ABLE MARINE ENERGY PARK (MATERIAL CHANGE 2 – TR030006)

UPDATED ENVIRONMENTAL STATEMENT

CHAPTER 13: FLOOD RISK AND DRAINAGE

Able Marine Energy Park, Killingholme, North Lincolnshire

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13.1.0 Introduction

Development Consent Order Context

13.1.1 The Development Consent Order (DCO) for the site approved a harbour development with the associated land development, to serve the renewable energy sector. The harbour comprises a quay of 1,279m frontage, of which 1,200m is solid quay and 79m is a specialist berth formed by the reclamation of intertidal and subtidal land within the Humber Estuary.

13.1.2 The associated development for the above proposals includes:

- Dredging and land reclamation;
- The provision of onshore facilities for the manufacture, assembly and storage of wind turbines and related items;
- Works to Rosper Road, the A160 and the A180; and
- Surface water disposal arrangements.

13.1.3 Documents relevant to this chapter, that were included in the original ES include:

- Environmental Statement Chapter 13[1]: Drainage and Flood Risk (AMEP site);
- Environmental Statement Annex 13.1[2]: Flood Risk Assessment and Drainage Strategy; and
- Environmental Statement Annex EX13.2[3]: Addendum to AMEP Flood Risk Assessment.

13.1.4 Other works relating to Flood Risk and Drainage were undertaken with respect to the Compensation Site on the north bank of the Humber Estuary. These are however not considered of relevance to the material amendment being applied for.

Consideration of Material Amendment

13.1.5 In the context of the proposed material amendment, this chapter considers the following areas:

- changes in the flood risk posed to the scheme resulting from the change in the proposed layout and any differences in final ground levels;

1 Environmental Statement Chapter 13: Drainage and Flood Risk, 2012, https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/TR030001/TR030001-000318-13%20-%20Drainage%20and%20Flood%20Risk.pdf

2 Environmental Statement Annex 13.1, Flood Risk Assessment and Drainage Strategy, 2012, https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/TR030001/TR030001-000400-13.1%20-%20Flood%20Risk%20Assessment%20and%20Drainage%20Strategy.pdf

3 EX13.2: Addendum to Flood Risk Assessment, JBA, June 2012 https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/TR030001/TR030001-001612-OS-003_TR030001_Able%20UK%20Ltd_Supplementary%20Environmental%20Information_File%202%20of%202.zip

- changes in flood impact arising from the scheme relating to displacement of tidal flood water; and
- changes in flood impacts arising from the scheme associated with changes in how storm water runoff will be generated and managed within the scheme.

Purpose and Structure of Chapter

13.1.6 This chapter of the Updated Environmental Statement (UES) considers the impact of the proposed material amendment on the planning policy and context of the area as relevant to Flood Risk and Drainage.

13.1.7 Consideration is given to:

- changes in legislation, policy and guidance relating to Flood Risk and Drainage since the DCO application and original ES;
- physical changes in the baseline context at the site as relevant to Flood Risk and Drainage and the proposed material amendment;
- changes in the understanding of risk for both the current day situation and future scenarios; and
- the material amendment to the proposed scheme.

13.2.0 Methodology

13.2.1 As part of the DCO application a Flood Risk Assessment (FRA) was undertaken for the AMEP scheme and presented within Chapter 13 of the original ES. The FRA assessed how the proposed development will affect the site and its surroundings as well as the integrity of the Humber Estuary's flood defences.

13.2.2 Within the Flood Risk and Drainage ES chapter of the original ES, the impact of the proposed development on the hydrological environment at the site was evaluated to determine the likelihood of the AMEP causing impacts to the surface water environment as follows:

- impacts on land drainage and flooding;
- impacts associated with the pollution of surface watercourses during the construction phase; and
- impacts associated with the pollution of surface watercourses during the operation phase.

Changes in Legislation, Guidance and Planning Policy

Water Environment (Water Framework Directive) (England and Wales) Regulations 2017

13.2.3 These regulations revoke and replace the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 (SI 2003 No. 3242). They continue to transpose Directive 2000/60/EC for England and Wales, establishing a framework for Community action in the field of water policy (the Water Framework Directive).

13.2.4 They also transpose aspects of Directive 2006/118/EEC on the protection of groundwater against pollution and deterioration (the Groundwater Directive) and of Directive 2008/105/EC on environmental quality standards in the field of water policy (the Environmental Quality Standards Directive).

National Planning Policy Framework[4]

13.2.5 The previous assessments reference Planning Policy Statement 25. This was superseded in 2012 by the National Planning Policy Framework (NPPF) and the associated Planning Practice Guidance (PPG) for Flood Risk and Coastal Change[5].

13.2.6 The NPPF and associated PPG now provide the framework for assessing development vulnerability and site suitability with regards to flood risk (Sequential Test and Exception test).

Flood Risk Assessments: Climate change allowances[6]

13.2.7 In February 2016 the Environment Agency issued updated guidance on the impacts of climate

4 National Planning Policy Framework, Ministry of Housing, Communities & Local Government, Published March 2012, Updated June 2019, https://www.gov.uk/government/publications/national-planning-policy-framework--2

5 Planning practice Guidance, Flood risk and coastal change, Ministry of Housing, Communities & Local Government, Published March 2014, https://www.gov.uk/guidance/flood-risk-and-coastal-change

6 Flood risk assessments: climate change allowances, Environment Agency, Published February 2016, Updated July 2020, https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

change on flood risk in the UK to support the NPPF. This advice, which was most recently updated in July 2020, sets out how projected changes in peak rainfall intensity, sea level, peak river flow; offshore wind speed and extreme wave heights associated with climate change should be considered within the development process.

Non-statutory Technical Standards for Sustainable Drainage Systems[7]

13.2.8 This document sets out non-statutory technical standards for the design, maintenance and operation of sustainable drainage systems. Systems to drain surface water from housing, non-residential or mixed-use developments for the lifetime of the developments.

Pollution Prevention for Businesses[8]

13.2.9 This guidance, published by the Environment Agency in 2016, supersedes the older Pollution Prevention Guidance documents referenced in Flood Risk and Drainage chapter of the original ES. The new guidance sets out how businesses and organisations can avoid causing pollution from oil and chemical storage, car washing, construction and other activities.

Scoping Opinion

13.2.10 Table 13-1 summarises the key aspects of the scoping opinion as relevant to drainage and flood risk. This incorporates comments from the Environment Agency and North Lincolnshire Council (the Lead Local Flood Authority).

Table 13-1: Scoping Opinion

Page & Paragraph No.	Scoping Opinion	Comments	Outcome	Reference within UES
Page 31, Paragraph 4.7.1	Arrangements for the disposal of surface water and foul water from the development site do not need to be scoped into the updated assessment.	Agreed	Scoped Out	13.2.23
Page 31, Paragraph 4.7.2	The higher Upper End predictions for sea level rise and the Humber extreme water levels should be used to inform the assessment.	We note that the design would typically be undertaken in relation to High Central climate change allowance with the Upper End allowance used for sensitivity testing.	Changes in extreme still water levels and climate change allowance are considered in this assessment. Future tidal flood levels for the Higher Central scenario are lower than	13.3.12 – 13.3.18

7 Sustainable Drainage Systems: non statutory technical standards, Department for Environment, Food and Rural affairs, Published March 2015, https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards

8 Pollution prevention for businesses, Department for Food and Rural Affairs and Environment Agency, Published July 2016 (updated May 2019), https://www.gov.uk/guidance/pollution-prevention-for-businesses

			previously considered; while for Upper End scenario they are slightly (0.11m) higher.	
Page 31, Paragraph 4.7.2	The updated assessment of flood risk should identify any alteration to overtopping rates on flood defences and be conducted using updated climate change allowances.	The change in quay alignment is unlikely to affect the potential for overtopping at the site. It is however noted that updated assessment is required to ensure compliance with the 2l/s/m over topping limit for the existing flood defences adjacent to the quay for a period of twenty years as specified in the legal agreement between Able and the EA.	A revised assessment of quay overtopping has been undertaken and is included in Appendix UES13-4. This is based on information provided by EA from the Humber 2100+ work (Appendix UES13-1). Overtopping of the flood defences to the north of the quay is related to wave reflection and this is reviewed in Chapter 8 and will be reduced by the setback berth	13.4.3 - 13.4.6

Additional Consultation

13.2.11 A virtual consultation meeting with officers from the Environment Agency was undertaken on the 27th April 2021. Key outputs from that meeting as relevant to this chapter were;

- Updated extreme still water flood levels for the Humber estuary were published in February 2021 (Appendix UES13-1) and should be considered as part of this application.
- No additional work on extreme wave heights or joint probability analysis for extreme wave and extreme still water levels has occurred since the DCO application and as such the base studies referenced in the original ES remain the best source of data.
- The Environment Agency expect the applicant to adhere to the terms of the 2013 legal agreement relating to Flood Defences between Able Humber Ports Limited and the Environment Agency (Appendix UES13-2). Specifically, they advised that the requirement to limit over topping of existing 'soft' flood defences to 2 l/s/m should be maintained for 20 years, and must reflect the current understanding of extreme water levels and current guidance relating to potential changes in sea level and wave height associated with climate change.
- Guidance on the use of the climate change allowances[6] recommends that the Higher Central scenario is used as the design allowance and the Upper End can be used to test the sensitivity of the proposals to flood risk. Testing the sensitivity is important as it will help inform potential future impacts as climate change allowances will continue to be revised at key points in the future.

- Changes in the current understanding of extreme water levels, and guidance relating to potential changes in sea level associated with climate change, could have a small impact on the severity of breach flooding. It was however agreed that this will not significantly alter the prevailing risk. Previously agreed control measures (site evacuation in response to flood warnings) were felt to provide sufficient protection and, as such, there was no expectation that assessments relating to breach flooding should be updated.

Consultation responses following submission of Preliminary Environment Information Report (PEIR)

13.2.12 Following submission of the PEIR North Lincolnshire Council have advised (response dated 26th March (*sic*) 2021) that; "*Having reviewed Chapter 13 of the PEIR it is agreed that the proposed variation to the DCO is unlikely to result in any significant additional or materially different impacts in respect of the disposal of surface or foul water compared to the consented DCO.*"

13.2.13 Following submission of the PEIR, and a meeting held on 27 April 2021, the Environment Agency have provided further comments of relevance to this chapter as detailed below in Table 13-2.

Table 13-2: EA response to PEIR

Applicant's Assessment	EA Comment	Outcome	Reference within UES
Based on the wave rose and the reassessment in the PEIR, oblique wave attack from the southeast is more critical than direct wave attack on the quay.	The wave rose was presented in the meeting but we cannot find similar diagrams in the PEIR document to look at this in more detail. If we have missed these in the document, could you please sign post us to them or advise if they can be included for the formal application consultation documents.	Wave rose added to the ES chapter	Figure 13-1 and Figure 13-2
The overtopping of the quay is no greater in the Higher central case than previously assessed and reported in the original FRA 91.8l/s/m v 85l/s/m	Agreed	No comment	Table 13-7
In the Upper End case the sensitivity analysis shows the overtopping to be within 1.3% of the maximum value assessed in the original FRA following the addition of 200mm to the quay wall in the future (91.8l/s/m v 93l/s/m). The raising of the quay in the future was part of the original adaptive approach to climate change – see abstract from original FRA below:	We are satisfied with the figures calculated and presented in the PEIR with regards to overtopping and how the updated climate change allowances compare with the previous assessment.	No comment	Table 13-7

Applicant's Assessment	EA Comment	Outcome	Reference within UES
"The level of the quay could be raised by 0.2m, if required in the future, as an adaptive mitigation measure in response to potential rising sea levels which may be caused by climate change. With that measure in place, the effective defence level of the quay would rise to 6.58mAOD, which would provide a freeboard of 0.34m above the maximum predicted 200-year still water level of 6.24mAOD (Which includes an allowance of 1.19m to represent 100 years of climate change)."			
Overtopping of the quay is a matter of operational risk to be assessed by the developer and the risk is not materially different.	We agree that overtopping onto the quay is an operational risk as long as this remains on the quay and does not cross the Quay Strategic Flood Defences as defined and covered by the Legal Agreement Relating to Flood Defences at the Able Marine Energy Park.	A fall is provided on the quay to direct overtopping waters back into the estuary.	Table 13-7
The qualitative assessment of wave reflection onto the strategic flood defences which shows the impacts will be no worse than reported in the original ES is appropriate and sufficient in this case.	This is unclear – see comment re section 8.8.3	The EA comment on section 8.8.3 relate to updates to the wave modelling to reflect more extreme climate change scenarios. this has now been undertaken.	Chapter 8
The South Bank Flood Agreement continues to provide the appropriate mitigation	Agreed. Please note that we are still awaiting a response from Able regarding outstanding issues in respect of clause 9.1(i), which seeks to ensure that all persons owning a legal estate in the Quay have entered into a legal agreement on the same terms as the original agreement.	This matter is ongoing	N/A

13.2.14 A second meeting with the Environment Agency was held on 18 May to further discuss the content of the PEIR and the forthcoming UES but did not further address flood risk.

Assessment Methodology

Study Area

13.2.15 A study area for Flood Risk and Drainage was not formally defined within the original ES.

13.2.16 In relation to drainage, the assessment considered all direct surface water receptors of the site down to where these systems discharged into the Humber Estuary. With regards to Flood Risk the assessment considered the site and the local flood cell of the Killingholme Marshes within which the site is situated.

13.2.17 The same study area has been applied for the preparation of this UES.

Significance of Effect

13.2.18 Significance criteria relating to drainage and flood risk are defined within Table 13.1 of the original ES.

13.2.19 The same significance criteria have been applied for the preparation of this UES and there has been no change in the receptors identified or their defined sensitivity from that contained within the original ES.

Magnitude of Change (Impact)

13.2.20 With the original ES the magnitude of change was incorporated into the definitions for the significance of effect. The same approach has been applied for the preparation of this UES.

Mitigation Hierarchy

13.2.21 While not defined within the original ES, a hierarchy has been employed for mitigation. Where possible this seeks to avoid adverse effects and only where this is not possible are remedial options for reducing, remedying or compensating for any identified effects considered.

Effects Not Requiring Further Assessment

13.2.22 Since the DCO came into force, North Lincolnshire Council has approved the surface water drainage strategy for the terrestrial areas of the site and for the quay (DCO Requirement 13). The approval notices are included as Appendix UES13-3.

13.2.23 No changes are proposed to the arrangements for the disposal of surface water and foul water from the development site. The amendments to the proposed design will not therefore give rise to any new or different impacts on drainage.

13.2.24 The risk posed to the scheme by a breach of the tidal flood defences and the impact of the scheme on breach flooding will not be altered by the proposed change in quay alignment. No further consideration of breach flooding is therefore required.

13.3.0 Changes in Baseline Conditions

DCO Baseline

13.3.1 Chapter 13 of the original ES[1], the Flood Risk Assessment included as Appendix 13.1 of the original ES[2], and the addendum to the Flood Risk Assessment included as Appendix EX13.2 of the original ES[3], provide a robust summary of flood risk at the AMEP site.

13.3.2 Tidal flood defences are in place along the entire south bank of the Humber Estuary. The site is low-lying behind these defences and is predominantly shown to be located within Flood Zone 3 on the Flood Map for Planning, indicating that without flood defences the annual probability of flooding would be greater than 0.5 per cent (1 in 200).

13.3.3 The existing defences at the proposed development site consist of an earth embankment topped by a concrete pavement and wave return wall. As set out in the original Flood Risk Assessment[2] these are currently maintained by the Environment Agency and provide an annual standard of protection that varies between 1 in 50 and 1 in 150.

DCO Future Baseline

13.3.4 The original ES has considered potential changes in tidal flood severity over next 100 years (paragraph 13.5.5 therein). The allowances predicted were:

- an uplift in sea level between 2014 and 2114 of 1.11m; and
- a 10 % increase in peak wave heights.

Current Baseline

13.3.5 The applicant has begun to improve the drainage network at and around the site by widening ditches and has commenced construction of the pumping station consented under the DCO.

13.3.6 In some areas of the site, levels have been raised since the DCO application through the import of engineered fill which will have an impact on storm water runoff rates. This has been undertaken in line with the consented surface water drainage strategy.

13.3.7 Aside from this there have been no physical changes to baseline conditions that are believed to have significantly altered the prevailing levels of flood risk at and around the site since the DCO application. There have also been no significant changes made to the drainage networks on or adjacent to the site.

13.3.8 In December 2013 extreme high-water levels were experienced within the Estuary that were in excess of the previous maximum recorded tidal levels. In the aftermath of this event the Environment Agency updated their tidal level analysis and have recently published further updated estimates for extreme still water levels.

13.3.9 Updated current day (2021) estuarine flood levels at North Killingholme (NGR 517581 421056) are presented in Table 13-3 taken from work undertaken by the Environment Agency as part of the Humber 2100+ project (Appendix UES13-1). This modelling used the 2018 coastal flood boundary data and for the current day (2021) these boundary water levels were uplifted by 0.02m to account

for changes in sea level between 2018 and 2021. This small uplift applied is in line with the Higher Central climate change scenario; however, the resultant outputs are assumed to provide a good representation of current conditions. For comparison, the older estuarine flood levels included in the DCO Flood Risk Assessment are also provided (Immingham H090).

Table 13-3: Tidal Flood Levels (current day)

Location	Easting	Northing	Data source	Base date	Annual Chance (1 IN X) of tide level (m ODN)						
					1	2	10	50	100	200	1000
Immingham (H090)	519141	417449	Northern Area Tidal Model Analysis, 2006	2006	4.08	-	4.49	4.76	4.88	5.05	5.34
North Killingholme	517581	421056	Humber Extreme Water Levels, 2020	2021	-	4.38	4.63	4.92	5.05	5.21	5.53

13.3.10 The data presented in Table 13-3 are for different locations along the Humber Estuary and relate to different base dates. Notwithstanding these differences, the more recent data predicts current day still water flood levels that are between 0.14m and 0.19m higher than were considered in the original ES.

13.3.11 For reference, based on advised current annual sea level rise increment, as set out in Environment Agency guidance[6] uplifts of between 0.08m and 0.10m would have been expected between the respective base dates for the modelling (2006 to 2021).

Future Baseline

13.3.12 As a result of an improved, or more robust, understanding of potential impacts associated with climate change, allowances advised for design purposes have been updated. Specifically, the allowances used for sea level rise are now different than was considered within the original ES and Flood Risk Assessment prepared in support of the DCO application[2].

13.3.13 Environment Agency guidance[6] now presents projected sea level rises as two scenarios (Higher Central and Upper End). In line with discussions with the Environment Agency (see paragraph 13.2.11), the Higher Central allowance should be used for design purposes and the Upper End used to test the sensitivity and consider the uncertainty and risk associated with current predictions.

13.3.14 For the Higher Central allowance, which equates to the 70th percentile (i.e. exceeded by 30% of the projections in the range) projected sea level rises from 2000 through to 2125 are 1.15m. This is broadly similar to what was considered within the original ES as part of the DCO application (1.11m from 2014 to 2114).

13.3.15 For the Upper End allowance, which equates to 95th percentile (i.e. exceeded by 5% of the projections in the range) projected sea level rises from 2000 through to 2125 are 1.55m. This is in excess of what was considered within the original ES as part of the DCO application.

13.3.16 For estuarine situations the projected uplifts to open sea level discussed above can be altered by funnelling within the confined estuarine bathymetry. As such, where possible, the projected uplifts should be applied as a downstream boundary on estuarine modelling and changes in estuarine flood levels assessed based on outputs from modelling. This analysis has been undertaken by the Environment Agency as part of the Humber 2100+ project.

13.3.17 Based on this work, the future (2121) 1 in 200 annual probability flood level at North Killingholme is

estimated to be 6.11m above Ordnance Datum (aOD) for the Higher Central allowance and 6.35m aOD for the Upper End allowance. This compares to a maximum predicted 1 in 200 annual probability still water food level in 2114 of 6.24m aOD considered in the original ES.

13.3.18 The projected future flood levels equate to an uplift of 0.9m (Higher Central) and 1.14m (Upper End) above the current day (Humber Estuary 2020 flood levels detailed in Table 13-3.

13.4.0 Assessment of Effects

Additional Construction Phase Effects

13.4.1 Construction phase impacts associated with Flood Risk and Drainage will be unchanged from those considered in the original ES.

Additional Operational Phase Effects

13.4.2 The higher current day peak tidal water levels and the change in climate change allowances could potentially result in additional operational phase impacts associated with flooding.

13.4.3 Specifically, there is a risk that overtopping rates may change. The FRA within the original ES reported overtopping at Appendix H and a summary of the reported rates for the 1:200 probability event in 2114 subject to oblique wave attack is provided in Table 13-4.

Table 13-4: 2114 Overtopping rates for the new quay reported in the original FRA

Sea Water Level (m aOD) (2114)	Wave Height - Hs (m) (2114)	Q deterministic (~Q68%)	
		Crest = 6.1m aOD	Crest = 6.3m aOD
		Q (l/s/m)	Q (l/s/m)
4.92	2.18	73.8	55.4
5.66	**1.62**	**91.8**	**61.6**
5.98	1.10	52.0	32.3

13.4.4 An updated assessment of overtopping rates along the quay frontage in 2121, using the Humber 2100+ predictions is included in Technical Appendix UES13-4 with key data reproduced in Table13-5 and Table 13-6 below for the Higher Central and Upper end scenarios respectively. In the updated assessment, overtopping rates are presented for two scenarios: direct attack from waves approaching perpendicular to the quay, and oblique wave attack for the largest waves approaching from the southeast.

13.4.5 The maximum wave heights are based on a wave rose for the site extracted from '*The Humber Tidal Database and Joint Probability Analysis of Large Waves and High Water Levels, Annex II: Addendum to Data Report',* (ABP Mer, 2007). The wave rose is reproduced in Figure 13-1 below and is superimposed on the quay in Figure 13-2 below. In short, for waves perpendicular to the quay, the maximum significant wave height is <0.8m, whilst for oblique attack waves can be much greater.

Figure 13-1: Wave Rose for South Killingholme (E518263, N421126)

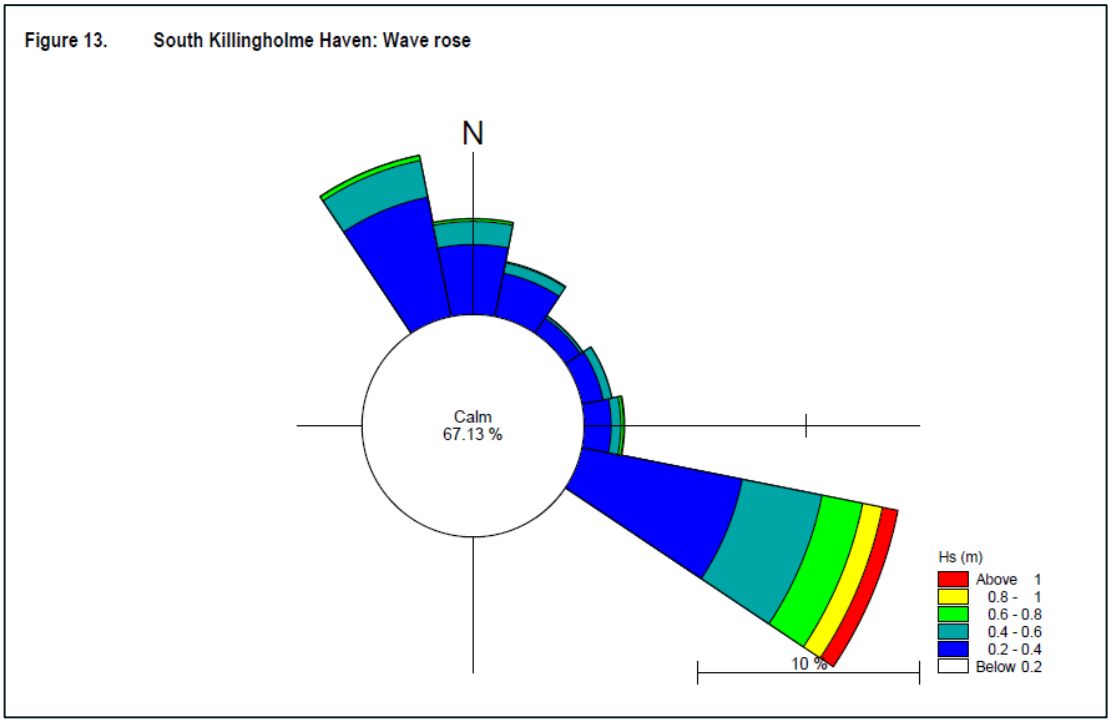
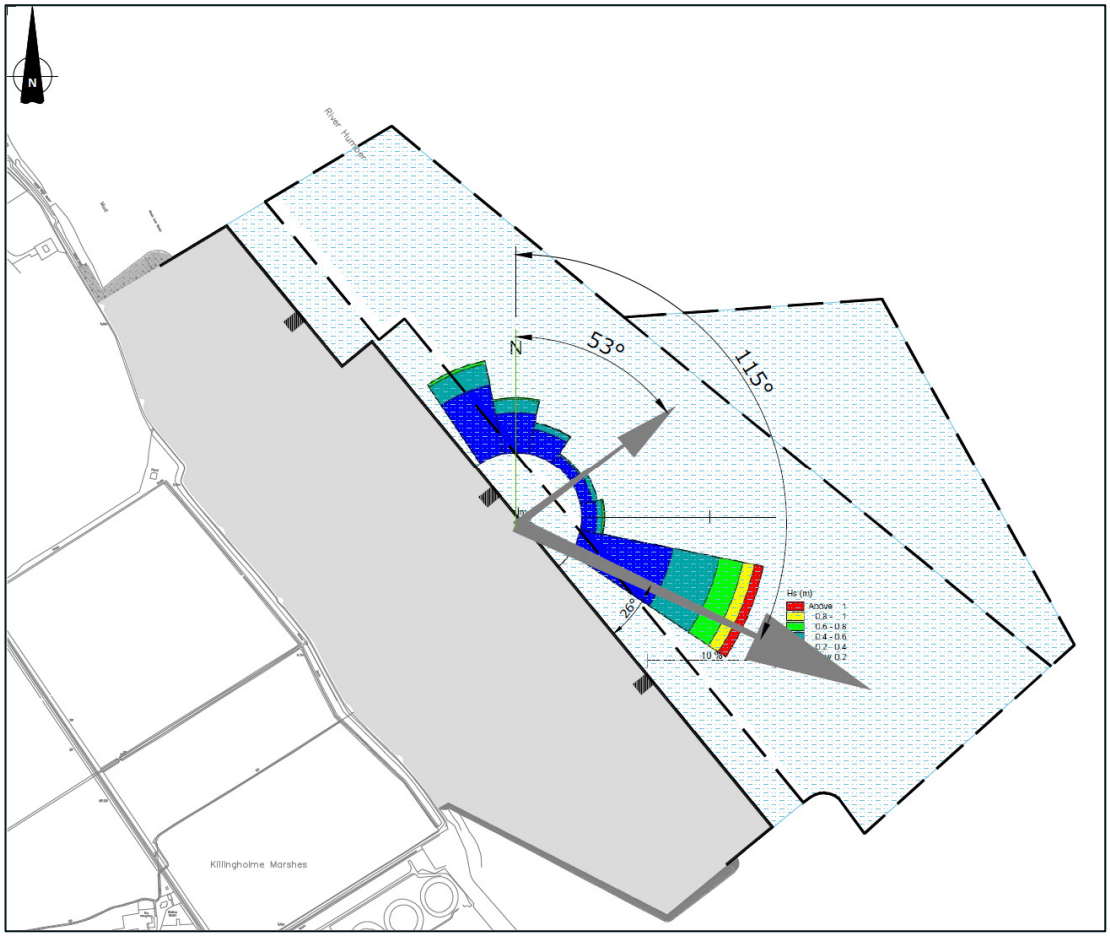


Figure 13-2: Wave Rose Superimposed on AMEP Quay



13.4.6 References to 'FLOODED' in Table 13-5 and Table 13-6 only take into account the front level of the quay and not the rear level (which is 280mm higher). For the avoidance of doubt given the still water levels considered there would be no general over topping across the quay.

Table 13-5: Updated 2121 Overtopping rates of the new quay using Humber 2100+ Higher Central Scenario

Sea Water Level[1] (m aOD) (2121)	Wave Height[2] – H_{m0} (m) (2121)	Equation 7.6 Design approach (Direct attack)			Equation 7.16 Oblique wave effect		
		Crest = 6.1m aOD	Crest = 6.3m aOD	Crest = 6.5m aOD	Crest = 6.1m aOD	Crest = 6.3m aOD	Crest = 6.5m aOD
		Q (l/s/m)	Q (l/s/m)	Q (l/s/m)	Q (l/s/m)	Q (l/s/m)	Q (l/s/m)
3.34	2.38	n/a max significant wave height for direct attack is <0.8m			6	5	3
4.07	2.37				21	15	11
4.80	2.18				50	35	25
5.54	**1.62**				**85**	**52**	**33**
5.86	1.10				78	39	19
5.90	0.88	89	49	27	54	22	9
5.96	0.66	60	27	12	37	11	4
6.02	0.55	54	21	8	36	9	2
6.05	0.44	42	13	4	29	5	1
6.09	0.33	34	7	1	26	3	0
6.11	0.22	Flooded	2	0	Flooded	1	0

1. Including 0.9m of sea level rise to account for climate change (Higher Central Allowance) through to 2021.

2. It is noted that the values quoted are H_{m0} and not significant wave height (H_s); however, while calculated differently the two values are broadly comparable, albeit with H_{m0} typically being slightly higher (i.e. more conservative)

Table 13-6: Updated 2121 Overtopping rates of the new quay using Humber 2100+ Upper End Scenario

Sea Water Level[1] (m aOD) (2121)	Wave Height[2] – H_{m0} (m) (2121)	Equation 7.6 Design approach (Max Overtopping)			Equation 7.16 Oblique wave effect (Min Overtopping)		
		Crest = 6.1m aOD	Crest = 6.3m aOD	Crest = 6.5m aOD	Crest = 6.1m aOD	Crest = 6.3m aOD	Crest = 6.5m aOD
		Q (l/s/m)	Q (l/s/m)	Q (l/s/m)	Q (l/s/m)	Q (l/s/m)	Q (l/s/m)
3.58	2.38	n/a max significant wave height for direct attack is <0.8m			10	7	5
4.31	2.37				31	22	16
5.04	2.18				77	54	38
5.78	**1.62**				**150**	**93**	**58**
6.10	1.10				181	90	44
6.14	0.88	Flooded	100	55	Flooded	64	27
6.20	0.66	Flooded	70	32	Flooded	47	15
6.26	0.55	Flooded	66	25	Flooded	48	12
6.29	0.44	Flooded	53	16	Flooded	42	7
6.33	0.33	Flooded	Flooded	10	Flooded	Flooded	4
6.35	0.22	Flooded	Flooded	3	Flooded	Flooded	1

1. Including 1.14m of sea level rise to account for climate change (Upper End Allowance) through to 2021.
2. It is noted that the values quoted are H_{m0} and not significant wave height (H_s); however, while calculated differently the two values are broadly comparable, albeit with H_{m0} typically being slightly higher (i.e. more conservative).

13.4.7 Comparable rates between the original and updated assessment are summarised Table 13-7 below. This demonstrates that if future sea level rises progress in line with the Higher Central climate change scenario, over topping rates will be lower than previously considered. If future sea level rises progress in line with the Upper End scenario over topping rates onto the quay could (if required for operational reasons) be controlled to levels less than previously considered through raising the quay to a height of 6.5m aOD.

Table 13-7: Comparison of overtopping analyses

Quay Level (m aOD)	Overtopping Rates (l/s/m)		
	Original FRA, 2114	Humber 2100+ Higher Central, 2021	Humber 2100+ Upper End, 2021
6.1	91.8	85 *Max SWL = 6.11 m aOD* *Rear Quay level = 6.38 m aOD**	150 *Max SWL = 6.35 m aOD* *Rear Quay level = 6.38 m aOD**
6.3	61.6	52	93 *Max SWL = 6.35 m aOD* *Rear Quay Level = 6.58 m aOD**
6.5	Not reported	33	58
* the quay will have a 1:100 gradient and rises to this level at 28m from the quay face			

13.4.8 The overtopping analysis in the original FRA[2] also considered the effects of reflected waves on existing flood defences to the north of the quay. In short it was concluded that rock armour was required over the existing flood defence revetment to limit overtopping to 2l/s/m for a period of 20 years. The effect of the proposed change on wave reflection, and in particular the setback berth is discussed in Chapter 8 of this PEIR. In short, it concludes that the setback will have a beneficial effect on wave reflection which is likely to reduce over topping. The assessment also concludes that sea level rise over the design life of 20 years (as agreed with eth Environment Agency) is not likely to be a significant factor.

Additional Cumulative Effects

13.4.9 There will be no additional cumulative effects associated with Flood Risk and Drainage.

Consideration of DCO

13.4.10 It is concluded that the changes in baseline understanding and the changes to the scheme will not result in any new or significant increased effects on Flood Risk and Drainage.

13.5.0 Requirement for Additional Mitigation

DCO Mitigation

13.5.1 Key mitigation proposed for the construction phase as part of the DCO involves adherence to good construction methodology as set out in Environment Agency Pollution Prevention Guidance [now Pollution Prevention for Business]. Much of this is secured under requirements of Schedule 11.

13.5.2 This will include:

- minimising pollution risk through the use of good construction practices including use of drip trays on mechanical equipment such as pumps and generators and fail-safe bunded storage of fuel and cement and other materials to prevent spillage to groundwater, watercourses or the sea;
- over-pumping around works in watercourse channels will be carried out with a suitably-sized pump, in order that excessive flows are not generated and disturbance of the bed material is minimised;
- watercourse bank reinstatement works will be carried out by vehicles operating from the bank rather than the watercourse channel;
- for work on, over or adjacent to the watercourses, a maximum of one third of the watercourse will be bunded at any time, and the bunds will have a minimal height above normal water level, and should either wash out or create minimal obstruction during flood conditions.
- construction materials will be prevented from entering watercourses or the sea and blocking either the channels or culverts and bridges; and
- care will be taken with all works involving concrete and cement. Suitable provision will be made for the washing-out of concrete mixing plant or ready-mix concrete lorries, and such washings will not be allowed to flow into watercourses or the sea.

13.5.3 Key mitigation proposed for the operational phase as part of the DCO, will also include adherence to Environment Agency Pollution Prevention Guidance [now Pollution Prevention for Business]. In addition, the following additional mitigation measures are proposed:

- fail-safe bunded storage of fuel and other substances to prevent spillage to groundwater, watercourses and the sea;
- provision of oil interceptors in paved areas;
- installation of penstocks on outfalls to watercourses and the sea to contain any pollution incidents (where there is an identified risk); and
- the implementation of a robust Flood Warning and Evacuation Plan for the site with its key objective being to evacuate the site before flooding occurs. Any people on the site will make their way off site (if safe to do so) or to the safe refuges on the upper floors of the buildings and await rescue by the emergency services. The Flood Warning and Evacuation Plan will not have any particular environmental impacts.

Alternate or Additional Mitigation

13.5.4 It is concluded that no further mitigation is required, over and above that committed to as part of the DCO application. This will be sufficient to control adverse effects to Flood Risk and Drainage relating to the proposed scheme.

13.6.0 Residual Effects

Construction Phase

13.6.1 Within the original ES, following consideration of mitigation, the residual effects relating to Flood Risk and Drainage during the construction phase were identified to be:

- the accidental release of polluting substances into the sea and inland watercourses (control measures will be implemented to mitigate the impacts of pollution incidents).

Operational Phase

13.6.2 Within the ES submitted for the DCO, following consideration of mitigation, the residual effects relating to Flood Risk and Drainage during the operation phase were identified to be:

- Flood risk due to breach of tidal defences (to be mitigated by implementation of a robust Flood Warning and Evacuation Plan);
- Flood risk due to over topping of the existing tidal defences to the north of the quay which, under the terms of legal agreement (Appendix UES13-2), will be restricted to no more than 2l/s/m for the 1 in 200 annual probability event over a 20 year period, following which the EA will be responsible for maintenance;
- Flood risk due to failure of the proposed NELDB pumping station (residual impacts are likely to be Minor Adverse and will be mitigated by the use of multiple pumps, alarms, etc); and
- Flood risk due to failure of the proposed foul pumping stations (residual impacts are likely to be Minor Adverse and will be mitigated by the use of standby pumps, alarms and flow storage facilities).

Consideration of DCO

13.6.3 It is concluded that there are no changes to the residual effects previously identified within Chapter 13 of the original ES.

13.7.0 Other Environmental Issues

13.7.1 This Section seeks to detail any considerations and environmental effects which have been identified with regard to the range of topics which have been introduced into EIA requirements through the EIA Regulations 2017. Where there are no such considerations or environmental effects, this is also specified below for clarity.

13.7.2 Refer to Chapter 25 for a summary of the 'Other Environmental Issues' identified across all of the technical assessments undertaken and the Chapters prepared as part of the ES.

Other Environmental Issues of Relevance

Infrastructure

13.7.3 The risks associated with Infrastructure are not of relevance to this Chapter.

Waste

13.7.4 The risks associated with Waste are not of relevance to this Chapter.

Population and Human Health

13.7.5 The Chapter has considered the risks associated with Flood Risk and the impacts this may pose with regard to population and human health.

Climate and Carbon Balance

13.7.6 The assessment has duly considered the risks associated with climate change through assessment of a suitable future flood risk scenario with raised sea levels. As such, the consideration of climate change is inherently contained within the existing assessment.

Risks of Major Accidents and/or Disasters

13.7.7 The assessment duly considers the risks associated with major accidents and/or disasters through assessing the risks associated with flooding, especially with regard to a breach flood scenario.

Summary

With regards to the EIA regulations 2017, in terms of Flood Risk and Drainage there are not considered to be any likely significant effects with regards to Other Environmental Issues.

13.8.0 Summary of Effects

13.8.1 Chapter 13 of the original ES states that all potential residual effects (no greater than Minor Adverse) relating to Flood Risk and Drainage will be further controlled through the implementation of additional mitigation (see Section 13.8 therein). While not expressly stated in the original ES, it is therefore clear that the residual effects of the DCO scheme in relation to Flood Risk and Drainage would not be significant.

13.8.2 This chapter demonstrates that proposed material amendments will not result in increased levels of impact and therefore the residual effect of the scheme in relation to Flood Risk and Drainage will remain not significant.

13.9.0 Conclusions

13.9.1 The site is set in a context where flooding is possible; however, this risk is largely controlled through flood defences. The scheme design has been developed to reflect the prevailing risk and will not exacerbate flood risk elsewhere. Residual risk will then be managed through implementation of a robust flood warning and evacuation strategy.

13.9.2 With regards to drainage, storm water runoff from the site will largely be discharged to the Humber Estuary. Particularly during construction there is however a potential for pollution to occur to the adjacent surface water channels and networks. This will be controlled and managed through the implementation of good construction practices.

13.9.3 In both cases the proposed material amendment will make no difference to the potential effects identified within the original ES (not significant) and no additional mitigation will be required.

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