Sizewell C's Development Consent Order decision documents assure the public that '…the Proposed Development of Sizewell C takes account of conservative assumptions around the evolution for the coastline…'. How exactly? This paper examines the claim.

Nick Scarr 08 9 2022, latest edit 30/05/2023

Synopsis

In the DCO decision, 20 July 2022, The Applicant, BEIS[1] and the Planning Inspectorate assure the public that '*conservative evolution of the coastline has been established*':

- *"Section 2.6 of the Applicant's response notes that coastal flooding studies for the Proposed Development take account of conservative assumptions around the evolution for the coastline, geomorphology..."*

The ONR stated that they were satisfied with this: 'There is nothing we would wish to add…'

- However, the Applicant tells us in the same SDSR document that: *"The rationale behind the definition and projection of a likely future shoreline…of SZC is set out in Reference [20]."*

'Reference [20]' quoted by the SDSR is TR403, The Expert Geomorphological Assessment (EGA) for shoreline retreat. The EGA is a self-declared non-conservative assessment.

The Applicant's assessment, we are told, for the evolution of the coastline at Sizewell C is then, non-conservative (non-precautionary), i.e., based on the EGA, and thus seemingly invalidates the public assurance presented by the Applicant, Planning Inspectorate and BEIS with the ONR's approval?

Introduction

EDF informs us in the DCO submission, that it commissioned seven expert geomorphologists to examine the shoreline change processes associated with Sizewell C:

> *"Seven Expert Geomorphologists, internal and external to Cefas, were convened to assess the physical and scientific evidence for shoreline change processes and to derive a plausible future shoreline baseline using the* ***EGA [Expert Geomorphological Assessment]*** *approach. "*
>
> DCO: Main Development Site Chapter 20 Coastal Geomorphology and Hydrodynamics
> Appendix 20A Coastal Geomorphology and Hydrodynamics: Synthesis for Environmental Impact Assessment TR311 Sizewell MSR1 (Ed 4) Paragraph 7.2.1.

The Expert Geomorphological Assessment (EGA) is defined by the Applicant as establishing **'…the future shoreline between Dunwich and Thorpeness, including the proposed SZC.' This is often referred to as the Greater Sizewell Bay.**

[1] Now the Department for Energy Security & Net Zero

The seven geomorphologists responsible for the study are named on page 133 of 167 of *App-312*. The EGA is based on BEEMS technical documents TR311 and TR403 *'Expert Geomorphological Assessment of Sizewell's Future Shoreline Position' 21/3/19 rev. 21/4/20'*.

The establishment of future shoreline position at Sizewell forms an essential part of the flood risk assessment and the remit of the Coastal Monitoring and Mitigation plan (CPMMP). The EGA for Sizewell C, however, is non-conservative (non-precautionary) in that it assumes, and relies on, major best-case conditions, hence is compromised and, in my view, is totally unsuited to underpinning the flood risk safety case or the CPMMP.

I formally requested of the Planning Inspectorate on the 25th of May 2022, during the Development Consent Order (DCO) Examination process, that it may then be beneficial to ask the independent geomorphologists who prepared the EGA to explain their approach and why they placed such limitations on their exercise. This request is copied in Appendix 1.

I did not receive a reply and as far as I am aware the Inspectorate did not discuss these matters with the geomorphologists. However, the Development Consent Order (DCO) 'Decision documents' make clear that, *" …the MTF (EA, MMO, ESC and NE) serves to provide independent scrutiny of the assessments, monitoring and mitigation during pre-application, the Examination, and post Examination. The ExA considers that this provides robust scrutiny of the Applicant's evidence,* ***and that a further EGA would be superfluous***". (MTF - Marine Technical Forum, EA - Environment Agency, MMO- Marine Management Org., ESC - East Suffolk Council and NE - Natural England). *See: Sizewell C New Nuclear Power Station Examining Authority's Report of Findings and Conclusions and Recommendation to the Secretary of State for Business, Energy and Industrial Strategy VOLUME 2 OF 4 paragraph 5.8.123*

In other words, the Regulators–primarily the Environment Agency–validated and accepted the non-conservative, non-precautionary EGA for shoreline change in the Greater Sizewell Bay and the Examiners and BEIS, in turn, accepted and validated the position of the Regulators.

Even in the face of such compelling, if circular, affirmation I fail to understand how the EGA is either adequate or appropriate for underpinning the flood risk safety case for flood and erosion risk for Sizewell C until 2140.

I am perplexed that an assessment such as the EGA which, in my view, violates the fundamental principle of 'nuclear safety by conservative assessment', could ever be *submitted* for a nuclear plant proposal never mind approved by the Regulators such as the Environment Agency, the Office for Nuclear Regulation, Examiners and BEIS.

BEIS and the Examiners, nevertheless, in their DCO decision documents, assure the public that *'…the Proposed Development [Sizewell C] take[s] account of conservative assumptions around the evolution for the coastline…'*. How exactly? This paper examines the claim.

Section 1 The seven major limitations of the Expert Geomorphological Assessment (EGA) defining the future shoreline of the Greater Sizewell Bay.

The limitations to the EGA study are defined by the following *self-declared* non-conservative, non-precautionary aspects of its approach:

1. The EGA adopts a future projection based only on "reasonably foreseeable" conditions. Extreme events appear to be essentially dismissed.
2. The EGA limits sea level rise to the year 2070. Sizewell C, however, will be operational well beyond this and have spent fuel cooling onsite until an agreed and established minimum date of 2140.
3. The EGA assumes the offshore wave climate remains unchanged. This is despite Environment Agency published guidance which suggests a 5% to 10% increase should be used as a safety factor.
4. The EGA assumes the inshore wave climate remains unchanged. This indicates a reliance and dependence on the Sizewell-Dunwich offshore banks and longshore, nearshore bars remaining in their current form. This bank network acts as a set of three 'breakwaters' that attenuate and dissipate wave energy reaching the nuclear foreshore. This is an unreasonable assumption as the Dunwich bank and the nearshore bars are made entirely of *sand* and the Dunwich bank has dropped 2m in its northern third *in the last decade.*
5. The EGA limits its scope to 3Km of coastline.
6. The EGA limits its remit to 2087. End of plant life, however, is a minimum of 2140 and likely to be 2190.
7. The EGA assumes that shoreline sinuosity remains similar to the present. In other words, the coastline remains similar to now. This ignores the possibility of shoreline retreat across the low-lying marshland of Minsmere and Sizewell which, in my view is imperative to consider and could have profound implications for the flood risk safety case and the Coastal Processes Monitoring and Mitigation plan.

See: DCO: Coastal Geomorphology and hydrodynamics, Appendix 20A, op.cit., Page 134

Each of these assumptions and limitations are discussed below:

1) The Expert Geomorphological Assessment limited its study to 'reasonably foreseeable conditions' a phrase that does not appear to be completely clear in this context. EDF claims that 'no assessment can be made of extreme events', and the drivers of change are 'moderate' events:

> *"A projection based on the 'reasonably foreseeable' conditions was considered the most appropriate method of reaching consensus as* ***'extreme events' that could occur have a low (or poorly-determined) chance of occurrence*** *and geomorphic systems tend to be shaped by more frequent moderate events (Wolman and Miller, 1960), with the exception of cataclysmic change".* Coastal Geomorphology and hydrodynamics, Appendix 20A, op.cit., Page 134 and BEEMS TR403, p.33.

Wolman and Miller's studies of geomorphic processes were produced in the 19**60**s; the explicit exclusion of extreme events is surely *an unsupportable premise where conservative consideration should be a given.* The shoreline at Sizewell is dominated by frequent small low-energy events, so it is shaped by these most of the time, and then a storm (particularly Easterly) does much damage through erosion and flooding. Increases in overall energy supply to the coastline will occur from any increase in either storm frequency or intensity. See section 2 and 4 of Rep2-393.

The Intergovernmental Panel on Climate Change (IPCC) confirms the possibility of a much-increased shoreline energy supply in stark contrast to the approach of the EGA:

- *"Extreme sea level events that are historically rare (once per century) are projected to occur frequently (at least once per year) at many locations by 2050".*

Why is a shoreline change assessment for a new nuclear installation not taking these more conservative data into account?

2) The 'panel of seven geomorphologists' limited sea-level rise to 0.52m at 2070 – a mid-category Representative Concentration Pathway.

> *"…future shoreline change affecting the Sizewell C development was assessed based on SLR in 2070 of 0.54m (the 95th percentile under the UKCP18 mid-range scenario)."*
> DCO: Coastal Geomorphology and hydrodynamics, Appendix 20A, op.cit., *Paragraph 2.4.1 Page 48*

This is not a conservative approach—advice from UKCP18 which advises that planners use H++ values, or at least RCP8.5, 95th percentile. See section 4 of Rep2-393.

- **The EGA states "*no direct correlation between sea level rise and shoreline retreat is anticipated…"*** (see TR403 section 3.1.3.1). Yes indeed, of course. This does not provide reassurance.

Sea level rise needs to be considered to at least 2140 as a minimum, not 2070.

3) The panel limited the offshore wave climate to 'unchanged'. UKCP18 does not stress major increase in offshore wave climate, nevertheless, EDF notes in the Main Development Site Flood Risk Assessment:

> *"4.2.16 The Environment Agency guidance (Ref 1.7) suggests assuming a precautionary increase in wave height of 5% up to 2055 and then 10% from 2055 to 2115."*
> DCO: Main Development Site Flood Risk Assessment, op.cit., Page 54.

Also, UKCP18 suggests 'inherent uncertainty' as regards 'Significant Wave Height' predictions as they represent an area of low predictive accuracy:

> *"Given the inherent uncertainty in projections of storm track changes and the limited sample size available, the wave projections presented here should be viewed as indicative of the potential changes with low confidence."* [2]

It continues that wave patterns are defined by local activity, which, for Sizewell C will be from a North/North/East fetch across the large expanse of the North Sea. The 1:100 return period (an 81.9% chance of occurring between now and 2190) wave height being 7.3m-7.8m.

4) For the 'inshore wave climate to remain unchanged' is to explicitly state there is a reliance and dependency on the Sizewell-Dunwich offshore banks and longshore, nearshore bars remaining in their current form. This bank network acts as a set of three 'breakwaters' that attenuate and dissipate wave energy reaching the nuclear foreshore. As stated in BEEMS TR553, the banks have ***'natural energy dissipating effects'***—reducing and controlling the inshore wave climate. To assume the banks' stasis and to rely on their 'energy dissipating effects' for station life is, however, a profoundly non-conservative approach as explained below.

Leading authorities such as Mott Macdonald, the respected global engineering consultancy which undertook an extensive study of the area in 2014 considers that:

[2] UKCP18 Page 28.

"…at a local scale the SDBC [Sizewell-Dunwich Bank Complex] has the potential to change over time-scales shorter than a few decades." [3]

Cefas also acknowledges uncertainty:

"…our understanding of bank dynamics is poor"
BEEMS Technical Report Series 2009 no. 058, Sizewell: Morphology of coastal sandbanks and impact to adjacent shorelines. Page 47.

- The Marine Management Association states: ***'the northern end of Dunwich bank has lowered 2 metres in the past 10 years; the most logical assumption would be for this trend to continue.'*** This roughly equates to 4 million tonnes of bank deposits 'lost to the system' in a decade.[4]

- The Applicant states definitively in its responses to me that:

  - *"...shingle is effectively confined to the system… that is, the pebbles are confined to the system,* ***but the sand is not****."*
  - The Applicant also confirms that the *"****Dunwich Bank is made from sand, not shingle or mud".***[5]

How can the Dunwich bank be expected to be fully maintained if the sand of which it is formed is not 'confined to the system'? Why should the sand remain on the bank? Why is the Dunwich bank depleting now and, as the Marine Management Organisation confirms, is most likely to continue doing so? Why does historical evidence show clearly that the bank has had many forms and depletions (that have resulted in some of the highest shoreline erosion rates recorded) over the last 200 years? Is this not '*strong evidence'* that future change to the Dunwich bank sands and nearshore bars is effectively unknowable?

Despite the clear and extensive evidence of these irrefutable variables, the Applicant states in the DCO:

"The principal receptors (beach, bars, bank and crag) of the future baseline can be expected to resemble the present (i.e. no regime shift) over much or all of the station life." Chapter 20 DCO: Coastal Geomorphology and Hydrodynamics. Paragraph 20.4.78.

The Examiners and BEIS in the final 'Decision' documents fully agree with this one paragraph ignoring all the discussed variables and strong evidence that change to the bank network is unknowable:

"In respect of the Sizewell-Dunwich banks the ExA notes [ER 5.8.147/148] that in contrast ESC and the EA are satisfied that the Applicant's assessment of these features is robust and the EA advises there is no strong evidence to suggest the system would lose these controls in the lifetime of the Proposed Development [ER 5.8.147]." Section 4.272 BEIS SzC Decision letter 20/7/2022 5.11.196.

[3] Mott Macdonald, 'Thorpeness Coastal Erosion Appraisal, Final Report, December 2014', Mott Macdonald page 57.

[4] See 5.1.7, MMO Reference: DCO/2013/00021, 30th Sept 2020.

[5] "SZC Co.'s Response to Nick Scarr's correspondence to BEIS regarding EN010012 18th March 2022 Section 5 'Coastal Considerations'. Published on the planning website 25th May 2022

So, apparently, as far as the Examiners and BEIS are concerned, not only is there '*no strong evidence'* that the Dunwich bank could change but also the Applicant's non-conservative assessment is actually '*robust'*. I fail to understand how any non-conservative, non-precautionary assessment that chooses to dismiss authoritative advice underpinned by empirical and historically validated variables can possibly be 'robust'.

In fact, the statement above accepted by the Examiners and BEIS is in direct contradiction to the following admission by the Applicant itself in a different document:

> *"It is important to note that changes to the broad coastal regime and coastal processes may occur within the station life."*
> The Sizewell C Project 6.14 Environmental Statement Addendum, Volume 3: Environmental Statement Addendum Appendices Chapter 2 Main Development Site, Appendix 2.15.A Coastal Geomorphology and Hydrodynamics. Para 6.5

In summary of point 4 and in my view, it is axiomatic to state that relying on the '*natural energy dissipating effects'* of the Sizewell Dunwich banks and nearshore longshore bars remaining unchanged and controlling and mitigating nuclear shoreline erosion rates over the next 150 years is not a conservative or precautionary approach.

5) Conservative modelling of coastal processes should extend beyond the 3Km remit of the EGA. Sizewell C is a major project, and its assessment scope of shoreline impacts should extend beyond the Greater Sizewell Bay.

6) The EGA limits its remit, 'temporal range', to 2087 (and sea level rise to 2070) instead of end of station life which is a minimum of 2140 and more likely 2190. In a recent 'East Anglian Daily Times' article, a senior coastal scientist at Cefas, and one of the seven expert geomorphologists responsible for the study is reported as saying:

> *"… that while Cefas does look far ahead into the future, it is generally only possible to predict detailed changes to the coastline over the next 10 years."* He continues, *"We can try and predict as much as we like, but almost every prediction in the very long-term has no certainty around it." 'Flooding and 'extreme' storms won't put Sizewell C in danger, experts say'* by Andrew Papworth, East Anglian Daily Times, 06 August 2020', https://www.eadt.co.uk/news/cefas-sizewell-c-coastal-erosion-2684774

Therefore, in the face of 'admitted uncertainty' one might reasonably think it more than ever imperative to take a conservative view from authoritative sources such as the IPCC instead of assuming best-case outcomes? This uncertainty is nowhere evident in EDF's public information newsletter, '*Doing the power of good to Britain'*, and quoted in the introduction in REP2-393, that the Expert Geomorphological Assessment forecasts the *'very best assessment of long-term coastal change'* and therefore shows Sizewell C to be *'future-proofed'*.
The EGA in the form presented and approved in the DCO hearing does not support this statement.

7) The EGA assumes that shoreline sinuosity remains similar to the present *"The consensus view was that the 'natural' future shoreline was likely to be no more sinuous than it is"* Page 135 Appendix 20A.

- The idea that the shoreline remains essentially unchanged is non-conservative, non-precautionary and not in accord with accredited and authoritative advice such as the Intergovernmental Panel on Climate Change (IPCC): "*Sea-level rise under emission scenarios*

that do not limit warming to 1.5°C will increase the risk of coastal erosion and submergence of coastal land (high confidence)." The Minsmere levels and Sizewell marshland are low-lying land – why would the shoreline not retreat over these levels in the next 150 years and therefore cause a vastly different 'shoreline sinuosity'.

- Coastal wetlands provide a degree of natural defence against coastal flooding by dissipating wave energy and stabilising shore sediments. All this is lost when permanently inundated. The assumption that '*shoreline sinuosity remains similar to the present'* affirms a reliance on these coastal marshlands remaining as they are and hence providing wave energy dissipation during flood and surge conditions.

Summary of the IPCC view:

The IPCC (Intergovernmental Panel on Climate Change) reports significantly increased shoreline stress occurring by 2050:

- *"Under the same assumptions,* ***annual coastal flood damages are projected to increase by 2–3 orders of magnitude by 2100 compared to today (high confidence)".*** The report continues: ***"For example, extreme sea levels (e.g., the local "hundred-year flood") now occurring during storms that are historically rare are projected to become annual events by 2100 or sooner at many low-lying coastal locations."***
  IPCC: '*The Ocean and Cryosphere in a Changing Climate This Summary for Policymakers was formally approved at the Second Joint Session of Working Groups I and II of the IPCC and accepted by the 51th Session of the IPCC, Principality of Monaco, 24th September 2019*. Pages spm-22, spm-32 and 1-44.

- The 2022 IPCC report increases the risk: ***"Extreme Sea level events that are historically rare (once per century) are projected to occur frequently (at least once per year) at many locations by 2050".*** IPCC Climate Change 2022 Impacts Adaptation Vulnerability, section 11-8.

- *"The increasing frequency of high-water levels can have severe impacts in many locations depending on exposure (high confidence). Sea level rise is projected to continue beyond 2100 in all RCP scenarios."*

The increasing rate of storm delivery, particularly from 2050, affirmed by accredited sources such as the IPCC, **will result in greater overall energy level delivered to shorelines**. This will have more relevance to 'soft' coastlines such as Sizewell. The first 80 metres or so of the Sizewell nuclear shoreline is recently accreted material (1836-1920, see Appendix 2) and can be assumed to be particularly vulnerable. It is not clear whether EDF and its advisors have considered the latest modelling techniques—such as Accumulated Excess Energy—in their shoreline assessments.

The Applicant, in fact, confirms knowledge of this but, extraordinarily in my view, chooses to ignore it: *"…an increase in frequency of erosive events could increase the 'steady' rate of retreat…the EGA concluded that no additional estimate of uncertainty should be derived for the effect of faster 'background' retreat rates as there is no obvious mechanism for this to occur before the earliest projected date for the future shoreline".* Expert Geomorphological Assessment of Sizewell's Future Shoreline Position TR403 Page 69, 70.

The IPCC adds:

> "*Sea-level rise under emission scenarios that do not limit warming to 1.5°C will increase the risk of coastal erosion and submergence of coastal land (high confidence)"*

IPCC_AR6_WGII_FinalDraft_FullReport.pdf Page 381 of 3676 Chapter 3 (3-5).

As stated earlier, why would this statement not apply to the low-lying marshlands of Minsmere and Sizewell surrounding the proposed Sizewell C?

Note that elsewhere the Applicant acknowledges that '*without mitigation*' there will be *"..deepening of the eroding sub-bay between Minsmere outfall and the northeast corner of Sizewell C (Southern Barrier), with shoreline retreat of up to 100m (approximately the width of the existing barrier, perhaps bring this sub-bay too into a phase of roll-back within 50 years".* Chapter 20 Coastal Geomorphology and Hydrodynamics 20.4.80. This recognition of erosion is noted but should be evaluated north of the sluice to Minsmere cliffs where there is, as far as I am aware, no plan for mitigation in place. IPCC expert advice suggests a higher risk profile for 'roll back' of the shoreline but nevertheless, 100m recession could expose the entire marshlands to greater risk of permanent inundation. As stated previously, the period of evaluation must not be limited to recent periods and should be to at least 2140.

Summary of Section 1.

In my view, the opportunity and capacity within which the review has taken place, combined with one of the geomorphologist's views that their forecasts cannot extend reliably beyond 10 years, fully compromises any value in the current Expert Geomorphological Assessment's analysis of future shoreline recession.

- How can the EGA's severely limited remit be expected to provide reassurance of future shoreline change until at least 2140?
- How can reliance and dependence on the Sizewell-Dunwich offshore banks and longshore, nearshore bars remaining in their current form (i.e., as a set of three 'breakwaters' attenuating and dissipating wave energy reaching the nuclear foreshore) be acceptable when it is non-conservative, non-precautionary position that is contrary to accredited authoritative advice as well as empirical and historical evidence?
- How can the EGA be seen as appropriate for forming the basis of a flood risk assessment safety case defining Sizewell C's sea-defence design?
    - The Flood Risk Assessment (FRA) modelling of storms and surges presented in the DCO is itself characterised by regarding the three offshore breakwaters as permanent features and the shoreline basis (and hence the wave dissipating effects of non-inundated marshlands) as defined by the EGA. How can this be regarded as conservative (precautionary) approach to flood resilience? (See Note 1 at end of document).
- Is there awareness that the first 80 meters or so of the nuclear shoreline is recently accreted material – will it not therefore be particularly soft and vulnerable to erosion thereby increasing the risk of exposing the marshlands to permanent inundation? (See Appendix 2)
- How can a Coastal Monitoring and Mitigation plan (CPMMP) be effectively structured without first establishing conservative assessments of potential shoreline change?
- Uncertainties relating to climate change, offshore geomorphological change and hence shoreline change are a given. Why then did the EGA not adopt a conservative, cautious approach?

In my view 'high-confidence' IPCC advice should be afforded authority and its conservative advice represents a duty to the Applicant, BEIS and the Regulators; the EGA should be replaced with a conservative assessment of shoreline change for the Greater Sizewell Bay, and this should inform all

relevant aspects of the flood Risk Assessment (FRA) including the Coastal Processes Monitoring and Mitigation plan and hence overall station flood-defence design**.**

The next section looks at the final Development Consent Order (DCO) decision documents from BEIS and the Planning Inspectorate which assure the public that 'conservative assumptions around the evolution for the coastline, have been established'. Section 1 has shown that this assurance could not be valid if just based on the Expert Geomorphological assessment so what is it based on?

Section 2 – the Applicant's and ONR's responses to EGA questions during the DCO process and the final position taken by the Planning Inspectorate and BEIS on shoreline change for Sizewell C.

2.1 The Applicant, in its responses to questions raised concerning EGA non-conservative methodology offered the following:

- *"Expert Geomorphological assessment (EGA):*
  The purpose of the EGA, as set out in the Evidence Synthesis for Coastal Geomorphology [APP-312], was to review the potential for future shoreline change that could lead to exposure of the Hard Coastal Defence Feature (HCDF) without secondary mitigation (beach maintenance)." See: Response to the Applicant's document *"SZC Co.'s Response to Nick Scarr's correspondence to BEIS regarding EN010012 18th March 2022 Section 5 'Coastal Considerations'*.

However, this response is neither an explanation nor a justification for a non-conservative, non-precautionary shoreline change assessment. Also, the purpose of the Expert Geomorphological Assessment (EGA) as defined by the Applicant is for establishing *'…the future shoreline between Dunwich and Thorpeness, including the proposed SZC.*' (i.e., it is not just the Hard Coastal Defence Feature but the whole Greater Sizewell Bay. The EGA assumes, as confirmed by the Applicant above, little or no coastal retreat inland of the HCDF, a view seemingly inconsistent with IPCC recommendation – see pages 6-7).

In section 2 of the same document, the Applicant states: *"Mr Scarr does not provide any rationale in support of his view that the adjacent shoreline recession case is not 'severely receded'. The severely eroded adjacent (to the SCDF) shoreline case is derived from the EIA evidence base (Section 7.7 of Appendix 20A, Volume 2 of the Environmental Statement [APP-312]".*

- This is a response to my statement that the Applicant's claim to be representing *"…severely receded shorelines*" in TR544 (Sections 3.2.2 and 3.2.3, REP10-124 Page 44) is not necessarily fully substantiated. The Applicant's shoreline recession as proposed by '*App-312 section 7.7*' mentioned above appears to be primarily based on the EGA, Expert Geomorphological Assessment. This assessment, as stated many times in this paper, is non-conservative and therefore how can it possibly establish the credentials for the Applicant's claim to a 'severely receded' shoreline recession case?

2.2 It is informative to look at another set of responses from the Applicant and the ONR (Office for Nuclear Regulation) in response to a question raised by the Austrian government during the DCO process. The Austrian government expressed similar concerns to those discussed in this paper regarding flooding across the Greater Sizewell Bay marshlands:

Question 'FR4' from the Austrian government during the DCO process **and the response from the Applicant**:

- *Question "FR4: It is recommended to use a conservative approach that should address the loss of major sections of the marshlands whether from depletion of the Sizewell-Dunwich banks or climate change sea level rise of anything above 1.5°C."*

Applicant's response:

"2.6.1 Within the SDSR, coastal flooding studies for SZC take account of conservative assumptions around the evolution for the coastline/geomorphology and climate change in accordance with latest government guidance (UKCP18). This is fully inline with ONR and Environment Agency's expectations for these studies. As noted in the response to FR3, the RCP8.5 scenario used by SZC is the most precautionary scenario defined in UKCP18 and considers climate change where surface temperature exceeds the 1.5°C referred to (+4.3°C)."

My response to the Applicant part 2.6.1, with regard to coastline, i.e., shoreline retreat:

- The SDSR (the Site Data Summary Report). This is not a DCO document however a draft SDSR has been obtained by TASC from the ONR under FOI202202052 and is quoted from below:
- The SDSR, in fact, states: "*The rationale behind the definition and projection of a likely future shoreline baseline during the operational phase of SZC is set out in Reference [20]." (SDSR 2.4.2)*
- However, 'Reference [20]' quoted by the SDSR is TR403, The Expert Geomorphological Assessment (EGA) for shoreline retreat. The EGA, as repeatedly stated, is a self-declared non-conservative assessment.

20	TR403; Sizewell- Expert Geomorphological Assessment of Sizewell's Future Shoreline Position

SDSR Page 95 of 108

In summary, the Applicant, referring to its SDSR, claims that it took "*…account of conservative assumptions around the evolution for the coastline/geomorphology…"* however, the SDSR tells us that '*The rationale behind the definition and projection of a likely future shoreline...'* is actually based on the **non**-conservative EGA. (Clause 2.4.2, page 18 of 108).

Question 'FR4' from the Austrian Government during the DCO process **and the response from the ONR:**

In its response to the same question, the ONR claims that the Austrian government's question relating to these flood and erosion risk is, in fact, *'outside its vires'…*

- *Question "FR4: It is recommended to use a conservative approach that should address the loss of major sections of the marshlands whether from depletion of the Sizewell-Dunwich banks or climate change sea level rise of anything above 1.5°C."*

"ONR Response: This is essentially an environmental/habitats matter and therefore outside ONR's vires. There is nothing we would wish to add to the response provided by SZC Co."

My response to the ONR statement:

The flooding of the marshlands around Sizewell C is just an 'environmental/habitats matter'? Really? Is the ONR unaware that coastal wetlands provide natural defence against coastal flooding by dissipating wave energy and stabilising shore sediments? All this is lost when permanently

inundated. A major change to shoreline sinuosity must invalidate the EGA hence undermine the Flood Risk Assessment, flood risk safety case and subsequent analysed impacts for Sizewell C, including the Coastal Processes Monitoring and Mitigation plan – where exactly would that be? All this is then *'outside the vires of the ONR'*, an organisation that declares its role as *'[s]ecuring the protection of people and society from the hazards of the nuclear industry*'. I am unable to corelate the ONR's response with the ONR's responsibilities.

The final BEIS/Planning Inspectorate decision in the Development Consent Order.

These details related to question 'FR4' are essentially repeated in the final BEIS/PINS DCO decision documents:

The final BEIS/PINS DCO decision, 20 July 2022 repeats the assertion that *conservative evolution of the coastline has been established*:

- *"Section 2.6 of the Applicant's response notes that coastal flooding studies for the Proposed Development take account of conservative assumptions around the evolution for the coastline, geomorphology and climate change in accordance with the latest government guidance. The ONR did not wish to add anything beyond the Applicant's response." Section 4.345 BEIS SzC Decision letter 20/7/2022.*

  For reference of the DCO questions see: Response to the Applicant's document *'SZC Co.'s Response to the Secretary of State's Letter dated 31 May 2022'* section FR4 and the ONR's document *'Sizewell C: Final Recommendations from the Government of Austria - ONR Response to the Secretary of State June 2022 CM9 Ref. 2022/36295'* Section 2.4.

However, as the previous section shows, the Applicant claims that it took '*conservative assumptions around the evolution for the coastline'* then explains that the *'The rationale behind the definition and projection of a likely future shoreline…'* is based on its **non**-conservative EGA. This is a matter of concern explained in the Overall Summary below.

Overall Summary

The position taken by BEIS and the Planning Inspectorate in effectively reassuring the public that, '*conservative assumptions around the evolution of the coastline have been established'* does not appear to be securely founded; rather, it appears instead that the opposite has occurred, and **non-**conservative assumptions have been used to establish the evolution of the coastline. Non-conservative assumptions around the evolution of the coastline could represent high risk to future generations.

I hope that 'TASC' in discussions with the ONR and East Suffolk Council will be able to obtain clarification and review of this critical matter that, in my view, underpins the entire flood risk safety case.

I am perplexed that an assessment such as the EGA which seems to violate the fundamental principle of 'nuclear safety by conservative assessment', could ever have been *submitted* for a nuclear plant proposal never mind approved by the Regulators such as the Environment Agency, the Office for Nuclear Regulation, Examiners and BEIS.

The BEIS, Planning Inspectorate's decision that '*notes…the proposed development takes account of conservative assumptions around the evolution for the coastline'* may be incorrect, as this paper

shows, however, it serves to confirm that conservative assessment is the necessary approach for safely establishing shoreline change for Sizewell C.

Therefore, as stated earlier, the current Expert Geomorphological Assessment, the EGA, should, in my view, and based on the evidence in this paper, be replaced with a conservative assessment of shoreline change for the Greater Sizewell Bay for the full lifetime of the site, and this should inform all relevant aspects of the flood Risk Assessment (FRA) including the Coastal Processes Monitoring and Mitigation plan and hence overall station flood-defence design**.**

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Statements made in this document are my opinions, there is a basis to those statements and are therefore statements that any honest person could make. I have confirmed with the Intergovernmental Panel on Climate Change (IPCC) legal office in Geneva that I may cite or quote their documentation.

APPENDICES

Appendix 1 – My formal request to the Examiners for explanation.

From: Nick Scarr

Date: Wed, 25 May 2022 at 14:17

Subject: Expert Geomorphological Assessment EGA. Sizewell C. Formal request. 25 May 2022

To: <xxxxx@beis.gov.uk>, SizewellC <sizewellc@planninginspectorate.gov.uk>

For the attention of Gareth Leigh, Head of Infrastructure Planning BEIS, ref: Sizewell C.

From: Nick Scarr Interested Party number 20025524.

RE: Expert Geomorphological Assessment EGA. Sizewell C. Formal request.

It is axiomatic that nuclear build safety-case assessments and modelling should be conservative and hence precautionary.

However, the Sizewell C shoreline change analysis (The Expert Geomorphological Assessment, EGA) is non-conservative and hence non-precautionary.

I therefore formally request BEIS and the Examiners to kindly ask of the seven experts, internal and external to Cefas, who prepared the assessment to explain their position. Kind regards

Appendix 2 - The control and influence of the Sizewell-Dunwich banks on shoreline change and Coastal processes at Sizewell.

This is taken from my main paper REP2-393 Section 2, reproduced here for convenience.

EDF's BEEMS report TR058, quoting Pye and Blott, states:

> *"The 1836 [1736-1836] shoreline at Sizewell is the most eroded shoreline in the records assembled by Pye and Blott (2005), being some 60 – 100 m landward of its current position and just 20 m seaward of the present location of the Sizewell B cooling-water pump house. By 1883, the shoreline had advanced by up to 130 m, presumably as a result of the increased sediment supply from the cliffs to the north."*
> BEEMS Technical Report Series 2009 no. TR058, Sizewell: *Morphology of coastal sandbanks and impact to adjacent shorelines*. Page 40.

> *"Major changes have occurred along the coastline in the last 1000 years, with coastal projections north of Southwold, at Southwold itself, at Dunwich and at Thorpeness all having been eroded by significant distances (up to over 1 km)".* BEEMS TR139, Edition 2: A Consideration of "Extreme Events" at Sizewell, Suffolk, With Particular Reference to Coastal Morphological Change and Extreme Water Levels. Page 4 of 301.

For details of erosion/accretion described in the following, see: *Coastal Processes and Morphological Change in the Dunwich-Sizewell Area, Suffolk,* UK Author(s): Kenneth Pye and Simon J. Blott (May, 2006), pp. 453-473. See also Pye Blott, 2005, *Coastal Processes and Morphological Evolution of the Minsmere Reserve and Surrounding Area, Suffolk*.

Three 'approximately 100-year' episodes are recorded for Sizewell:

1. **Erosion:** As stated above, the Sizewell shoreline between 1736 and 1836 is *"the most eroded shoreline in the records"* according to BEEMS TR058 quoting Pye and Blott (2005). It appears that the 1836 shoreline had eroded approximately 300m in one century and was just 20m seaward of the present-day Sizewell B. Orange arrow in the air photo below.

2. **Accretion: The Sizewell-Dunwich bank grew after 1824 and protected the shoreline**; between 1836 and 1903/1920 the Sizewell shoreline accreted by 83m with sediment from cliffs to the north, particularly Dunwich, to roughly its present location. The present Sizewell shoreline is hence 'soft and erodible'. Blue arrow on the air photo below.

    - BEEMS states, however, *"The last 2 to 3 decades of strong erosion at Dunwich were not, however, matched by ongoing accretion in the south".* BEEMS TR223 op cit., Page 119, Table 12 on p. 115.

3. **Stability:** 1920- present day, relative stability. Green arrow on the photo below.

The following 'air photograph' taken in 2000 showing imposed historical coastline positions and Sizewell B power station shows the three episodes:

Three major 100-year episodes of erosion, accretion and relative stability of the Sizewell shoreline discussed earlier on a large-scale air photograph:

Approximate 1736 shoreline-300m seaward.

'Coastal Processes and Morphological Change in the Dunwich-Sizewell Area, Suffolk', UK Author(s): Kenneth Pye and Simon J. Blott Source: Journal of Coastal Research, Vol. 22, No. 3 (May 2006).

1. Orange arrow shows erosion period 1736-1836.
2. Light blue arrow shows accretion period post the development of the Sizewell-Dunwich banks, 1836-1920.
3. Light green double arrow shows the relative stability period 1920- present.

The following two historical maps illustrate the coastline in 1736 and 1836. The 1736 shoreline according to Pye and Blott appears to be approximately 300m-350m to seaward of Sizewell B and as stated earlier is *"…the most eroded shoreline in the records assembled by Pye and Blott (2005)".*

"Historical maps showing coastal changes at Minsmere since 1736, based on maps by Kirby (1737), Hodskinson (1783), and the Ordnance Survey (1837, 1883–84, 1928, and 1976–82). The position of mean high water in 1976 is displayed as a solid line on each map for reference. Topography is shaded at 5m intervals." See: 'Coastal Processes and Morphological Change in the Dunwich-Sizewell Area, Suffolk', UK Author(s): Kenneth Pye and Simon J. Blott Source: Journal of Coastal Research, Vol. 22, No. 3 (May 2006). Page 462

Squares are 1km scale.

My own measurements, which are not included in this document, using modern Ordnance Survey and maps drawn of the Suffolk Coast in 1737 by John Kirby et al., and allowing for major errors, suggest erosion at Sizewell *far greater* than 350m in this period 1736-1836. This is consistent with other observations on this coast such as Benacre cliffs: *"the mean rate of retreat of the Benacre Cliffs was 7.02 meters per year"* BEEMS TR311, 2.3.3.

This extreme erosion that has particularly occurred at Sizewell may be explained by the following statement that wave energy coefficients are not constant along this length of coast:

> *"Indeed [wave energy coefficients] suggest a concentration of energy in the Sizewell area, [offshore of the Sizewell-Dunwich banks] especially for wave headings between 230 and 300 degrees. Wave refraction calculations also suggest that, particularly with waves come from the direction of maximum fetch (210 degrees),* ***there are energy foci along the coast,***

notably between Sizewell and Thorpeness.” Institute of Oceanographic Sciences, Sizewell-Dunwich banks field study, Topic Report 6, Carr, King, Heathershaw and Leeds. Page 15

It appears clear that sediment released in northern cliff erosion cannot be relied up on to remain within the system:

1. “*The last 2 to 3 decades of strong erosion at Dunwich were not matched by ongoing accretion in the south*.” BEEMS TR223 Table 12, shows net erosion of the Sizewell C foreshore since 1993.
2. The Dunwich bank northern third has dropped between 1 and 2m – a huge amount of sediment seemingly lost to the system, not retained.

Based on the above, in my view there is **no plausible mechanism** that could justify the assumption for the maintenance and preservation of the unconsolidated Dunwich bank over the next two 100-year episodes of coastal processes, the uncertainties of which can only be increased by climate change sea-level rise and storm level change. This loss could result in significant shoreline erosion around Sizewell C. See my papers REP2-393, REP7-219, REP10-345.

2.1 The Applicant’s view on the Sizewell nuclear shoreline.

EDF/Cefas, in its consideration of the impacts on coastal processes appear to overlook the much of the detail of these events briefly commenting on only two distinct phases:

- In the BEEMS TR311 historical backdrop it states: *“The Sizewell shoreline has experienced two distinct phases in the past 180 years*.” BEEMS TR311 Sizewell Coastal Geomorphology and Hydrodynamics Syntheses. Section 2.3.6/2.3.6.1.

- This is repeated in EDF’s main geomorphological DCO documents: “*The Sizewell shoreline has experienced two distinct phases in the past 180 years.”* DCO: Appendix 20A Coastal Geomorphology and Hydrodynamics: Synthesis for Environmental Impact Assessment, Page 37.

In later DCO responses to this paper (REP7-059) EDF suggests that the “*The system conditions prompting erosion in 1736-1836 do not pertain in the present day. Pye and Blott (2005) describe a large Broad prone to frequent freshwater flooding (prompting installation of the sluice 1810-1830, and drainage such that the Broad identity is effectively lost by 1890). This phase of erosion ended with the sluice and was partially reversed in the 20th Century. Given this, it makes no sense to emphasise data from this period.”*

There is no documentary evidence, however, that the drainage of the Sizewell belts occurred to the south at Sizewell Gap but certainly we know that by 1783 the area drained northwards (accredited source Pye and Blott, 2005) and therefore the wetlands to the north do not appear to have a clear link with the acute erosion experienced along the shoreline at Sizewell itself.

The phase of severe erosion also appears to have ended *prior to the building of the sluice* in 1810-30 as Hodskinson’s map of 1783 indicates. Minsmere sluice may have aided the accretion period after 1836 but in my view the end of the acute erosion period and the start of the accretion period coincides, as stated, with the development of the Sizewell Dunwich banks.

There is, therefore, in my opinion, much merit and ‘sense in emphasising’, not just the erosion period but *each of the three main episodes of coastal change* that have occurred at Sizewell from

1736 to the present day. In my view a study that will illustrate the indispensable role of the Sizewell-Dunwich banks to nuclear shoreline stability and security.

The acute 1736-1836 erosion episode appears to have ended with the development of the Sizewell-Dunwich banks to the north, what is now called the Dunwich bank. Its loss therefore might reasonably return the shoreline erosion to a similar level of erosion.

2.2 The clear 'linkage' between the Dunwich bank and its effect on what is now the nuclear shoreline.

The Applicant has attempted to claim in later responses to me that:

- *'…shoreline behaviour is incoherent and shows no clear linkage to the form of the [Sizewell-Dunwich] bank'.*

In my view this statement has no merit. The following explains the clear evidence for 'linkage'.

I am unable to locate periods of significant (approximately 80 m), non-transient accretion on this section of coastline from 1836 anywhere except at Sizewell. I suggest this affirms the ineluctable importance of the Sizewell-Dunwich banks to Sizewell shoreline stability.

The following points support this view:

- *"Between 1835 – 1930 the northern part of the Sizewell – Dunwich Bank system grew significantly in size"* BEEMS TR223 Page 137.

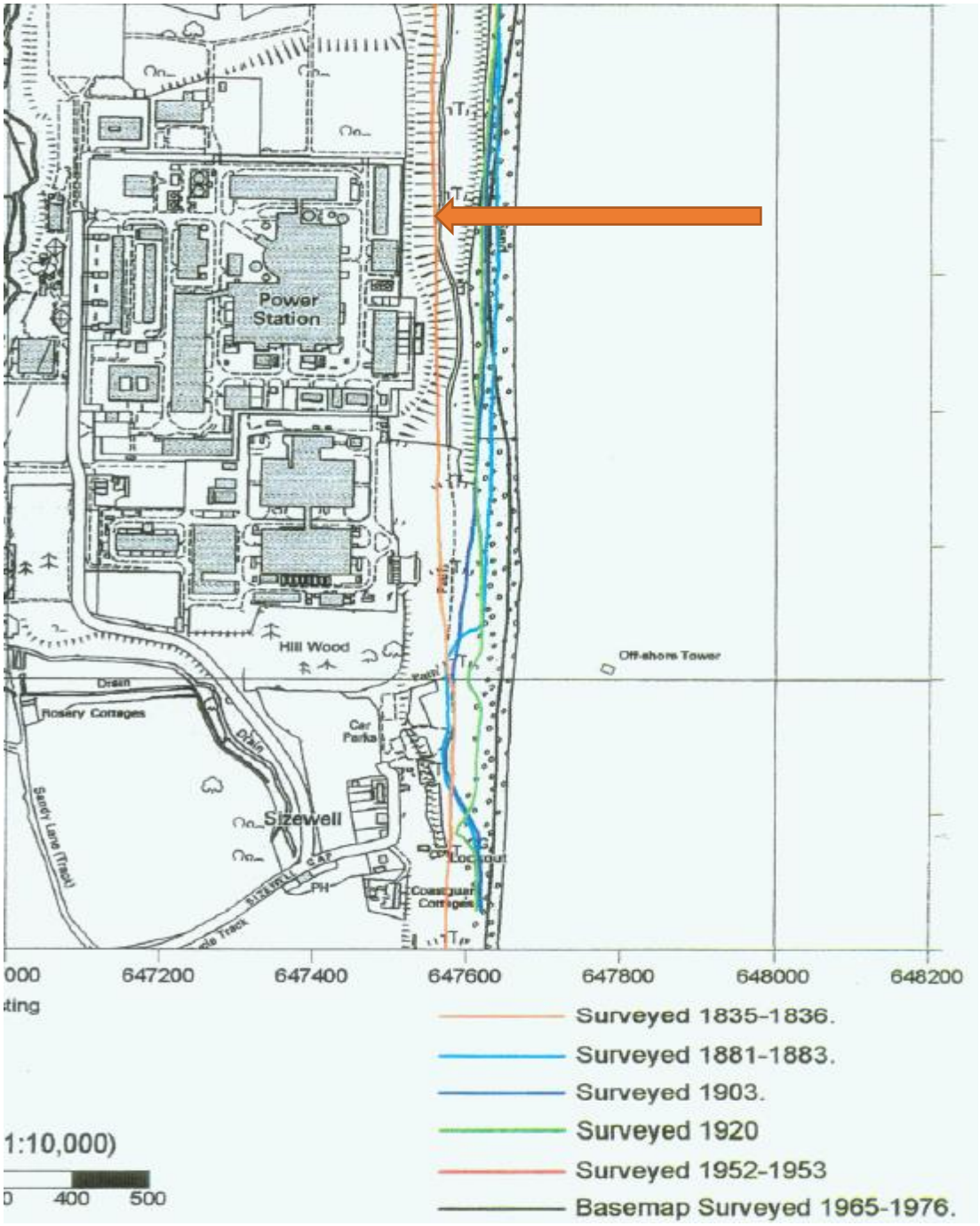
- *"Evidence from historical marine charts and maps suggests that Sizewell Bank was in existence at least by the 1820's, but the bank extended northwards rapidly towards Dunwich during the period 1824 to 1930."* BEEMS TR107, Page 83

- *"Growth of the Sizewell-Dunwich Bank after 1824 probably also played a role"* BEEMS TR139, page 1. Many references to bank growth of the bank in this period in this paper.

- *"The present regime is considered to be the result of: …an overall reduction in inshore wave energy due to growth of the Sizewell – Dunwich Bank (elevation, width and extent), which is thought to have been a sink for some of the material eroded from Minsmere – Dunwich Cliffs during its 19th Century erosive phase"*
  EDF DCO: Coastal Geomorphology and Hydrodynamics, Appendix 20A. Page 19.

- The phase of severe erosion appears to have ended *prior to the building of the sluice* in 1810-30 as Hodskinson's map of 1783 indicates.

- The following two charts '*Changes in coastline position and MLW position from historical OS maps*' clearly show the geographical location of the period of accretion being coincident with the development of the Dunwich bank after 1824. **The shoreline beyond the protection of the Dunwich bank did not accrete and continued eroding.**

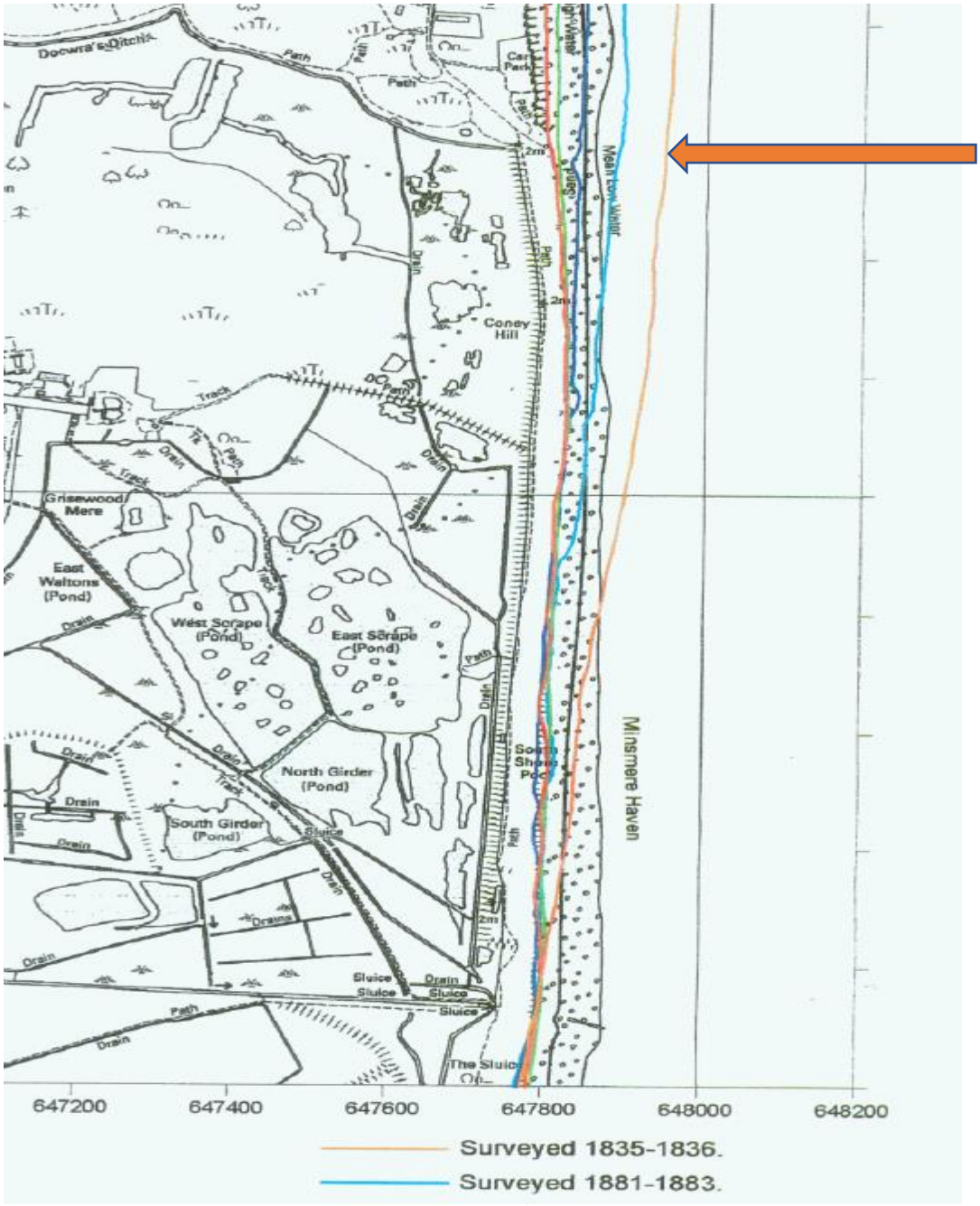


Pye, Blott, 2005 Coastal Process and Morphological Evolution of Minsmere. RSPB.

The 1952-3 survey is not shown and starts further North. The orange arrow shows the 1836 survey line in both charts.

"Changes in coastline from historical OS maps". Map 1 – Sizewell.

Note that the 1835-6 survey line is further ***landward*** than present at Sizewell. *(Hence, protected by the development of the Dunwich bank from 1824, the shoreline accreted approximately 80m between 1836 and 1920)*



Pye, Blott, 2005 Coastal Process and Morphological Evolution of Minsmere. RSPB.

"Changes in MLW position from historical OS maps". Map 2 – North of Minsmere sluice.

Note that the 1835-6 survey line is further ***seaward*** north of Minsmere sluice. *(Hence, unprotected by the Dunwich bank, erosion continued between 1836 and 1920).*

A technical paper, *Cumulative versus transient shoreline change: Dependencies on temporal and spatial scale* Eli Lazarus et. al., offers a scientific validation of the shoreline—offshore bank relationship and suggests that long-term shoreline behaviour may be partly explained by "*hydrodynamic interactions with nearshore geologic bathymetric structures*" (i.e., the Sizewell-Dunwich banks in our case). This paper is freely available at the following location: https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2010JF001835

There is then, clear evidence of 'linkage' between the development of the Dunwich bank and the end of the erosion period, and the accretion/stability period is geographically coincident with the development of the Dunwich bank; therefore if the Dunwich bank were to be lost or compromised, that the shoreline at Sizewell could return to a period of extreme erosion.

In summary of Appendix 3 it can be stated that the Sizewell Dunwich banks are ***the*** decisive arbiter of micro-stability of the nuclear coastline at Sizewell. They protect the inner and outer longshore bars and after the growth of the Dunwich bank from 1836 has protected the shoreline from being the '*most eroded in records'* through accretion to stability. The banks will always be of critical importance to Sizewell C and conservative modelling cannot, under any circumstances in my view, rely on their overall retention and maintenance to end of station life. See my document REP2-393 sections 2, 6, 7.

Appendix 3 – the late announcement from the ONR – the Office of Nuclear Regulation.

On the 19 July 2022 (the day before the Planning decision announcement) the Office for Nuclear Regulation (ONR) sent the following email to me which appears to corroborate my concerns and hence may effectively call into question aspects of the validation and approvals given by BEIS, the Examiners and the Regulators as discussed in this paper:

> *"With reference to the concerns you raise regarding the potential effects of coastal erosion and the suggestion that extended sea defences and a reappraisal of platform height be considered. In our assessment of NNB GenCo (SZC) Ltd.'s application for a nuclear site licence, we noted that the evolution of the coast and offshore sediment has the potential to impact on the coastal flood hazard for SZC. That assessment identified a number of items related to coastal flood hazard characterisation that will need to be resolved prior to detailed design and/or construction of the sea defences."*
>
> *"NNB GenCo (SZC) Ltd has committed to further coastal flood hazard studies, and we would expect the impacts of changing geomorphology and bathymetry to be taken into account accordingly in these studies. Our assessment recommended that for all components of the coastal flood hazard, the derivation of the 10-4/yr annual frequency of exceedance event uses the best available relevant data source(s) and methodologies that align with relevant good practice. Our assessment report will be available in due course."* My red text.

Appendix 4 – Recent erosion photos of Sizewell beach

Note 1:

The Applicant confirmed at Issue Specific Hearing 'ISH11' Tuesday 14 September 2021 and confirmed in writing in ExQ2 that: *"…the scenario…**with the Sizewell - Dunwich bank in situ**… [and the nearshore, longshore bars] was adopted in the MDS FRA [Main Development Site Flood Risk Assessment modelling] **for all scenarios and epochs**..." REP7-052 (EN010012-007054- Responses to ExQ2 epages 104-115.*