The Sizewell C Project

5.2 Main Development Site Flood Risk Assessment Addendum

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EXECUTIVE SUMMARY

NNB Generation Company (SZC) Limited (SZC Co.) submitted an application for a Development Consent Order (DCO) to the Planning Inspectorate under the Planning Act 2008 for the Sizewell C Project (referred to as the 'Application') in May 2020. The Application was accepted for examination in June 2020. As part of the submission, the **Main Development Site Flood Risk Assessment** (Doc Ref. 5.2) [APP-093] and its accompanying appendices were provided to assess the flood risk from all sources both to and from the proposed main development site.

The **Main Development Site Flood Risk Assessment** (Doc Ref. 5.2) [APP-093] in the Application confirmed that, following review of all sources of flooding, the main development site areas would be at low risk of flooding throughout the development lifetime. This is with the exception of coastal flood risk during the early construction phase and at the end of the theoretical maximum site lifetime (2190 epoch) where there would be medium risk of flooding from wave overtopping and extreme sea levels considering reasonably foreseeable (based on UKCP18 RCP8.5 95th percentile) and credible maximum (H++ and BECC Upper) climate change projections.

Following submission of the Application, review of the **Main Development Site Flood Risk Assessment** (Doc Ref. 5.2) [APP-093] Assessment and continuing consultation with key stakeholders (including the Environment Agency), a number of comments have been received. These comments were primarily in relation to the relative impact of flood risk on off-site properties, lack of clear proposed mitigation and detailed assessment of the flood risk to the site and its users during the construction phase of the development. Some further comments were also received in relation to the hydraulic modelling, including queries on general model schematisation and overall model performance, blockage assessment as well as comments on surface water drainage and the need for a flood risk emergency plan. Further assessment and analyses carried out in response to these comments are discussed within this **Main Development Site Flood Risk Assessment Addendum**.

In response to further engagement with the key stakeholders, SZC Co. has revised the design of some aspects of the scheme to provide further mitigation against potential flood risk and environmental impacts, and to increase the resilience of the site to future climate change.

In the original Application the sea defence met the basis of design by addressing coastal overtopping for the 1 in 10,000-year return period scenario, including a reasonably foreseeable allowance for climate change (based on the UKCP18 RCP 8.5 projections), for the operational phase of the development. However, our assessments at that time showed that the raised HCDF of 14.2m AOD (maximum crest height presented in the Application) would need to be established by 2046, a relatively short period of time after the completion of construction at the main development site in 2034. Furthermore, in the period since the Application submission, SZC Co. has, in consultation with internal and external stakeholders, established an initial set of Safety

Functional Requirements for the HCDF as part of the ongoing design process. These include a more conservative tolerable overtopping rate (design basis limit) of 2 l/s/m based on guidance provided in the CIRIA 'Rock Manual' (Ref. 1.2) to limit the potential for flooding on the platform by increasing safety margin throughout the operation and decommissioning phases of the project.

Correspondingly, in order to delay future HCDF raising activities, and to take account of the revised design basis limit for the HCDF, a revised initial height of 12.6m AOD (from 10.2m AOD minimum crest height presented in the Application) has been established for both the HCDF and Northern Mound. This gives a total height with landscaping of up to 14.6m AOD. Based on the UKCP18 RCP 8.5 projections, the raised 16.4m AOD HCDF would not be required until after 2140. These design changes have been set out in **Chapter 2** of **Volume 2** of the **ES Addendum** (Doc Ref. 6.14).

Results of the updated wave overtopping assessment show that the revised defence design would be sufficient to protect the site against the 1 in 200-year and 1 in 1,000-year events up to the end of the theoretical maximum site lifetime (2190 epoch) under the reasonably foreseeable climate change scenarios.

Changes to the design of the proposed SSSI crossing are also proposed, replacing the 8m culvert option with a single span bridge with embankments, with the bridge opening measuring 23.8m at ground level and up to 30m wide at soffit level. The revised design would occupy less of the SSSI marshes and associated floodplain and provide a wider opening for otters and other species, therefore mitigating the environmental (i.e. through less encroachment to the SSSI and reduced habitat fragmentation) and flood risk impacts.

A further proposed change would increase flood storage capacity by providing an additional flood mitigation area in place of a water resource storage area presented in the Application. The area would also be used to provide additional wetland habitat.

The updated scheme design with embedded mitigation has been assessed in updated hydraulic modelling to review the assessment of on-site and off-site flood risk impacts presented in the Application. The results of this additional hydraulic modelling confirm that the main development site and the SSSI crossing would not be at risk of fluvial or coastal inundation and tidal breach flooding throughout the development lifetime.

No additional properties would be at risk of flooding as a result of the scheme with embedded mitigation in place. There is a limited impact on flood depth to some residential and non-residential properties that would be flooded without the proposed development, however there is no significant impact on flood velocity or hazard rating to any of the affected properties.

The methodology and sequencing for the construction of the main development site has been progressed since submission of the Application, and so further details are available. A temporary sheet pile wall is proposed to be constructed prior to removal of the existing defences in front of Sizewell C that would protect the construction site until the core of the HCDF is constructed. This proposed change (i.e. the temporary sheet pile wall) would therefore reduce the risk of wave overtopping to the construction site and its users throughout the construction phase, mitigating the risk that was identified in the Application. A "Bailey" style temporary crossing would still be installed in advance of the main crossing and within the SSSI crossing working area to provide an early route between the temporary construction area and the main construction area and to facilitate construction of the permanent bridge. This would be placed above the fluvial and coastal flood levels providing safe access to the main construction area.

To manage surface water flood risk during the construction phase of the main platform, measures set out in the Outline Drainage Strategy (Doc Ref. 6.3) [APP-181] in the Application comprise a Combined Drainage Outfall (CDO) to discharge treated surface water run-off from the site and use of Water Management Zones (WMZ) 1 and 2 while the CDO is being constructed. Residual risk was identified in the MDS Flood Risk Assessment (Doc Ref. 5.2) [APP-093], where at times of high surface water inundation, there may be a necessity to include additional attenuation storage within the main construction area as temporary measures.

To mitigate the residual risk, a temporary outfall is proposed, so that surface water from the main platform area would be temporarily pumped over the temporary sea defences and into a chamber before discharging through a gravity pipe towards the shoreline. The temporary outfall would be in operation prior to the commissioning of the permanent outfall (CDO) for approximately a 2-year period. Once the CDO is constructed the temporary outfall would be removed. Further details on the temporary outfall are provided in Chapter 2 of Volume 2 of the ES Addendum (Doc Ref. 6.14).

The new temporary outfall will allow more efficient drainage prior to construction of the CDO when compared with the approach set out in the Application. As such it is concluded that it would provide improved mitigation of the surface water flood risk within the main platform construction area during the early construction phase.

Details on management of flood risk during early construction phase and throughout operational and decommissioning phases are set out in the Main Development Site Flood Risk Emergency Plan, appended to this document, where procedures for safe access and egress, flood warning, evacuation procedures and need for safe refuge in response to a flooding event are described.

Further clarifications relating to specific areas of the development, including the Water Management Zones, Water Resource Storage Area, Beach Landing Facility and surface water drainage strategy are also included in this **Main Development Site Flood Risk Assessment Addendum**.

Additionally, this document and its accompanying appendices provide clarification on the comments received with regard to hydraulic modelling undertaken for the Application, discussing additional modelling for fluvial, coastal and wave overtopping analysis, including sensitivity testing carried out to inform the assessment of on-site and off-site impacts.

1 INTRODUCTION

1.1.1 NNB Generation Company (SZC) Limited (SZC Co.) submitted an application for a Development Consent Order (DCO) to the Planning Inspectorate under the Planning Act 2008 for the Sizewell C Project (referred to as the 'Application') in May 2020. The Application was accepted for examination in June 2020.

1.1.2 Since the submission of the Application, SZC Co. has continued to engage with the local authorities, environmental organisations, local stakeholder groups and the public to gather their responses to the Application. This process has identified potential opportunities for changing the Application to further minimise impacts on the local area and environment in many cases, whilst reflecting the further design detail that has come forward in preparation for implementation of the Sizewell C Project.

1.1.3 In addition to the proposed changes, SZC Co. has continued to develop the detail of its proposals and of the implementation of the Sizewell C Project (the 'project'), and has undertaken some additional environmental assessment work in response to continuing engagement with stakeholders. This 'Additional Information' adds to the information supporting the Application and should assist interested parties in their understanding of matters.

1.1.4 The proposed changes and the Additional Information are described and assessed in a number of updates and Addenda to the originally submitted application documents.

1.1.5 This report provides additional information to support the **Main Development Site Flood Risk Assessment** (Doc Ref. 5.2) [APP-093] (hereafter referred to as the **MDS Flood Risk Assessment**) for the Project, which was provided in support of the Application.

1.1.6 This **Main Development Site (MDS) Flood Risk Assessment (FRA) Addendum** presents additional information provided in response to further engagement with key stakeholders, including the Environment Agency's Relevant Representation on the Application, dated 30th September 2020 (Ref. 1.1.1). An overview of the Relevant Representation on flood risk matters in connection with the main development site is provided in **APPENDIX A**.

1.1.7 This **MDS FRA Addendum** also presents assessment and further clarifications in response to comments from the Environment Agency received on 5th February 2020 and subsequently, post Application, on 4th August 2020 relating to the **MDS Flood Risk Assessment** (Doc Ref. 5.2) [APP-093] and associated hydraulic modelling studies submitted with the Application (collated in **APPENDIX B).**

1.1.8 Review of the Relevant Representation and additional responses identified several key focus areas for further assessment. Each is addressed in a separate section of this document, as follows:

- Hydrology and hydraulic modelling for the main development site (**Section 2**);
- Management or mitigation of increased flood risk to off-site properties resulting from the main development site (**Section 3**);
- Measures to ensure the safety of the site and its users during construction and operational phases of the proposed development (including the Flood Risk Emergency Plan) (**Section 4**).

1.1.9 Additional clarifications in response to other comments raised in further engagement with key stakeholders are provided in **Section 5**.

1.1.10 Note that this document presents additional work only and should be read alongside the original documentation submitted as part of the Application.

2 UPDATES TO THE MAIN DEVELOPMENT SITE MODELLING

2.1 Summary of comments received from the Environment Agency

a) Summary of Relevant Representations

2.1.1 The Environment Agency raised one comment within the Relevant Representation relating to fluvial hydrology, stating:

> *"The main area of concern is over the main development site fluvial hydrology. Some aspects of the analysis are rigorous but others are not. There are a number of shortcomings, particularly in the choice of an outdated method for flow estimation and limited use of available local data. Whilst it is possible that the overall conclusion of the FRA is unaffected by these shortcomings, it seems reasonable to expect to see a hydrological assessment that is above reproach in the case of a new nuclear development. Where shortcomings have been identified these need to be properly checked and tested using more recent hydrological methods and datasets to ensure that the conclusions of the FRA are not affected."*

2.1.2 Whilst the Environment Agency acknowledged that the overall conclusions drawn in the **MDS Flood Risk Assessment** (Doc Ref. 5.2) [APP-093] may not be affected by the sensitivity around hydrological assessment, it also requested and re-iterated within detailed comments (collated in **APPENDIX B**) that further justification, checks and analysis ought to be carried out. Additional assessment has been undertaken in response to these comments and is presented in **Section 2.2**.

b) Further technical comments raised by the Environment Agency

2.1.3 In addition to its Relevant Representations, the Environment Agency also identified further issues regarding some of the technical elements of the **MDS Flood Risk Assessment** (Doc Ref. 5.2) [APP-093] and associated hydrology and hydraulic modelling studies for fluvial, coastal inundation, tidal breach flooding and wave overtopping analysis. These responses are collated in **APPENDIX B**.

2.1.4 The majority of the additional comments relate to the hydraulic models, including model schematisation, parameters and general model performance. Further comments also indicated potential gaps in the analyses, where additional scenarios (flood events) should be assessed.

2.1.5 As such, additional assessment was carried out with changes being made to the hydraulic models in line with the received responses (sensitivity testing). This has included testing additional scenarios to understand their implications for the flood risk modelling results and the overall conclusions drawn in the **MDS Flood Risk Assessment** (Doc Ref. 5.2) [APP-093].

2.1.6 The sensitivity testing aims to understand how changes in the model parameters could affect the results of the modelling and whether this has an impact on flood risk to and from the proposed development. Additional climate change epochs were also assessed to confirm the understanding of flood risk on-site and off-site for a range of plausible scenarios.

2.1.7 The issues raised, and the appropriate additional analysis requested, relate to the following:

- Fluvial hydrology checks and further assessment;
- Fluvial and coastal/tidal breach model schematisation updates;
- Blockage assessment and other sensitivity testing;
- Intermediate epochs assessment (coastal inundation and tidal breach model); and
- Gaps in the wave overtopping assessment.

2.1.8 For more comprehensive details of the issues raised and justification for undertaking sensitivity tests and additional assessment, see the collated comments from the Environment Agency (**APPENDIX B**).

2.1.9 The additional hydrological analysis and hydraulic modelling undertaken in response to the Environment Agency's comments are presented in the subsequent sections.

2.2 Additional hydrology and fluvial modelling

a) Approach

2.2.1 This section outlines briefly the updates to and review of the hydrology and fluvial modelling and additional assessment carried out in response to further engagement with key stakeholders (**APPENDIX A**) and additional comments from the Environment Agency (**APPENDIX B)**.

2.2.2 Key elements of the additional hydrological assessment focused on analysis of the preferred rainfall-runoff method (ReFH2) for flow estimation, and sensitivity testing was carried out to test the impact of the alternative method on the overall model results and conclusions. Similarly, sensitivity to percentage runoff (PR) values was also tested in the hydraulic model to understand the relative change of the model response to amendments in those parameters.

2.2.3 Further flow and stage records were obtained for the temporary gauging stations and the Middleton gauging station to review their quality and suitability for the hydrological assessment for the Project.

2.2.4 Sensitivity testing in the hydraulic model was also carried out to assess the impacts of updates to the model schematisation, timing of coinciding peak fluvial and tidal flows and extended simulation time, risk of blockage and relative impact of the SSSI crossing and the main platform on the flood levels and overall conclusions.

2.2.5 The details of the sensitivity testing and further assessment undertaken have been set out in the **Main Development Site (MDS) Fluvial Modelling Report Addendum** (**Appendix C**).

b) Results

i. Hydrology review

2.2.6 The ReFH2 rainfall-runoff method was tested in the hydraulic model and the results compared with those produced by the FEH method, adopted in the Application. This sensitivity test was carried out for the baseline 121-hour storm duration 1 in 100-year return period event present day scenario with scheme. The peak flow and total volume produced by the FEH method, adopted in the Application, are higher than the ReFH2 method. This translated into the peak flood levels across the catchment, where the FEH method consistently produced higher peak flood depths (by 0.20 – 0.21m) and therefore the original results, adopted in the Application, are considered more robust than the results obtained with the ReFH2 method.

2.2.7 Sensitivity testing with the adjusted PR values at each inflow boundary produced higher peak flood depths (between 5% and 9%), as would be expected with the PR values increased to 75% from the 50% adopted within the Application. This test was run for the 121-hour storm duration 1 in 100-year return period event with 80% allowance for climate change (2190 epoch) to assess the potential impact on model results at the end of the development lifetime. Since this is an extreme event it is anticipated that the difference in peak flood levels due to increased PR values would be less for lower return period events and climate change scenarios.

2.2.8 Review of the additional records obtained for the temporary gauging stations found that the data at the G5 temporary gauging station remains the most reliable and dependable out of the temporary gauges installed, with the fewest gaps in the data record or reliability issues. This is in line with the conclusions drawn within the Application where the G5 temporary gauge is the most suitable as a donor site for other sub-catchments. On that basis, the assessment carried out for the Application remains valid.

2.2.9 The extended record for the G5 temporary gauge (just short of 6 years) was then used to review Median Flood (QMED) estimation, which has previously been derived based on 18-month data (i.e. shorter than advisable). With the additional data record the derived QMED value of 1.4m^3/s is comparable with the previous estimate of 1.6m^3/s reported in **Appendix 3** of the **MDS Flood Risk Assessment** (Doc Ref. 5.2) [APP-099] and therefore is still considered to be representative.

2.2.10 Analysis of the additional records from the Middleton gauging station identified a number of discrete high flow events that could potentially be used in model calibration. However, upon further investigation, it was found that the shape of the runoff event hydrographs extracted from the extended time-series show the same general shape and characteristics as the events already assessed in the model calibration, presented in **Appendix 3** of the **MDS Flood Risk Assessment** (Doc Ref. 5.2) [APP-099] and therefore these would be unlikely to change the results of the current model calibration.

2.2.11 To confirm the representative nature of the G5 temporary gauging station, an assessment of sub-catchment characteristics, i.e. the soils and geology, was carried out. The soils and superficial geology mapping showed that the G5 temporary gauging station catchment is broadly representative of the other upland sub-catchments and therefore it is acceptable to use the G5 temporary gauging station site as a donor catchment, confirming the approach adopted in the assessment for the Application.

2.2.12 Further details on the review of the hydrological assessment and the associated results are provided in the **MDS Fluvial Modelling Report Addendum** (**Appendix C**).

ii. Hydraulic modelling sensitivity testing

2.2.13 Sensitivity testing on the model schematisation (alignment of the 2D layers representing the SSSI crossing) was carried out for the 1 in 100-year return period event with 65% climate change allowance, as this is a key scenario in the assessment of on-site flood risk. The results of this sensitivity testing showed no significant impact on model results and peak flood levels within the catchment (**Section 4.2** of **Appendix C**).

2.2.14 In the assessment for the Application, based on the critical storm duration (121-hour), the timing of the coinciding tidal peak level at the downstream end of the model was set to approximately 121-hours, as this was the time of the peak fluvial flow as it propagated through the catchment. In its response, the Environment Agency noted that for the baseline present day scenario the peak flood levels within the floodplain are at about 123.7-hours, by which point the peak surge tide level has passed.

2.2.15 Sensitivity testing was therefore carried out with the adjusted timing of peak tide levels, moving it forward by 2 hours so that it coincides with the peak levels on the floodplain, i.e. to ~ 123.5 hours. In addition, a second test was carried out for the with scheme 1 in 100-year return period event with 65% climate change allowance, as the key scenario for on-site flood risk assessment.

2.2.16 Results for both tests show that the adjusted time of peak tide levels has very minimal impact on peak flood levels, where the maximum difference within the model is no more than 0.01m during the with scheme +65% climate change allowance scenario. This difference is not significant when compared with the flood levels (**Section 4.3** of **Appendix C**), which are approximately 2m AOD. Also, the time of peak for the different return period events and climate change scenarios will vary slightly, and it is standard modelling practice to test and adopt one approach for the assessment.

2.2.17 A further sensitivity test was carried out with an extended simulation time from 300 to 400 hours for the baseline and with scheme model schematisations during the 1 in 5-year return period event with 80% climate change allowance, since the results presented in the Application indicated that peak flood levels within Scott's Hall Ditch were not reached for these two scenarios at the end of the 300-hour simulation.

2.2.18 Results show that flood levels kept rising very slightly (less than 0.01m) until the end of the extended simulation time. Further investigation of the results within the Application and the extended simulation indicate that this is caused by the extreme tide levels in the 2190 epoch (80% climate change allowance for fluvial flows), where the ingress of tidal water is contributing to rising levels within the floodplain rather than fluvial flows (as illustrated in **Plate 4.2**, **Section 4.4** of **Appendix C**).

2.2.19 Comparison of the results with other modelled return period events with the same climate change allowance presented in the Application revealed that the rising water levels at the end of simulation only affect the 1 in 5-year event and in all cases the flood levels at the end simulation reach very similar level, including the extended simulation for the 1 in 5-year event, showing the influence of the extreme tide levels in the 2190 epoch. Therefore, it is very unlikely that the flood levels in the 1 in 5-year event scenario would continue to rise further beyond flood levels for the higher return period events, considering that fluvial flows are much lower and peak fluvial flows pass at around 121-hours.

2.2.20 Blockage assessment of the key structures, including the proposed SSSI crossing culvert, was not carried out for the Application given the dimensions of the culvert, which meant that blockage was expected to have limited impact on flood risk to the development. Following the submission, the design of the SSSI crossing has been updated, and it is proposed that the culvert is replaced with a single span bridge structure with an opening that measures 23.8m at ground level and up to 30m wide at soffit level. On this basis, it has been agreed with the Environment Agency (meeting held on 23rd November 2020) that blockage of the crossing is highly unlikely and therefore this assessment is no longer required. Details of the updated design of the SSSI crossing are presented in **Section 3.2** of this document.

2.2.21 To assess the residual risk to the development itself, a sensitivity test was carried out incorporating a blockage of the Minsmere Sluice, which is the key discharge structure within the catchment. The test was undertaken with a 70% blockage ratio for the 1 in 100-year return period event with 65% climate change allowance which is the key scenario when assessing on-site flood risk. Results show a maximum increase in peak flood depth across the model by up to 0.01m. However, the peak flood levels of 2.14m AOD are still significantly below the key development areas (i.e. the main platform and SSSI crossing), which are both set at a level of 7.3m AOD as discussed in **Section 4.5** of **Appendix C**.

2.2.22 Although not raised within responses received during further engagement with key stakeholders, sensitivity testing in the hydraulic model without the proposed SSSI culvert crossing in place (i.e. with only the main platform present) was carried out to better understand the relative impact of the main platform and the SSSI crossing on change in flood risk. This scenario was tested for the 1 in 100-year and 1 in 1,000-year return period events with 35% climate change allowance as two key scenarios for assessment of off-site impacts (**Section 4.6** of **Appendix C**).

2.2.23 Results show that, even with complete removal of the SSSI crossing, the scheme still has some impact on peak flood depth across the catchment with increased flood depth up to 0.01m for the 1 in 100-year event, when compared with the baseline, and that this largely occurs due to the loss of floodplain within the main platform area.

2.2.24 In the larger 1 in 1,000-year event, the peak flood levels are the same as in the baseline scenario suggesting limited impact of the scheme. This is translated to the impact on off-site properties, where the number of residential and non-residential properties affected did not change; with the maximum increase in flood depth up to 0.01m when compared to the baseline scenario.

2.2.25 Further details on the sensitivity testing, results and supplementary plots and tables are provided in the **MDS Fluvial Modelling Report Addendum** (**Appendix C**).

c) Conclusion

2.2.26 Results from the rainfall-runoff method sensitivity test show that the FEH method used in the Application produces higher peak flows and flood levels across the catchment than the alternative ReFH2 method and continues to be adopted within the modelling analysis for the Project to assess the greatest potential impact of the development.

2.2.27 Sensitivity testing with a PR value of 75% (compared to 50% used in the Application) shows some increase in peak flood levels, however such a PR value is relatively high, often used for smooth (urban) areas and therefore the increase in flood levels shown was to be expected. Nevertheless, a 25% increase in PR values results only in a 5%-9% increase in peak flood depth and therefore, for consistency, the PR values in the further modelling analysis were not changed from those adopted in the Application.

2.2.28 Following a review of the additional event data from the Middleton gauge it is considered that there is no requirement to utilise additional event hydrograph data to recalibrate the hydraulic model. This is because the observed event hydrographs from the Middleton gauge exhibit the same unit hydrograph shape and characteristic as those used in the original model calibration and therefore there would be little or no difference to the results of the calibration exercise.

2.2.29 Sensitivity testing on model schematisation (alignment of the 2D layers representing the SSSI crossing) showed no significant impact on model results, but, as best practice, the revised model schematisation was used in all following sensitivity tests and any further assessment.

2.2.30 Sensitivity testing utilising the adjusted timing of coinciding tidal and fluvial peak flows showed very limited impact on model results and therefore it was concluded that, for consistency in the approach, the timing of the peak tide levels in the further modelling analysis should not be changed from that adopted in the Application.

2.2.31 Based on the results from the blockage assessment the updated assessment has shown that the residual risk to the development in an event of blockage of the Minsmere Sluice is not significant.

2.2.32 Considering results from the test without the SSSI culvert crossing in place, it can be concluded that the SSSI crossing culvert design presented within the Application does not pose a constriction to fluvial flows and rather any impact on fluvial flood levels is caused by loss of floodplain mostly within the main platform area but also within the footprint of the SSSI crossing embankments. These conclusions have, to some extent, been superseded with results of the assessment utilising the updated design of the SSSI crossing, which are discussed in **Section 3.3**.

2.3 Additional coastal inundation and tidal breach modelling

a) Approach

2.3.1 This section outlines briefly the updates to the coastal inundation and tidal breach modelling and additional assessment carried out in response to comments received from key stakeholders following submission of the Application (**APPENDIX A** and **APPENDIX B**) outlined in **Section 2.1**.

2.3.2 Key comments focused on improvements to the model schematisation (relating to alignment and representation of some watercourses and embankments), risk of blockage of key structures, and assessment of flood risk at intermediate epochs, between the 2030 and 2190 epochs that were considered in the Application.

2.3.3 As per the assessment of fluvial flood risk due to blockage of key structures, the risk related to tidal breach and coastal inundation was also assessed considering blockage of the Minsmere Sluice structure only, as the updated design of the SSSI crossing with a much wider opening is unlikely to become blocked.

2.3.4 Similarly, sensitivity testing in the coastal inundation and breach models was also carried out to assess the relative impact of the SSSI crossing and the main platform on the flood levels and overall conclusions. All tests were carried out for the reasonably foreseeable climate change scenarios (based on the UKCP18 RCP 8.5 projections).

2.3.5 Details of the further modelling and assessment undertaken are set out in the **Main Development Site (MDS) Tidal Breach and Coastal Inundation Modelling Report Addendum** (**Appendix D**).

b) Results

2.3.6 The risk of blockage was assessed for the 1 in 1,000-year event at the 2030 epoch, which was reported in the Application to have, overall, the greatest impact on flood levels. The Minsmere Sluice was treated as blocked by 67%, reducing its discharge capacity. Results show that for the baseline scenario (without the scheme) comparing flood levels with and without the blockage, flood levels increase slightly in the upstream part of the catchment (up to 0.02m), whereas for the with scheme scenario there is no change (**Section 2.2** of **Appendix D**).

2.3.7 To address comments relating to the model schematisation, changes to the alignment of some of the drains and overtopping lines were made together with other improvements discussed in **Section 2.3** of **Appendix D**. Results for the 1 in 1,000-year event at the 2030 epoch show some reduction in flood levels within the Minsmere Levels (up to 0.08m) for both the baseline and the with scheme scenarios coastal inundation and tidal breach models. This is mostly due to the revised alignment of the overtopping line along the Scott's Hall Ditch that was moved seawards to align with the primary defence (instead of the secondary defence) that resulted in improved conveyance through the Leiston Drain.

2.3.8 Assessment within the Application (**Appendix 4** of the **MDS Flood Risk Assessment** (Doc Ref. 5.2) [APP-099]) considered only two extreme epochs, i.e. 2030 and 2190. The results showed that the greatest change in flood depths due to the development was in the 1,000-year 2030 epoch scenario for both the coastal inundation and the tidal breach models. To confirm that the greatest potential impact of the scheme has been captured, the intermediate epoch at 2090 was modelled post submission. This epoch was chosen as it comprises a key point in the development lifetime i.e. the end of the operational phase.

2.3.9 Analysis of the results for all epochs showed that the Minsmere-Leiston system responds slightly differently to flood volumes of coastal inundation and tidal breach associated with the different epochs tested. In some areas there is a greater change in flood levels due to the scheme in the earlier epoch, i.e. 200-year event at 2030, whereas in other areas, and considering impact on off-site properties, it is in the 1,000-year event at 2090 epoch.

2.3.10 Overall, when considering the change in flood depth and impact to off-site receptors, the greatest impact of the scheme is presented for the 2090 epoch, where, although it is not the largest increase in relative flood levels across the catchment, it affects more properties to a greater depth (as it has a greater extent than the 2030 epoch).

2.3.11 Detailed assessment of the results with different epochs is provided in the **MDS Tidal Breach and Coastal Inundation Modelling Report Addendum** (**Appendix D**).

2.3.12 Sensitivity testing without the SSSI crossing in place (i.e. with the main platform only) showed, similarly to the fluvial flood risk, that the narrowing at the crossing contributes to the impacts on flood risk. However, this is not the only cause, because loss of floodplain within the main platform area and crossing embankments play a significant role in the overall impact of flood levels. This is demonstrated in both the tidal breach and coastal inundation results, where the change in flood levels is less than in results with the full scheme (more so for the earlier epochs), although the impact is not eliminated.

c) Conclusion

2.3.13 Assessment of the blockage scenario shows no overall change in flood levels in the with scheme scenario when compared with the results presented in the Application, and therefore, based on conclusions drawn in the **MDS Flood Risk Assessment** (Doc Ref. 5.2) [APP-093], the residual risk to the proposed development in an event of Minsmere Sluice blockage is not significant.

2.3.14 Sensitivity testing with updated model schematisation shows some change in flood levels, both in the baseline and with scheme scenarios, more so in the coastal inundation model. Since the improved schematisation is more representative of the existing situation it was therefore used in any further modelling assessment.

2.3.15 Assessment of the intermediate epoch, i.e. 2090, shows overall a greater impact of the scheme on off-site receptors, when considering relative change in flood depth and corresponding changes in flood depth for properties. Therefore, the 2090 epoch was included in any further modelling assessment of coastal inundation and tidal breach flood risk.

2.3.16 These conclusions have, to some extent, been superseded with the results of the assessment with the updated design of the scheme (SSSI crossing and flood mitigation area), which are discussed in **Section 3.4**.

2.3.17 Detailed results, including figures of flood depth, velocity and hazard rating, are provided in the **MDS Tidal Breach and Coastal Inundation Modelling Report Addendum** (**Appendix D**).

2.4 Additional coastal wave overtopping modelling for on-site risk

a) Approach

2.4.1 This section outlines briefly the additional wave overtopping assessment carried out for extreme coastal events. This was undertaken for on-site risk in response to the collated comments from the Environment Agency, which are summarised in **APPENDIX B**.

2.4.2 One of the comments from the Environment Agency relates to the assessment of coastal flood risk from wave overtopping under the credible maximum scenario and states:

> *"A credible maximum scenario for the 0.5% (200 year) & 0.1% (1000 year) overtopping event at 2190 has not been modelled…. Run 0.5% & 0.1% credible maximum scenario and provide wave overtopping rates and inundation modelling & mapping so we can establish the possible impacts of climate change into the future."*

2.4.3 It is acknowledged that the credible maximum scenario should be assessed as part of the flood risk assessment for a nuclear site. However, in the scenarios suggested, the extreme still water levels for most of the credible maximum scenarios are above the main platform level of 7.3m AOD.

2.4.4 As such, the main platform area would be inundated by water ingress from the land side due to significant inundation of the existing sand dunes/shingle defences to the north and south of the site (which are much lower than the proposed sea defences for the Project and the defences for the existing power stations). On this basis, the main platform could potentially be inundated via overtopping of the defences to the north and south rather than the proposed sea defence alongside the main platform itself. As such, overtopping analysis for the proposed sea defence alongside the main platform was not undertaken, and instead flood risk on the main platform was assessed based on horizontal projection of the extreme still water levels. This is discussed further in **Section 4**.

2.4.5 The Environment Agency raised two comments relating to gaps in the assessment presented in the Application (**APPENDIX B)**. These are:

> *"…table shows overtopping rates at the northern mound at 2110 for UKCP09 and H++ allowances for a range of return periods… This does not follow the latest guidance*

which is to apply the RCP8.5 95th Percentile from UKCP18."

"FRA concludes there is no risk of overtopping at 2090 in the 0.5% (200 year) event when this scenario has not been run with UKCP18 RCP 8.5 95th percentile climate change."

2.4.6 In response to the comment above, additional overtopping assessment for the Northern Mound defence was carried out for an additional 6 scenarios comprising the 1 in 200-year, 1,000-year and 10,000-year return period events at 2140 and 2190 climate change epochs (based on UKCP18 RCP8.5 climate change projections).

2.4.7 It is acknowledged that the scenario for the 1 in 200-year event at 2090 epoch has not been explicitly modelled, however results presented in the Application for the 1 in 200-year return period at 2140 epoch (sea level rise allowance higher by 0.9m) showed very limited overtopping rate of 0.3 l/s/m (well below 1 l/s/m). Hence, it is reasonable to assume that overtopping would be less or none during the 2090 epoch (considering current UKCP18 projections for sea level rise). Therefore, additional calculations for this scenario were not undertaken as part of this assessment.

b) Results

2.4.8 **Table 2.1** presents the predicted mean overtopping rates at the Northern Mound defence for the additional scenarios assessed in response to comments from the Environment Agency. All runs were carried out utilising the defence crest of 14.2m AOD. The revised proposals for the design of the HCDF (including the Northern Mound) assume a crest level of up to 14.6m (**Figure 2.2.23** in **Chapter 2** of **Volume 2** of the **ES Addendum**). However, overtopping calculations were carried out adopting the more conservative defence crest level of 14.2m AOD as per the design details set out in the Application.

Table 2.1: Predicted mean overtopping rates for the Northern Mound profile

Return Period	Epoch	Climate Change	Extreme Sea Level (m AOD)	Inshore Wave Height (m)	Mean Overtopping Rate (l/s/m)
200-year	2140	RCP8.5 / 95%ile	5.00	3.73	0.00
	2140	BECC Upper	7.10	4.45	0.04
	2190	RCP8.5 / 95%ile	5.83	4.23	0.00
1,000-year	2140	RCP8.5 / 95%ile	5.84	3.94	0.00
	2190	RCP8.5 / 95%ile	6.67	4.43	0.00

Return Period	Epoch	Climate Change	Extreme Sea Level (m AOD)	Inshore Wave Height (m)	Mean Overtopping Rate (l/s/m)
10,000-year	2140	RCP8.5 / 95%ile	6.75	4.41	0.00
	2190	RCP8.5 / 95%ile	7.58	4.73	0.45

c) Conclusion

2.4.9 Results of the additional wave overtopping assessment show that the proposed design crest of the Northern Mound defence would be sufficient to limit overtopping (below 1 l/s/m rate) for the reasonably foreseeable scenario up to the basis of design 1 in 10,000-year return period event throughout the development lifetime (2190 epoch).

3 MANAGEMENT OR MITIGATION OF INCREASED FLOOD RISK RESULTING FROM THE MAIN DEVELOPMENT SITE

3.1 Summary of key stakeholders' responses

3.1.1 Further engagement with key stakeholders raised a number of comments with regard to lack of detail around proposed mitigation for the reported impact on flood risk as a result of the scheme.

3.1.2 The Environment Agency's Relevant Representation (full response collated in **APPENDIX A**) states:

> *"The Main Development Site Flood Risk Assessment demonstrates that 4 residential and 6 non-residential properties will be put at an increased risk of flooding as a result of the development, with no compensatory storage or property-level mitigation provided. This increase in flood risk off-site is contrary to paragraph 5.7.16 of National Policy Statement EN-1. This is an unacceptable conclusion to draw, without at least providing assurances that these increases in flood risk can be managed / or mitigated to an appropriate level."*

3.1.3 Further responses from the Environment Agency re-iterated the issue around the proposed mitigation. The key comments are quoted below, and full responses are collated in **APPENDIX B**:

> *"Although the modelling report has identified an increased off-site fluvial flood risk as a result of the proposed development, adequate mitigation has not been proposed."*
>
> *"The breach modelling … appears to increase flood risk to 1 residential property in the 0.1% 2030 epoch event. No assessment of the potential impacts of this on the property itself, or any mitigation for this has been proposed".*

3.1.4 Following submission of the Application, SZC Co. carried out further design works to investigate options for inclusion within the embedded mitigation. This was in response to the flood risk impact and other environmental concerns around the proposed design of the scheme.

3.1.5 It was recognised that further efforts should be taken to reduce the impact of the scheme, where possible. Therefore, following the Application submission, key elements of the scheme design have been updated to address these flood risk and environmental impact concerns.

3.1.6 The design changes proposed relevant to the flood risk assessment include change of the SSSI crossing design, relocation of the water resource storage and using that area to provide wetland habitat creation and flood mitigation instead. These are discussed in further detail in the subsequent **Section 3.2**.

3.1.7 Further assessment has been undertaken to consider these proposed updates to the scheme design and consequently revise the impacts on flood risk to the development itself and any off-site receptors. This is provided in **Section 3.3** and **Section 3.4** discussing fluvial and tidal breach, and coastal inundation flood risk, respectively.

3.1.8 In the original Application the sea defence met the basis of design by addressing coastal overtopping for the 1 in 10,000-year return period scenario, including a reasonably foreseeable allowance for climate change (based on the UKCP18 RCP 8.5 projections), for the operational phase of the development. However, our assessments at that time showed that the raised HCDF of 14.2m AOD (maximum crest height presented in the Application) would need to be established by 2046, a relatively short period of time after the completion of construction at the main development site in 2034. Furthermore, in the period since the Application submission, SZC Co. has, in consultation with internal and external stakeholders, established an initial set of Safety Functional Requirements for the HCDF as part of the ongoing design process. These include a more conservative tolerable overtopping rate (design basis limit) of 2 l/s/m based on guidance provided in the CIRIA 'Rock Manual' (Ref. 1.2) to limit the potential for flooding on the platform by increasing safety margin throughout the operation and decommissioning phases of the project.

3.1.9 Correspondingly, in order to delay future HCDF raising activities, and to take account of the revised design basis limit for the HCDF, a revised initial height of 12.6m AOD (from 10.2m AOD minimum crest height presented in the Application) has been established for both the HCDF and Northern Mound. This gives a total height with landscaping of up to 14.6m AOD. The permanent HCDF design retains the ability to raise the sea defence further to mitigate this risk with the maximum crest height of 16.4m AOD. These design changes have been set out in **Chapter 2** of **Volume 2** of the **ES Addendum** (Doc Ref. 6.14).

3.2 Description of the proposed embedded flood risk mitigation

a) SSSI crossing

3.2.1 The SSSI crossing provides an essential pedestrian and vehicular connection across Sizewell Marshes SSSI, linking the main platform with the temporary construction area and the new access road. Design of the SSSI crossing within the Application was presented as an 8m wide portal culvert with soffit level at 3.5m AOD. It was designed to provide sufficient capacity to convey extreme fluvial flows, however the embankments occupied a significant portion of the existing floodplain. This was perceived by stakeholders as posing not only a flood risk but also raised terrestrial ecology concerns, as concern was expressed that the culvert and embankment option could limit the upstream and downstream migration of numerous species.

3.2.2 In the Relevant Representation (**APPENDIX A**), the Environment Agency stated:

> *"The choice of a culvert is contrary to Environment Agency expectations that watercourses should be crossed by means other than culverts wherever a practical and viable alternative may exist, due to the flood risk implications that culverts present and the overwhelming evidence that they cause harm to the delicate balance of ecosystems that reside within, and along, the watercourse into which the culvert may be placed."*

3.2.3 To address these concerns, SZC Co. proposes to change the design of the SSSI crossing submitted in the Application. The proposed design comprises a 30m wide single span bridge with separate embankments at either end of the SSSI crossing and a soffit raised to a level of 4.35m AOD. This will provide additional flood relief and ecological connectivity, alongside less SSSI land-take (reduction of approximately 450m^2), compared with the current design.

3.2.4 Environmental sheet pile barriers would be installed to separate the existing ground around the Leiston Drain channel and floodplain from the crossing embankments, giving a 23.8m wide clear channel and floodplain in between. A ledge would also be installed to enable passage by otters, and artificial bat roosts would be included either within or on the bridge abutments. A visualisation showing the completed SSSI crossing with the proposed changes in place is shown in **Plate 3.1** with a cross-section illustrated in **Plate 3.2**.

3.2.5 The revised crossing design has been included in the hydraulic modelling studies to assess on-site and off-site impacts on fluvial, coastal inundation and tidal breach flood risk.

Plate 3.1: Visualisation of the updated SSSI crossing design (extract from Figure 2.2.16 of Chapter 2 of Volume 2 of the ES Addendum (Doc Ref. 6.14))

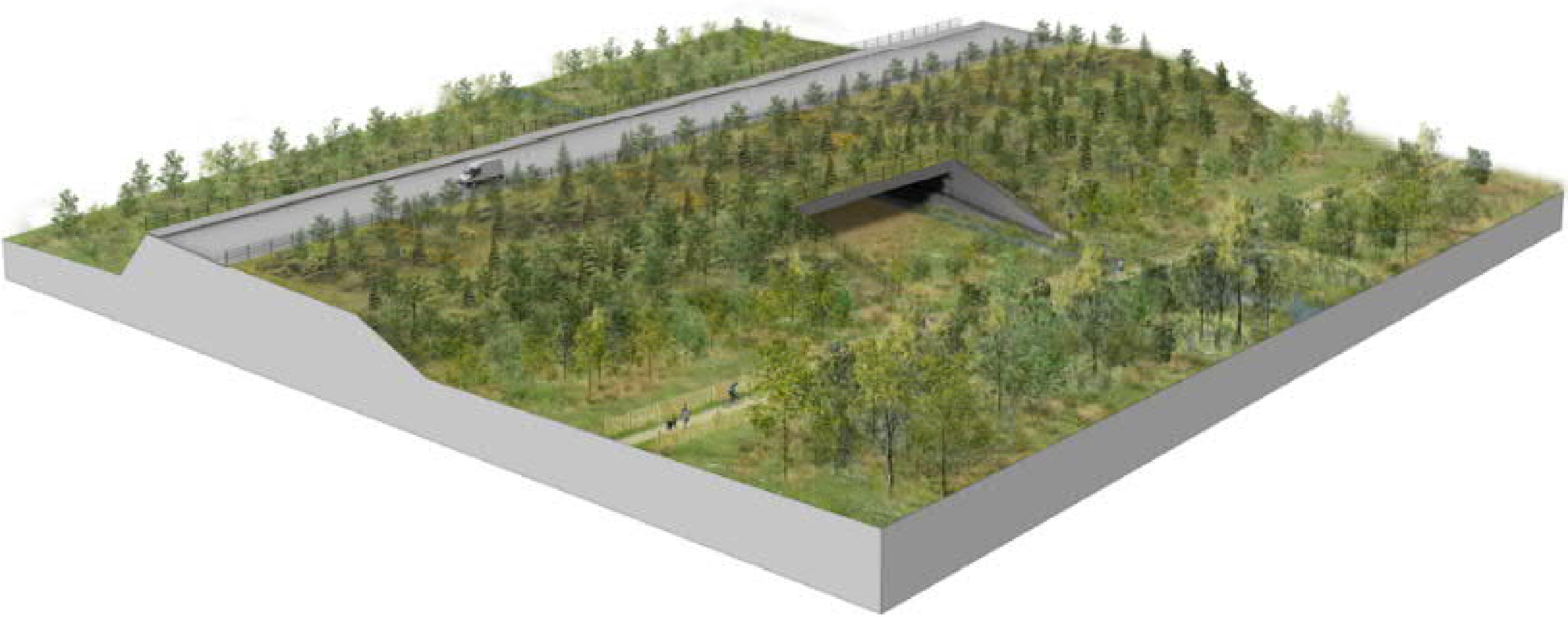
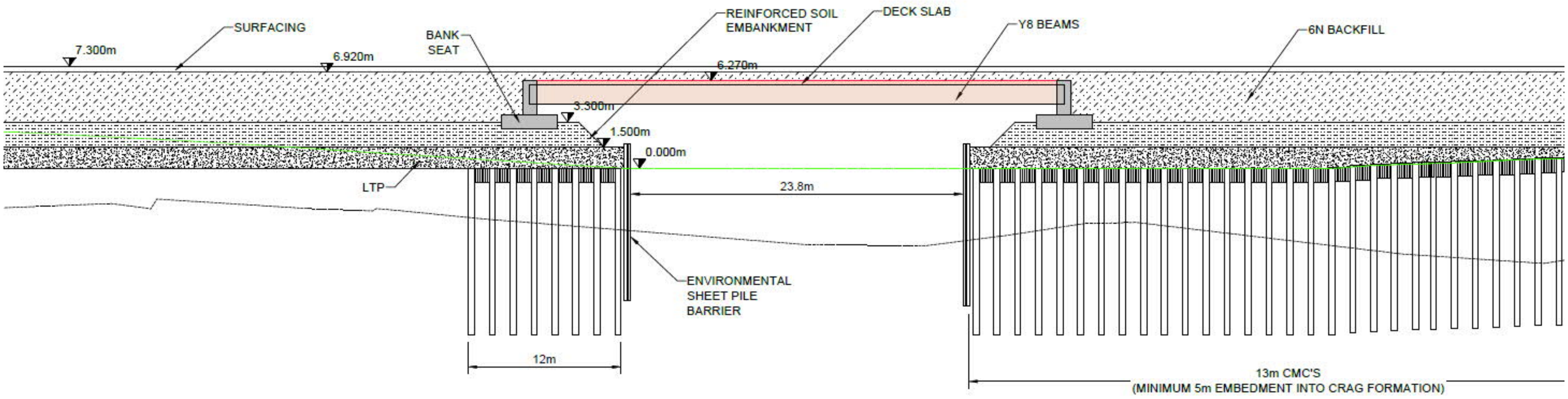


Plate 3.2: Cross-section of the updated SSSI crossing design (extract from EDF Energy drawing no. SZC-EW0102-XX-000-DRW-400009 SSSI Section, rev. 01, 30/11/20)



b) Flood mitigation area

3.2.6 The Application submission included a temporary non-potable water resource storage area that is required for use in the construction activities, including for dust suppression on the stockpiles. This area was proposed to be located on the northern boundary of the temporary construction area that would be partly below and partly above the existing ground levels with raised embankments up to approximately 3m in height. The **MDS Flood Risk Assessment** (Doc Ref. 5.2) [APP-093] concluded that this water resource storage area could introduce residual flood risk to the downstream area.

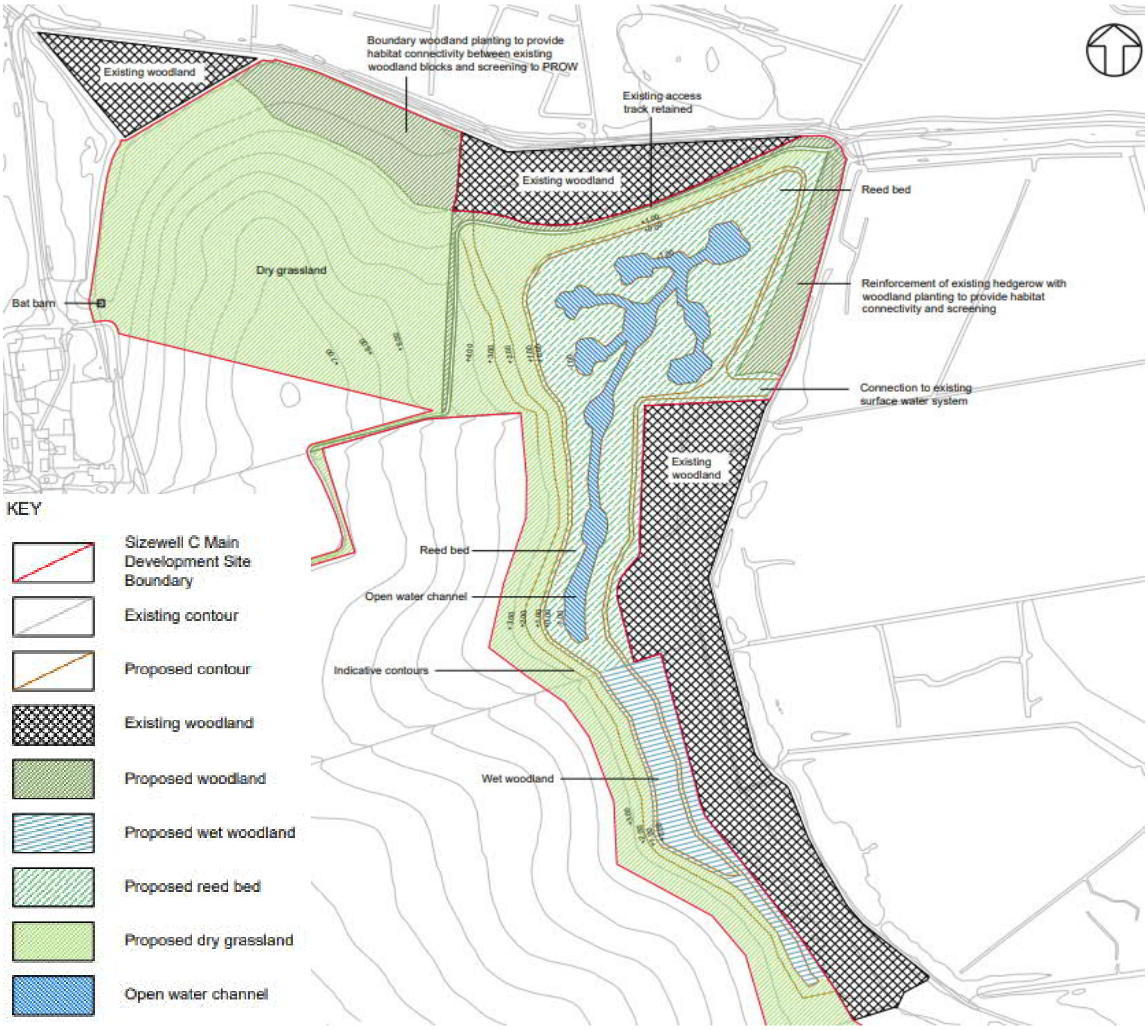
3.2.7 Following the Application submission, SZC Co. has identified that the water resource storage area can now be located elsewhere on the construction site, adjacent to a proposed attenuation pond and adjacent to the proposed borrow pits and stockpiles, outside of the floodplain. Flood risk related to this relocated water resource storage area is discussed in **Section 5c)**.

3.2.8 This proposed change would allow the area and volume associated with the water resource storage area's original location to instead provide permanent wetland habitat and up to approximately 100,000m^3 for flood mitigation (considering available storage up to 3m AOD contour line). The wetland habitats would be open water channels and wet reedbeds to provide high quality foraging habitats for marsh harriers.

3.2.9 The proposed change would introduce embedded flood mitigation for storage loss caused by the development on parts of the main platform area and by the SSSI crossing embankments. This development type is classed as water compatible development and therefore appropriate for location within Flood Zone 3.

3.2.10 The flood mitigation area would be linked to the proposed permanent wetland habitat corridor immediately to the south to create a single integrated wetland feature, as illustrated in **Plate 3.3** below.

Plate 3.3: Proposed habitat and flood mitigation area (extract from Figure 2.2.14 of Chapter 2 of Volume 2 of the ES Addendum (Doc Ref. 6.14))



3.2.11 Together with the updated design of the SSSI crossing, the flood mitigation area has been included in the hydraulic modelling studies as embedded mitigation to assess on-site and off-site impacts on flood risk from fluvial, coastal inundation and tidal breach sources. Details of this are provided in subsequent **sections 3.3** and **3.4**.

3.2.12 For the purposes of the hydraulic modelling, the potential storage within the mitigation area was assumed as being levels above the 0m AOD contour on the assumption that areas below this level would be ‘wet’ at all times to serve as open water channels.

3.3 Additional fluvial flood risk assessment

a) Approach

3.3.1 The embedded mitigation features presented in the previous section were incorporated into the hydraulic model. The schematisation of the model was updated accordingly to include the proposed design of the SSSI bridge crossing and the flood mitigation area. The model was simulated for the 1 in 5-year, 1 in 20-year, 1 in 100-year and 1 in 1,000-year return period events, with climate change allowances of 25%, 35%, 65% for the reasonably foreseeable scenario and 80% for the H++ climate change scenario. The choice of these scenario runs was aimed at assessing flood risk over a broad range of fluvial events.

3.3.2 In line with the assessment in the Application, the results were analysed to assess flood risk to the development itself (focusing on events with 65% climate change allowance) and the impact on flood risk to off-site receptors when compared to the baseline scenario (which focused on events with 35% climate change allowance). A summary of the results of these is presented in the following section.

b) Results

3.3.3 This section discusses the results from the fluvial hydraulic modelling with the embedded mitigation and includes an assessment of on-site and off-site impacts.

i. On-site impacts

3.3.4 Time series of water levels from the with scheme model runs at model nodes downstream of the proposed main platform and the SSSI crossing (1D model node LEIS01_1646d, location shown in **Plate 3.4**), are presented in **Plate 3.5** for the 1 in 100-year return period event with 25%, 35%, 65% and 80% climate change allowance scenarios. These results show that the peak flood levels in the vicinity of the main development site for all considered events are well below the main platform level and the SSSI crossing road level (7.3m AOD) and also below the soffit of the proposed SSSI bridge (4.35m AOD) at the crossing location.

Plate 3.4: Location of model nodes selected for results comparison

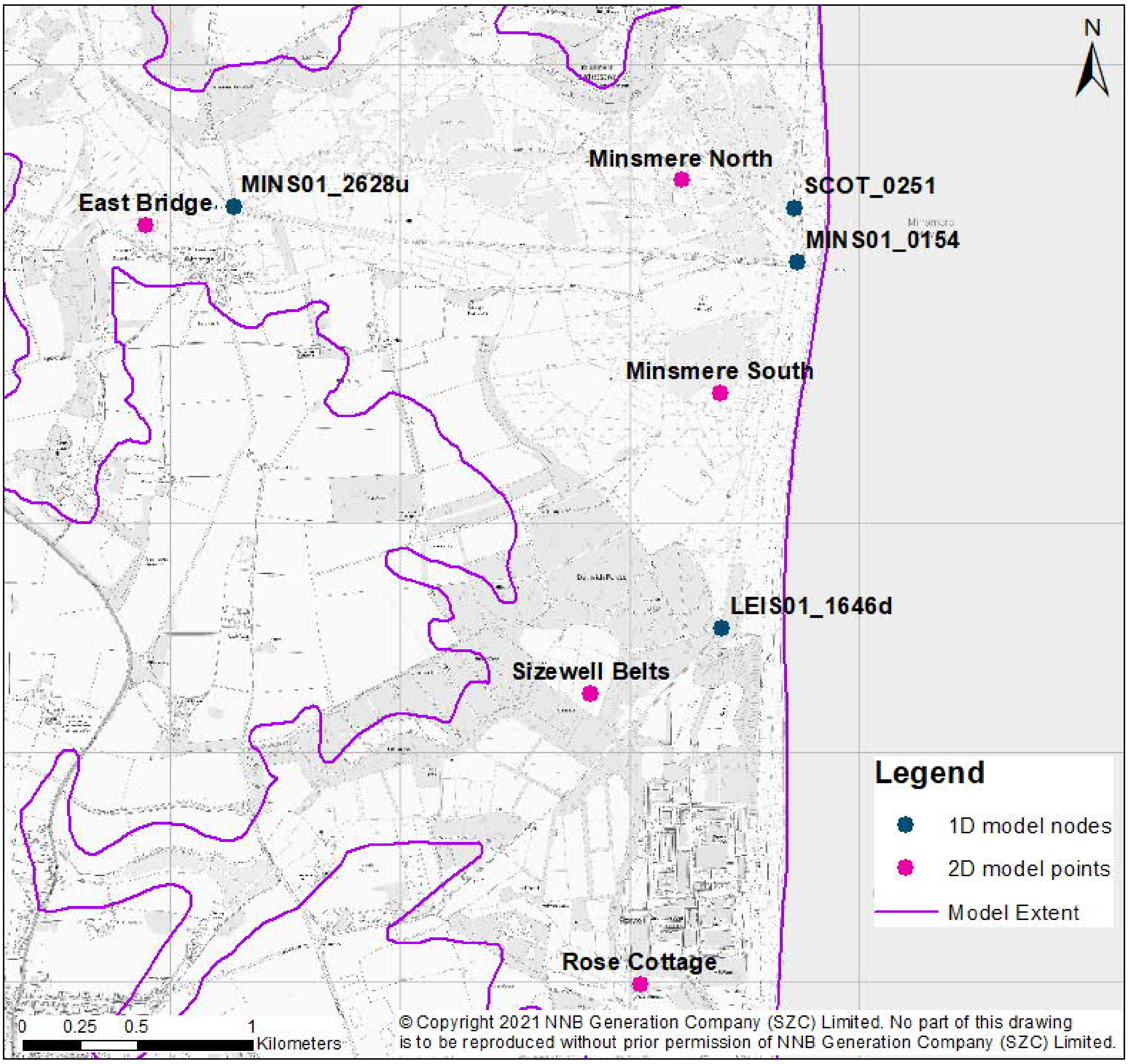
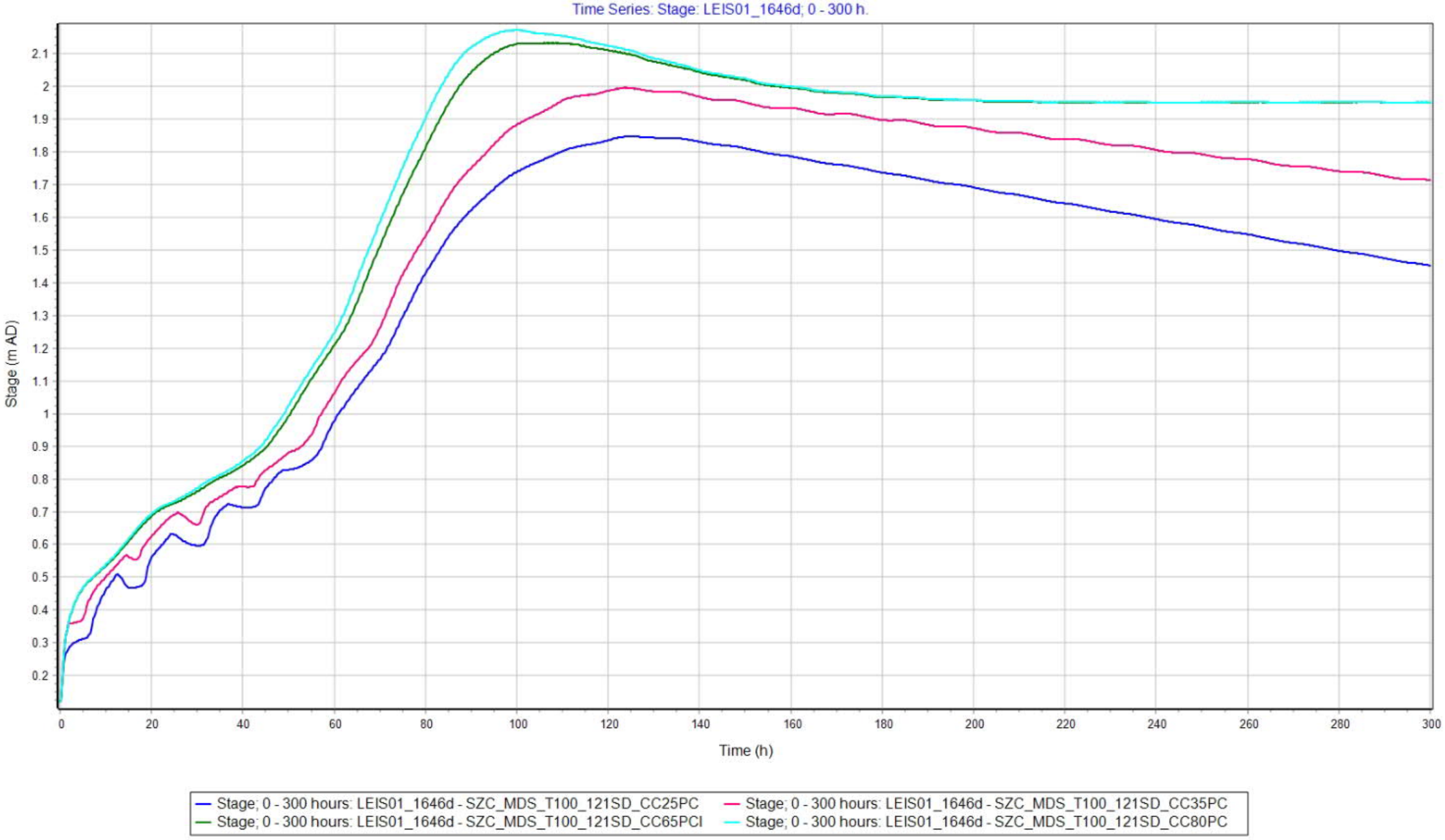


Plate 3.5: Time series of water level at Leiston Drain, downstream of the main platform location (LEIS01_1646d) – 1 in 100-year return period (with 25%, 35% 65% and 80% climate change)



3.3.5 Overall, the maximum flood depth within the floodplain has reduced slightly across the study area with the embedded mitigation design when compared with the results presented in the Application. There is no significant change in flood velocity or hazard rating.

3.3.6 The flood extent within the study area has not changed significantly from that presented in the Application. This is illustrated in **Figure 1** – **Figure 4** attached to this document for the end of the construction phase (i.e. scenarios with 25% climate change allowance) for the study area, main platform area, temporary construction area (TCA) and Land East of the Eastlands Industrial Estate (LEEIE) respectively. Similarly, **Figure 5** – **Figure 8** present the flood extents at the operational and decommissioning phases for the 1 in 100-year event with 35%, 65% and 80% climate change allowance for the main development site areas respectively.

3.3.7 Additional figures illustrating flood depth, hazard and velocity for the 'with scheme' scenario with embedded mitigation design for the 1 in 5-year, 1 in 20-year, 1 in 100-year and 1 in 1,000-year return period events with climate change allowances of 35%, 65% and 80% are provided in **Appendix A** of the **MDS Fluvial Modelling Report Addendum** (**Appendix C**).

ii. Off-site impacts

3.3.8 To assess the impact of the updated design of the scheme on flood risk to off-site receptors, a comparison has been made with the baseline scenario to determine the change in flood extent, depth, velocity and hazard throughout the development lifetime.

3.3.9 **Table 3.1** presents a comparison of modelled maximum water levels between the baseline and with updated scheme design scenarios. The results are presented for all considered return period events and climate change allowances at the 1D model node located downstream of the proposed main platform and the SSSI crossing (location shown in **Plate 3.4**). Since variation in peak flood levels is not significant, these results are representative for the whole Minsmere catchment.

Table 3.1: Difference in maximum flood water level at node LEIS01_1646d downstream of SSSI crossing

Return Period	Climate change allowance	Max Water Level (m AOD)		Difference (m)
		Baseline	With scheme	
5-year	25%	1.33	1.33	0.00
	35%	1.45	1.45	0.00
	65%	1.85	1.85	0.00

Return Period	Climate change allowance	Max Water Level (m AOD)		Difference (m)
		Baseline	With scheme	
	80%	1.91	1.92	0.01
20-year	25%	1.56	1.56	0.00
	35%	1.71	1.71	0.00
	65%	2.01	2.01	0.00
	80%	2.05	2.06	0.01
100-year	25%	1.84	1.85	0.01
	35%	1.99	2.00	0.01
	65%	2.13	2.13	0.00
	80%	2.17	2.17	0.00
1,000-year	25%	2.13	2.13	0.00
	35%	2.19	2.19	0.00
	65%	2.29	2.30	0.01
	80%	2.31	2.32	0.01

3.3.10 **Table 3.1** shows that the maximum increase in peak flood levels as a result of the scheme with the embedded mitigation is up to 0.01m for all considered return period events and climate change scenarios.

3.3.11 Change in peak flood velocity is very localised, mostly within the proposed flood mitigation area (up to 0.15m/s) and a small area along the Leiston drain, up to +/-0.01m/s. The overall difference in flood velocity is not considered to be significant.

3.3.12 Similarly, change in flood hazard rating is limited to the proposed flood mitigation area and a few small areas within the Minsmere Levels, where the hazard rating increased due to a small increase in flood depth. However, there are no properties located within the areas of increased flood hazard.

3.3.13 An additional set of figures illustrating the difference in flood depth, velocity and hazard between the 'with scheme' and baseline scenarios for other return period events, namely 1 in 5-year, 1 in 20-year, 1 in 100-year and 1 in 1,000-year with climate change allowances of 35%, 65% and 80%, are provided in **Appendix B** of the **MDS Fluvial Modelling Report Addendum** (**Appendix C**).

iii. Risk to properties

3.3.14 Assessment of residential and non-residential properties at risk of flooding in the **MDS Flood Risk Assessment** (Doc Ref. 5.2) [APP-093] was undertaken on 'raw' National Receptors Dataset (NRD), meaning that no validation of the NRD points within flood extents was included (to check if their location appropriately represents a valid property). Also, no threshold level for residential properties (to account for raised step into the property) was applied. This was considered as a conservative approach.

3.3.15 Following submission of the Application, further checks were carried out to determine the validity of the affected properties and the 0.1m threshold was applied when assessing flood depth of residential properties. No threshold was applied for the non-residential properties as often they require vehicular access and therefore have no raised entry or doorstep at the entrance.

3.3.16 The use of a threshold value of 0.1m or 0.15m for residential properties is considered appropriate and consistent with common industry practice. For the purpose of the assessment of impacts of the updated scheme design with embedded mitigation, the lower 0.1m threshold has been applied to be conservative. Note that the use of a threshold has no impact in respect of relative change in flood depths (i.e. the threshold applied has been adopted for both baseline and with scheme scenarios).

3.3.17 To confirm the appropriateness of the threshold, visual checks were carried out for the affected residential properties where sufficient imagery (Google Maps street view) was available. The exercise showed that the residential properties in the area have an average door step at the entrance that is raised up by approximately 0.15m.

3.3.18 Following further detailed assessment of NRD data points it was found also that one residential property in Eastbridge (NRD ID 11845919, post code: IP16 4SG) was initially counted as flooded, however the NRD point is located in the middle of a road and could not represent a real property. All other properties in the area are counted.

3.3.19 Similarly, when investigating risk to non-residential properties, it was found that a total of 10 non-residential properties (considering fluvial, coastal inundation and tidal breach flood risk) could be discounted as not representing valid properties since they do not appear as real residential or commercial property on any mapping (OS Map or Google Map). The NRD IDs of these non-residential properties removed from the assessment are: 11947004, 11947019, 11947055, 11947157, 28354356, 28733820, 28733815, 1491781, 752183 and 664315. Based on the above findings these properties were therefore removed from the assessment.

3.3.20 In the **MDS Flood Risk Assessment** (Doc Ref. 5.2) [APP-093], it was concluded that, as a result of the proposed scheme, 5 residential properties would experience an increase in flood depth during the 1 in 100-year with 35% climate change scenario up to 0.01m and the hazard rating would increase for one of these properties. Also, 4 non-residential properties would experience an increase in flood depth up to 0.01m and 5 additional properties would be affected.

3.3.21 Results from the hydraulic modelling with the embedded mitigation design show that a total of 5 residential and 2 non-residential are at risk of fluvial flooding for the 1 in 100-year event with 35% climate change allowance. In accordance with national policy, no additional residential or non-residential properties would be at risk of fluvial flooding as a result of the proposed development, i.e. all properties affected are flooded in both baseline and with scheme scenarios and is therefore considered acceptable in flood risk terms.

3.3.22 Out of the properties at risk, only 1 residential and 1 non-residential property experience an increase in peak flood depth as a result of the updated scheme design with embedded mitigation. This is by 0.01m in the 1 in 100-year return period event with 35% climate change allowance (with overall flood depth of approximately 0.5m). None of the properties experience a change in flood velocity or flood hazard rating in this scenario and this is therefore considered acceptable in flood risk terms.

3.3.23 Across all assessed scenarios, a maximum of 6 residential and 6 non-residential properties experience an increase in flood depth up to 0.01m (for up to 1,000-year event with 80% climate change allowance) with insignificant increase in flood velocity (up to 0.01m/s for two properties) and no change in hazard rating for any of the affected properties. These are located mostly within the Eastbridge area with a couple of properties in Sizewell village, as illustrated in **Plate 5.11** in **Appendix C**.

3.3.24 A summary table with comparison of flood depth, velocity and hazard rating for all properties at flood risk for the assessed return period event and climate change allowances is provided in **Appendix B** of the **MDS Fluvial Modelling Report Addendum** (**Appendix C**).

c) Conclusions

3.3.25 Revised hydraulic modelling for fluvial flood risk with embedded mitigation shows that the main platform and the SSSI crossing areas are not at risk of flooding from any of the considered extreme fluvial events. Overall, flood risk has not changed for any of the main development site areas. Therefore, the conclusions drawn within the Application are still valid.

3.3.26 Based on the modelling results it can be concluded that the proposed development with the updated design of the SSSI crossing and added flood mitigation area does not have a significant impact on flood risk to off-site receptors. The maximum increase in flood levels as a result of the scheme is up to 0.01m and there is no significant change in flood velocity or hazard rating when compared to the baseline scenario.

3.3.27 The impact on properties has reduced when compared to results presented in the Application. There are no additional properties flooded as a result of the scheme. Overall, there is a limited number of residential and non-residential properties at fluvial flood risk (total of 16) with only 6 affected by maximum increase in flood depth of 0.01m as a result of the scheme and no change in flood velocity or hazard rating when compared to baseline. Therefore, it is concluded that the embedded mitigation design has reduced the overall impact of the development on fluvial flood risk elsewhere.

3.4 Additional coastal inundation and tidal risk assessment

a) Approach

3.4.1 The embedded mitigation features presented in detail in **Section 3.2** were incorporated into the coastal inundation and tidal breach models. The schematisation of the model was updated accordingly to include the proposed design of the SSSI crossing and the flood mitigation area.

3.4.2 The model was simulated for the two relevant return period events, i.e. 1 in 200-year and 1 in 1,000-year events, with climate change allowances for the 2030, 2090 and 2190 epochs to assess a range of flood risk scenarios over the development lifetime. Details of model schematisation are provided in the **MDS Tidal Breach and Coastal Inundation Modelling Report Addendum** (**Appendix D**) and the results are presented below.

b) Results

3.4.3 This section discusses results from the coastal inundation and tidal breach hydraulic modelling with the embedded mitigation and assessment of on-site and off-site impacts.

i. On-site risk

3.4.4 Results with the embedded mitigation show no significant change in flood extent when compared to that presented in the Application. This is illustrated in **Figure 9** – **Figure 12** for the 1 in 200-year and 1,000-year coastal events at the end of construction phase (i.e. 2030 epoch) for the study area, main platform area, TCA and LEEIE respectively.

3.4.5 This is also the case throughout the operational phase until the end of the development lifetime, as illustrated in **Figure 13** – **Figure 28** for the coastal inundation and tidal breach 1 in 200-year and 1,000-year coastal events at the 2090 and 2190 epochs for the study area, main platform area, TCA and LEEIE respectively.

3.4.6 Similarly, there is no significant change in flood depth, velocity or hazard rating in the vicinity of the development when compared with the results presented in the Application.

ii. Off-site impacts

3.4.7 To assess the impact of the updated design of the scheme with the embedded mitigation on flood risk to off-site receptors, a comparison has been made with the baseline scenario to determine the change in flood depth, velocity and hazard rating throughout the development lifetime.

3.4.8 **Table 3.2** and **Table 3.3** summarise the difference in flood depths between the baseline and scheme model with embedded mitigation for selected locations across the catchment (locations shown in **Plate 3.4**) for the coastal inundation and tidal breach models, respectively.

3.4.9 Both tables show that the greatest increase in flood depth relates to the lower epochs within the downstream part of the Minsmere Levels area. However, there are no properties located within that area. Any potential impact on environmental receptors would not be significant, since there is no significant change in flood extent or duration of flooding, also the area comprises wetland habitats that rely on seasonal flooding (as illustrated in **Figure 9** – **Figure 28**).

Table 3.2: Difference in peak flood depth between the scheme with embedded mitigation and baseline scenarios – coastal inundation

Key location	Return period					
	2030 epoch		2090 epoch		2190 epoch	
	200-year	1,000-year	200-year	1,000-year	200-year	1,000-year
Eastbridge	0.00	+0.03	+0.02	+0.02	-0.01	0.00
Minsmere North	0.00	+0.02	+0.02	+0.02	-0.01	0.00
Minsmere South	+0.03	+0.14	+0.02	+0.02	-0.01	0.00
Sizewell Belts	-0.02	-0.07	0.00	+0.02	-0.24	0.00
Rose Cottage	0.00	-0.07	0.00	+0.02	-0.24	0.00

Table 3.3: Difference in peak flood depth between the scheme with embedded mitigation and baseline scenarios – tidal breach

Key location	Return period					
	2030 epoch		2090 epoch		2190 epoch	
	200-year	1,000-year	200-year	1,000-year	200-year	1,000-year
Eastbridge	+0.03	+0.05	+0.05	+0.02	-0.01	0.00
Minsmere North	+0.04	+0.06	+0.05	+0.02	-0.01	0.00
Minsmere South	+0.15	+0.13	+0.05	+0.02	-0.01	0.00
Sizewell Belts	-0.36	-0.33	-0.27	-0.15	-0.36	-0.04
Rose Cottage	-0.36	-0.33	-0.27	-0.15	-0.37	-0.04

3.4.10 Figures illustrating change in flood depth, velocity and hazard from both, coastal inundation and tidal breach models are provided in **Appendix C** of the **MDS Tidal Breach and Coastal Inundation Modelling Report Addendum** (**Appendix D**).

3.4.11 With regard to properties, the overall results show that no additional residential or non-residential properties are flooded as a result of the development in all the assessed coastal inundation and tidal breach events and epochs. For assessment of flood depth for residential properties, a 0.1m threshold was applied in line with the approach for fluvial flood risk assessment discussed in **Section 3.3b)iii**.

3.4.12 While the raw results of the breach modelling show one new residential property flooded for each of the 1 in 200-year event at 2090 epoch and one non-residential property at the 1 in 1,000-year event at 2030 epoch, further investigation of the results shows that the footprint of these properties is flooded over the relevant thresholds in the baseline scenarios and the assessment of the NRD points is skewed by the location of the point within the property outline. This is discussed further in detail in the **MDS Tidal Breach and Coastal Inundation Modelling Report Addendum** (**Appendix D**).

3.4.13 Although no new properties are flooded, some residential and non-residential properties experience an increase in flood depth. This is presented in **Table 3.4**, which shows the number of properties experiencing an increase in flood depth, with the maximum increase in metres added in brackets.

Table 3.4: Number of properties affected by increase in peak flood depth (m)

Scenario	Property type	Return period					
		2030 epoch		2090 epoch		2190 epoch	
		200-year	1,000-year	200-year	1,000-year	200-year	1,000-year
Coastal Inundation	Residential	0	0	1 (0.02)	12 (0.02)	0	18 (0.01)
	Non-residential	0	0	2 (0.02)	10 (0.02)	0	8 (0.01)
Tidal Breach	Residential	0	0	10 (0.05)	17 (0.02)	0	8 (0.01)
	Non-residential	0	1 (0.08)	10 (0.06)	16 (0.02)	0	5 (0.01)

3.4.14 **Table 3.4** shows that, for both the coastal inundation and tidal breach scenarios, most properties experiencing the greatest increase in flood depth are affected in the 2090 epoch (except one non-residential property with slightly higher increase in the 1 in 1,000-year event at 2030 epoch in the tidal breach scenario). However, the relative change in flood depth should be considered with overall total flood depth, which is mostly 0.5m for the 1 in 200-year event and over 1m depth for the 1 in 1,000-year event at 2090 epoch.

3.4.15 There is no significant change in peak flood velocity for any of the affected properties (maximum increase up to 0.5m/s) or flood hazard rating. Tables showing differences in flood depth, velocity and hazard for each affected property are included in **Appendix C** of the **MDS Tidal Breach and Coastal Inundation Modelling Report Addendum** (**Appendix D**).

c) Conclusions

3.4.16 The **MDS Flood Risk Assessment** (Doc Ref. 5.2) [APP-093] concluded that, the main platform and the SSSI crossing with levels at 7.3m AOD are not at risk of flooding under the reasonably foreseeable scenario up to 2190, with extreme still water levels at 5.70m AOD and 6.02m AOD for the 1 in 200-year and 1 in 1,000-year events respectively. Since the results with the embedded mitigation don't show significant change in flood levels throughout the development lifetime in the vicinity of the development areas, the conclusions drawn in the Application still remain valid.

3.4.17 Based on the modelling results it can be concluded that the proposed development with the updated design of the SSSI crossing and added flood mitigation area has an impact on flood risk to off-site receptors; however, the relative change is not considered significant and would not adversely impact either properties or environmental receptors.

3.4.18 There are no additional properties flooded as a result of the proposed development. There are a limited number of residential and non-residential properties affected with an increase in flood depth as a result of the scheme up to 0.06m (with overall flood depth around 0.5m for the 200-year event at 2090 epoch) and no significant change in flood velocity or hazard rating when compared to baseline. These properties are mostly located within Eastbridge and Leiston, with further details provided in **Appendix D**.

3.4.19 Therefore, it is concluded that the overall impact of the development on coastal inundation and tidal breach flood risk with the embedded mitigation design is not significant.

4 MEASURES TO ENSURE SAFETY OF THE MAIN DEVELOPMENT SITE AND ITS USERS DURING THE CONSTRUCTION AND OPERATIONAL PHASES

4.1 Summary of Environment Agency's responses

4.1.1 In the Relevant Representation and further responses to the Application, the Environment Agency raised comments with regard to the safety of the development site and its users during the construction phase and throughout the development lifetime (presented in **APPENDIX A** and collated in **APPENDIX B**). Comments with regard to the construction phase state:

> *"The temporary SSSI crossing during construction will be at risk of fluvial flooding and also coastal flooding in the 0.1% event as the existing defences are inundated, and also during a breach flood event."*
>
> *"A short-term bridge will be required over the Leiston Drain to provide access between the temporary construction area and the main platform. Information regarding the design and levels of the temporary crossing have not been provided."*
>
> *"There is a lack of clarity over the proposed sequencing of the early construction phases, which has implications for assessing the flood risks posed from overtopping of the defences during the construction phases."*

4.1.2 With regard to the safety of the site and its users during the operational phase and throughout the development lifetime, the Environment Agency (comments collated in **APPENDIX B**) states:

"The FRA has determined the anticipated coastal overtopping rates, but has not interpreted what this may mean for the safety of people. Table 7.4 of the FRA presents the overtopping rates that may be experienced at the crest of the new Hard Coastal Defence. However, there is limited interpretation of what these rates will mean for the safety of the site or how this will be managed on site."

"Report states that the tolerable overtopping rates for the SSSI crossing are 5l/s/m but it does not state what the tolerable rate for the platform is."

4.1.3 Further assessment has been undertaken to address the above comments and is provided in this section.

4.2 Description of proposed temporary and permanent structure

i. Temporary SSSI crossing

4.2.1 The temporary SSSI crossing would be installed to provide an early route between the temporary construction area and the main construction area and to facilitate construction of the permanent bridge.

4.2.2 The temporary crossing is likely to comprise two off-the-shelf bridges (e.g. 'bailey bridges' or equivalent), on a temporary foundation to the south and to the north the foundation will be shared with the proposed permanent foundation. The bailey bridges will be installed on the eastern side of the site to allow access between the temporary construction area and the main construction area at the main platform.

4.2.3 As such, the soffit of the temporary structure would be at a minimum of 2.1m AOD, which is above both the 1 in 100-year fluvial and 1 in 200-year coastal flood levels of approximately 1.8m AOD. The deck would be set at approximately 3.5m AOD. The footprint of the temporary crossing will be no bigger than the proposed permanent crossing.

4.2.4 At the end of the construction phase, the construction haul road would be removed and planted with trees. The remaining access road would be positioned to the western edge of the embankment, away from the coastal edge.

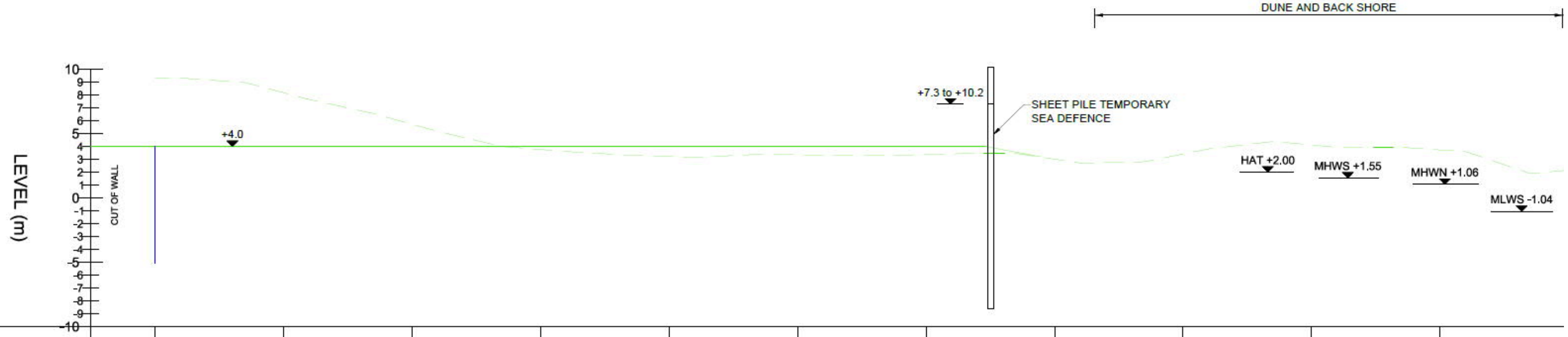
ii. Temporary coastal defence

4.2.5 Details of the construction phase sequencing within the Application were limited, as the design was ongoing. In the **MDS Flood Risk Assessment** (Doc Ref. 5.2) [APP-093] the assessment of risk from wave overtopping was assessed on the basis that the existing sea defence would be removed to carry out ground improvement works prior to constructing the HCDF. The **MDS Flood Risk Assessment** concluded that the construction area would be at risk of flooding from the 1 in 200-year event and therefore would pose risk to safety to people working at the site.

4.2.6 Following the Application submission, further design and construction sequencing works have been undertaken giving more detailed information. A change in design is proposed, where a temporary sheet pile wall around the construction area would be installed, extending from the Sizewell B defence to another temporary sheet pile wall at the SSSI crossing construction area. The sheet pile wall would have a crest set at a minimum level of 7.3m AOD, as illustrated in **Plate 4.1** improving management of flood risk during early construction phase when compared with the approach presented in the Application.

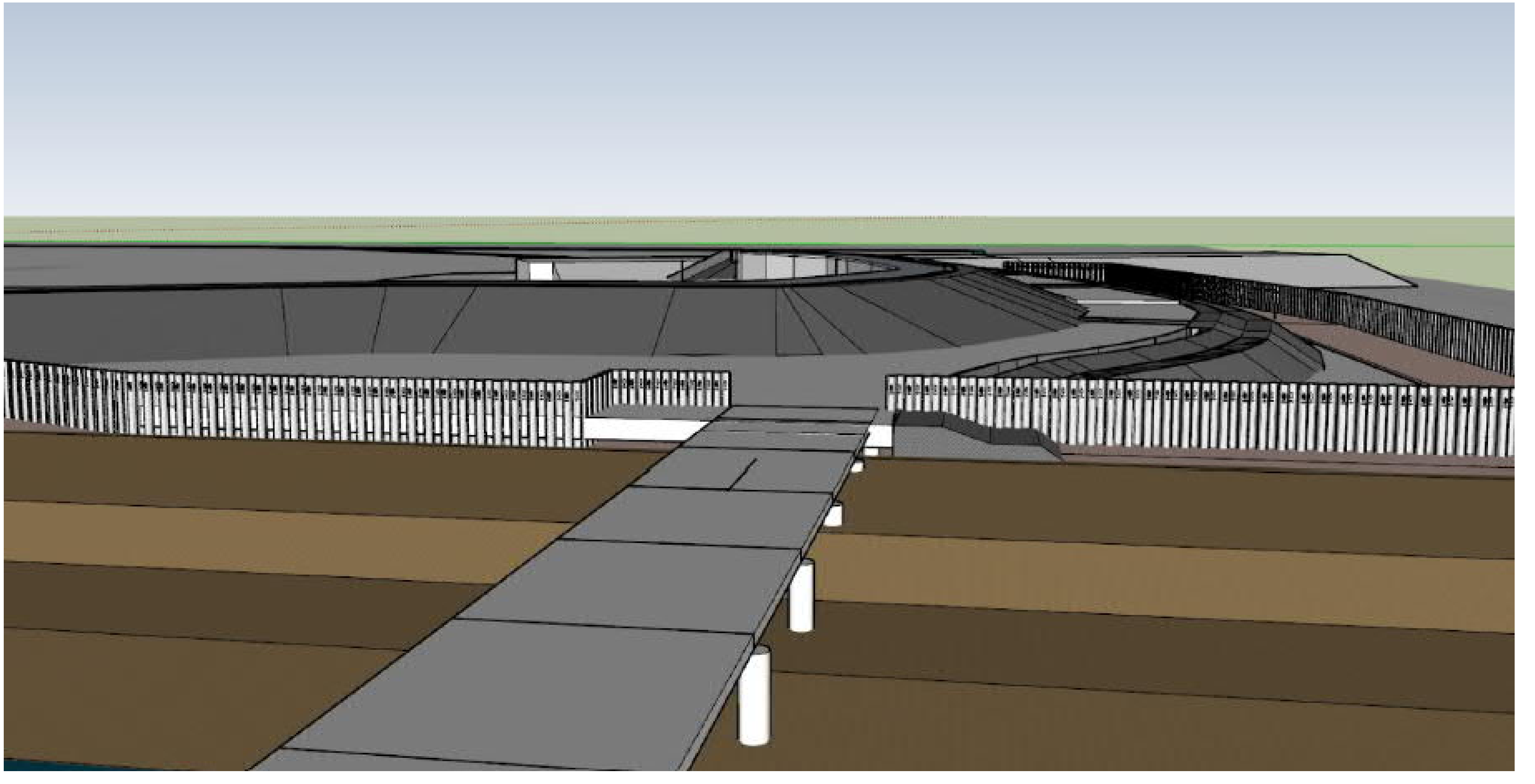
4.2.7 The temporary defence would be installed prior to the removal of any existing defences and would remain in place until the core of the permanent defence would be completed, as illustrated in **Plate 4.2**. The temporary defence would be breached to allow access to the permanent Beach Landing Facility (BLF); however, this would only happen after the reinforced core of the permanent defence has been constructed up to a minimum level of 9.1m AOD.

Plate 4.1: Enabling works sea defence profile (extract from EDF Energy drawing no. SZC-EW0601-XX-000-DRW-400025 rev. 01, 27/11/20)



CHAINAGE (m)	00.000	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000	100.000
EXISTING LEVELS (m)	9.286	8.183	5.731	3.769	3.226	3.355	3.383	3.010	3.415	4.115	3.731

Plate 4.2: Alignment of the temporary sheet pile wall and breach for BLF access road



iii. Temporary outfall

4.2.8 To manage surface water flood risk during the construction phase of the main platform, measures set out in the **Outline Drainage Strategy** (Doc Ref. 6.3) [APP-181] in the Application comprise a Combined Drainage Outfall (CDO) to discharge treated surface water run-off from the site and use of Water Management Zones (WMZ) 1 and 2 while the CDO is being constructed. Residual risk was identified in the **MDS Flood Risk Assessment** (Doc Ref. 5.2) [APP-093], where at times of high surface water inundation, there may be a necessity to include additional attenuation storage within the main construction area as temporary measures.

4.2.9 To mitigate the residual risk, a temporary outfall is proposed, so that surface water from the main platform area would be temporarily pumped over the temporary sea defences and into a chamber before discharging through a gravity pipe towards the shoreline. The temporary outfall would be in operation prior to the commissioning of the permanent outfall (CDO) for approximately a 2-year period. Once the CDO is constructed the temporary outfall would be removed. Further details on the temporary outfall are provided in **Chapter 2** of **Volume 2** of the **ES Addendum** (Doc Ref. 6.14).

4.2.10 The temporary outfall would be designed to be pumped at a maximum permitted rate of 200 litres per second. It is assumed that the temporary outfall would typically only be used when surface water is captured in the construction site which cannot be discharged through infiltration or to the surrounding watercourses (e.g. due to flooding or storm events), therefore mitigating residual risk and ensuring that surface water run-off is managed appropriately during the early construction years to help protect both the site and Sizewell Marshes SSSI.

4.2.11 The proposed change would mean that the surface water from the main platform area would be pumped to the coastal environment during the early phases of construction. This would therefore prevent the localised effects on groundwater and surface water that were predicted in the Application as a result of moving this water to the detention basins in the WMZs. The temporary outfall will allow continued drainage from the platform and divert discharge away from the Sizewell Marshes SSSI and pump surface water to the marine environment therefore mitigating potential flood risk and environmental impacts.

4.2.12 The new temporary outfall will allow more efficient drainage prior to construction of the CDO when compared with the approach set out in the Application. As such it is concluded that it would provide improved mitigation of the surface water flood risk within the main platform construction area during the early construction phase and therefore no additional assessment was carried out.

iv. Permanent HCDF

4.2.13 In the original Application the sea defence met the basis of design by addressing coastal overtopping for the 1 in 10,000-year return period scenario, including a reasonably foreseeable allowance for climate change (based on the UKCP18 RCP 8.5 projections), for the operational phase of the development. However, our assessments at that time showed that the raised HCDF of 14.2m AOD (maximum crest height presented in the Application) would need to be established by 2046, a relatively short period of time after the completion of construction at the main development site in 2034. Furthermore, in the period since the Application submission, SZC Co. has, in consultation with internal and external stakeholders, established an initial set of Safety Functional Requirements for the HCDF as part of the ongoing design process. These include a more conservative tolerable overtopping rate (design basis limit) of 2 l/s/m based on guidance provided in the CIRIA 'Rock Manual' (Ref. 1.2) to limit the potential for flooding on the platform by increasing safety margin throughout the operation and decommissioning phases of the project. The EurOtop manual on wave overtopping (Table 3.1 in Ref. 1.1.3) suggests limit for wave overtopping for structural design of rubble mound breakwaters, seawalls, dykes and dams with reinforced rear side is quoted as 5-10 l/s/m. Therefore, the adopted overtopping limit for the design basis is considered to be conservative.

4.2.14 Correspondingly, in order to delay future HCDF raising activities, and to take account of the revised design basis limit for the HCDF, a revised initial height of 12.6m AOD (from 10.2m AOD minimum crest height presented in the Application) has been established for both the HCDF and Northern Mound. This gives a total height with landscaping of up to 14.6m AOD. The permanent HCDF design retains the ability to raise the sea defence further to mitigate this risk with the maximum crest height of 16.4m AOD and total height of up to 18m AOD with landscaping. The permanent defence is illustrated in **Plate 4.3** and adaptive defence crest at 16.4m AOD in **Plate 4.4**. These design changes have been set out in **Chapter 2** of **Volume 2** of the **ES Addendum** (Doc Ref. 6.14).

4.2.15 As illustrated in **Plate 4.3**, the current design also includes a Soft Coastal Defence Feature (SCDF) with crest level raised to 6.4m AOD compared with 5.2m AOD presented in the Application, that would comprise shingle won from the excavation of the footings for the HCDF, providing that suitable size and quality of the source material is available.

4.2.16 The SCDF is a sedimentary, sacrificial embedded mitigation feature that is designed to erode and release sediment to the beach face during severe storms and high water levels, thereby slowing overall erosion rates locally, as well as supplementing the flood risk protection from the HCDF. For that reason, the SCDF would be maintained throughout the design life of the

HCDF, up to 2140. Monitoring and mitigation would be employed in line with the CMMP (refer to **Volume 3, Appendix 2.15.A** of the **ES Addendum**).

Plate 4.3: Proposed Permanent HCDF cross-sectional profile (extract from EDF Energy drawing no. SZC-EW0601-XX-000-DRW-400025 rev. 01, 27/11/20)

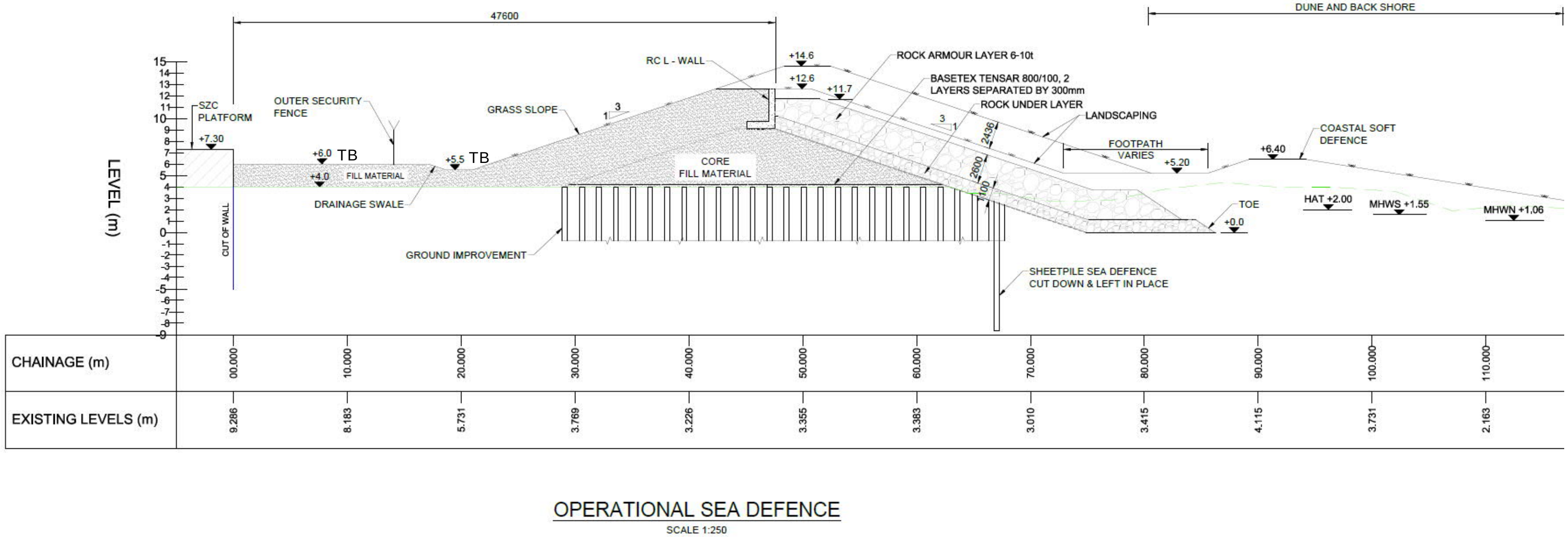
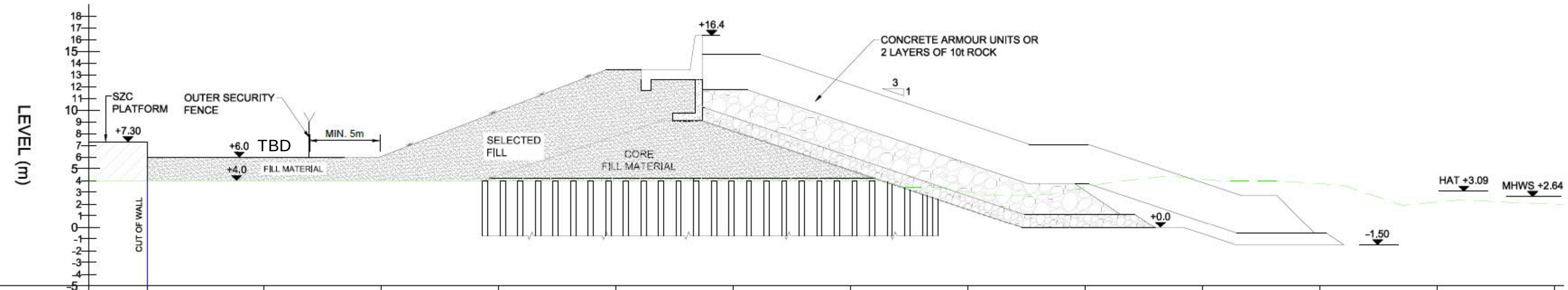


Plate 4.4: Proposed Adaptive Sea Defence (HCDF) cross-sectional profile (extract from EDF Energy drawing no. SZC-EW0601-XX-000-DRW-400025 rev. 01, 27/11/20)



CHAINAGE (m)	00.000	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000	100.000	110.000	120.000
EXISTING LEVELS (m)	9.286	8.183	5.731	3.769	3.226	3.355	3.383	3.010	3.415	4.115	3.731	2.163	1.994

ADAPTIVE SEA DEFENCE

SCALE 1:250

4.2.17 Beyond 2140 epoch, the adaptive defence would be constructed (shown in **Plate 4.4**), as required, to comply with the Nuclear Site Licence, depending on the trajectory of current climate change projections and decommissioning activities.

4.3 Additional assessment

a) Approach

4.3.1 Since the temporary SSSI crossing structure has a soffit level above extreme flood levels and it will be contained within the footprint of the completed permanent crossing, no further modelling was required to inform assessment of flood risk during construction phase. As such, the results presented in the Application were used.

4.3.2 The addition of the temporary coastal defence (sheet pile wall) significantly reduces the risk of overtopping to the whole of the construction area throughout the entire construction phase. To support that conclusion, further overtopping assessment was carried out for the 1 in 200-year and 1 in 1,000-year return period events at 2030 epoch as the permanent defence would be completed by that time. The enabling works defence profile with crest of 7.3m AOD was adopted for the overtopping calculations. Input conditions (extreme sea level, wave height etc.) were adopted in line with the assessment for the Application for the corresponding scenarios.

4.3.3 Overtopping calculations for the updated permanent defence design were carried out for the 1 in 200-year, 1,000-year and 10,000-year return period events with reasonably foreseeable climate change allowances as set out within the Environment Agency and ONR joint advice note (Ref. 1.4).

4.3.4 In addition, two scenarios for the credible maximum climate change allowance were also tested, i.e. 1 in 200-year return period at 2140 epoch (BECC Upper) and the H++ scenario for 1 in 10,000-year event at 2090 epoch. The credible maximum scenarios are assessed as a part of sensitivity testing for the beyond basis of design events, to understand flood risk for future credible predictions that might arise during the life of the station and the interim spent fuel stores, in line with the Safety Assessment Principles (SAPs) set out by the ONR (Ref. 1.5).

4.3.5 Where significant overtopping was determined for the above credible maximum scenarios beyond the end of the operational phase (post 2090), inundation modelling was undertaken to determine flood depth, velocity and hazard on the main platform and further inform the flood risk assessment. For this purpose, the 2D model developed for the coastal inundation and tidal breach studies was used. Details on the model schematisation and parameters can be found in **Appendix 4** of the **MDS Flood Risk Assessment** (Doc Ref. 5.2) [APP-099] and **Appendix D** of this document.

4.3.6 The model was updated to include a detailed representation of the proposed layout of the buildings on the main platform (as within the Application) and the updated sea defence (HCDF) with proposed defence crest raised to 12.6m AOD. The main platform was set at flat level of 7.3m AOD tying directly into the sea defence, without any further mitigation measures that might be developed as part of the Safety Case works.

4.3.7 Buildings on the main platform were represented by raising the ground levels within the footprint of the buildings by 0.2m (following common modelling practice). This threshold was assigned based on design parameters, which state that the threshold level for all buildings on the main platform will be set, as a minimum, 0.2m above the platform level. The sea defence around the Northern Mound was adopted with the crest at 14.2m AOD as per the design set out within the Application. Further details on the inundation model schematisation and input conditions are provided in **Appendix E.**

4.3.8 The level of the platform (7.3m AOD) was designed such that it was located above the extreme still water levels up to the 1,000-year event 2190 epoch (end of life) under the reasonably foreseeable climate change scenario. Therefore, it is considered that there is no risk of inundation to the platform from these events.

4.3.9 As discussed in **Section 2.4**, for scenarios with extreme still water levels that are above the platform height (7.3m AOD) the primary mechanism for flooding was identified as water ingress onto the platform from the land side due to significant inundation of the existing sand dunes/shingle defences to the north and south of the site. The inundation (horizontal projection of the extreme still water levels) was used to determine the flood depth on the main platform and the SSSI crossing serving as the main access route. The events that could result in inundation of the platform are the beyond basis of design scenario, i.e. the 10,000-year event beyond 2140 with the reasonably foreseeable climate change and the credible maximum climate change scenarios. These analyses would be used to inform the subsequent Safety Case assessment that would support the Nuclear Site Licence.

b) Results

4.3.10 Results from the overtopping assessment for the construction phase (2030 epoch for reasonably foreseeable scenario) with the temporary coastal defence (sheet pile wall) with crest at 7.3m AOD show no overtopping for the 1 in 200-year and very limited overtopping (less than 0.5 l/s/m) for the 1,000-year event scenario.

4.3.11 Results from the assessment of the updated design of the permanent sea defence are presented in **Table 4.1** showing the predicted overtopping rates for HDCF crest at 12.6m AOD. The results presented in the table correspond to overtopping rates during the peak of the surge event (extreme still water levels). It should be noted that such high water levels would last approximately 3 hours during the peak surge event only and therefore the risk would be limited to a relatively short period of time.

4.3.12 The beyond basis of design events (2190 epoch and credible maximum climate change scenarios) will inform the severe accident and 'cliff-edge' effects analysis that would form part of the Safety Case assessment, in line with the requirements set out by ONR, and ultimately support the Nuclear Site Licence.

Table 4.1: Predicted mean overtopping rates for the updated HCDF design (crest at 12.6m AOD)

Return Period	Epoch	Climate Change	Extreme Sea Level (m AOD)	Inshore Wave Height (m)	Mean Overtopping Rate (l/s/m)
200-year	2140	RCP8.5 / 95%ile	5.00	3.73	0.0
	2140	BECC Upper	7.10	4.48	5.2
	2190	RCP8.5 / 95%ile	5.83	4.25	0.1
1,000-year	2140	RCP8.5 / 95%ile	5.84	3.94	0.0
	2190	RCP8.5 / 95%ile	6.67	4.42	1.9
10,000-year	2090	RCP8.5 / 95%ile	5.85	4.15	0.1
	2090	H++	6.46	4.34	1.2
	2140	RCP8.5 / 95%ile	6.75	4.42	2.4

4.3.13 **Table 4.1** shows that for both the 1 in 200-year and 1,000-year events with reasonably foreseeable climate change scenarios, the proposed defence design stops overtopping up to the end of the 2140 epoch, and it also limits overtopping rates below the 2 l/s/m threshold for the 2190 epoch. Results show no overtopping for the reasonably foreseeable scenarios with the adaptive defence at 16.4m AOD, up to the 1 in 10,000-year event and therefore are not included in the **Table 4.1** above.

4.3.14 For the credible maximum scenario (BECC Upper) for the 1 in 200-year event at 2140 epoch, the overtopping rate is above the adopted threshold. This event is beyond the basis of design and is used to inform the severe accident and 'cliff-edge' effects analysis required by ONR that would be discussed within the Safety Case assessment.

4.3.15 For the basis of design event, i.e. 1 in 10,000-year event, results show overtopping rates closely within the design basis limit of 2 l/s/m, including the H++ scenario at the end of the operational phase of the development.

4.3.16 The four events in **Table 4.1** with predicted overtopping above 0.1 l/s/m were assessed in the inundation modelling. Results show the maximum flood depth on the main platform is up to 0.1m with flood velocity below 1m/s and low hazard rating for all four considered events.

4.3.17 Assessment of the extreme still water levels above main platform height (7.3m AOD), presented in **Table 4.2**, shows that for the 1 in 10,000-year event at 2190 epoch the flood depth on the platform is greater than the building threshold set in the design parameters and for the credible maximum climate change scenarios (i.e. BECC Upper) flood depths are significantly above the main platform height and threshold of the buildings. However, it is anticipated that by this time i.e. 2190, there will be very limited (if any) activities on site and most buildings would be decommissioned and demolished. Also, the inundation would be limited to the peak of the surge event only, for a period of approximately 3 hours, and therefore the risk would also be time limited.

Table 4.2: Assessed flood depth on the main platform for scenarios with extreme still water level above platform height

<table>
<tr><th>Return Period</th><th>Epoch</th><th>Climate Change</th><th>Extreme Sea Level (m AOD)</th><th>Main Platform Level (m AOD)</th><th>Flood Depth on the Main Platform (m)</th></tr>
<tr><td>200-year</td><td>2190</td><td>BECC Upper</td><td>8.00</td><td rowspan="6">7.3</td><td>0.70</td></tr>
<tr><td rowspan="2">1,000-year</td><td>2140</td><td>BECC Upper</td><td>7.94</td><td>0.64</td></tr>
<tr><td>2190</td><td>BECC Upper</td><td>8.84</td><td>1.14</td></tr>
<tr><td rowspan="3">10,000-year</td><td>2140</td><td>BECC Upper</td><td>8.85</td><td>1.55</td></tr>
<tr><td>2190</td><td>RCP8.5 / 95%ile</td><td>7.58</td><td>0.28</td></tr>
<tr><td>2190</td><td>BECC Upper</td><td>9.75</td><td>2.45</td></tr>
</table>

4.3.18 Further details on the results from the wave overtopping assessment and inundation modelling (including flood depth, velocity and hazard rating maps) are provided in **Appendix E**.

c) Conclusions

4.3.19 In the **MDS Flood Risk Assessment** (Doc Ref. 5.2) [APP-099] it was concluded that, once completed, the proposed SSSI crossing would no longer be at risk from fluvial or coastal inundation flooding. As discussed in the previous section, the soffit level of the temporary bridge would be above fluvial and coastal still flood levels and therefore, there would be no risk to the structure or its users once operational. There would be risk of wave overtopping of the crossing in future epochs considering sea level rise and wave action. The risk can be however mitigated with the adaptive defence (crest at 10.5m AOD) up to the 1 in 1,000-year event throughout the development lifetime. That is discussed in further detail in the Application and has not been revised since there is no change to the proposed design of the crossing embankment and its adaptive defence. Flood risk to site users during early construction will be discussed in the Flood Risk Emergency Plan (FREP) provided in **Appendix E**.

4.3.20 Coastal flood risk from wave overtopping during the construction phase in the Application was considered to be significant, with a tangible risk to people during the 1 in 200-year event. To mitigate this a temporary defence (sheet pile wall) is being proposed. Based on the results of the wave overtopping assessment with the temporary sheet pile wall in place, it is concluded that flood risk to the main construction site and its users during construction phase is not significant. Therefore, it is considered that the proposed design changes successfully mitigate flood risk compared to the proposals set out in the Application. Early construction risk (when the sheet pile wall would be put in place) is discussed in the Flood Risk Emergency Plan (FREP) provided in **Appendix F**.

4.3.21 As discussed in **Section 3.3**, fluvial flood risk to the main development site is considered not significant throughout the whole development lifetime.

4.3.22 Assessment of coastal flood risk shows that the proposed sea defences would be sufficient to protect the main platform area against the 1 in 200-year and 1 in 1,000-year events with reasonably foreseeable climate change till the end of the development life and up to 2140 epoch for the basis of design event (1 in 10,000-year return period). Potential limited overtopping does not result in significant risk when considering flood depth, velocity or hazard rating on the main platform, and therefore the overall coastal flood risk to the site is not considered to be significant.

4.3.23 As part of the sensitivity testing, considering the beyond basis of design scenarios (with the credible maximum climate change allowance), flood depth on the main platform would rise above the threshold of the buildings of 0.2m set in the design parameters. However, it should be noted that such high water levels would last approximately 3 hours during the peak of the surge event only and therefore the risk would be limited to a relatively short period of time. The risk for the beyond basis of design events will inform the severe accident and 'cliff-edge' effects analysis that will be discussed as part of the Safety Case assessment, in line with the requirements set out by ONR and therefore is not further discussed in this document.

5 ADDITIONAL CLARIFICATIONS

5.1.1 The Relevant Representation responses and the comments received from the Environment Agency, both prior to and following the Application, included a number of requests for further clarifications that have not been addressed within the additional assessment reported in the previous sections of this **MDS FRA Addendum**.

5.1.2 To address these further comments, the detailed table presented in the Environment Agency's response has been reproduced in **APPENDIX B** with supporting clarifications provided against individual points. Where further response or information was required to these additional comments, further information has been provided in the following sections, focused on the following areas:

- Water Management Zone 1;
- proposed water management at Fen Meadows;
- Water Resource Storage Area;
- Beach Landing Facility;
- requirement for a Flood Risk Emergency Plan; and
- surface water drainage strategy.

a) Water Management Zone 1

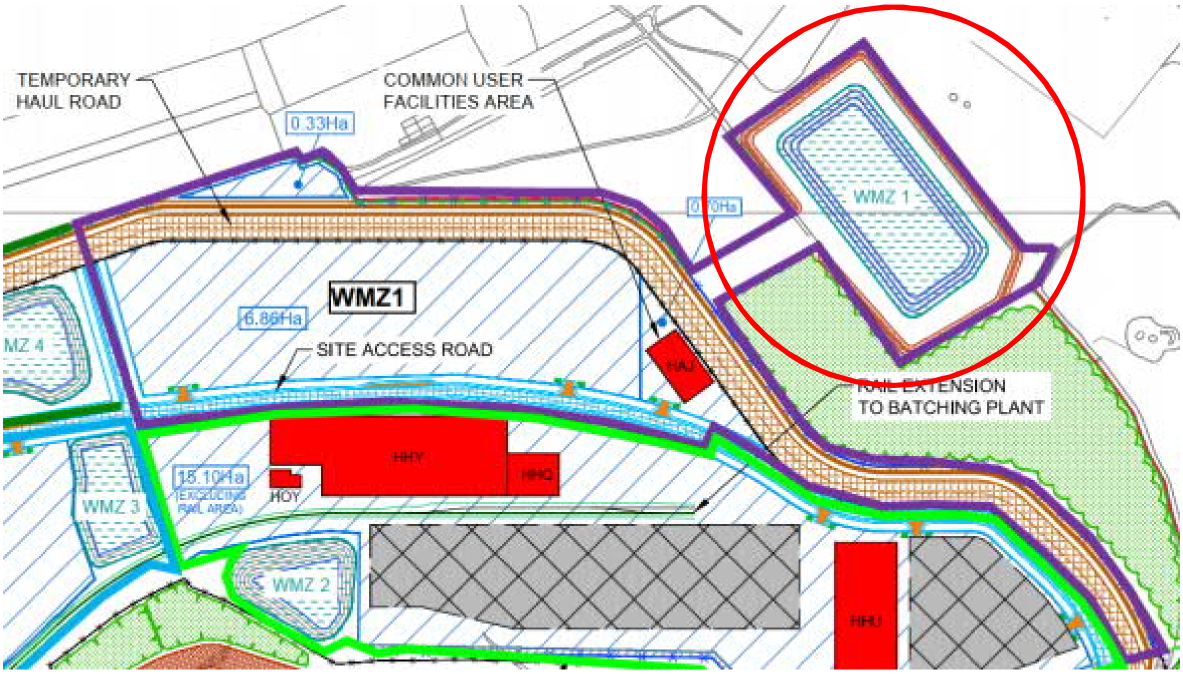
5.1.3 An extract of the Environment Agency Relevant Representation related to Water Management Zone 1 (WMZ-1) states:

> *"Water Management zone 1 basin is shown to be at fluvial risk in the 1000yr (and to a lesser extent the 200yr) extent in the baseline scenario, however, in the with scheme mapping, the proposed basin acts as the boundary for the flood extent."*

5.1.4 WMZ-1, presented in the Application (**Outline Drainage Strategy** proposed in **Volume 2, Appendix 2A** of the **ES**) and shown in **Plate 5.1**, is part of the surface water drainage strategy for the proposed temporary haul road during construction as well as part of the site access road. The detention basin that forms part of the design (marked with a red circle in **Plate 5.1**) will allow infiltration prior to the construction of the CDO and will be retained for exceedance storms and balancing excess volume that exceeds infiltration capacity throughout the construction phase.

5.1.5 As discussed in **section 4.2iii**, during the early years when the construction areas are being created, the CDO would not yet be complete. In order to provide additional flexibility and resilience in the management of surface water, a temporary outfall is proposed for approximately a 2-year period. This would be used to discharge surface water from the main platform area out to the sea reducing pressure on WMZ-1 and managing surface water flood risk within the main platform construction area. It is assumed that the temporary outfall would typically only be used when surface water is captured in the construction site which cannot be discharged through infiltration or to the surrounding watercourses. The Application assumed that there would be no temporary outfall during the construction phase.

Plate 5.1: Water Management Zone 1 (edged in purple) (extract from SZC Co. Consultation Document (Doc Ref. 5.1Ad [APP-068])



5.1.6 The detention basin would comprise an earth bund with a crest above maximum flood levels during construction phase. As such, this configuration was included in the hydraulic modelling assessment in the Application, which showed slight encroachment into the fluvial flood extent for the 1 in 100-year and 1 in 1,000-year return period fluvial events, indicating therefore that the bund would form a boundary of the flood extent for these scenarios. However, this would only be the case during the construction phase of the development, as WMZ-1 will be a temporary feature and removed at the end of the construction phase.

5.1.7 The earth bund crest is well above the coastal and fluvial flood levels throughout the construction phase (less than 2.5m AOD) and therefore, once constructed, WMZ-1 would not be at risk of flooding. Management of flood risk during construction of the earth bund is discussed within the **MDS FREP** in (**Appendix F**)**.**

b) Water management at Fen Meadows

5.1.8 The Application identifies two sites for fen meadow mitigation habitat, one to the south of Benhall and one to the east of Halesworth, to create permanent fen meadow habitats to mitigate the loss of approximately 0.7 hectares of fen meadow habitat from the Sizewell Marshes SSSI.

5.1.9 One of the comments provided by the Environment Agency in the additional responses (**APPENDIX B)** relates to the proposed fen meadow habitat compensation areas that states:

> *"We previously asked for FRA and acknowledgement of requirement of FRAP for Fen Meadow compensatory habitat. Fen Meadows is referenced in 9.2.14, 9.3.23 and12.5. No detail has been provided regarding the specific mechanisms of water management. No assessment of flood risk has been undertaken and any potential off site impacts have not been considered. Flood Risk Activity Permit will be required."*

5.1.10 As outlined in the Application, **Volume 2**, **Chapter 3** of the **ES** (Doc Ref. 6.3) [APP-184], to create suitable conditions for the fen meadow habitat the following works could be required:

- Installation of water control structures, to maintain or manipulate water levels;
- Removal of any existing field drains, to reverse historic patterns of drainage;
- Local excavation to reduce local ground levels, create low bunds and /or create minor surface watercourses to help distribute surface water and reduce nutrient levels;
- Translocations of some turfs from the fen meadow areas of the Sizewell Marshes SSSI that would otherwise be lost through construction works; and
- Limited planting of other locally sourced native species and use of appropriately sourced 'green hay' from Sizewell Marshes SSSI or

potentially adjacent Pakenham Fen SSSI to accelerate colonisation by key fen meadow species.

5.1.11 The required works would be determined depending on the characteristics of each of the sites at detailed design stage so that potential new/repositioned structures required to maintain water levels within the fen meadow habitat are appropriate.

5.1.12 The **MDS Flood Risk Assessment** (Doc Ref. 5.2) [APP-093] states that the fen meadow sites are at a medium to high risk of flooding throughout the lifetime of the development, however these are water compatible sites which are designed to flood, and therefore the flood risk is not considered to be significant.

5.1.13 Since the sites are located within Flood Zones 2 and 3, and a Flood Risk Activity Permit (FRAP) would be required. Since the design of the scheme is ongoing, the application for the FRAP will be prepared and submitted to the Environment Agency at an appropriate stage of the Project.

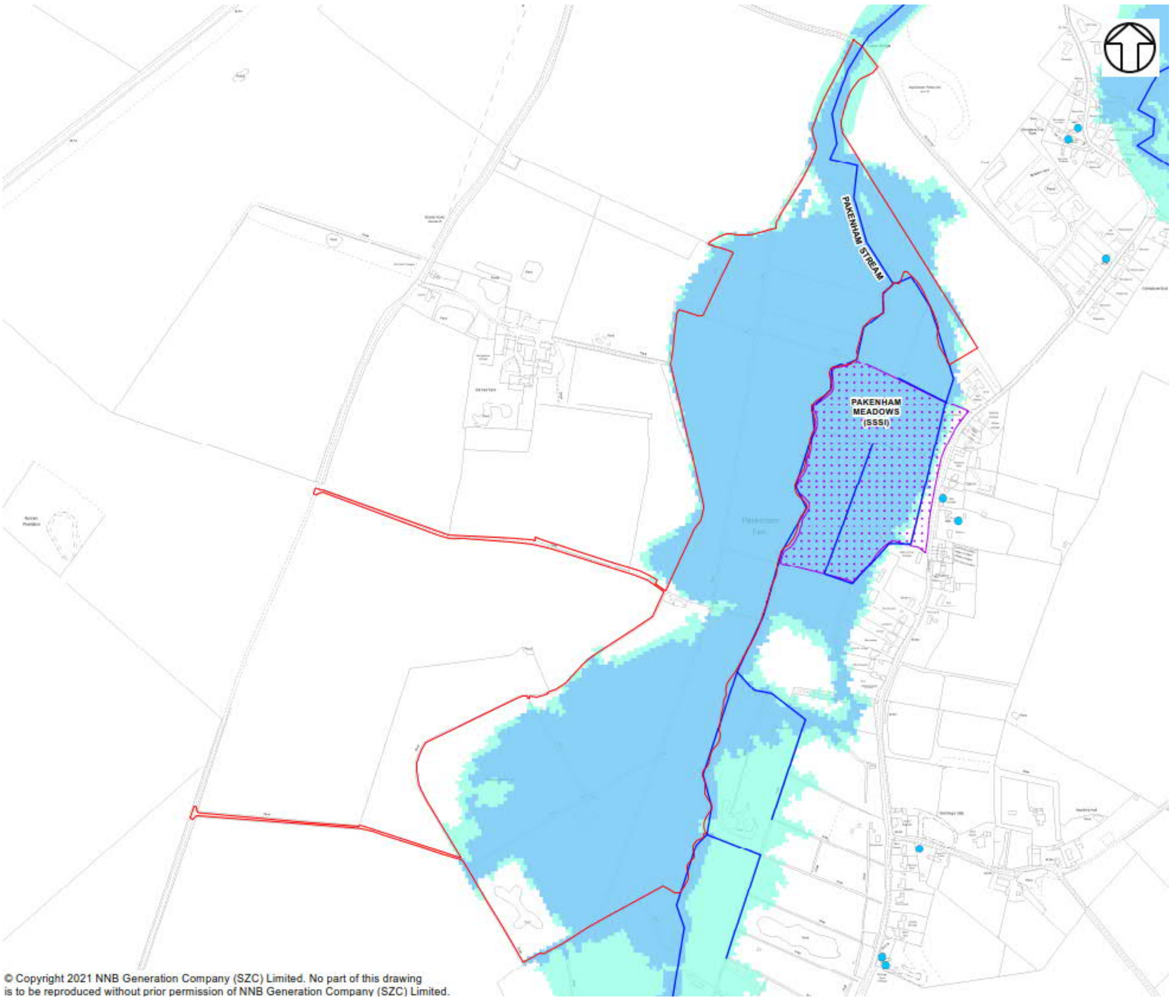
5.1.14 Following the Application submission and further engagement with Natural England, a change is proposed to add another area to the Application in order to ensure sufficient mitigation of the fen meadow habitat, as outlined in in **Chapter 2** of **Volume 2** of the **ES Addendum** (Doc Ref. 6.14).

5.1.15 The identified additional area is located at Pakenham (see **Plate 5.2**) in West Suffolk, comprising approximately 32ha of land that would provide mitigation for fen meadow loss from the Sizewell Marshes SSSI and is in close proximity to other areas of fen meadow habitat. The site currently comprises a mix of grassland, fen meadow, rush pasture and drier grassland.

5.1.16 The Pakenham Stream, an Environment Agency controlled main river, and tributary of the Black Bourne, flows northwards along the eastern edge of the proposed Packenham fen meadow. A network of ordinary watercourses flow within the proposed fen meadow.

5.1.17 As with the other fen meadow compensation sites, the proposed additional fen meadow is primarily within Flood Zone 3 (high risk), although, as noted above the use for the site comprises a water compatible development which is appropriate for this location. The floodplain is well defined and has no properties within it.

Plate 5.2: Fen Meadow at Pakenham Environmental Site Context Plan (extract from Figure 2.2.27 of Chapter 2 of Volume 2 of the ES Addendum (Doc Ref. 6.14))



5.1.18 Works to create the fen meadow habitat at Pakenham would be similar to those described earlier in this section, in relation to Benhall and Halesworth habitat mitigation sites (as discussed in paragraph 5.1.8). However, the impact of measures to increase the wetness of the meadow would be limited to the meadow area if kept within the ordinary watercourses.

5.1.19 Any measure that would have the effect of directly restricting the flow of the Pakenham Stream would have the potential to impact beyond the meadow and would require more detailed assessment and engagement with the Environment Agency. Any measure that forms a weir, culvert or like structure within the ordinary watercourses is likely to require the consent of the LLFA (Suffolk County Council), through the submission of an Ordinary Watercourse Consent application.

5.1.20 Further detailed studies and engagement with the Environment Agency, LLFA and Natural England will determine the suitability of the areas identified and inform the development of the detailed design and plans.

c) Water Resource Storage Area

5.1.21 The Application identifies that a temporary non-potable water storage area would be constructed for use in the construction process. The water would be used for construction activities and would not have direct links to the outline drainage strategy methods as it is for water storage. The area proposed would be located on the northern boundary of the temporary construction area.

5.1.22 It was identified within the **MDS Flood Risk Assessment** (Doc Ref. 5.2) [APP-093] that the proposed temporary water resource storage area would introduce flood risk to the downstream area. The Environment Agency, in their further responses (**APPENDIX B**) raised a comment stating:

> *"A new reservoir flood risk has been identified, although the potential flood risk impacts have not been made clear."*

5.1.23 Following submission of the Application, further work with the Sizewell C Project team and contractors has identified that the temporary water storage area can be located elsewhere on the construction site, adjacent to a proposed attenuation pond (water management zone 5), and the proposed borrow pits and stockpiles, as illustrated in **Plate 5.3**.

5.1.24 Relocation of the water storage area creates operational efficiencies by storing the water closer to stockpiles, where it is needed for dust suppression, and closer to the haul road. This would also allow the storage area's original location to instead provide permanent fluvial flood mitigation additional wetland habitats in this area. The wetland habitats would be open water channels and wet reedbeds to provide high quality foraging habitats for marsh harriers. Further details on the proposed flood mitigation area and its impact on flood risk are discussed in **Section 3** earlier in this document.

5.1.25 The proposed relocated water resource storage area moves away from Flood Zone 3 (high risk) defined in the proposals in the Application to Flood Zone 1 (low risk) and therefore flood risk to the relocated site is not significant. In the Application, one property downstream of the water resource storage area had been identified as being at potential risk of flooding in an event of a breach. Since the relocated water resource storage area would be created by ground lowering rather than construction of an embankment, risk of breach is fully mitigated (eliminated risk of breach).

Plate 5.3: Proposed location of the water resource storage area (extract from Figure 2.2.13 of Chapter 2 of Volume 2 of the ES Addendum (Doc Ref. 6.14))

d) Beach landing facility

5.1.26 The Application includes a permanent BLF, for use in both the construction and operational phases of the development. The BLF would be located on the coast directly in front of the Northern Mound at the northern end of the sea defences, with an associated private access road connecting it to the main platform.

5.1.27 In their response to the Application, the Environment Agency raised a comment stating:

> *"The beach landing facility is on the seaward side of the defence. There is limited assessment of the flood risk posed to this area and how people using this facility will remain safe in a flood event."*

5.1.28 As described in **Volume 2, Chapter 3** (Doc Ref. 6.3) [APP-184], the proposed BLF is a water compatible semi-demountable coastal structure, and therefore it will be exposed to the coastal elements. To mitigate the risk, the BLF would be used during the low wave energy season (between 31 March to 31 October).

5.1.29 Since submission of the Application, further works have been undertaken to investigate ways to enhance the capacity for sustainable freight transport. This has led to the proposal for enhancement of the permanent BLF and a new temporary BLF facility to facilitate material imports by sea where this is practical and cost effective, in accordance with one of the guiding principles of our Freight Management Strategy.

5.1.30 Enhancements of the permanent BLF would comprise additional submerged beams that span parallel to the beach on piled foundations, thereby creating a solid base and allowing more regular deliveries of bulk materials and Abnormal Indivisible Loads without maintenance works.

5.1.31 To substantially reduce the amount of construction material that would otherwise need to be delivered on land, an additional beach landing facility is proposed solely for the delivery of bulk materials such as aggregate and backfill soils. The temporary BLF would be in operation for approximately 8 years and would be up to approximately 505m in length and up to approximately 12m in width for the main jetty. Further details of the proposed changes relating to the permanent and temporary BLF are set out in **Chapter 2** of **Volume 2** of the **ES Addendum** (Doc Ref. 6.14).

5.1.32 The proposed changes to the permanent BLF do not change flood risk to the site. The temporary facility would be built at the same time as the permanent structure and therefore flood risk associated with the construction phase would be managed in the same way for both facilities.

Similarly, the temporary BLF would normally operate from April to October (inclusive) in any given year during the construction phase, which is the same period as that proposed for the enhanced permanent BLF. The potential for use in the remainder of the year is proposed but principally for resilience in the freight management strategy.

5.1.33 Flood risk during construction and operation for both BLFs would be appropriately monitored and managed. This is discussed further within the **MDS FREP** (**Appendix F**).

e) Flood Risk Emergency Plan

5.1.34 In the Environment Agency's additional responses, it was stated:

> *"The FRA states that a Flood Risk Emergency Plan (FREP) will be in place, although no FREP has been submitted. It is therefore unknown whether the Environment Agency's Flood Warning Service will be used, or how site users will know what to do in the event of a flood, or whether safe dry access, egress and refuge is even available to help people escape from the effects of flooding. This information is required to demonstrate that site users will be safe, during both the construction and operational phases, and throughout the lifetime of the development."*

5.1.35 A Flood Risk Emergency Plan (FREP) describes the evacuation procedure and need for safe access, egress and refuge in response to a flood.

5.1.36 The **MDS FREP** (**Appendix F**) has been developed to set out the procedures that will be required during the construction, operation and decommissioning phases of the main development site. The FREP has been completed in accordance with the guidance provided by the Association of Directors of Environment, Economy, Planning & Transport (ADEPT) and the Environment Agency (Ref. 1.6).

5.1.37 Guidance for a FREP indicates it can either form part of a Flood Risk Assessment or be a standalone document. Whilst the FREP for the main development site is written such that it can be read as a standalone document, to aid in future updates, where necessary, it has been included as **Appendix F** of this **MDS FRA Addendum**.

5.1.38 Within a FREP it is necessary to consider the timing of the proposed works, whether there are tools available for flood forecasting for all sources of flooding, the identification of evacuation areas, refuges and shelters and specification of the roles required to ensure that the FREP is implemented during an event. A FREP is also required to consider the response needed following a flooding event.

5.1.39 The FREP for the main development site focuses on the risk to people during the construction phase and operational phase, although information on the operational phase will need to be developed into wider site management procedures and therefore a summary of the main elements is provided in the FREP.

5.1.40 The FREP notes that once constructed, the main development site and its sea defence will be elevated, such that the maximum fluvial and coastal flood levels would be significantly below the level of the main platform and the SSSI crossing throughout its operational phase. Only when future extreme scenarios are considered, would the main development site be at some risk of flooding from wave overtopping and coastal inundation.

f) Surface water drainage strategy

5.1.41 In its response to the Application, the Environment Agency raised a comment with regard to the surface water drainage, that states:

> *"Full details of the surface water drainage strategy are not available. Infiltration is proposed to manage surface water. This is dependant upon infiltration testing which has not been undertaken in all circumstances."*

5.1.42 The design of the surface water drainage for the main development site has been summarised in an **Outline Drainage Strategy** that was submitted as part of the Application as **Appendix 2A**, **Volume 2**, **Chapter 2** of the **ES** (Doc Ref. 6.3) [APP-181] and confirms that infiltration testing on the main development site has been carried out as part of previous investigations in 2014 and 2017, through both trial pits and boreholes.

5.1.43 The **MDS Flood Risk Assessment** (Doc Ref. 5.2) [APP-093] identified that the increase in impermeable area following construction of the main platform would result in a surface water flood risk on the platform. However, this flood risk would be managed by discharging the surface water to the sea, therefore reducing the surface water flood risk to the surrounding onshore areas.

5.1.44 The discharge from the SSSI crossing to the temporary construction area would result in some of the surface water being locally drained off-site to discharge to ground. The scale of the transfer from surface water to ground discharge is minimal and therefore it was concluded that it was likely to result in a negligible change in the associated level of surface water flood risk from the SSSI crossing.

5.1.45 The surface water from the main platform area during the early phases of construction would be temporarily pumped over the temporary sea defences and into a chamber before discharging water through a gravity pipe towards the shoreline. This temporary outfall would be in operation prior to the commissioning of the permanent outfall (CDO), and therefore providing further mitigation of the surface water flood risk within the main platform construction area during early construction phase, as discussed in **section 4.2iii**. It is assumed that the temporary outfall would typically only be used when surface water is captured in the construction site which cannot be discharged through infiltration or to the surrounding watercourses (e.g. due to flooding). Further details are set out in **Chapter 2** of **Volume 2** of the **ES Addendum** (Doc Ref. 6.14).

5.1.46 Further details on the evolving design for the surface water drainage and, thereby the management of surface water flood risk continue to be developed and will be finalised post-DCO. However, the ongoing design of the surface water drainage, incorporating attenuation and controlled discharge via infiltration, is such that the proposed development would not have an impact on surface water flooding.

REFERENCES

1.1 Environment Agency. September 2020. Relevant Representation on Sizewell C Development Consent Order (AE/2020/125515/01).

1.2 CIRIA C683 The Rock Manual (2nd Edition), Rev 00, The Rock Manual: The use of rock in hydraulic engineering (2nd edition), CIRIA, 2007.

1.3 EurOtop. Manual on wave overtopping of sea defences and related structures. An overtopping manual largely based on European research, but for worldwide application. Van der Meer, J.W., Allsop, N.W.H., Bruce, T., De Rouck, J., Kortenhaus, A., Pullen, T., Schüttrumpf, H., Troch, P. and Zanuttigh, B. Second Edition 2018: www.overtopping-manual.com

1.4 Office for Nuclear Regulation and Environment Agency Joint Advice Note. Principles for Flood and Coastal Erosion Risk Management. July 2017.

1.5 Office for Nuclear Regulation Safety Assessment Principles for Nuclear Facilities. 2014 Edition, Revision 1 (January 2020).

1.6 Environment Agency and Association of Directors of Environment, Economy, Planning & Transport (ADEPT). September 2019. Flood risk emergency plans for new development – A guide for planners: How to consider emergency plans for flooding as part of the planning process. September 2019. (Online) Available from: https://www.adeptnet.org.uk/system/files/documents/ADEPT%20%26%20EA%20Flood%20risk%20emergency%20plans%20for%20new%20development%20September%202019....pdf

APPENDIX A: EXTRACT OF THE ENVIRONMENT AGENCY RELEVANT REPRESENTATION RELATED TO FLOOD RISK

A.1. Introduction

A.1.1. This appendix provides an extract from the Environment Agency's Relevant Representation on Sizewell C Development Consent Order (Ref. 1.1.1) relevant to the Main Development Site and its associated flood risk.

A.2. Relevant Responses

A.2.1. The following responses have been provided by the Environment Agency within the main body of the Relevant Representation document:

> *"Much of the Sizewell C Main Development Site and Associated Development Sites are in Flood Zone 3 (high probability of flooding), and there are also numerous proposed watercourse crossings. It is therefore essential for the DCO application to be supported by an adequate Flood Risk Assessment (FRA), based on information from appropriate flood risk modelling that demonstrates that there will be no increased risk of flooding on-site or elsewhere."*

> *"During the Pre-Application stage of the DCO, the Environment Agency repeatedly gave NNBGenCo (SzC) Ltd comprehensive specialist guidance to help them ensure that an adequate FRA would be submitted so that the Examining Authority would have a sound evidence base upon which to make their decisions. It is therefore a great disappointment to the Environment Agency that NNBGenCo (SzC) Ltd has knowingly chosen to submit an FRA which is neither supported by adequate modelling, nor demonstrates that the site, its users, and neighbouring areas will be safe in the event of a flood."*

> *"The main area of concern is over the main development site fluvial hydrology. Some aspects of the analysis are rigorous but others are not. There are a number of shortcomings, particularly in the choice of an outdated method for flow estimation and limited use of available local data. Whilst it is possible that the overall conclusion of the FRA is unaffected by these shortcomings, it seems reasonable to expect to see a hydrological assessment that is above reproach in the case of a new nuclear development. Where shortcomings have been identified*

these need to be properly checked and tested using more recent hydrological methods and datasets to ensure that the conclusions of the FRA are not affected."

"The Main Development Site Flood Risk Assessment demonstrates that 4 residential and 6 non-residential properties will be put at an increased risk of flooding as a result of the development, with no compensatory storage or property-level mitigation provided. This increase in flood risk off-site is contrary to paragraph 5.7.16 of National Policy Statement EN-1. This is an unacceptable conclusion to draw, without at least providing assurances that these increases in flood risk can be managed / or mitigated to an appropriate level. "

"During the early construction phase, the existing defences will need to be removed prior to the construction of a new haul road / site flood and coastal defence structure. Coastal inundation during this phase has not been adequately assessed. The overtopping assessment, for the period when the existing defences are removed, has indicated a flood flow rate of 140.36l/s, which dangerously exceeds the recommended safety limits for people. The FRA does not address how the safety of the site, and its users, will be ensured during this period of the construction phase."

"The FRA states that a Flood Risk Emergency Plan (FREP) will be in place, although no FREP has been submitted. It is therefore unknown whether the Environment Agency's Flood Warning Service will be used, or how site users will know what to do in the event of a flood, or whether safe dry access, egress and refuge is even available to help people escape from the effects of flooding. This information is required to demonstrate that site users will be safe, during both the construction and operational phases, and throughout the lifetime of the development."

A.2.2. In addition to comments within the main body of text, further responses have been provided in a table to the rear of the Relevant Representation document. Responses relevant to the Main Development Site Flood Risk Assessment are reproduced as follows:

Document Title	Paragraph number	Issue	Comment	Suggested solution
Sizewell C Main Development Site FRA	General comment	The FRA must show that site users will have safe dry access to and from the site in fluvial & tidal flood events, but access/egress, refuge and flood warning and evacuation are not discussed in detail. This is contrary to paragraph 5.7.5 of National Policy Statement EN-1. Appendix D of the EA & ONR Joint Advice Note (July 2017) states that Safe assess /egress must be provided in the 0.5% tidal flood and 1% fluvial flood with an allowance for climate change. A safe means of escape (or sufficient time available) must be provided up to the 0.1% fluvial and tidal event.	NNBGenCo (SzC) Ltd has stated an intention is to develop a Flood Risk Emergency Plan (FREP) post-DCO stage, which will be informed by emerging information regarding construction phasing and operations. However, this information is required in order to demonstrate that workers and users of the site will be safe during the construction and operation phases. It is unknown whether the site will use the Environment Agency's Flood Warning Service, how site users will know what to do in the event of a flood, when evacuation should occur, whether there is safe dry access, egress and refuge available, or what the flood hazard presented to site users would be.	Provide further information on the flood warning and evacuation procedures to demonstrate that the proposed development can be made safe for people both during construction and operation. This Flood Response Plan should be informed by the hazards posed to people using the site and the phasing of construction activities, as well as ongoing operational activities throughout the lifetime of development. Please refer to guidance on Flood Risk Emergency Plans for New Development Also refer to the standards set out in Appendix D of the EA & ONR Joint Advice Note (July 2017) to ensure people on site are safe in the event of a flood. We will object where these are not met.
Sizewell C Main Development Site Fluvial Model Update Report & Appendix C, D & E	MDS FRA 11.3.8, 12.7.1912.7.22 and Fluvial Model Update Report 8.1.9	The Fluvial Flood Risk Assessment has established that the hazard rating category for 4 residential properties will be increased as a result of the proposed development. Modelling shows the development will increase flood risk elsewhere which is contrary to paragraph 5.7.16 of National Policy Statement EN-1	The fluvial modelling results confirm that the change in the maximum water levels within the Minsmere catchment area is less than 15mm for all the considered scenarios, including 100-year and 1,000-year events with 65% and 80% climate change allowances. the number of residential properties at risk of fluvial flooding does not increase as a result of the scheme, the hazard rating which 4 of these residential properties could experience will be increased (in 1% with 35%climate change event). There is inconsistency within the FRA as to	Investigate whether the provision of compensatory flood storage could mitigate this increased fluvial flood risk. Threshold survey data could inform of specific nature of anticipated flood risk (e.g. internal flooding). Adequate mitigation and compensation should be provided to ensure the development does not increase flood risk to property.

			whether the flood hazard rating increases from 'Danger to Some' to 'Danger to Most' or from 'Danger to Most' to 'Danger to All'	
Sizewell C Main Development Site Fluvial Model Update Report & Appendix C, D & E.	Tables 6.2 and 6.3, Plates 6.146.20, Table 6.5	The FRA has identified that, as a result of the proposals, an additional 5/6 non-residential properties will be at risk of fluvial flooding, which currently are not. Modelling shows the development will increase flood risk elsewhere which is contrary to paragraph 5.7.16 of National Policy Statement EN-1.	Reference to Tables 6.2 and 6.3 clearly show that the scheme could result in an additional 5 non-residential properties at risk in all return period events, from the 5year to the 1000 year event, with 6 additional non-residential properties at risk in the 1000year with the higher 65% and 80% climate change allowances. The location of the properties at risk is not made clear. The FRA appears to excuse this increased flood risk to non-residential property as being within the Very Low hazard category (as the increase in peak flood level is less than 0.1m). However, the inclusion of these properties within the flood outlines constitutes an increased flood risk to people and property.	Investigate whether the provision of mitigation measures, including compensatory flood storage could mitigate this increased fluvial flood risk. Threshold survey data could inform of specific nature of anticipated flood risk (e.g. internal flooding). Adequate mitigation should be provided to ensure the development does not increase flood risk to property.
Sizewell C Main Development Site FRA	11.3.13, 11.3.6, 11.3.8 & 11.3.9	FRA has demonstrated an increased change in off-site fluvial flood risk to both residential and non-residential properties as a result of the development. Yet, compensatory flood storage has not been provided. There is no clear and justified explanation for this. FRA states that EA confirmed that compensatory storage is not usually required where change in flood depth is less than 30mm, which is inaccurate.	Generally 30mm is a small change but the consequence of this change must still be assessed in the FRA to confirm this. The FRA has identified that the change in fluvial flood risk as a result of the scheme will result in the flood hazard rating increasing for 4 residential properties for the 1% with 35% climate change. This therefore confirms that the scheme is anticipated to increase the fluvial flood risk to 4 residential properties, with at least one of these becoming considered dangerous for most users. It is not acceptable to increase flood risk to people or properties. Paragraph 11.3.9 also	The evidence submitted demonstrates that the off-site fluvial flood risk will be increased as a result of the scheme. Compensatory flood storage or other means of mitigation should be investigated to determine whether this would mitigate against this increased risk.

			states that the scheme will result in an increase in flood risk to 5/6 non-residential properties. Flood depths are assessed to be between 5 and 8mm with low velocities. However, this is still a greater number of properties at risk as a direct result of the scheme.	
Sizewell C Main Development Site FRA	General and 7.1.12 & 7.2.9, Table 7.4 & 7.1.29 7.1.20	There is a lack of clarity over the proposed sequencing of the early construction phases, which has implications for assessing the flood risks posed from overtopping of the defences during the construction phases.	The existing defences will be removed prior to construction of a new haul road/defence. It is not made clear how long this phase will take, or the time of year etc. No detail regarding the proposed design or construction of the temporary haul road has been provided. Throughout this phase, the crest level is anticipated to be as low as 4.36mAOD. The overtopping assessment has indicated rate of 140.36l/s during this stage. This is not within safe threshold limits. The FRA has not fully assessed what this means for the safety of the site and its users during this early construction phase (depth, extent, duration, velocity, and hazard). NNBGENCO (SZC) Ltd have commented that they will address this post DCO, as a better understanding of sequencing and inundation modelling for construction phase is developed, alongside the FREP. Works to remove existing defences are also likely to require an environmental permit. On the basis of the FRA at the current time, it is therefore not clear how, or whether, this level of risk from overtopping can be managed.	Clarify the following issues within the FRA: What are the implications of this rate of overtopping. How might the temporary lowering of the defences impact on flood extents and receptors? What are the risks to the site itself and to the ongoing construction works across the site area? How could these risks be managed?

Sizewell C Main Development Site FRA	8.1.11, Table 8.2 & 8.2.7, 8.3.10	The temporary SSSI crossing during construction will be at risk of fluvial flooding and also coastal flooding in the 0.1% event as the existing defences are inundated, and also during a breach flood event.	The risk of fluvial flooding for the area of the temporary SSSI crossing is unclear. 8.3.10 indicates that the levels of the proposed temporary crossing are unknown, but that these should be set above 2.0mAOD in order that the road would remain dry from fluvial flooding (1 in 100yr +25% level 1.86mAOD). However, there is no assessment of the potential implications of fluvial flood risk on the construction site itself, nor for the safety of the construction workers. Para 8.1.13 states a 0.1% still water level of 4.35mAOD, which is above the shingle crest. This is below the level of the proposed haul road (7.3mAOD). However, there will be a period of risk during the early construction phase BEFORE completion of the haul road. For a period of time where this risk will be real and there will be no defences in place. What impacts would this event have at this time and how will this risk be managed?	Explain the fluvial and coastal flood risk posed to the temporary crossing and people using it, for both the risk of fluvial flooding or coastal inundation during the early construction phase, and also in the event of a breach occurring. Ensure there is a safe access/egress or a safe means of escape. Detail how this would be implemented and how people on site will know when to evacuate or stop work. A breach flood can occur without warning.
Sizewell C Main Development Site FRA	11.2.6	FRA identifies a change in flood risk associated with a breach at Tank Traps, and attempts a description of the impacts of this change, however references a Table (8.2), the data in which does not appear to be consistent with the description.	Any change in flood risk (either increased or reduction) must be clearly identified in the FRA with maps, plates or figures so it is clear to the reader what the impact of the development is. This must then be assessed in detail (depth, hazard, velocity) and the results interpreted for the receptors affected. What is the consequence of this change in flood risk? For example if an area is already at risk of flooding in a breach to significant depths additional flooding which does not increase the hazard to people could be	Provide full assessment of change in off-site flood risk in a breach. Clearly show change in depth, hazard and velocity and identify key areas where the impact is felt. Assess the consequence of this change to the receptors present. This also applies to offsite flood risk as result of the development for tidal overtopping and fluvial flood risk.

			acceptable. If there are new areas flooded that were not flooded before this would be a more significant consequence. The receptors in this area would then need to be identified to determine if this change is significant.	
Sizewell C Main Development Site FRA	7.2.16, Tables 7.5, 7.6 and 7.7	There is detailed assessment of the depth, hazard, velocity and time until inundation on the platform in the event of a breach at: 1).Tank Traps (Table 7.5; during the construction phase, prior to raising of the platform area and construction of the new defences), 2). the main defence (Table 7.6 and 7.7 during the operational epoch and beyond).	7.2.7 and Table 7.5 show the depth, velocity and hazard of a breach at tank traps in 2030 and 2190. There is no information on how this risk (which at some points/locations indicates Danger for Most/All) shall be managed (including main platform 2030 in 0.5%/0.1% events, which would present a risk during the early construction phase, prior to raising of the platform area). Breach in main HCFD in 2140 (worst case credible maximum) results in flooding to MPlatform, 7.2.27 indicates 70mm170mm of internal flooding for up to 3hours. The FRA (7.2.25-7.2.26) mentions forecasting, warning, suspension of operations and a flood emergency plan, although there is no detail to indicate that this could act as a means of keeping people safe.	The FRA must be updated to show how the risk to people will be managed.
Sizewell C Main Development Site FRA	Fig 33, 9.2.13 and Fig 56 and 9.3.3	Water Management Zone 1 basin is shown to be at fluvial risk in the 1000yr (and to a lesser extent the 200yr) extent in the baseline scenario, however, in the with scheme mapping, the proposed basin acts as the boundary for the flood extent.	The proposals should be made clear. Will proposed raised embankments create the boundaries of the flood extents? If so, the updated flood extents must be demonstrated. Figure 56 indicates that this location would be inundated in the future 100year flood events, based upon upper end and credible maximum scenarios.	Provide plates and figures showing flood risk and the construction site location. Illustrate the flood risk for the areas of the construction site that are at risk (depth, hazard & velocity). Confirm mitigation measures if required.

Sizewell C Main Development Site FRA	General comment	The FRA must show that site users will have safe dry access to and from the site in fluvial & tidal flood events, but access/egress, refuge and flood warning and evacuation are not discussed in detail. This is contrary to paragraph 5.7.5 of National Policy Statement EN-1. Appendix D of the EA & ONR Joint Advice Note (July 2017) states that Safe assess /egress must be provided in the 0.5% tidal flood and 1% fluvial flood with an allowance for climate change. A safe means of escape (or sufficient time available) must be provided up to the 0.1% fluvial and tidal event.	NNBGenCo (SzC) Ltd has stated an intention is to develop a Flood Risk Emergency Plan (FREP) following the examination stage of the DCO, which will be informed by emerging information regarding construction phasing and operations. However, this information is required in order to demonstrate that workers and users of the site will be safe during the construction and operation phases. It is unknown whether the site will use the Environment Agency's Flood Warning Service, how site users will know what to do in the event of a flood, when evacuation should occur, whether there is safe dry access, egress and refuge available, or what the flood hazard presented to site users would be.	Provide further information on the flood warning and evacuation procedures to demonstrate that the proposed development can be made safe for people both during construction and operation. This Flood Response Plan should be informed by the hazards posed to people using the site and the phasing of construction activities, as well as ongoing operational activities throughout the lifetime of development. Please refer to guidance on Flood Risk Emergency Plans for New Development Also refer to the standards set out in Appendix D of the EA & ONR Joint Advice Note (July 2017) to ensure people on site are safe in the event of a flood. We will object where these are not met.