stage 1 - strategic application & development vulnerability

Q1.1 Has the Sequential Test already been carried out for this development at Local Plan level? If yes, reference should be provided for the site allocation and Local Plan document in question.

Q1.2 Is the flood risk vulnerability classification of the proposal appropriate to the Flood Zone in which the site is located according to tables 1 and 3 of technical guidance to the NPPF? The vulnerability of the development should be clearly stated.

Finish here if the answer is Yes to BOTH questions 1.1 and 1.2

Only complete stages 2 and 3 if the answer to EITHER questions 1.1 or 1.2 is `No'

D.3.1.2. Stage 2 - defining the evidence base

Q2.1 State the geographical area over which the test is to be applied.

Q2.2 If greater or less than the district boundary **justify why the geographical area for applying the test has been chosen.**

Identify the geographical area of search over which the test is to be applied - this will usually be over the whole of the LPA area but may be reduced where justified by the functional requirements of the development (e.g. catchment area for a school or doctors surgery) or relevant objectives in the Local Plan. For example, if a local need such as affordable housing or town centre renewal has been identified as part of the Sustainability Appraisal process that has reached `submission' stage, this might mean that the geographical area of search is restricted to a specific regeneration area. Equally, in some circumstances it may be appropriate to expand the search area beyond the LPA boundary for uses that have a sub-regional, regional or national market. For example, the location of an oil refinery serving the whole country should be determined on a countrywide basis

Q2.3 Identify the source of reasonably available sites, either**:**

- background/evidence base documents (state which), or if not available
- other sites known to the LPA that meet the functional requirements of the application.

Identify the source of `reasonably available' alternative sites - these sites will usually be drawn from the evidence base/background documents that have been produced to inform the emerging Local Plan.

In the absence of background documents, `reasonably available' sites would include any sites that are known to the LPA and that meet the functional requirements of the application in question, and where necessary, meet the Local Plan Policy criterion for windfall development (see box below).

Windfall sites

Windfall sites are those which have not been specifically identified as available in the Local Plan process. They comprise previously-developed sites that have unexpectedly become available.

The acceptability of windfall applications in flood risk areas should be considered at the strategic level through a policy setting out broad locations and quantities of windfall development that would be acceptable or not in Sequential Test terms.

In the absence of a flood risk windfall policy, it may be possible (where the data is sufficiently robust) for the LPA to apply the Sequential Test taking into account historic windfall rates and their distribution across the district relative to Flood Zones. Where historic and future trends evidence indicate that housing need in the district through windfall can be met largely/entirely by development outside high flood risk areas, this may provide grounds for factoring this into the consideration of `reasonably available' alternative sites at the planning application stage.

Q2.4 State the method used for comparing flood risk between sites, either:

- Environment Agency Flood Map, or
- An up to date Strategic Flood Risk Assessment (SFRA) held by the LPA, or
- Site specific Flood Risk Assessments (FRA) where they are suitable for this purpose, or
- Another map or sources of flooding information not listed (state which).

Identify the means of comparing flood risk between each site - as a starting point this will be the Environment Agency Map showing the Flood Zones. If comparing sites within the same Flood Zone it is necessary to use a SFRA showing a variation in risk throughout the Flood Zone or site specific FRAs where these are available and suitable for the purpose.

D.3.1.3. Stage 3 - applying the Sequential Test

Compare the reasonably available sites identified under stage 2 with the application site. Sites should be compared in relation to flood risk; development plan status; capacity; and constraints to delivery including availability, policy restrictions, physical problems or limitations, potential impacts of the development, and future environmental conditions that would be experienced by the inhabitants of the development.

Q3.1 State the name and location of the reasonably available site options being compared to the application site.

Q3.2 Indicate whether flood risk on the reasonable available options is higher or lower than the application site. State the Flood Zone or SFRA classification for each site.

Q3.3 State whether the reasonably available options being considered are allocated within the Local Plan. Confirm the status of the Plan.

Q3.4 State the approximate capacity of each reasonably available site being considered. This should be based on:

- The density policy within the Local Plan, and
- Past performance in this respect.

Q3.5 Detail any constraints to the delivery of identified reasonably available options; for example, availability within a given a time period or lack of appropriate infrastructure. This part of the test should include recommendations on how these constraints could be overcome and when.

D.3.1.4. Sequential Test conclusion

Are there any reasonably available sites in areas with a lower probability of flooding, that would be appropriate to the type of development or land use proposed?

D.4. Exception Test

Application of the Sequential Test should ensure that more vulnerable property types, such as residential housing, will not be allocated to areas at high risk of flooding. In exceptional circumstances, there may be valid reasons for a development type which is not entirely compatible with the level of flood risk at a particular site to nevertheless be considered. In these circumstances, it will be necessary for the LPA or developer to demonstrate that the site qualifies for development in the manor proposed by passing all elements of the Exception Test.

There are 3 stringent conditions that must be fulfilled:

- it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk;
- the development must be on developable previously-developed land, or, if it is not on previously developed land, that there are no reasonable alternative sites on developable previously-developed land; and
- a site-specific FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and where possible, will reduce flood risk overall.

It is the responsibility of the developer to develop a comprehensive flood risk management strategy for the site in question, covering:

- the design of any flood defence infrastructure;
- access;
- operation and maintenance;
- resident awareness
- flood warning; and
- evacuation procedures and funding arrangements.

Where necessary, the Exception Test should now be applied in the circumstances set out by table 1 and 3 of the technical guidance to the NPPF.

Applying the sequential approach at site level

In addition to the formal Sequential Test, the NPPF sets out the requirement for developers to apply the sequential approach (see paragraph 103, first bullet point) to locating development within the site. As part of their discussions with planning applicants, LPAs should ask the following questions:

- Can risk be avoided through substituting less vulnerable uses or by amending the site lay-out?
- Has the applicant demonstrated that less vulnerable uses for the site have been considered?
- Can density be varied to reduce the number or vulnerability of units located in higher risk parts of the site?

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Appendix E. CLIMATE CHANGE GUIDANCE

Adapting to Climate Change

Advice for Flood and coastal Erosion Risk Management Authorities

August 2011

E.1. Introduction

This part describes Defra's policy statement and its relation to this advice

This advice replaces Defra's Supplementary Note to Operating Authorities – Climate Change Impacts, October 2006. It is provided as supplementary information to Defra's policy statement on Appraisal of Flood and Coastal Erosion Risk Management (2009) and the Environment Agency's Flood and Coastal Erosion Risk Management Appraisal Guidance (FCERM-AG), as well as supporting the FCERM National Strategy for England.

This advice is based on Government's policy for climate change adaptation, and is specifically intended for projects or strategies seeking Government Flood Defence Grant in Aid (FDGiA). However, Risk Management Authorities (RMA) in England may also find this information useful in developing plans and making FCERM investment decisions even if there is no intention of applying for central government funding. Guidance for Wales is still provided by the Defra 2006 supplementary note - Treatment of climate change impacts.

The purpose of this advice is to ensure that an economically credible appraisal, taking account of the uncertainties associated with climate change, can be made to support Government investment decisions. This is necessary to ensure that a fair comparison can be made between investment in projects in different locations that compete for central government grant, as well as ensuring that the most appropriate means of reducing risk is investigated in any one place.

Given the long lifetime and high cost of the built environment and many flood and coastal erosion management measures, it is imperative that plans and investment projects take into account in, an appropriate way, the changing risks over the coming century. This includes designing for adaptation to a changing climate where appropriate.

Defra's appraisal policy statement recommends a "managed adaptive approach" where possible and sets out some broad principles that should be considered. A managed adaptive approach is based on taking action when particular trigger points are observed. It is most likely to be appropriate in cases where ongoing responsibility can be assigned to tracking the change in risk, and managing that risk through pre-determined interventions. This provides flexibility to manage future uncertainties associated with climate change.

In some circumstances, a managed adaptive approach may not be technically feasible. For example, it may not be possible to manage multiple interventions or it may be economically more efficient to build in a precautionary element at the outset. In these cases, a precautionary approach, with a one-off intervention, may be the only feasible or best option. Considering only precautionary options would lead to greater levels of investment at fewer locations. A managed adaptive approach would ensure a fairer and more flexible spread of public investment and therefore should be preferred where possible.

E.2. Provision of Change Factors

E.2.1.1. What is the change factor?

To assess the potential impacts that climate change may have on extreme rainfall, river flood flows, sea level rise and storm surges, change factors are provided in Annex 1 of the guidance. The change factors quantify the potential change (as either mm or percentage increase, depending on the variable) to the baseline. It is recommended that options are developed planning for the change factor covering the whole of the decision lifetime. However, rather than base options solely on the change factor, the upper and lower end estimates can be used to refine the options to prepare for a wider range of future change.

The change factors are based on UKCP09 or research using UKCP09 data. UKCP09 provides a large toolkit of information and data. The change factors have been developed to help RMAs use the UKCP09 information in a timely and cost-effective way and to provide a consistent approach. Change factors for river flood flows, extreme rainfall, mean relative sea level rise and storm surges are provided in the tables in Annex 1 of the guidance.

Upper and lower end estimates of change are provided to help represent the range of the future risks. Government recommends that when considering climate change a full appreciation of emission scenario and climate uncertainty is taken into account. The upper and lower end estimates are designed to achieve this within flood and coastal erosion risk management applications.

Although, it is anticipated that the eventual change in river flows and sea level rise will lie somewhere within the range of lower to upper end estimates, more extreme change cannot be discounted. To help represent this extreme change “H++ scenarios” have been included in line with the UKCP09 approach. These can be used to represent more severe climate change impacts and help identify the options that would be required.

E.2.1.2. What is the H++ scenario?

For those circumstances involving events of extremely high probabilities or where the consequences of rare events could be extreme. i.e. large tidal barriers, then the upper end of the full range may be better informed through use of the H++ limits.

The H++ scenario provides an estimate of sea level rise and river flood flow change beyond the likely range but within physical plausibility. It is useful for contingency planning to understand what might be required if climate change were to happen much more rapidly than expected. It is not possible to say how likely the H++ scenario is.

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