South Ormsby Estate Weir Reconstruction

Flood Risk Assessment

On behalf of: **South Ormsby Estate**

Project Ref: 332610355 | Rev: A | Date: December 2023

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Document Control Sheet

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For and on behalf of Stantec UK Limited				

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-	13/12/23	Planning issue	JNP/EE	JNP	RR
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Executive Summary

This Flood Risk Assessment (FRA) has been prepared by Stantec UK Ltd to accompany a full planning application for a proposed weir reconstruction on the Oester Dale at South Ormsby Hall in Lincolnshire.

The planning application description is:

"Replacement of existing weir with new structure, fish pass, hydropower unit, footbridge, landscaping and associated works"

The proposals in more detail are to undertake the following:

- Demolish the existing failing weir structure and replace with a new overfall weir the same length (6m)
- A rock ramp style fish and eel pass downstream of the weir with a gradient of approximately 1 in 20.
- Local land raising around the lake to the south of the weir to contain extreme event lake levels.
- A spillway channel to the south of the weir 3m wide at the entry to divert extreme flows from the lake back into the downstream channel at the end of the rock ramp fish pass.
- A new footbridge at the downstream end of the rock ramp fish pass.
- A hydropower facility located below ground taking water from the lake and discharging back into the downstream channel.

In accordance with the fundamental objectives of the National Planning Policy Framework (NPPF), the FRA demonstrates that:

(i) The development is safe;

(ii) The development does not increase flood risk; and,

(iii) The development does not detrimentally affect third parties.

The Environment Agency (EA) data confirms that the site is located within Flood Zone 3, defined as follows:

- **Flood Zone 3 'High Probability' greater than a 1 in 100 (1.0%) Annual Probability of river flooding or greater than a 1 in 200 (0.5%) Annual Probability of flooding from the sea.**

Detailed hydraulic modelling was undertaken by Stantec as part of proposals for the wider South Ormsby Estate that included a flood alleviation scheme (FAS) to reduce flood risk within the Hall complex and this has been re-run with updated hydrology and climate change allowance of +21% ('Central' allowance, 2080s epoch) to update the baseline flood extents, flows and levels both with and without the FAS.

This hydraulic model has then been used to model the proposed weir and spillway design both with and without the FAS.

The hydraulic modelling shows that the downstream impacts are limited to the downstream channel upstream of Brinkhill Road and overall are similar to the impacts already accepted by the EA as part of the previously consented FAS.

Flood risk from groundwater, reservoirs and sewer flooding are not relevant to the proposals.

The proposals for this 'Water-compatible' development, which is considered appropriate within Flood Zone 3 subject to passing the flood risk Sequential Test. The proposed development is to reconstruct the existing weir to ensure the continued safety of the upstream lake and downstream receptors and provide improved fish and eel passage. The development is flood control infrastructure and cannot be in an area of lower flood risk. Therefore, the sequential approach is not relevant to the development.

In summary, the FRA demonstrates that the proposed development is safe and in accordance with the requirements of national and local planning policy.

Summary of Key FRA Data

Aspect of flood risk	Applicable Guidance/ Source of Data	Summary	Section of FRA
Site Location	n/a	South Ormsby Estate LN11 8QS	**1.2**
Existing Ground Levels	Topographic Survey by 3D SurveyScan and Malcolm Hughes	Varies – see text	**Appendix A**
Primary source of flood risk	n/a	Oester Dale	**4.0**
Presence of flood defences	n/a	None at present	**-**
Proposed Development	Proposals by TSA	Proposed weir replacement and associated flood control infrastructure	**Section 5 and Appendix B**
Planning Aspects			
Flood Risk Vulnerability	Planning Practice Guidance (PPG) 'Flood Risk and Coastal Change'	'Water compatible'	**5.3**
Flood Zone		Flood Zone 3a 'High Probability'	**4.2**
Sequential Test		Sequential Test not appropriate for replacement of existing weir	**5.4**
Exception Test		Not required	**-**
Applicable Climate Change Allowances	EA climate change allowances guidance	Witham Management Catchment +21% (Central) for 2080s	**2.1 & 4.4**
Reference Flood Levels			
Present Day	Stantec Hydraulic Model	See text.	**6.0**
Climate Change		See text.	**6.0**
Proposed Mitigation Measures			
Ground Floor Levels	BS8533:2017	Not applicable	**-**
Floodplain Storage	Planning Practice Guidance (PPG) 'Flood Risk and Coastal Change'	Not applicable	**-**
Flood Flow Routes	Planning Practice Guidance (PPG) 'Flood Risk and Coastal Change'	Not applicable	**-**
Safe Access	Planning Practice Guidance (PPG) 'Flood Risk and Coastal Change'	Not applicable	**9.3**
Surface Water Drainage	Planning Practice Guidance (PPG) 'Flood Risk and Coastal Change'	Not applicable	**-**
Other	n/a	Not applicable	**-**

Abbreviations

ABI	-	Association of British Insurers
AP	-	Annual Probability
BGS	-	British Geological Survey
CDM	-	Construction (Design and Management)
CIRIA	-	Construction Industry Research and Information Association
DDA	-	Disability Discrimination Act
DEFRA	-	Department for Environment, Food and Rural Affairs
EA	-	Environment Agency
ELDC	-	East Lindsey District Council
FAS	-	Flood Alleviation Scheme
FRA	-	Flood Risk Assessment
FRAP	-	Flood Risk Activity Permit
FRMP	-	Flood Risk Management Plan
GIS	-	Geographic Information System
LCC	-	Lincolnshire County Council
LLFA	-	Lead Local Flood Authority
mAOD	-	Metres Above Ordnance Datum (Newlyn)
NPPF	-	National Planning Policy Framework
PFRA	-	Preliminary Flood Risk Assessment
PPG	-	Planning Practice Guidance
ELDC	-	East Lindsey District Council
RoSWF	-	Risk of Surface Water Flooding
SuDS	-	Sustainable Drainage Systems
SFRA	-	Strategic Flood Risk Assessment

1 Introduction

1.1 Scope of Report

1.1.1 This Flood Risk Assessment (FRA) has been prepared by Stantec UK Ltd ('Stantec') on behalf of our client, South Ormsby Estate to support a planning application for the proposed reconstruction of the existing weir on the Oester Dale watercourse at the downstream end of the lake within the Estate.

1.1.2 The report is based on the available flood risk information for the site as detailed in **Section 1.3** and prepared in accordance with the planning policy requirements set out in **Section 2**.

1.2 Existing Site and Proposed Development

1.2.1 The existing site is located within the South Ormsby Estate located near Louth in Lincolnshire.

1.2.2 The site lies within the administrative boundary of East Lindsey District Council (ELDC).

1.2.3 The proposal is for "Replacement of existing weir with new structure, fish and eel pass, hydropower unit, footbridge, landscaping and associated works".

1.3 Planning Background

1.3.1 An FRA was prepared (with the assistance of Stantec) in July 2022 (ref. 212874) by Canham Consulting Engineers to accompany a planning application (ref. N/160/01507/21) which included the following proposals:

- Hall and stables renovation to include one permanent dwelling, seven self-catering holiday lets, creation of a sunroom, restoration of an architectural pediment and a new covered porch with associated alterations.
- Construction of a spa in an existing outbuilding, with an extension to that building.
- Construction of a new pool house with underground link to the spa building and basement plant room.
- Four new bridges and rebuilding of three existing bridges
- Construction of a maintenance building
- Creation of a surfaced tennis court
- Access roads and car parking spaces for 14 vehicles
- Construction of two car ports for 10 vehicles
- Construction of dog kennels
- New boathouse, seat/rotunda and bird hide.
- Conversion of outbuilding into a self-catering holiday let.

1.3.2 This is known as 'The Hall Application'.

1.3.3 As part of the works, a flood alleviation channel was proposed, and detailed hydraulic modelling was undertaken by Stantec to outline the baseline and proposed scenarios. This hydraulic modelling was approved by the EA.

1.3.4 The final form of the flood alleviation scheme is yet to be confirmed and will require further refinement at a later stage.

1.3.5 The baseline hydraulic model scenario has been re-run by Stantec with updated hydrology and the outputs from this are discussed in **Section 6**.

1.4 Sources of Information

1.4.1 The FRA has been prepared based on the following sources of information:

- **Topographic surveys** of the site undertaken by 3D SurveyScan in April and December 2019 and river channel survey data by Malcolm Hughes Chartered Land Surveyors in August 2019 (see selected extracts in **Appendix A**);
- **Hydrology update and hydraulic modelling** undertaken by Stantec in December 2023 ;
- **Development proposals** by Takero Shimazaki Architects (see **Appendix B**);
- **EA Opendata mapping on the Gov.uk** website;
- The **East Lindsey District Council (ELDC) Level 1 Strategic Flood Risk Assessment (SFRA)**, dated March 2017;
- The **Lincolnshire County Council (LCC) Preliminary Flood Risk Assessment (PFRA)**, dated June 2011, updated by Second Cycle Review 2017.

1.5 Caveats and Exclusions

1.5.1 This FRA has been prepared in accordance with the NPPF, the associated PPG and local planning policy. The approach for flood mitigation is based on the requirements of the EA and Lincolnshire County Council in its role as Lead Local Flood Authority (LLFA). The conclusions are based on data available at the time of the study and on the subsequent assessment that has been undertaken in relation to the development proposals as outlined in **Section 1.2**.

1.5.2 Activities during the construction phase may have an impact on the existing and future flood risk. Thus, an assessment of the risks and appropriate mitigation measures should be identified and managed by the contractor.

1.5.3 The Construction (Design and Management) Regulations (CDM Regulations) will apply to any future development of this site which involves “construction” work, as defined by the CDM Regulations. As such it is the responsibility of the proposed developer (ultimate client) to fulfil its duties under the CDM Regulations.

1.5.4 It should be noted that the insurance market applies its own tests to properties in terms of determining premiums and the insurability of properties for flood risk. Those undertaking development in areas which may be at risk of flooding are advised to contact their insurers or the Association of British Insurers (ABI) to seek further guidance prior to commencing development. Stantec do not warrant that the advice in this report will guarantee the availability of flood insurance either now or in the future.

2 Planning Policy Context

2.1 National Policy and Guidance

National Planning Policy Framework & Planning Practice Guidance

2.1.1 National policy in relation to flood risk is contained within the **National Planning Policy Framework (NPPF),** updated September 2023, issued by the Department for Levelling Up, Housing and Communities, with reference to Section 14 'Meeting the challenge of climate change, flooding and coastal change'.

2.1.2 The latest version of the associated **Planning Practice Guidance (PPG)** 'Flood Risk and Coastal Change' section was updated August 2022.

2.1.3 The NPPF and PPG demonstrate a flood risk management approach for the lifespan of the proposed development considering the effects of climate change. The document sets the framework to minimise vulnerability, provide resilience to the impacts of climate change, and to fully consider the potential impacts of climate change for the lifetime of the development within the mitigation measures.

2.1.4 The NPPF sets out the requirement for the Sequential Test and Exception Test in paragraphs 162 and 163 respectively. These Tests are to be applied where appropriate, depending on the proposed development flood risk 'vulnerability', the Flood Zone in which it is located and the risk of flooding from other sources. This is detailed further in **Section 5**.

2.1.5 The guidance on the application of climate change allowances in FRAs is linked via the PPG and was most recently updated in May 2022. The guidance provides contingency allowances for the potential increases in peak river flow, peak rainfall intensity and sea level rise which are considered accordingly subject to the site conditions – discussed further in **Section 3.**

Environment Agency Climate Change Allowances Guidance

2.1.6 The NPPF and PPG place emphasis on the need to fully consider – and design for – the impacts of climate change as set out in the 'Flood risk assessments: climate change allowances' planning guidance accessible at the following link:

https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

2.1.7 The peak river flow allowances provide a range of allowances based on percentile (i.e. the degree of certainty of an event occurring, based on the range of climate change scenarios assessed through scientific investigations). The applicable values for a Site are dependent on the 'River Management Catchment' in which the site is located, which can be confirmed via the online mapping tool embedded within the guidance.

2.1.8 The Central allowance is identified as the design standard for most forms of proposed development in all appropriate Flood Zones (the exception being 'Essential Infrastructure' which requires the 'Higher Central' value).

2.1.9 In the case of the site, the appropriate climate change allowance for 'Water-compatible' development located within the Witham River Management Catchment is **+21% (Central 2080s epoch)**. Fluvial flood risk to the site in relation to climate change is discussed further in **Section 5**.

2.1.1 The potential increase in peak rainfall intensity needs to be considered in the surface water drainage strategy for new developments, however as the proposals are for a weir construction

and does not require formal drainage, the application of climate change allowances for peak rainfall intensity is not required.

2.2 Local Policy and Guidance

East Lindsey Local Plan

2.2.1 Local planning policy is contained within the **East Lindsey Adopted Local Plan (2018)**, with particular reference to the following policies which pertain to flood risk and drainage:

- SP1 – A Sustainable Pattern of Places;
- SP2 – Sustainable Development;
- SP16 – Inland Flood Risk;
- SP23 – Landscape Biodiversity and Geodiversity;
- SP24 – Biodiversity and Geodiversity Green Infrastructure; and
- SP25 – Green Infrastructure.

East Lindsey Strategic Flood Risk Assessment

2.2.2 The **ELDC Strategic Flood Risk Assessment (SFRA)** was released in March 2017 and forms part of the Local Plan evidence base, to inform future spatial planning and to assist in developing planning policies to address flood risk. Moreover, the document provides an overall understanding of the flood risk within the study area taking into account all potential sources.

2.2.3 It is essential therefore that the Council are in a position to take informed decisions, providing a careful balance between the risk of flooding and other unrelated planning constraints that may place pressure upon *'at risk'* areas.

3 Site Setting

3.1 Site Description

3.1.1 The application site is located within the South Ormsby Estate at the downstream end of the existing lake just east of South Ormsby Hall. The Hall's postcode is LN11 8QS.

3.1.2 The application site boundary encompasses a narrow strip of land on the eastern edge of the lake, the existing weir structure and downstream Oester Dale watercourse. The weir is located at National Grid Reference 536,917m E,375,647m N.

3.1.3 The key features that are referenced within this FRA are shown on **Figure 3.1** and consist of the following elements:

1 – Oester Dale watercourse upstream of the Hall.

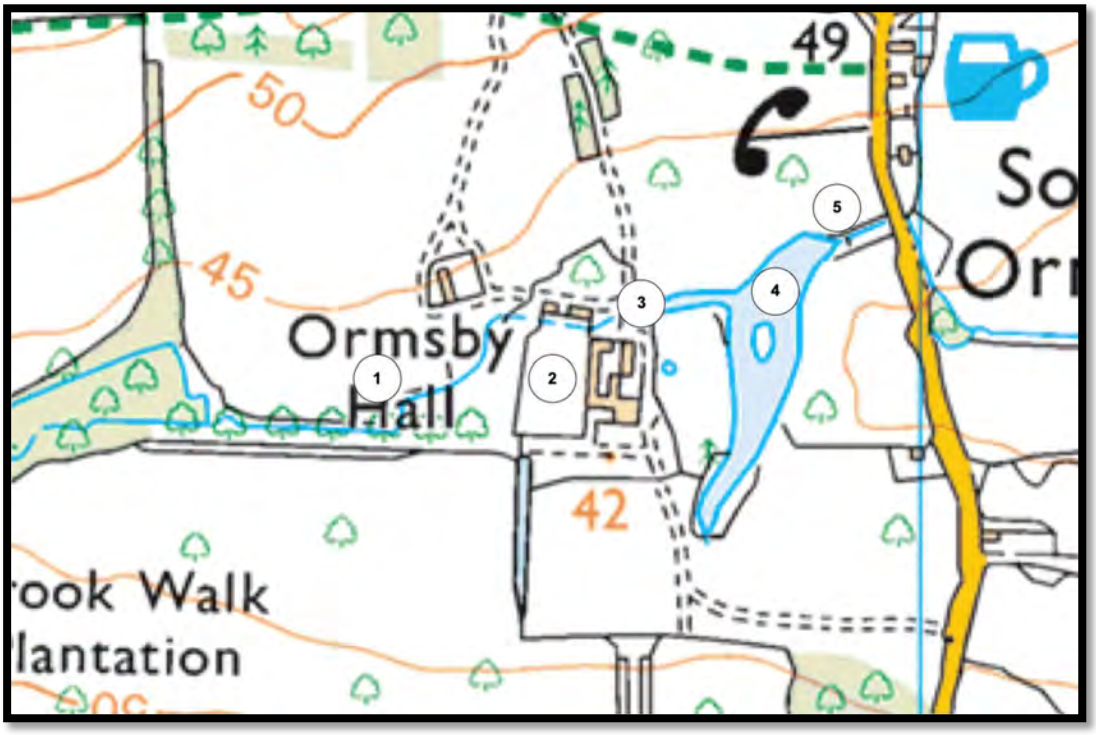
2 – Walled garden with culverts and weirs at entrance and exit.

3 – Historic culvert.

4 – Lake.

5 – Weir (see **Figure 3.3**).

Figure 3.1: Key Site Features



3.2 Lake and Weir Topography/Levels

3.2.1 The existing lake was created in the 18th century when the Hall was built by damming and diverting the Oester Dale watercourse which rises further west within the Estate.

3.2.2 The application site includes the downstream part of the lake extending over the weir to a small channel which then flows underneath the main road (Brinkhill Road) running north to south to the east..

3.2.3 Based on contemporary paintings, the weir initially was formed from rocks to create a cascade (see **Figure 3.2**).

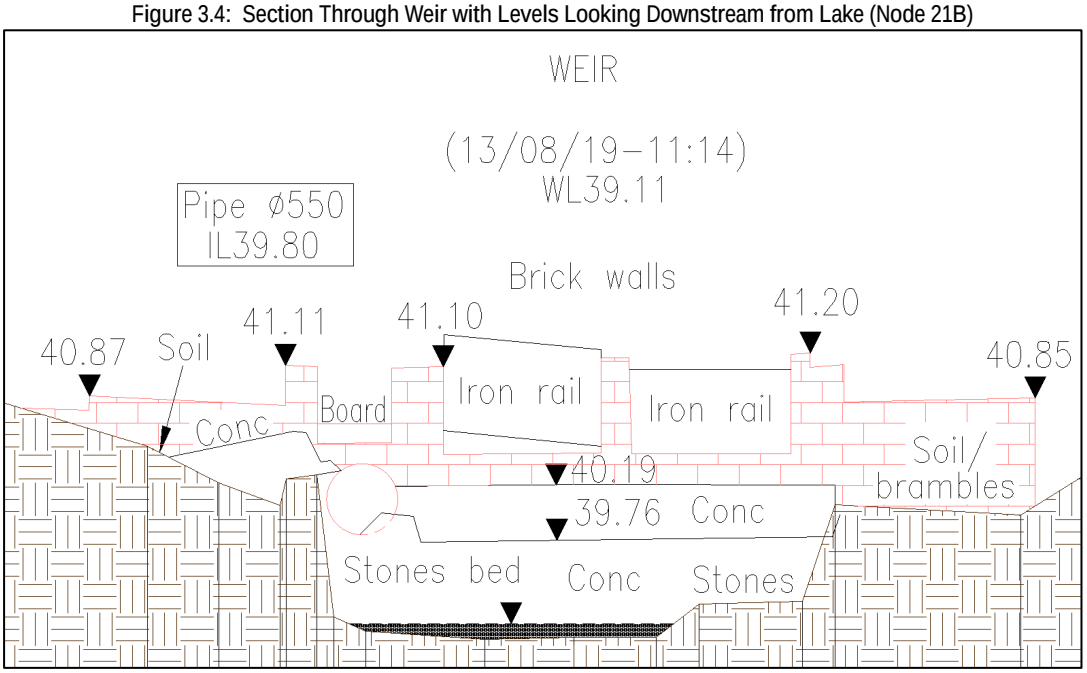
Figure 3.2: Historic Artwork of Existing Lake and Weir

3.2.4 The existing weir is shown in **Figure 3.3** and consists of a board, a 550mm diameter pipe and brick pillars with iron railings. A staggered concrete cascade is located downstream of the railings and brick pillars. The topographic survey information in **Appendix A** shows that the invert at the top of the weir (base of the brick pillars) is 40.19m AOD and 39.80m AOD at the

invert of the pipe and second step area of the weir, and approximately 39.20m AOD at the base of the weir/downstream channel. The top of the board is set at approximately 40.60m AOD. An extract of the cross section through the weir with levels is shown on **Figure 3.4**. The levels on the eastern side of the lake range from approximately 40.90m AOD to 40.70m AOD and slope down to between 40.60m AOD and 39.80m AOD along the eastern edge of the application site boundary.

Figure 3.3: Existing Weir From Downstream

Figure 3.4: Section Through Weir with Levels Looking Downstream from Lake (Node 21B)



3.3 Hydrological Setting

3.3.1 The **Oester Dale** is an ordinary watercourse that flows from west to east through the South Ormsby Estate to the north of the Hall and outfalls into the existing lake. The lake levels are controlled via the existing weir and overflows flow over the weir and down the channel beneath the main road to the east of the site. The watercourse then flows south to where it joins the **Calceby Beck**.

4 Assessment of Flood Risk

4.1.1 The assessment of flood risk has been undertaken based on the sources of information listed in **Section 1.3**.

4.2 EA Opendata Flood Maps

4.2.1 The following maps have been taken from the EA Opendata datasets available online.

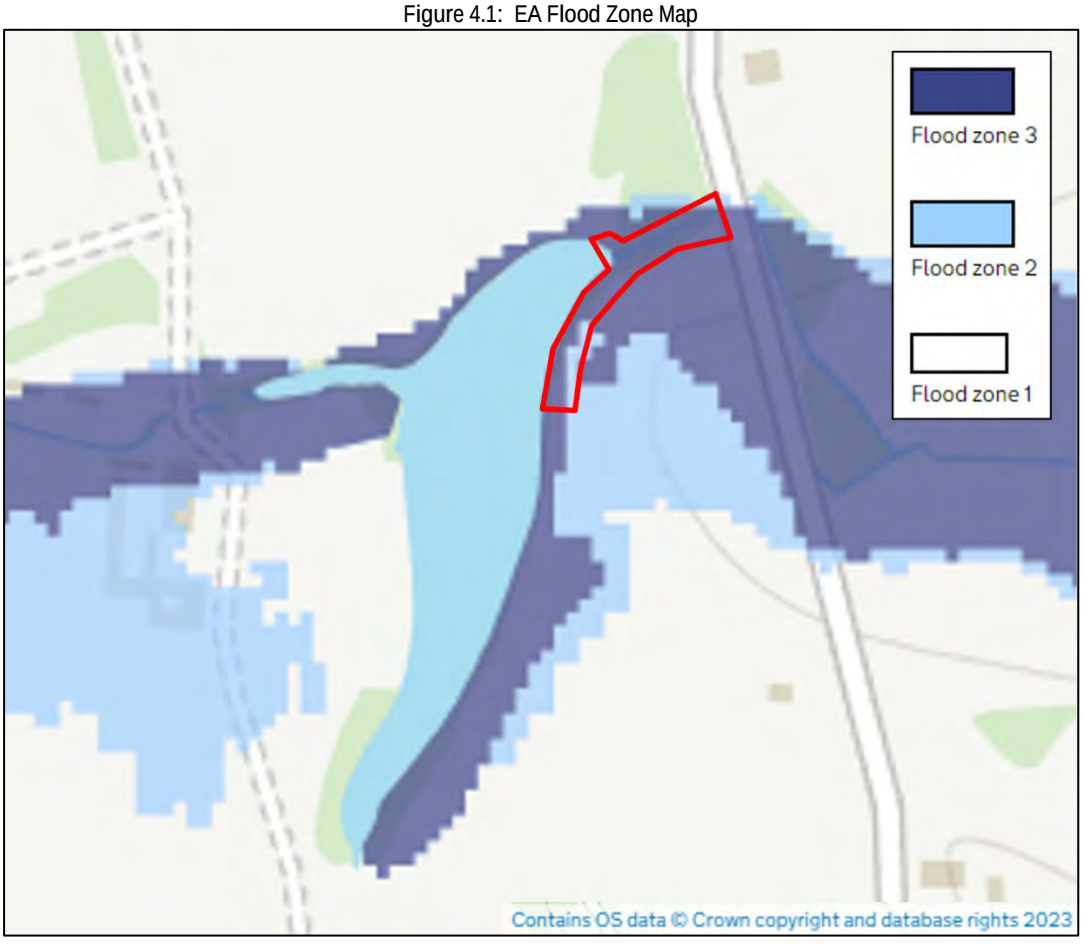
Flood Zone Map

4.2.2 The first phase in identifying whether a site is potentially at risk of fluvial or tidal flooding is to consult the EA's Flood Zone maps, available on the Gov.uk website. There is no tidal influence at the site therefore the flood zones relate to fluvial flood risk only.

4.2.3 The online EA Flood Zone Map for Planning (reproduced in **Figure 4.1** indicates the site lies within **Flood Zone 3 'High Probability'** – Land at 1 in 100 (1%) or greater annual probability (AP) of river flooding. A small area in the southern part of the site is located within **Flood Zone 2 'Medium Probability'** – Land that has between a 1 in 100 (1.0%) and 1 in 1000 (0.1%) AP of river flooding.

4.2.4 For this area, it is recognised that the online mapping is coarse and does not reflect the complex nature of the watercourses in the area. As the watercourse is not Main River, the EA held no detailed hydraulic modelling for the Oester Dale. The fluvial flood risk to the Estate and application site has been refined through hydraulic modelling undertaken by Stantec which is discussed in **Section 5**.

Figure 4.1: EA Flood Zone Map



Flood Risk from Surface Water

4.2.5 The EA 'Risk of Flooding from Surface Water' mapping identifies areas that could be susceptible to surface water flooding in various rainfall events. The latest mapping assesses flooding resulting from severe rainfall events based on the following three scenarios:

- 'High' Risk: 1 in 30 (3.3%) or greater AP rainfall event;
- 'Medium' Risk: Between a 1 in 100 (1%) and 1 in 30 (3.3%) AP rainfall event;
- 'Low' Risk: Between 1 in 1000 (0.1%) and 1 in 100 (1%) AP rainfall event;
- 'Very Low' Risk: Lower than 1 in 1000 (0.1%) AP rainfall event.

4.2.6 The EA mapping shows that the majority of the site has a 'High' risk of surface water flooding (this corresponds to the Oester Dale watercourse and lake), with areas to the south and east having a 'Low' to 'Medium' risk of surface water flooding, which correspond to an overland flow route that occurs during extreme rainfall events when the lake levels overtop the eastern bank.

4.2.7 Surface water flooding is not an issue of concern given the nature of the proposed works which is to control flows in the Oester Dale and control extreme event flows.

Flood Risk from Reservoirs

4.2.8 The EA mapping for reservoirs show that the site and the wider Estate are located outside of an area that is considered to be at risk of reservoir flooding.

4.3 Groundwater and Sewer Flooding

4.3.1 Whilst there is private drainage infrastructure within the wider estate, this is mostly located to the west of the application site and therefore the risk of sewer flooding is considered to be low.

4.3.2 Intrusive site investigations have been undertaken in the wider Estate indicate that groundwater levels are relatively shallow at approximately 1.5-2.4 metres below ground level (m bgl). For above ground structures (such as the weir) and flow control infrastructure, this is a low risk.

4.3.3 The information provided within the East Lindsey SFRA and the LLC PFRA is consistent with that presented in **Section 4.2** and confirm that the site is located outside of a Coastal Flood Risk Area. The SFRA and PFRA do not provide any further information in relation to flood risk for the site or the South Ormsby area.

4.3.4 Groundwater and sewer flooding are not issues of concern for the proposed works.

4.4 Climate Change

4.4.1 Guidance for the assessment of the potential impact of climate change on peak river flows is set out within EA Guidance and was last updated in May 2022. The guidance uses management catchments as sub-catchments within river basin districts. The site is in the Witham Management catchment.

4.4.2 The anticipated design life of the replacement weir is i 100 years and therefore the 2080s epoch is appropriate.

4.4.3 The EA guidance suggests that for water compatible development **(Section 5.2)** in Flood Zone 3, a +21% increase in peak flows is applied. This has been used in the hydraulic modelling **(Section 6).**

5 Proposed Development

5.1 Description of Proposed Development

5.1.1 This FRA accompanies a detailed planning application for the full reconstruction of the existing weir at the South Ormsby Estate to replace the existing failing weir. The opportunity is being taken to improve the passage of fish and eels by incorporating a 'rock ramp' type of fish pass, provide extreme flood event flow control infrastructure bypassing the weir and install a low head mini-hydro power facility to generate electricity by utilising the head drop between the lake up stream and the channel downstream.

5.1.2 Architectural details of the proposals by Takero Shimazaki Architects are included in **Appendix B**.

Figure 5.1: Artist's Impression of Reconstructed Weir from Downstream

5.2 Hydraulic Design

5.2.1 The hydraulic components of the proposals are:

- Replacement of the existing weir structure with a new weir located just upstream 6m wide with a crest level set at 40.60m AOD.
- Within the weir crest a small notch 200mm wide with a crest level of 40.40m AOD for fish and eel passage. This crest sets the permanent lake level.
- A fish and eel pass consisting of a rock ramp at approximately a 1 in 20 gradient.

- An auxiliary spillway on the right bank from the lake to the channel downstream of the fish pass to control previously uncontrolled spills from the lake in extreme events. Spillway crest level set at 40.80m AOD

- A hydropower installation consisting of three low head draft tube propeller turbines in an underground chamber that draws water from the lake when the lake level is 100mm above the main weir crest and discharges it downstream back into the channel via a 450mm diameter pipe to generate power intermittently.

- Local land raising around the lake to contain peak lake levels in extreme events and divert it via the spillway.

5.2.2 The components described above are used in the design model described in **Section 6**.

5.3 Flood Risk Vulnerability

5.3.1 The NPPF Annex 3 confirms the *'Flood risk vulnerability classification'* of a site, depending upon the proposed usage. The proposed development is classed as **'Water-compatible'** development as it is primarily flood control infrastructure.

5.3.2 This classification is subsequently applied to PPG 'Flood Risk and Coastal Change' Table 2 'Flood risk vulnerability and flood zone incompatibility' to determine whether:

- The proposed development is permitted or not for the Flood Zone in which it is located, and

- Whether an Exception Test is required for the proposed development.

5.3.3 The location of the proposed 'water-compatible' development is in Flood Zone 3a (parts of the proposed development not located within the lake of main channel) and Flood Zone 3b (the lake and main channel elements). Table 2 confirms that the development is permitted in these flood zones, providing that in Flood Zone 3b (functional floodplain) water-compatible uses 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.

5.3.4 These requirements are satisfied by the proposals.

5.4 NPPF Sequential Approach

5.4.1 The NPPF follows a sequential risk-based approach in determining the suitability of land for development in flood risk areas, with the intention of steering all new development to the lowest flood risk areas.

5.4.2 The proposed development is to reconstruct the existing weir to ensure the continued safety of the upstream lake and downstream receptors and provide improved fish and eel passage. The development is flood control infrastructure and cannot be in an area of lower flood risk. Therefore, the sequential approach is not relevant to the development.

5.4.3 The NPPF Exception Test is not required. The overall impacts of the proposals on flood risk are addressed within this FRA.

6 Stantec Hydraulic Modelling

6.1 Introduction

6.1.1 The Hall planning application (Section 1.3) included mitigation to reduce the fluvial flood risk to elements of the proposals, particularly the Stables that were identified by the EA's flood zone mapping. (Figure 4.1) as being in the area at risk of flooding.

6.1.2 As there was no hydraulic modelling available from the EA for the detailed assessment of baseline flood risk and design of the mitigation, Stantec assessed the hydrology of the catchment of the Oester Dale and constructed a hydraulic model for this purpose.

6.1.3 This model was then used by Canham Consulting to develop a flood alleviation scheme (FAS) that would reduce peak flood levels on the Oester Dale in the area proposed for development. This FAS consisted of a bypass channel and culvert from upstream, passing south of the Hall and discharging into the Lake downstream of the Hall.

6.1.4 The hydrology, hydraulic model and the mitigation proposed were accepted by the EA as suitable and the proposals are expected to be consented by ELDC soon.

6.1.5 Four scenarios are reported below:

- The updated Baseline model compared with previous FAS work.
- The updated Baseline model with the consented FAS only.
- The updated Baseline model with the proposed weir reconstruction and no FAS.
- The updated Baseline model with the proposed weir and FAS

6.2 Updated Baseline Model

6.2.1 As part of the design of the proposed works, the opportunity has been taken to update the hydrology using the latest rainfall data and software available and use the appropriate climate change allowance as these have also been updated since the original modelling work. The appropriate allowance has reduced from +35% to +21% for the recommended 2080's Central allowance for the Witham Management Catchment.

6.2.2 Using the updated hydrology and revised climate change allowance, the hydraulic model has been re-run to establish a new baseline for various return periods. The impact of the new baseline on the proposed FAS was also checked by including the FAS as consented and re-running the model.

6.2.3 The changes in the peak flows and peak flood levels for selected modelling nodes for the present day 1 in 100 year (1% annual probability) and 1 in 100 year after the impact of climate change are summarized in Tables 6.1 and 6.2 below:

Model Node	Location	Peak Flow (m^3/s)		Difference (m^3/s)	Peak Flow (m^3/s)		Difference (m^3/s)
		Existing 1 in 100 year	Updated 1 in 100 year		Existing 1 in 100 year + 35% CC	Updated 1 in 100 year + 21% CC	
BL1	Upstream end of model	1.549	1.846	+0.297	2.091	2.234	0.143
BL8_i4	Location of Proposed FAS Offtake	2.012	2.223	+0.211	2.416	2.499	0.083
BL16	Stableyard	2.141	2.486	+0.345	2.970	3.079	0.109
BL22	Upstream Brinkhill Road	1.937	2.169	+0.232	2.431	2.493	0.062
BL DS	Downstream end of model	2.463	3.054	+0.591	3.563	3.799	0.236

Table 6.1 Peak flow comparison for Design Events for updated baseline

6.2.4 It can be seen that the updated hydrology has a noticeable impact on the peak flows for the 1 in 100-year present day event, increasing these by approximately 0.2m^3/s (10%) upstream of the Hall.

6.2.5 This increase is partially offset for events after the impact of climate change by the reduced climate change allowance that reduces the increase to approximately 0.1m^3/s upstream of the Hall.

Model Node	Location	Peak Level (m AOD)		Difference (m)	Peak Flow (m AOD)		Difference (m)
		Existing 1 in 100 year	Updated 1 in 100 year		Existing 1 in 100 year + 35% CC	Updated 1 in 100 year + 21% CC	
BL1	Upstream end of model	46.301	46.320	0.019	46.335	46.342	0.007
BL8_i4	Location of Proposed FAS Offtake	43.122	43.164	0.042	43.202	43.217	0.015
BL16	Stableyard	41.924	41.941	0.017	41.963	41.967	0.004
BL22	Upstream Brinkhill Road	39.480	39.526	0.046	39.575	39.588	0.013
BL DS	Downstream end of model	36.896	36.97	0.074	37.029	37.055	0.026

Table 6.2 Peak Level comparison for Design Events for updated baseline

6.2.6 It can be seen that the peak levels have increased in line with the increase in flows for the 1 in 100 flows and for the 1 in 100 year after the application of the revised climate change allowances.

6.3 Design Model – with FAS only

6.3.1 The updated baseline model has been used to re-model the impact of the consented FAS to provide a comparison with the previous modelling work. This allows the net effect of the updated hydrology and the revised climate change allowance to be examined for the scenario where the FAS is constructed but the weir has not been reconstructed and the peak design flood levels that impact the areas around the Hall assessed.

6.3.2 It should be noted that due to the poor condition of the existing weir, it is proposed to undertake the weir reconstruction as soon as planning consent is granted, and the appropriate land drainage consent obtained to reduce the risk of the weir failing resulting in a sudden uncontrolled draining of the lake and flooding downstream at the Brinkhill Road.

6.3.3 Furthermore, work is underway to review the options for upstream natural flood management (NFM) as either a full or partial replacement for the FAS. This work will not be completed before the weir is reconstructed.

6.3.4 Therefore, the scenario of the FAS being completed prior to the weir being reconstructed is not a realistic one but is included for completeness.

6.3.5 The outputs from the hydraulic model, showing the peak flows and peak flood levels for selected modelling nodes for the present day 1 in 100 year (1% annual probability) and 1 in 100 year

after the impact of climate change (+21%) with and without the FAS are summarized in Tables 6.3 and 6.4 below:

Model Node	Location	Peak Flow (m^3/s)		Difference (m^3/s)	Peak Flow (m^3/s)		Difference (m^3/s)
		Updated Baseline 1 in 100 year	With FAS 1 in 100 year		Updated Baseline 1 in 100 year + CC	With FAS 1 in 100 year + CC	
BL1	Upstream end of model	1.846	1.846	+0.0	2.234	2.234	0.0
BL8_i4	Upstream Proposed FAS Offtake	2.223	2.067	-0.156	2.499	2.541	-0.042
BL16	Stableyard	2.486	0.266	-2.22	2.499	0.296	-2.203
BL22	Upstream Brinkhill Road	2.169	2.334	0.165	2.493	2.684	0.191
BL DS	Downstream end of model	3.054	3.470	0.416	3.799	4.298	0.499

Table 6.3 Peak flow comparison for Design Events for updated baseline with FAS

6.3.6 The introduction of the FAS increases the flow downstream of the lake as the flood flows arrive at the lake via the new channel and culvert more quickly than in the baseline scenario where the flows are retained on the floodplain to the north of the Hall. This increase was accepted by the EA as part of the Hall application.

Model Node	Location	Peak Level (m AOD)		Difference (m)	Peak Flow (m AOD)		Difference (m)
		Updated Baseline 1 in 100 year	With FAS 1 in 100 year		Updated Baseline 1 in 100 year + CC	With FAS 1 in 100 year + CC	
BL1	Upstream end of model	46.320	46.320	0.0	46.342	46.342	0.0
BL8_i4	Upstream Proposed FAS Offtake	43.164	43.252	0.088	43.217	43.310	0.093
BL16	Stableyard	41.942	41.253	-0.689	41.967	41.253	-0.714
BL22	Upstream Brinkhill Road	39.526	39.559	0.033	39.588	39.624	0.036
BL DS	Downstream end of model	36.970	37.018	0.048	37.055	37.106	0.051

Table 6.4: Peak level comparison or Design Events for updated baseline with FAS

6.3.7 These outputs confirm the anticipated benefits within the Hall area as the peak flood levels are significantly reduced as intended to facilitate development in that area.

6.4 Design Model – Weir Reconstruction only

6.4.1 The updated baseline model has been used to run the design scenario of the weir and associated infrastructure described in Section 5.2. For the purposes of modelling, it is assumed that the hydropower is not operational (e.g. for maintenance) during this event as a worst case. The flow through the hydropower effectively bypassing the weir and spillway would provide additional capacity within the overall system and therefore this represents a worst case with respect to the peak water level in the lake.

6.4.2 The comparison of peak flows and levels has been made for the ‘with design’ scenario with the baseline scenarios (with and without the FAS) in the following key locations:

6.4.3 The outputs from the hydraulic model, comparing the changes in the peak flows and peak flood levels for selected modelling nodes for the present day 1 in 100 year (1% annual probability) and 1 in 100 year after the impact of climate change are summarized in Tables 6.5 and 6.6 below:

Model Node	Location	Peak Flow (m^3/s)		Difference (m^3/s)	Peak Flow (m^3/s)		Difference (m^3/s)
		Updated Baseline 1 in 100 year	With Weir 1 in 100 year		Updated Baseline 1 in 100 year + CC	With Weir 1 in 100 year + CC	
BL1	Upstream end of model	1.846	1.846	0.0	2.234	2.234	0.0
BL8_i4	Upstream Proposed FAS Offtake	2.223	2.223	0.0	2.499	2.499	0.0
BL16	Stableyard	2.486	2.486	0.0	3.079	3.078	-0.001
BL22	Upstream Brinkhill Road	2.169	2.302	0.133	2.493	2.773	0.28
BL DS	Downstream end of model	3.054	3.063	0.001	3.799	3.795	-0.004

Table 6.5 Peak flow comparison for Design Events for updated baseline with new weir without FAS

6.4.4 The impact of the new weir is only realised in the channel downstream of the weir and upstream of Brinkhill Road where the more efficient transfer of flows from the lake increases the flow by 0.28m^3/s after the impact of climate change. The impact is dissipated by the end of the hydraulic model.

Model Node	Location	Peak Level (m AOD)		Difference (m)	Peak Flow (m AOD)		Difference (m)
		Updated Baseline 1 in 100 year	With Weir 1 in 100 year		Updated Baseline 1 in 100 year + CC	With Weir 1 in 100 year + CC	
BL1	Upstream end of model	46.320	46.320	0.0	46.342	46.342	0.0
BL8_i4	Upstream Proposed FAS Offtake	43.164	43.164	0.0	43.217	43.217	0.0
BL16	Stableyard	41.942	41.942	0.0	41.968	41.968	0.0
BL22	Upstream Brinkhill Road	39.526	39.597	0.071	39.588	39.694	0.106
BL DS	Downstream end of model	36.970	36.971	0.001	37.055	37.055	0.0

Table 6.6: Peak level comparison for Design Events for updated baseline with new weir without FAS

6.4.5 As would be expected the provision of a more hydraulically efficient weir system increases the peak flow in the downstream channel as it is passing a greater flow at the same lake water level and gives rise to a flood water level increase in the channel upstream of Brinkhill Road. This impact is dissipated by the downstream end of the model where there is no increase when compared with the baseline.

6.4.6 This demonstrates that the proposed weir improvements have no significant impact beyond the application site.

6.5 Design Model with FAS and Weir Reconstruction

6.5.1 The application assumes that the FAS is not implemented. To assess the scenario where the FAS or upstream NFM measures that have the same beneficial impact, is implemented in conjunction with the weir reconstruction, the hydraulic model has been run for this combined Scenario and compared with the updated baseline.

6.5.2 The outputs from the hydraulic model, comparing the changes in the peak flows and peak flood levels for selected modelling nodes for the present day 1 in 100 year (1% annual probability) and 1 in 100 year after the impact of climate change are summarized in Tables 6.7 and 6.8 below:

Model Node	Location	Peak Flow (m^3/s)		Difference (m^3/s)	Peak Flow (m^3/s)		Difference (m^3/s)
		Updated Baseline 1 in 100 year	With FAS & Weir 1 in 100 year		Updated Baseline 1 in 100 year + CC	With FAS & Weir 1 in 100 year + CC	
BL1	Upstream end of model	1.846	1.846	0.0	2.234	2.234	0.0
BL8	Upstream Proposed FAS Offtake	2.345	2.345	0.0	2.838	2.818	-0.20
BL16	Stableyard	2.486	0.289	-2.197	3.079	0.308	-2.771
BL22	Upstream Brinkhill Road	2.169	2.535	0.366	2.493	3.076	0.583
BL DS	Downstream end of model	3.054	3.473	0.419	3.795	4.305	0.510

Table 6.7 Peak flow comparison for Design Events for updated baseline with new weir and FAS

Model Node	Location	Peak Level (m AOD)		Difference (m)	Peak Flow (m AOD)		Difference (m)
		Updated Baseline 1 in 100 year	With FAS & Weir 1 in 100 year		Updated Baseline 1 in 100 year + CC	With FAS & Weir 1 in 100 year + CC	
BL1	Upstream end of model	46.320	46.320	0.0	46.342	46.342	0.0
BL8	Upstream Proposed FAS Offtake	43.325	42.348	0.088	43.368	43.411	0.0
BL16	Stableyard	41.942	41.253	-0.689	41.968	41.253	-0.715
BL22	Upstream Brinkhill Road	39.526	39.646	0.120	39.588	39.750	0.162
BL DS	Downstream end of model	36.970	37.017	0.047	37.055	37.106	0.510

Table 6.8: Peak level comparison or Design Events for updated baseline with new weir and FAS

6.5.3 In broad terms the combined effect of the FAS and the new weir being implemented has the same overall impact as the FAS alone. The differences are restricted to the channel downstream of the weir and upstream of the Brinkhill Road.

6.6 Peak Lake Levels

6.6.1 The typical water level has been set at 40.40m AOD to match the existing lake level. The incorporation of a 200mm high fish pass slot into the crest of the weir results in a main weir crest at 40.60m AOD. This compares with the existing crest that is generally at 40.40m AOD.

6.6.2 The reduction in capacity at 40.40m AOD is offset by a slightly longer crest with no intermediate brick piers at 40.60m AOD and the addition of a spillway with a crest at 40.80m. The net effect is to limit peak lake levels to approximately the same as pre-scheme.

6.6.3 The peak lake levels for the with and without FAS and with and without weir reconstruction scenarios are set out in Table 6.9 below for the present day and with climate change 1 in 100 year events.

Scenario	Peak Lake Level (m AOD)	
	1 in 100 Year	1 in 100 Year +21% CC
Baseline	41.064	41.095
With FAS only	41.080	41.112
With new Weir only	40.945	40.988
With FAS and New Weir	40.966	41.013

Table 6.9 Peak Lake Levels for Four Scenarios

7 Mitigation

7.1.1 The works are required to replace the existing failing weir and are essential to prevent the rapid draining of the lake and localised flooding of the public highway downstream.

7.1.2 The opportunity is being taken to include recreate the original 18thC appearance of the weir within the parkland setting, provide a fish and eel friendly structure, control overland flood flows and install a small hydropower facility.

7.1.3 As such the works in themselves are the mitigation required for a current flood risk problem and are designed to ensure safety of the land and lake upstream, the public highway downstream and have no significant impact downstream with the overall South Ormsby Estate.

7.1.4 The issues of changes in flood levels, flows, flood storage, are addressed through the design and demonstrated through hydraulic modelling.

7.2 Safe Access

7.2.1 It is necessary to consider and incorporate safe access arrangements as part of the mitigation, to ensure the users of the flood control infrastructure and the owners of the development are safe in times of flooding.

7.2.2 The site is not in an area currently covered by the EA flood warning system and even if it were the short time to peak for the Oester Dale at the site would give little time for actions to be taken in response. Although the Estate has employees on site 24 hours a day.

7.2.3 Therefore, the proposals are designed to operate without any intervention, consisting of simple overfall structures that will operate passively.

7.2.4 In any event, safe dry access is available to the northern bank for all design events.

7.2.5 The spillway channel on the southern bank would be flowing during an extreme event and therefore would not be safe to cross at this time. However, the weir is a passive structure that requires no human intervention during operation. Therefore, it should not be necessary for anyone to be in proximity to the weir during a design flood.

8 Residual Risk

8.1.1 The PPG states the following in relation to residual risk:

"Residual risks are those remaining after applying the sequential approach to the location of development and taking mitigating actions. Examples of residual flood risk include:

- *the failure of flood management infrastructure such as a breach of a raised flood defence, blockage of a surface water conveyance system, overtopping of an upstream storage area, or failure of a pumped drainage system;*
- *failure of a reservoir, or;*
- *a severe flood event that exceeds a flood management design standard, such as a flood that overtops a raised flood defence, or an intense rainfall event which the drainage system cannot cope with."*

8.1.2 It is difficult to completely guard against flooding since extreme events greater than the design standard event are always possible however, it is practicable to minimise the risk by allowing a substantial freeboard (safety margin) and suitable management techniques.

8.1.3 The proposed weir reconstruction works incorporates a shallow spillway channel to redirect extreme event flows from the lake to downstream of the weir if lake levels overtop the eastern bank during extreme rainfall events.

8.1.4 Safe access can be sufficiently managed by monitoring the lake levels to prevent access to the weir and spillway channel the event of heavy rainfall/high water levels.

8.1.5 As such, the residual risk is acceptable for the lifetime of the development.

9 Conclusion and Summary

9.1.1 This FRA has been prepared by Stantec to accompany a planning application for a proposed weir reconstruction on the Oester Dale at the downstream end of the lake at South Ormsby Hall in Lincolnshire.

Vulnerability and Sequential Test

9.1.2 The proposals are classified as 'Water-compatible' as defined in as defined in the National Planning Practice Framework (NPPF) Annex 3.

9.1.3 The site lies mostly in Flood Zone 3.

9.1.4 The proposed development is to reconstruct the existing weir to ensure the continued safety of the upstream lake and downstream receptors and provide improved fish and eel passage. The development is flood control infrastructure and cannot be in an area of lower flood risk. Therefore, the sequential approach is not relevant to the development.

9.1.5 The NPPF Exception Test is not required. The overall impacts of the proposals on flood risk are addressed within this FRA.

Flood Risk

9.1.6 The only source of flood risk for the site is fluvial as the works are on-line or introduce flood flow routes.

9.1.7 The hydraulic modelling has been updated to take into account updated hydrology and changes to the climate change allowances (which have reduced) and then used to test various scenarios: the proposed weir reconstruction, the FAS alone and the two in combination.

9.1.8 These scenarios have been compared with the updated baselines to quantify the impact on peak flows and flood levels.

9.1.9 The remaining sources of flood risk are not relevant to the consideration of flood risk to the weir or the impacts.

9.2 Mitigation

9.2.1 The proposed works are required to mitigate the potential environmental and flood risk impacts of the weir failing.

9.3 Safe Access

9.3.1 The Estate does not benefit from any EA flood warning coverage.

9.3.2 The area on the south bank of the weir would be inaccessible safely in an extreme flood event if the spillway was operational. The north bank would be accessible if required.

9.3.3 The weir and spillway are designed to operate without any manual intervention during a flood and therefore access is not required.

Summary

9.3.4 In summary, the works will replace the failing weir with a new robust structure to retain the lake and provide a significant environmental benefit in the form of a fish and eel pass as well as including measures to control extreme event flood flows and a small hydropower facility.

9.3.5 The occupants and users of the proposed development will be at a low risk of flooding and the development will not increase flood risk elsewhere. It is demonstrated that the proposal complies with the NPPF, Planning Practice Guidance (PPG) and the local planning policy with respect to flood risk and is an appropriate development at this location.