The Sizewell C Project

6.3 Volume 2 Main Development Site

Chapter 14 Terrestrial Ecology and Ornithology

Appendix 14B1 Plants and Habitats Synthesis Report

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Plates:

Please note that the red line boundary used in the figures within this document was amended after this document was finalised, and therefore does not reflect the boundaries in respect of which development consent has been sought in this application. However, the amendment to the red line boundary does not have any impact on the findings set out in this document and all other information remains correct.

Figures

None provided.

1. Plants and Habitats Synthesis Report

1.1 Introduction

a) Purpose of the synthesis report

1.1.1 The Ecology Chapter for the **Environmental Statement (ES)** of the power station at the main development site (referred to throughout this volume as the "proposed development") is supported by a detailed ecological baseline. The description and characterisation of impacts for ecology receptors for the proposed development site (hereafter referred to as the "site") are outlined in **Volume 2, Chapter 14** of the **ES**: Terrestrial Ecology and Ornithology**.**

1.1.2 For two ecology receptors, "plants and habitats" and "ornithology", Synthesis Reports have been produced to provide further detail on the evidence base underpinning the impact assessment. The reason for the focus on these two topics is that a significant proportion of the key ecological impacts arising from the proposed development would be pertinent to these ecological features, and because habitats and birds comprise the majority of the qualifying features of those European sites that are within the Zone of Influence (ZOI) (Ref. 1.1) of the proposed development. Therefore, a larger body of evidence has been required for these topics to underpin both the Ecological Impact Assessment and the Habitats Regulation Assessment (HRA). For the latter, it is necessary to demonstrate beyond reasonable scientific doubt that there would be no significant effects.

1.1.3 The Synthesis Reports bring together the following detailed information that has been collected to inform and support the HRA and Environmental Impact Assessment (EIA) processes:

- information from the scientific literature related to potential impact pathways arising from the proposed development and the likely effects on Important Ecological Features (IEFs);
- the results of related studies and modelling undertaken to inform specific aspects of the proposed development; for example, the likely effects of displacement of people currently using the EDF Energy Estate for recreation purposes; and
- information that has formed part of the extensive scoping and consultation process carried out with key stakeholders.

1.1.4 Note that the Synthesis Reports do not attempt to describe all potential impact pathways associated with the proposed development, only those

considered most relevant are discussed. In addition, no element of valuation or assessment is included. This information is instead presented in **Volume 2, Chapter 14** of the **ES**: Terrestrial Ecology and Ornithology.

b) Structure of this report

1.1.5 This document, **Appendix 14B1** of **Volume 2** of the **ES,** is structured to present information collected to inform and support both the HRA and EIA as follows:

- **Section 1** sets the context and purpose of the Synthesis Reports.
- **Section 2** summarises the key proposed development related effects (impact pathways) during construction and operation that are considered likely to affect plant and habitat features that have been determined as being of importance for the purposes of assessment (HRA and EIA).
- **Section 3** sets out the evidence base for each impact pathway, using the scientific literature, and studies undertaken to inform the impact description and characterisation for both the HRA and EIA. Each impact pathway is structured as follows:
  - (a) Description of impact pathway.
  - (b) Evidence base.
  - (c) Relevant IEFs.
  - (d) Summary implications for the HRA.
  - (e) Summary implications for the EIA.
- **Section 4** provides a list of the references used to compile the evidence base.

1.1.6 Note that this Synthesis Report only considers the plant and habitat interest features of designated sites and habitats and those potential impact pathways likely to affect them.

1.2 Potential effects and important ecological features

a) Introduction

1.2.1 This section sets out the evidence base for each of the potential impacts likely to affect plant and habitat receptors. For each impact, information from the published scientific literature, modelling work and project-specific studies is brought together in a synthesis. The information contained within this report has been used to aid the description and characterisation of the

impacts on each ecological receptor identified and, critically, provides the rationale for considering any potential effects on integrity.

b) Scoping

1.2.2 As indicated in **Section 1** of this Appendix, no detailed scoping has been undertaken within this Synthesis Report as this is addressed within the **ES**; however, to provide clarity, it is important to recognise that the potential impact pathways and potential IEFs considered in this Synthesis Report have been subject to an initial high-level scoping exercise and that some potential impact pathways and receptors are not considered in this synthesis as a result.

1.2.3 The HRA has taken the relevant European Designated Sites through detailed assessment and has considered impact pathways:

1.2.4 In addition, the Plants and Habitats Synthesis Report identifies several impact pathways relevant to plants and habitats. Those sites and features which have been scoped out have been presented in **Table 1.1**, including details on the justification.

Table 1.1: Impact pathways scoped out.

Impact Pathway	Justification for Scoping Out in Synthesis Report.
Radiological effects.	The Evidence Plan that has been produced for the Habitats Regulations Assessment (HRA) (Ref. 1.2) notes that there is a strict regulatory regime in place such that no significant effect should arise in relation to radiological effects.
Direct habitat loss.	Not considered in this Synthesis Report, as direct habitat loss does not require an evidence base to inform the characterisation and description of the impact. If a habitat is lost, the impact is self-evident.
Disturbance effects on species populations.	Not considered in this Synthesis Report as the focus is on plants and habitats not faunal populations. This includes the potential disturbance arising from noise, lighting and visual impacts, which are unlikely to cause an effect on plants.

1.2.5 **Table 1.2** summarises the impact pathways considered and their definitions. These effects and their definitions were set out and agreed as part of the HRA Evidence Plan (Ref. 1.2) process and therefore cover all the key effects of significance likely to affect plant and habitat IEFs.

Table 1.2: Generic effects and their definitions associated for the proposed development.

Effects	Definition
Alteration of coastal processes/sediment transport.	This includes the potential for erosion, accretion and sedimentation (short and long-term).

Effects	Definition
Disturbance due to increased recreational pressure.	Potential effects due to increased recreational pressure have been 'scoped in' where the site in question is within the ZOI for potential recreational effects. Potential effects include trampling and nutrient enrichment of supporting habitat.
Alteration of local hydrology and hydrogeology.	This covers potential physical effects on freshwater (including surface and groundwater resources), i.e. effects on flows and water levels, as well as any consequential indirect effects on habitats and species.
Changes in air quality.	Change in air quality through emissions to air and any consequential direct or indirect effects on habitats and species (e.g. lichens). Potential non-radiological air quality effects have been 'scoped in' where the site is within 10km of the site (and scoped out beyond this distance). Note, the ZOI for particulate (dust) emissions is generally much smaller than this (less than 200m from the emission source).

1.2.6 The potential impact pathways to be considered within this report are therefore as follows:

- alteration of coastal processes and sediment transport;
- recreational disturbance;
- alteration of local hydrology and hydrogeology; and
- alteration in air quality.

1.2.7 In addition to scoping the impact pathways to be included, an exercise has also been carried out to identify the IEFs to be considered in this Synthesis Report which are outlined in **Table 1.3**, with a summary of their importance:

Table 1.3: Generic effects and their definitions associated for the proposed development.

IEF	Summary of Importance.
Habitat forming the cited interest features of the Minsmere to Walberswick Heaths and Marshes SAC, namely: Annual vegetation of drift lines; European dry heaths; and perennial vegetation of stony banks.	• Annual vegetation of drift lines and perennial vegetation of stony banks has a limited distribution in the UK. • All three habitat types are interest features of the Minsmere to Walberswick Heaths and Marshes SAC. • All three habitat types listed in the citation for the Minsmere to Walberswick Heaths and Marshes Site of Special Scientific Interest (SSSI). • All three habitat types are habitat types listed on Section 41 of the Natural Environment and Rural Communities Act 2006 (NERC Act) (Ref. 1.3) and lowland heath and vegetated shingle are on the Suffolk's priority species and habitats list (Ref. 1.4). • Coastal vegetation supports elements of dry heath, an interest feature of the Minsmere to Walberswick SAC.

IEF	Summary of Importance.
	• Sand dune and dry heath are habitat types listed on Section 41 of the NERC Act and the Suffolk's priority species and habitats list. (International importance).
Habitat forming the cited interest features of the Alde - Ore and Butley Estuaries SAC, namely: Estuary, mudflats; sandflats and Atlantic salt meadows (saltmarsh).	• All three habitat types are an interest feature of the Alde – Ore and Butley Estuaries SAC. • All three habitat types are habitat types listed on Section 41 of the NERC Act and the Suffolk's priority species and habitats list. (International importance).
Habitat forming the cited interest features of the Orfordness to Shingle street SAC, namely: Annual vegetation of drift lines; coastal lagoons and perennial vegetation of stony banks.	• Annual vegetation of drift lines and perennial vegetation of Stoney banks has a limited distribution in the UK. • All three habitat types are an interest feature of the Orfordness to Shingle street SAC. • All three habitat types are habitat types listed on Section 41 of the NERC Act and saline lagoons and vegetated shingle are on the Suffolk's priority species and habitats list. (International importance).
Habitat forming cited interest features of Minsmere to Walberswick Heaths and Marshes SSSI. The site contains a complex series of habitats, notably mudflats; shingle beach; reedbeds; heathland and grazing marsh.	Specific notified habitat features (codes refer to the relevant National Vegetation Classification (NVC) code): • H1 – *Calluna vulgaris – Festuca ovina* heath. • H8 – *Calluna vulgaris – Ulex gallii* heath. • Lowland ditch systems. • M22 – *Juncus subnodulosus – Cirsium palustre* fen meadow. • M23 – *Juncus effusus* / *acutiflorus – Galium palustre* rush pasture. • M27 – *Filipendula ulmaria – Angelica sylvestris* mire. • S2 – *Cladium mariscus* swamp and sedge-beds. • S26 – *Phragmites australis – Urtica dioica* tall-herb fen. • S4 – *Phragmites australis* swamp and reed-beds. • S7 – *Carex acutiformis* swamp. • SD1 – *Rumex crispus – Glaucium flavum* shingle community. • SD11 – *Carex arenaria – Cornicularia aculeata* dune community. • SD12 – *Carex arenaria* – Festuca ovina – *Agrostis capillaris* grassland. • SD2 – *Cakile maritima-Honkenya peploides* strandline community. • SD6 – *Ammophila arenaria* mobile dune community. • dune grassland. • SM14 – *Atriplex portulacoides* saltmarsh. • SM24 – *Elytrigia atherica* saltmarsh. • Saline coastal lagoons. • U1 *Festuca Ovina – Agrostis Capillaris – Rumex Acetosella* Grassland.

IEF	Summary of Importance.
	• Vascular Plant Assemblage. • W6 – *Alnus glutinosa – Urtica dioica* woodland. The majority of these habitat types are listed on Section 41 of the NERC Act and listed on the Suffolk's priority species and habitats list. (National importance, except where habitat types are included under the International designation given above).
Habitat features forming cited interest features of Sizewell Marshes SSSI.	Specific notified habitat features: • Lowland ditch systems. • M22 – *Juncus subnodulosus – Cirsium palustre* fen meadow. • M23 – *Juncus effusus / acutiflorus – Galium palustre* rush pasture. • S26 – *Phragmites australis – Urtica dioica* tall-herb fen. • Vascular plant assemblage. The majority of these habitat types are listed on Section 41 of the NERC Act and the Suffolk's priority species and habitats list. (National importance).
Wet woodland present within Sizewell Marshes SSSI.	Wet woodland: • Is listed on the citation for Sizewell Marshes SSSI but is not a specific notified feature. • Has a relatively limited distribution in the UK. • Is a habitat type listed on Section 41 of the NERC Act and the Suffolk's priority species and habitats list. (National importance).
Coastal vegetation (sand dune with vegetated shingle) south of Sizewell C station, forming part Suffolk Shingle Beaches County Wildlife Site (CWS).	Vegetated shingle: • Has a limited distribution in the UK. • Forms part of the Suffolk Shingle Beaches CWS. • Supports several nationally scarce plant species and a diverse lichen flora. • Sand dune and vegetated area habitat types listed on Section 41 of the NERC Act and the Suffolk's priority species and habitats list. (National importance).
Broadleaved and mixed woodland within the site.	Broadleaved and mixed woodland: • Woodland cover is relatively scarce in Suffolk. • Broadleaved woodland is a habitat type listed on Section 41 of the NERC Act and mixed deciduous woodland is on the Suffolk's Priority Species and Habitats list. (County importance).
Acid grassland within the site.	Acid grassland: • Is limited in extent within the Suffolk Sandlings. • Is a habitat type listed on section 41 of the NERC Act and acid grassland on the Suffolk's priority species and habitats list. • Contributes towards the interest features of the Sizewell Levels and

IEF	Summary of Importance.
	Associated Areas and Leiston common CWS. (County importance).

1.2.8 The subsequent sections describe the evidence base for the four impact pathways scoped in and the IEFs that could be affected by them.

1.3 Evidence base for potential effects

a) Alteration of coastal processes and sediment transport

i. Description of impact pathway

1.3.1 This effect refers to changes in coastal processes and sediment transport that may result from construction and operation of marine infrastructure associated with the proposed development, namely:

- coastal defence features;
- Beach Landing Facility (BLF);
- cooling water intakes and outfall heads;
- Fish Recovery and Return (FRR) system; and
- combined drainage outfall.

1.3.2 Modification of the local wave climate, current speeds and sediment transport processes by the presence of proposed development infrastructure could reduce or enhance erosion and/or accretion along the coastline in the vicinity of Sizewell. If proposed development infrastructure led to significant change to coastal processes, then altered patterns of erosion/accretion could lead to a loss of coastal habitats (beach, shingle, dune) and potentially reduce flood defence resilience and lead to an increased frequency of inundation of low-lying wetland habitats situated behind existing defences.

1.3.3 The water intake and discharge and the FRR system are not envisaged to have any significant effect on the terrestrial environment and are not discussed further in this Synthesis Report. The full assessment is detailed in **Volume 2, Chapter 20** of the **ES**: Coastal Geomorphology and Hydrodynamics**, Volume 2 Chapter 21** of the **ES**: Marine Water Quality and Sediments and **Volume 2 Chapter 22**: Marine Ecology.

1.3.4 There would be two components to the proposed development coastal defences – a hard engineered feature that would protect the eastern and

northern flanks of the site, and a fronting soft feature made of beach grade sediments and vegetated soil. Similar material would be used to dress the hard feature where possible (including the use of existing sand and shingle substrate) so that it would be in keeping with the surrounding landscape and allow recolonization by a similar suite of plant species as present. The defences are described as follows:

1.3.5 The hard-coastal defence feature (HCDF) would be constructed from the north, beginning with the development of the BLF and its associated haul road for Abnormal Indivisible Loads (AILs). The materials and rock armour to build this first part of the HCDF and the BLF would be supplied from land. Once the BLF has been constructed and secured, it would be used to bring in the rock armour component of the HCDF, which would be placed along the seaward frontage of the site and to the northern flank of the AIL haul road.

1.3.6 The soft coastal defence feature (SCDF) would be made of landscaped beach grade sediments at 5 metres (m) ordnance datum (Newlyn) (ODN) elevation between the HCDF and the mean high-water spring (MHWS) (a distance of around 35m). It would cover any parts of the HCDF below this elevation. Sediments used to construct the SCDF would be delivered to the site (from a licenced aggregate extraction site) rather than re-profiling the beach, which would result in a volumetric increase in the back-beach area.

1.3.7 The BLF would consist of an 85m long piled jetty plus additional 11m of fenders and ramp. The last 36.5m of the BLF would be seaward of MHWS.

ii. Evidence base

1.3.8 Baseline information on the hydrodynamics and coastal geomorphology of the greater Sizewell Bay is set out in the British Energy Estuarine Marine Studies (BEEMS) Report TR311 (Ref. 1.5). This provides background data on the evolution of the Greater Sizewell Bay (including the offshore Sizewell-Dunwich banks), the local wave climate, tidal currents, sediment supply and transport. Report TR311 is itself supported by a number of other studies undertaken through BEEMS and which are listed in TR311.

1.3.9 BEEMS Report TR311 sets out that north of the Sizewell A and B power stations, two areas of persistent erosion are separated by an area of shoreline stability centred on the Minsmere Sluice. Erosion near the northern boundary of the Royal Society for the Protection of Birds (RSPB) Minsmere reserve (north of the Minsmere Sluice) is at a rate of up to -2.5 meters per year (m/y) between 1992 and 2013. The shorelines are stable for 0.5km either side of the Minsmere Sluice outfall because it acts like a groyne retaining sediment moving alongshore the shore. The second zone of persistent erosion extends from 500m south of the Minsmere Sluice to

250m north of the site boundary. Within this zone, a 400m long stretch of coast is eroding at up to -1.3 to -1.7m/y, largely due to rapid erosion since 2003 (-2.7m/yr).

1.3.10 From just north of the site, the shorelines are stable (change smaller than +/- 0.5m/yr) or advancing in net terms, with minor fluctuations associated with large storms, but overall the shoreline adjacent to the Sizewell A and B power stations has historically experienced shoreline stability. Any change to coastal processes caused by the proposed development infrastructure needs to be set against this context of historic stability.

Beach Landing Facility

1.3.11 The terrestrial piles of the BLF would be installed from a terrestrial piling machine. Although the method for marine piling has yet to be determined, it is likely to be using a cantilever method from the HCDF (no effects on coastal geomorphology) or from jack-up barge (tugboat or self-propelled). As the effects of constructing the intertidal sections of the BLF jetty would be localised, superficial and short lived, they would be expected to have no significant effect on the shoreline.

1.3.12 Modelling suggested that during operation the temporary rock jetty could cause minor effects on the Minsmere to Walberswick Heaths and Marshes SPA/SAC frontage. Whilst the bed level changes in the sub-tidal region off the end of the jetty are tidally dominated, the bed level changes and longshore shingle transport along the beach face is dominated by waves. A persistent period of south-east storms could lead to minor erosion north of the rock jetty and potentially as far as the Minsmere to Walberswick Heaths and Marshes SPA/SAC boundary. However, such effects would only be observed if the rock jetty was in place during a winter period with several months of south-east storms. If it were built, used and disassembled during the summer months, or a typical winter (north-east storm dominance), annually over the course of the construction phase, there would be no effect on the Minsmere to Walberswick Heaths and Marshes SPA/SAC frontage.

1.3.13 Modelling results (outlined in BEEMS Report TR311) show that when the BLF is in use there would be a higher impact on combined wave and currents bed shear stress, in both spatial extent and magnitude, in comparison when the BLF is not is use and covered by beach substrate. The area of change in bed shear stress extends to the Minsmere to Walberswick Heaths and Marshes SPA/SAC frontage, the magnitude of change is very small (1-2 N/m^2) compared to the maximum baseline bed shear stress (30-40 N/m^2) and therefore would have no effect on the shoreline, or the Minsmere to Walberswick Heaths and Marshes SAC habitat features.

Coastal protection features

1.3.14 The SCDF would be constructed of beach grade materials placed on the main platform frontage between the HCDF and MHWS at an elevation of 5m ODN, with a suitable slope to MHWS. These sacrificial sediments would be landscaped and planted with suitable vegetation. Once constructed, the 5m sacrificial dune's function is to minimise coastal erosion and release sediment to the beach face, which would only be activated during a storm event. Therefore, the effect on geomorphology would be localised and **not significant**. During operation the SCDF would provide a greater back beach volume and is likely to slow the rate of shoreline retreat locally.

1.3.15 The HCDF would be terrestrial, set well back from the coast and landward of the present 5m (ODN) dune/barrier. As the HCDF would be constructed terrestrially, and it is unlikely to affect coastal processes until the middle or late stages of station operation.

1.3.16 As outlined in BEEMS Report TR311 over time shoreline regression would eventually expose the HCDF. In the interim the eroding SCDF would introduce additional material slowing erosion rates and delaying the onset of breaching until the SCDF has been depleted. Various future coastline scenarios have been modelled both with and without the Sizewell C Project.

1.3.17 In summary, during the later stages of Sizewell C power station operation (i.e. some decades in the future) if the coast were allowed to recede without further intervention, the beaches along the main platform frontage would gradually reduce in width until the denuded beach exposed the HCDF. Two effects would then be expected: (1) scour at the exposed face of the HCDF due to the interaction between waves, currents and the HCDF, which would cause localised beach lowering and hinder sediment deposition; and (2) patterns of localised erosion and accretion caused by the HCDF's disruption to longshore sediment transport which may cause some small magnitude erosion on the Minsmere to Walberswick Heaths and Marshes SAC/SPA frontage which may require additional mitigation.

1.3.18 Modelling indicates that the coastal configuration at the 2053 – 2087 time horizon would have a similar basic form to that of today; however, breaching north of Minsmere outfall would have become more frequent signalling a transition from barrier scarping to roll-back. To the immediate north of the main platform, early breaching events may have occurred, although this is difficult to predict because the HCDF would trap material on its northern side, inhibit erosion and potentially prevent breaching altogether. There would be, however, some potential for the HCDF to cause low magnitude erosion of the main platform SAC/SPA frontage under south-east storms. To avoid exposure of the HCDF and erosion north of

main platform at this stage, additional mitigation would be undertaken, if required. The proposed additional mitigation is beach maintenance.

1.3.19 The method, location and volumes needed during an individual mitigation action would depend on the circumstances at the time, which cannot be predicted in detail now. However, the limited number of possibilities requiring mitigation provides an envelope for which a matching range of suitable measures has been determined. These are beach recycling, bypassing and beach recharge. The beach maintenance/sediment management approaches described in BEEMS Report TR311 are unlikely to have a negative effect on the Minsmere to Walberswick Heaths and Marshes SAC/SPA site north of the main platform, as they would not cause erosion. They could result in some localised short-term beach accretion, limited in extent by the relatively small volumes being moved or introduced.

1.3.20 The BEEMS Report TR311 also indicates that towards the end of Sizewell C power station operation, additional mitigation in the form of beach maintenance may no longer be appropriate and a monitoring plan would be used with appropriate evidence to justify the cessation of monitoring.

b) Conclusions of evidence base

1.3.21 The coastline adjacent to the Sizewell power stations has been historically relatively stable with little change.

1.3.22 The construction of the BLF is unlikely to significantly affect coastal processes. Modelling suggested that during operation the temporary rock jetty could cause minor effects on the Minsmere to Walberswick Heaths and Marshes SPA/SAC frontage, a persistent period of south-east storms could lead to minor erosion north of the rock jetty and potentially as far as the Minsmere to Walberswick Heaths and Marshes SPA/SAC boundary. Such effects, however, would only be observed if the rock jetty was in place during a Winter period with several months of south-east storms. If it were built, used and disassembled during the Summer months, or a typical winter (north-east storm dominance), there would be no effect on the Minsmere to Walberswick Heaths and Marshes SPA/SAC frontage.

1.3.23 During operation the BLF does have effects on combined wave and currents and bed shear stress but not sufficient for there to be a significant effect on the shoreline and therefore no likely effects on terrestrial habitats.

1.3.24 The 5m dune forming the SCDF would release sediment to the beach during a storm event and would be replenished following such an event. As such, this would have no long-term effect on coastal processes.

1.3.25 For the majority of the life of the Sizewell C power station the HCDF would remain covered with minimal effects on coastal processes and the

shoreline. In the 2053 – 2087 time horizon, uncovering of the HCDF could lead to accelerated erosion of the shoreline and effect terrestrial habitats and that this would be mitigated by beach maintenance including beach nourishment.

c) Relevant important ecological features

1.3.26 **Volume 2, Appendix 14A3** of the **ES** - Plants and Habitats Ecological Baseline, states that the following habitat types are present within the section of coastline lying 200m north and south of the proposed main platform:

1.3.27 North of the proposed main platform:

- dune grassland; and
- lowland dry heath vegetation, growing on sand with both Heather (*Calluna vulgaris*) and Bell Heather (*Erica cinerea*) considered to form part of the 'Lowland Dry Heath' interest features of the Minsmere to Walberswick Heaths and Marshes SAC (Ref. 1.6).

1.3.28 South of the proposed main platform:

- vegetated shingle and sand dune which forms part of the Suffolk Shingle Beaches CWS.

1.3.29 **Volume 2, Appendix 14A3** of the **ES** also states that no vegetated strandline shingle is present north of the proposed Sizewell C station, and that the Minsmere to Walberswick Heaths and Marshes SAC interest feature 'Annual vegetation of drift lines' is not present in this location (this comprising strandline vegetation growing on shingle). It should be noted that the existing coastline is already restrained by coastal squeeze resulting from the existing sea defences. The proposed development defences will not change the current situation and will not affect the natural drift line vegetation above and beyond the conditions and natural processes that are already taking place. As the earlier text notes, the area of the SAC immediate to the north of the Sizewell C Station does not comprise drift line vegetation which has been the result of existing / baseline coastal processes.

1.3.30 Therefore, the IEFs most likely to be affected by this impact pathway are as follows:

- coastal sand dune vegetation forming part of the Minsmere to Walberswick Heaths and Marshes SAC interest features: lowland dry heath; and

- vegetated shingle and sand dune vegetation forming the interest feature of the Suffolk Shingle Beaches CWS.

d) Summary implications for Habitats Regulation Assessment

1.3.31 The development of the proposed main platform would not result in the direct loss of any habitat area forming part of a European designated site.

1.3.32 The proposed development infrastructure would not be likely to significantly affect coastal processes and there would be no net loss of SAC plant or habitat features envisaged.

1.3.33 The SCDF would help maintain beach levels and reduce the potential for coastal erosion.

1.3.34 In the long-term, beach maintenance to keep the HCDF covered would reduce the potential for shoreline erosion.

e) Summary implications for Environmental Impact Assessment

1.3.35 The development of the proposed Sizewell C power station would not result in the direct loss of habitat of the Minsmere to Walberswick Heaths and Marshes SSSI.

1.3.36 The section of coast south of the proposed main platform forms part of the Suffolk Shingle Beaches CWS, which is designated for its species-rich shingle and dune vegetation. This habitat would be lost when the new HCDF is constructed but subject to mitigation as outlined as part of this assessment. Disturbance due to recreation displacement

i. Description of impact pathway

1.3.37 During the construction and operation of the proposed development, patterns of recreational usage in the Sizewell area may alter as a result of the displacement of existing recreational users (due to perceptions of the intrusive nature of construction activities, actual increases in noise levels and visual disturbance, and alterations to the local public rights of way network) and the influx of workers into the area. Resulting changes in the patterns of recreational activities, largely as a result of displacement of existing activities in the local area, may increase levels of recreational disturbance to sites supporting sensitive habitat types.

1.3.38 An increased number of visitors to an area can increase the physical trampling of habitat types such as heath and vegetated shingle, leading to the loss of component plant species and the replacement of these habitat types with bare un-vegetated substrate. An increase in dog-walking can also lead to a localised build-up of nutrients, due to dog faeces and urine,

causing localised enrichment which would favour vigorous fast-growing plants. This could cause slower-growing plant species to be out-competed, thus leading to an overall loss in plant species diversity.

1.3.39 Impacts of recreational disturbance of faunal species are considered elsewhere in the Ornithology Synthesis Report within **Appendix 14B.2** of **Volume 2, Chapter 14** of the **ES.**

ii. Evidence base

1.3.40 The evidence base relating to this issue can be split into three main areas:

- the baseline – designated site vulnerabilities and existing evidence for recreational pressure effects on sensitive habitats in the area;
- the predicted changes in recreational usage resulting from construction and operation activities and the spatial distribution of likely recreational pressure change; and
- studies on the sensitivities of plants and habitats to recreational pressure, in particular physical trampling, and nutrient enrichment from dog waste.

f) Designated site vulnerabilities

1.3.41 Following a review of publicly available documentation, **Table 1.4** provides a synthesis of the sensitivity and vulnerability of designated sites to recreational disturbance in particular trampling and nutrient enrichment.

Table 1.4: Designated site vulnerabilities and sensitivities.

Designated Site.	Summary of Vulnerability and Sensitivity Information.
Minsmere to Walberswick Heaths and Marshes SAC, SPA, Ramsar and SSSI.	• The Natura 2000 data form highlights that the annual vegetation of drift lines is vulnerable to human disturbance (Ref. 1.6). • The Ramsar Information Sheet highlights that the site is vulnerable to external forces such as sea level rise, coastal erosion, and visitor pressure causing trampling of vegetated shingle (Ref. 1.7). • The site improvement plan for the site (Ref. 1.8) raises several issues, including the need to reduce habitat disturbance (primarily from recreational disturbance). • The Natural England Condition Assessment of the SSSI underpinning the Minsmere to Walberswick Heaths and Marshes SAC (Ref. 1.6) indicates that over half of the site is in favourable condition, with 54% of units being 'favourable' and 40.5% being 'unfavourable but recovering'. • Reasons given for management units not being in favourable condition include coastal squeeze, inappropriate coastal management and public disturbance.

Designated Site.	Summary of Vulnerability and Sensitivity Information.
Orfordness to Shingle Street SAC and SSSI.	The National Trust have a rigid policy in place restricting the number and locations where visitors can wander to reduce the effects of trampling. • The Natura 2000 data form highlights that the vegetated shingle within the Orfordness to Shingle Street SAC is a sensitive habitat that is particularly vulnerable to recreational pressure (Ref. 1.9). • The site improvement plan for the site (Ref. 1.10, Ref 1.11) raises several issues, including public access and disturbance leading to trampling of shingle vegetation. • The Natural England Condition Assessment of the SSSI underpinning the Orfordness to Shingle SAC (Ref. 1.9) highlights that recreational activity is implicated in trampling of shingle vegetation.
Sandlings SPA and SSSI.	Most sensitivities for the Sandlings refer to the ground-nesting bird species, rather than plants and habitats *per se.* Nevertheless, the condition and sensitivity of the habitats is discussed in places. • The site improvement plan for the site (Ref. 1.12) raises several issues, including public access and disturbance, and the need to determine the impacts of recreational pressure, in particular dogs off leads. • The Sandlings SPA is underpinned by three individual SSSIs: Leiston to Aldeburgh, Snape Warren and the Sandlings Forest. The Natural England Condition Assessment for the entirety of Snape Warren and the Sandlings Forest SSSIs show that both sites are in 'unfavourable but recovering' condition. In contrast, the Condition Assessment for the Leiston to Aldeburgh SSSI shows over half of the site to be in 'favourable' condition, with 53% being 'favourable' and 44% being 'unfavourable but recovering'. Whilst 2% is in 'unfavourable and declining' condition, due to the trampling of shingle vegetation (not a qualifying feature of the SPA) (Ref. 1.13).

1.3.42 **Table 1.4** clearly indicates that recreational disturbance including physical trampling of vegetation is a key concern.

i. The recreational disturbance preliminary assessment baseline

1.3.43 The detailed evidence base pertaining to the predicted changes in recreational usage resulting from construction and operation activities has been provided within the Ornithology Synthesis Report, provided in **Appendix 14B.2** of this volume, and a summary of the findings presented here.

1.3.44 The Recreational Disturbance Evidence Base (Ref. 1.14) is a comprehensive body of evidence based on field surveys and questionnaires of people undertaking recreational activity. It was carried out in locations around Sizewell in 2014 and within the RSPB Minsmere

Reserve in 2015. The surveys have indicated that the Suffolk Coast is an extremely well-used recreational resource, receiving over two million visitors each year. The Sizewell area, mainly the EDF Energy Estate and the beach, received in the region of 500,000 recreation visits a year, with most visitors arriving by car. Of the respondents questioned, 29% indicated that they would avoid the Sizewell area during the construction phase and seek other locations in which to undertake recreation; a large number of the respondents, ~30% of the total, were also dog walkers. The results for the visitor survey at Minsmere were comparable, with approximately 30% of respondents indicating they would seek other locations in which to undertake recreation.

1.3.45 The locations that questionnaire respondents indicated that they would be displaced to varied widely, with 40 different locations being named. The assumption has been made that, as most visitors accessing the Sizewell area arrive by car, then they would use a car-parking location from which to access alternate sites. The majority (96%) of these alternative car-parking locations fall within a 16km study zone established for the Recreational Disturbance Evidence Base, with a concentration of car-park locations falling within the boundaries of the following European designated sites:

- the Minsmere to Walberswick Heath and Marshes SAC, SPA and Ramsar site;
- the Sandlings SPA; and
- the Alde-Ore and Butley Estuaries SAC, SPA and Ramsar site, including the Orfordness to Shingle Street SAC.

1.3.46 A combination of desk-based evidence and professional judgement has been used to estimate the existing level of recreational visits that these European Sites currently experience and the contribution (over and above the existing baseline) that the proposed development would be expected to contribute if users were displaced during the construction period. Two alternative approaches to extrapolating the survey data have therefore been used to determine the likely percentage increase in visits per year at the individual locations. The results of this extrapolation are provided in **Table 1.5**. It should be noted that the figures presented in **Table 1.5** also additionally include the number of visits that may be undertaken by the construction workforce to selected locations. The approach to determining the number of visits that could be undertaken by the construction workforce to these locations is detailed in Recreational Disturbance Evidence Base.

1.3.47 The first approach, which is considered to represent a realistic situation, has been applied in other studies. This involves determining the percentage of survey respondents who said that they would be displaced to each named location, provided **Table 1.5**, and then calculating the number of

additional visits that would be generate (by multiplying the estimated number of annual visits at each of the locations, as provided in Column 1 in **Table 1.5**, by the percentage of displaced users, seen in Columns 3 and 4 in **Table 1.5**).

1.3.48 There are four locations for which measured visitor numbers are available from the main 2014 surveys: Aldringham Walks, Dunwich Heath, Eastbridge and Sizewell Beach. Local knowledge of the area, thirty years of data from hundreds of other outdoor visitor destinations and other data supplied to SZC Co. by Natural England (for Westleton Heath National Nature Reserve (NNR), Walberswick NNR and Benacre NNR) and the RSPB for the RSPB Minsmere Reserve have been used to allocate the locations to one of three categories - a low, medium or high level of use. The calculations have then been based on the median value between the range limits for each level of use category e.g. 60,000 visits per year for the medium level of use category from 20,000 to 100,000 visits per year.

1.3.49 The second approach adopts the same basic method as the first, except that the calculated number of additional visits to each specified location (Column 2 in **Table 1.5**) has been taken as a percentage of an estimated 500,000 annual visits to the Sizewell survey area as a whole. The figure of 500,000 visits per year is based on extrapolation of the 4,214 visitors observed over the survey period to give an estimated annual figure. This provides a figure for the number of displaced visits to each location for which a percentage increase above the annual number of visits to each location can then be calculated (Column 8 in **Table 1.5**). This approach is considered to be precautionary in that it assumes that visitor numbers can be extrapolated to provide a figure for the total number of visits over the year, whereas in reality, many of the visitors recorded during the survey are likely to visit the Sizewell area only a few times during a year.

1.3.50 The results of this exercise are presented in **Table 1.5.**

Table 1.5: Extrapolated visitor numbers for locations given by questionnaire respondents as sites which they would relocate to during the construction phase.

Location Name.	Estimated Number of Annual Visits.	Based on % of Displaced Visitors.				Based on 500,000 Visits to Sizewell Area.		
		% of Survey Visitors Who Gave as Alternate Location.	Increased Visits/Year.	Increased Total Visits /Day.	% Increased Over Existing Visits.	Increased Total Visits/Day.	Increased Total Visits/Day.	% Increased Over Existing Visits.
Alde-Ore and Butley Estuaries SPA/SAC.								
Aldeburgh	150,000	2.92%	4377	12.0	2.9	14591	40	9.7
Butley	10,000	0.19%	119	0.05	0.2	950	2.6	1.5
Iken	60,000	0.58%	350	1.0	0.6	2918	8	4.8
Orford	150,000	0.78%	1167	3.2	0.8	3891	11	2.6
Sailors Path	60,000	0.39%	233	0.6	0.4	1946	5	3.3
Snape	150,000	0.97%	1459	4.0	1.0	4864	13	3.2
Sandlings SPA.								
Aldringham Walks.	60,000	0.58%	348	0.9	0.6	2900	7.9	4.8
North Warren	60,000	0.58%	350	1.0	0.6	2918	8	4.9
Rendlesham	150,000	0.78%	1170	3.2	0.8	3900	10.7	2.6
Sandlings Walk.	150,000	0.58%	875	2.4	0.6	2918	8	1.9
Thorpeness	60,000	3.89%	2335	6.4	3.9	19455	53	32.4
Tunstall Forest.	150,000	1.36%	2040	5.6	1.4	6800	18.6	4.5

Location Name.	Estimated Number of Annual Visits.	Based on % of Displaced Visitors.				Based on 500,000 Visits to Sizewell Area.		
		% of Survey Visitors Who Gave as Alternate Location.	Increased Visits/Year.	Increased Total Visits /Day.	% Increased Over Existing Visits.	Increased Total Visits/Day.	Increased Total Visits/Day.	% Increased Over Existing Visits.
Minsmere to Walberswick Heaths and Marshes SPA/SAC.								
Dunwich Heath.	150,000	2.33%	4107	11.3	2.3	11673	32	6.6
Dunwich/Beach	150,000	3.11%	4669	12.8	3.1	15564	43	10.4
Eastbridge	38,871	1.56%	605	1.7	1.6	7782	21	20.1
Minsmere Core.	120,000	0.74%	888	2.43	0.7	3700	10.1	3.0
Minsmere Outer.	30,000	2.96%	888	2.43	3.0	14800	40.5	49.3
Sizewell Beach.	195,557	1.95%	3805	10.4	1.9	9728	27	5.0
Southwold	15,000	1.75%	2626	7.2	1.8	8755	24	5.8
Walberswick	150,000	1.17%	1751	4.8	1.2	5837	16	4.3
Westleton	60,000	1.36%	817	2.2	1.4	6809	19	11.3
Westwood Marshes.	60,000	0.19%	117	0.3	0.2	973	3	1.6

1.3.51 As can be seen from **Table 1.5**, the displacement of recreational users from the Sizewell area during the construction phase of the proposed development would be expected to result in low numbers of additional visits to the three European sites identified. In addition, the pattern would be diffuse, with the additional visits spread across a number of named locations.

1.3.52 The number of proposed development construction workers would peak at approximately 5,600. Of these, it is envisaged that 3,120 would represent a net additional population who may choose to undertake recreational activity in the countryside. The Recreational Disturbance Evidence Base has estimated that the total number of additional visits to the wider countryside by the construction workforce would be 60,000 per year.

1.3.53 Specifying the individual locations to which visits may be taken and the nature of the activities is difficult and cannot be determined with any certainty. The assumption made in allowing for the increase in visits from the construction workforce is that most activities from the campus would be made locally, possibly in the evenings (e.g. runs/walks) or at the weekend. Trips further afield during the weekends would mirror those likely to be made by residents and day visitors of a similar demographic, and therefore would be likely to focus on coastal/beach activities, although some of the larger, local wildlife visitor centres (e.g. Minsmere/Dunwich) may also be popular. The 60,000 additional annual visits attributed to construction workers have been assigned to the following locations:

- Sizewell Beach/Sizewell Estate – 20,000;
- Aldeburgh – 7,000;
- Thorpeness – 4,000;
- Dunwich Heath – 2,000;
- Dunwich Beach - 4,000; and
- Minsmere – 2,000.

1.3.54 The conclusion from the Recreational Disturbance Evidence Base is that designated sites already receive a large number of recreational visits. The construction of the proposed development would lead to the displacement of a small number of individuals who currently undertake recreation activities within the Sizewell Estate and the beach. They would be displaced to adjacent designated sites, but the increase experienced by these adjacent sites would be very small in the context of the existing visitor number; In addition, this pressure would be diffuse and spread across a large number of potential access points.

1.3.55 The Recreational Disturbance Preliminary Assessment (Ref. 1.15) states that there is no automatic correlation between an increase in the number of recreational visits and the potential for the interest features of a European site to be detrimentally affected. Any effects of increased visitor usage would depend upon the behaviour of visitors and the pattern of recreational usage undertaken. For example, a well-used site, with wide, clearly defined access tracks, in which visitors behave in a similar manner and remain on the path network, could potentially have the capacity to absorb many additional visits. In contrast, at sites with limited existing recreational use and poorly-defined path networks, it is more likely that increased disturbance (through an increase in visitor numbers) could have an ecological effect, as people may be less inclined to follow the path network and therefore wander into areas of sensitive habitat.

1.3.56 Notwithstanding this, given the existing relatively high levels of recreational disturbance, as recognised in the site improvement plans, and the inherent difficulties in assessing relatively small incremental changes that may be attributable to Sizewell C Project against this background, it is considered prudent to develop a recreational management and monitoring strategy, in partnership with relevant stakeholders.

Trampling effects

1.3.57 As noted in **Table 1.2,** trampling of vegetation has been highlighted as an issue at the designated sites identified. There is evidence from the literature suggesting trampling by people can adversely affect shingle, sand dune and lowland heath vegetation.

1.3.58 The reaction of vegetation to physical disturbance is the result of two factors: the susceptibility of the vegetation to the disturbance, and the ability of the vegetation to regenerate. Several human activities may cause physical disturbance with trampling often being considered as one of the main damaging effects, particularly at coastal locations.

1.3.59 Studies of sand dune vegetation have shown that formation of trampled paths in grey dune and dune heath communities caused a reduction in the organic content of the soil, a rise in pH, and a reduction in conductivity and carbonate content. As a consequent, there could be a considerable decrease in the cover of the vegetation, with no or only a few species left in the central, more trampled parts. In moderately trampled zones along paths, a community of colonizers or early succession plant species can develop.

1.3.60 Santoro *et al.* (Ref. 1.16) on a study of sand dunes in Italy found that plant communities subject to trampling tended to be poorer in species and less structured, since only dominant and tolerant plant species persisted.

Furthermore, limiting trampling appears to have produced positive changes in the dune vegetation assemblage after a period of only two years, indicating that recovery is possible.

1.3.61 Some of the most susceptible communities on shingle structures are those with abundant lichens. These slow-growing species are very sensitive, especially in dry weather, when they are particularly easy to damage. Compaction of the surface may also affect the seed bank making it more difficult for some species to germinate.

1.3.62 Light trampling of some shingle vegetation communities may increase floral diversity; however, under conditions of heavy trampling, vegetation may be lost altogether, and soil conditions altered, such that recovery of vegetation may not occur without management intervention. Edwards (Ref. 1.17) found that along the shingle bar at Slapton Ley, Devon, soil depth followed a general pattern of decreasing values from Strete Gate to Torcross, which in part controlled the vegetation communities. This change in soil structure was considered to be largely related to compaction through trampling, due to greater numbers of visitors walking between Torcross and the main car park compared to the northern end of the site.

1.3.63 Because of the succulent nature of many shingle and drift-line pioneer plants, they are particularly susceptible to trampling. Other factors such as the frequency of storm conditions, mobility of shingle/beach structures, management for coastal defence purposes and longer-term sea-level rise may play an equally important or more important role in the health of these vegetation communities.

1.3.64 Heathland vegetation is also considered vulnerable to trampling. Roovers *et al*. (Ref. 1.18) undertook a study of human trampling on some common forest and heath communities in central Belgium. Vulnerability to disturbance was compared among plant communities in terms of resistance, resilience, and tolerance, which are based on cover measurements. The herb layer of the examined forest communities appeared to be more sensitive than the heath and dry forest community, which were dominated by more resistant grass (*Molinia caerulea*, *Deschampsia flexuosa*) and dwarf-shrub species (*Vaccinium myrtillus*, *Calluna vulgaris*, *Erica tetralix*). The analysis showed that site structure and vegetation were already affected by low intensities of trampling, while vegetation recovery during the first year after trampling was limited in most plant communities. Recovery during the second year in both vegetation cover and height, was most pronounced in forest communities. Occasional trampling clearly can lead to increased visual evidence of previous use and continued recreational disturbance. Therefore, management plans should discourage hiking activity off paths and restrict recreation activities to the least vulnerable communities.

1.3.65 Torn *et al*. (Ref. 1.19) investigated how timing and direction of low-pressure and short–term trampling influences revegetation of sub-alpine heath in Northern Finland. Downward trampling reduces vegetation cover and the cover of evergreen shrubs, but only during the trampling year. Cover of vascular plants decreased directly after trampling, with bryophytes showing a slower response. Although impacts from trampling occur rapidly, even under very low levels of use, revegetation and recovery is rapid if the trampling pressure is removed.

Nutrient enrichment from dog faeces and urine

1.3.66 There is a detailed evidence base that nutrient enrichment from dog-fouling can affect vegetation communities.

1.3.67 Dogs will typically defecate within ten minutes of a walk starting, and consequently most (but not all) deposition tends to occur within 400m of a site entrance (Ref. 1.20). In addition, most deposits are approximately 1m from the path edge (Ref. 1.21). Similarly, dogs will typically urinate at the start of a walk, but they will also urinate at frequent intervals during the walk.

1.3.68 The total volume of dog waste deposited on sites can be large. Barnard (Ref. 1.22) estimated that in a single year 30,000 litres of urine and 60 tonnes of faeces are deposited at Burnham Beeches NNR.

1.3.69 Limited information on the chemical composition of dog faeces suggests they are particularly rich in nitrogen and that modern dog foods contain an excess of nutrients which is excreted (Ref.1.21). In a study on a heathland site frequently used by dog walkers, available soil nitrogen and phosphate was consistent with the spatial distribution of dog faeces, which were most numerous within 1m from the path and correlated with a conversion from a heathy to grassy sward (Ref. 1.22). The same was also true for sand dunes at a site receiving many dogs (Ref. 1.21).

1.3.70 It must be noted that trampling also has an impact on the floristic composition near paths and is therefore highly correlated with the occurrence of dog faeces; however, it is thought that trampling exacerbates the problems that occur due to nutrient enrichment (89).

1.3.71 Smith (Ref. 1.23) highlighted that plants growing on shingle are well-adapted to the lack of nutrients within the environment in which they grow. Addition of nutrients through dog fouling encourages the development of non-specialised species which outcompete the highly-adapted shingle plants.

1.3.72 Very little is known about the nutrient composition of dog urine and its impacts on habitats. It is known, however, that dog urine can scald

vegetation and does provide some enrichment of soil nitrogen, and that urine does more damage on dry soils because the salts cannot disperse as easily (Ref. 1.23).

g) Conclusions of evidence base

1.3.73 Designated sites in close proximity to the Sizewell power stations are considered to be sensitive to human disturbance including physical trampling of vegetation.

1.3.74 Sensitive habitat in the vicinity of the Sizewell power stations already receives a large number of recreational visits.

1.3.75 Construction of the proposed development would lead to the displacement of a small number of recreational users who would likely be displaced to nearby European sites. The number of individuals displaced would be small and the pressure would be diffused, spread across a large number of potential access points.

1.3.76 Trampling by visitors can cause damage to sensitive vegetation.

1.3.77 Dog faeces and urine can cause localised enrichment and changes to the composition of vegetation communities.

1.3.78 Any effects of increased visitor usage would depend upon the behaviour of visitors and their pattern of recreational usage.

i. Relevant IEFs

1.3.79 The IEFs that could be affected by this impact pathway are the following:

- habitats forming the cited interest features of the Minsmere to Walberswick Heaths and Marshes SAC, namely: annual vegetation of drift lines, European dry heaths, and perennial vegetation of stony banks;
- habitats forming the cited interest features of the Alde-Ore and Butley Estuaries SAC, SPA and Ramsar Sites, including the Orfordness to Shingle Street SAC, in particular: annual vegetation of drift lines, and perennial vegetation of stony banks;
- lowland heath habitat which forms part of the habitat mosaic on which the interest features of the Sandlings SPA (nightjar (*Caprimulgus europaeus*) and woodlark (*Lullula arborea*)) depend for breeding and foraging;

- vegetated shingle, sand dune vegetation and lowland heath comprising cited interest features of the component SSSIs that underlie the above European site designations; and
- vegetated shingle which forms the interest features of the Suffolk shingle beaches CWS.

ii. Summary implications for HRA

1.3.80 Trampling and nutrient enrichment are most likely to cause a negative effect where car park locations are close to sensitive habitats; for example, car parks that give direct access to the beach, such as Walberswick and Dunwich where sensitive shingle and dune habitat is present, and small sites such as heathland sites where the path network is not well defined, and people may be encouraged to wander off the path and let the dogs range widely off the lead. This would affect the Minsmere to Walberswick Heaths and Marshes SAC, SPA and Ramsar site and parts of the Sandlings SPA where heath vegetation is present.

1.3.81 As discussed in **Section 3.1** of this chapter**,** the Natural England Condition Assessment of the SSSI under-pinning the Minsmere to Walberswick Heaths and Marshes SAC states that Unit 113, located north of the site, no longer supports "*Annual vegetation of drift lines*" (Ref. 1.24). This habitat feature has been destroyed and lost to coastal erosion.

1.3.82 Habitats forming the cited interest features of the Alde-Ore Estuary SAC, SPA and Ramsar site, including the Orfordness to Shingle Street SAC, have been excluded due to the access restrictions put in place by the National Trust, as seen in **Table 1.4**.

iii. Summary implications for EIA

1.3.83 Car parks located at Thorpeness and Aldeburgh give direct access to the beach. The beach between Leiston and Aldeburgh supports vegetated shingle, one of the cited interest features of the Leiston to Aldeburgh SSSI. This vegetation is particularly well represented at Thorpeness. There is the potential for a slight increase in trampling and nutrient enrichment to occur in these locations.

1.3.84 Small car parks at Thorpeness and Aldeburgh also give access to North Warren, part of the Leiston to Aldeburgh SSSI, which supports lowland heath vegetation. There is, therefore, the potential for a slight increase in trampling and nutrient enrichment to occur in these locations.

1.3.85 The beach located seaward of the Sizewell B and the proposed Sizewell C power stations supports vegetated shingle, forming the cited interest

features of the Suffolk Shingle Beaches CWS. It is considered that as a proportion of existing recreation users are likely to be displaced away from the Sizewell Beach that an increase in recreational disturbance is unlikely in this location. Therefore, impacts such as trampling will be reduced/ avoided and the interest features will not be impacted by visitors, particularly as the Suffolk Shingle beach will be off limits during the HCDF construction.

h) Alteration of hydrology and hydrogeology

i. Description of impact pathway

1.3.86 This impact pathway refers to any changes in the hydrological conditions, both groundwater and surface water, underlying the habitat types present within and adjacent to the site.

1.3.87 Any changes in hydrological conditions to both groundwater and surface water (by making conditions wetter or drier) could potentially alter the plant composition of the habitat types present, leading to a loss of individual species that require specific conditions. For example, increased inundation by surface water could smother plants preventing growth and setting of seed.

1.3.88 The proposed development elements likely to cause hydrological change are:

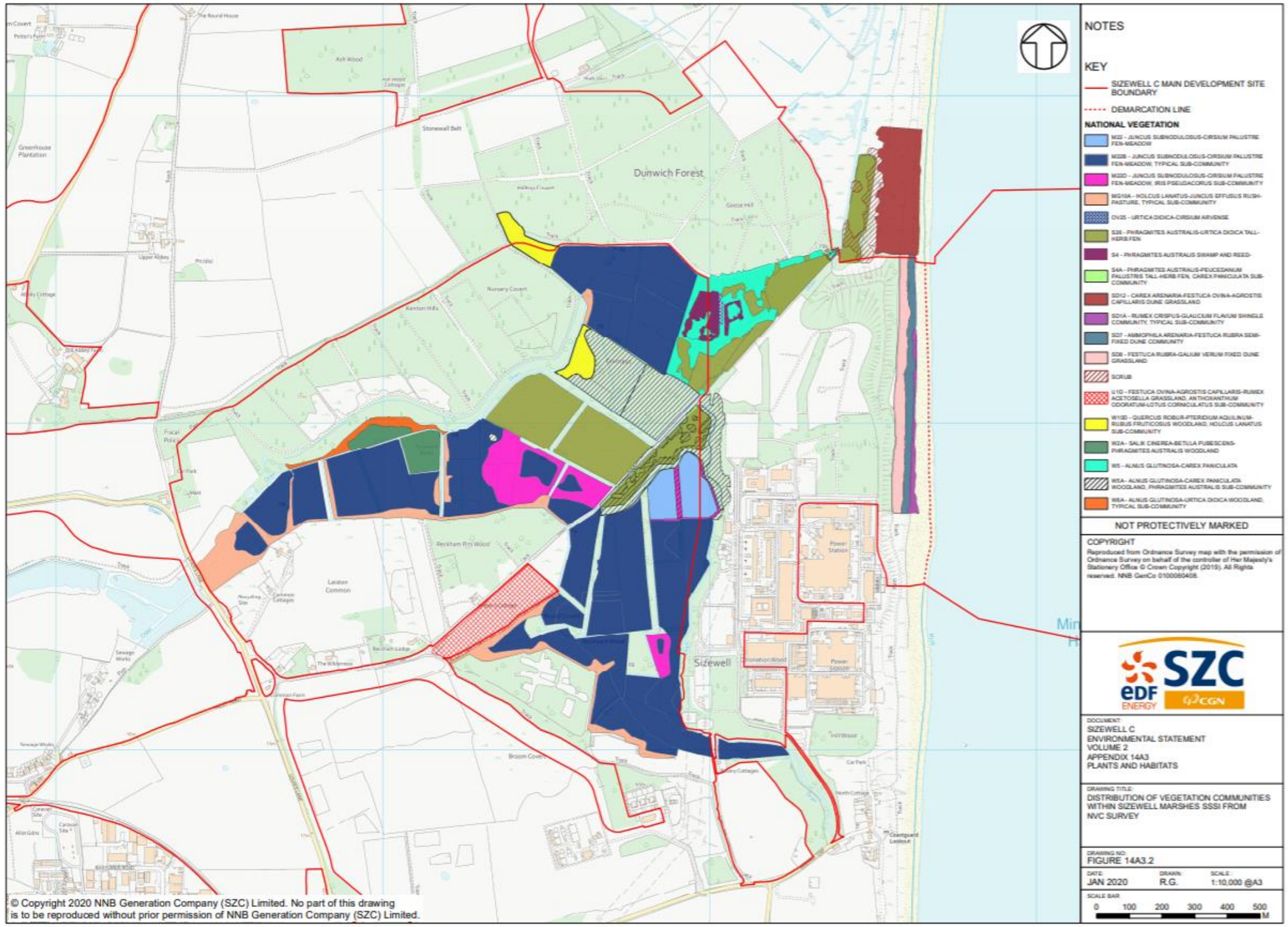
- loss part of Sizewell Marshes SSSI to accommodate the main platform, requiring:
  - the diversion of the Sizewell drain within Sizewell Marshes SSSI; installation of a barrier between Sizewell Marshes SSSI and the site;
  - installation of sheet piling to protect Sizewell Marshes SSSI;
  - infilling the former Sizewell Marshes SSSI land; and
  - construction of the SSSI crossing to provide access to the main construction area.
- isolation of the main platform construction site from groundwater influences by installing a reinforced concrete cut-off wall, then allowing the site to be dewatered.

ii. Evidence base

1.3.89 This section provides an overview of the evidence base for the potential impact pathway, and has considered the following elements:

- the Surface Water Conceptualisation Report developed for the proposed development (Ref. 1.25);
- Sizewell C SSSI Crossings: Environmental appraisal of options under consideration (Ref. 1.26);
- detailed assessment and review of the plant species composition and eco-hydrological characteristics of the M22 fen meadow community (Ref. 1.27);
- a detailed assessment of the hydrological sensitivities of the fen meadow community in SZC Co. The M22 Vegetation Community: Hydrological tolerances and sensitivities: A proposed approach for assessing hydrological impacts (Ref. 1.28);
- the M22 Vegetation Community: Hydrological Tolerances and sensitivities, revised approach for assessing hydrological impacts. (Ref. 1.29 and **Plate 1.1**) and
- Technical Note Sizewell C Hydrological Impacts on the Minsmere to Walberswick Heaths and Marshes SSSI (Ref. 1.30)
- Surface and groundwater water conceptualisation.

Plate 1.1: Distribution of vegetation communities within Sizewell Marshes SSSI from NVC Survey.



1.3.90 The Technical Note Sizewell C Hydrological Impacts on the Minsmere to Walberswick Heaths and Marshes SSSI (Ref. 1.30) identify that there are two water catchments in close proximity to Sizewell. **Plate 1.2** summarises the key surface water features. The systems of particular interest are the Minsmere River (New Cut and Old River), Leiston drain, Scott's Hall drain and Internal Drainage Board (IDB) drain No. 7. These systems drain towards the Minsmere Sluice from where they discharge to sea.

1.3.91 RSPB have raised concerns that any changes in the flow regime of the Leiston drain having an impact on the nature of flows and inundation of the Minsmere to Walberswick Heaths and Marshes SSSI as a result of prolonged back flooding of the Scott's Hall drain, provided in **Plate 1.2 A**. The RSPB is concerned that if the flows within the Leiston drain are increased, this would cause excessive back flooding of the Scott's Hall drain. This back flooding can result in increased inundation of the scrape, lowered reed beds and Dowleys and north levels drainage units which could potentially affect waterfowl that utilise the area.

1.3.92 A Technical Note (Ref. 1.30) has been prepared by Atkins addressing these issues. The Minsmere Sluice is the main control structure governing the flow and water level regimes of the Minsmere New Cut, Leiston drain and Scott's Hall drains. The sluice is divided into two chambers, each with its own gravity-outlet culvert. The northern chamber receives flows from the Minsmere New Cut, while the southern chamber receives flows from Leiston drain and Scott's Hall drains. The southern chamber is also connected to the Minsmere New Cut through its southern culvert, which includes a penstock at its upstream face, however this inlet valve is only opened during times of excessive back flooding upstream of the structure within the Minsmere river catchment. When river levels exceed sea levels (low tide), water flows from river to sea. When sea levels exceed river levels (high tide), river flow would cease, with water stored upstream of the sluice.

1.3.93 Some ingress of seawater into the freshwater system has been factored into the design as this is important to maintain conditions in the Minsmere scrape.

1.3.94 The Leiston drainage system provides a relatively small hydrological input to the study area and supplies approximately 14% of the total contributing catchment of the Minsmere Sluice. From a geomorphological perspective, the Leiston drain has been artificially modified and is uniform and trapezoidal in shape with near-vertical banks and a gentle longitudinal profile. As part of the construction phase, the Sizewell drain (a tributary of the Leiston drain) would be diverted, parallel to the base of the proposed main platform slope.

1.3.95 At its northern extent, the Sizewell drain would discharge to the Leiston drain upstream of the proposed SSSI crossing. In addition, revised water level management may be required for the drainage units and watercourses adjacent to the construction site (Sizewell Belts and Sizewell Marshes SSSI). This would require the inclusion of additional water level control structures and potentially the revised operation of other existing structures. The design of the structures considered the interfaces with other drains and ditches and aimed to ensure the existing water balance of the surrounding wetlands was maintained. The enhanced water level control within the Sizewell Belts and Sizewell Marshes SSSI would allow for fine tuning of the management regime over time.

1.3.96 There is a potential risk that a greater volume of discharge down the Leiston drain may be required to ensure the Sizewell Marshes SSSI water levels behind the water management structures are maintained. If the increased discharge flows are sufficient to reduce available capacity in the southern chamber of the Minsmere Sluice this could cause back flooding within the Scott's Hall drain. The back flooding could lead to adverse impacts on the Minsmere to Walberswick Heaths and Marshes SSSI. Mitigation measures have been embedded into the design of the proposed development to manage surface water discharges from the site adequately during the construction and operational phases that could potentially affect the flow regime of the systems and include:

- A perimeter ditch/swale and bund would be constructed to prevent untreated surface water run-off from leaving the site. Oil/petrol interceptors would be incorporated into the drainage design.
- Where complete infiltration to ground is not feasible, water management zones have been embedded into the design. These would intercept surface water run-off, sediment and contaminants. These systems would be designed to discharge treated water to the surface water drainage network at greenfield run-off rates.
- Foul water would be pumped to a central treatment plant, prior to discharge to sea. This would prevent the contamination of surface waters with sewage effluent during construction.
- A cut-off wall would be anchored into the London Clay Formation, to limit the extent of drawdown associated with dewatering during construction works in the main platform area. The cut-off wall may be breached towards the end of the construction period to enable groundwater levels and flow regime across the area to recover as close as possible to original conditions.

- An operational phase drainage system would be implemented, including Sustainable Drainage Systems (SuDS) measures to intercept water, sediment and contaminants.
- Rainfall falling onto the power station site would be managed through an engineered drainage system. This water would be discharged to sea with the cooling water and would therefore no longer influence flow/water level of the Leiston drain.
- At the western perimeter of the site, a filter drain would be installed to capture surface water run-off and prevent direct discharge to Sizewell drain. The realigned Sizewell drain would remain during the operational phase as described in the construction phase.
- Foul effluent would be discharged to the existing local foul water system located in the south east corner of the site. Treated effluent would be pumped to the cooling water outfall tunnel and disposed to sea.
- A Water Level Management Plan would also be implemented to ensure appropriate management of water levels can be undertaken.

1.3.97 The mitigation measures above, combined with the proposed Sizewell drain realignment, largely isolate the proposed development from the surrounding areas. The mitigation measures also ensure that any flows discharged to an existing surface water receptor would have passed through water quality treatment measures and would be discharged at greenfield rates. Therefore, it is anticipated that the proposed development should create no significant effect on the flow regime of the existing surface water receptors.

1.3.98 The management of water levels within Sizewell Marshes SSSI may result in increased flow volumes discharging down the Leiston drain towards the Minsmere Sluice, which would be similar to the current hydrograph during an intense rainfall event in the catchment. These flash flows would be of a short duration. It is important to note that the flat topography of Sizewell Marshes, together with the inter-connected nature of the drainage network, means that the variations in the flow of water would be relatively modest and driven by seasonal and local variations in water level. It is also likely that the drainage pattern could easily be modified through simple changes in water level management and channel maintenance.

1.3.99 Changes to the percentage of hardened surfaces (proposed Sizewell C campus) within the catchment of the IDB drain No. 7 can also influence the flow regime within the lower reaches of the Leiston drain. However, effects caused by the development are anticipated to be of minor significance due

to the following mitigation measures that have been embedded in the design of the campus facility:

1.3.100 During the construction phase, water management zones would ensure runoff from the vicinity of the campus are returned to groundwater at greenfield runoff rates. Oil/petrol interceptors would be incorporated into the drainage design.

1.3.101 An operational phase drainage system would be implemented, including SuDS measures to intercept water, sediment and contaminants.

1.3.102 Based upon currently available information, it is concluded that the main site operation should not lead to any significant effects on the flow regime of the Sizewell drain, Leiston drain, and IDB drain No. 7 through a variety of mechanisms. The proposed water management structures also allow for easy manipulation of the water levels and flows and thus levels/flows within the Leiston drain can be reduced as and when required to allow for the Scott's Hall drain to discharge efficiently when required. This coupled with the fact that the relatively small contribution from Leiston drain to the overall flow at Minsmere Sluice, limited effects on the flow regime of the southern chamber of the Minsmere Sluice are anticipated and thus no significant effect is predicted for the Scott's Hall drain and associated drainage network.

1.3.103 Additional detailed studies pertaining to hydrological modelling and flood risk would provide assurances to what the future flow regimes of the impacted systems would be. The addition and implementation of a Water Level Management Plan will ensure greater controls over both short and long-term water levels therefore safeguarding habitat conditions. In addition, the Water Level Management Plan and mitigation measures being proposed provide a betterment opportunity. In the absence of these mitigation measures, climate change and coastal erosion would reclaim these areas. Therefore, through the addition of the Sizewell C mitigation package, longer-term protection and safeguarding measures will be implemented.

Plate 1.2: Surface water features and flow direction.

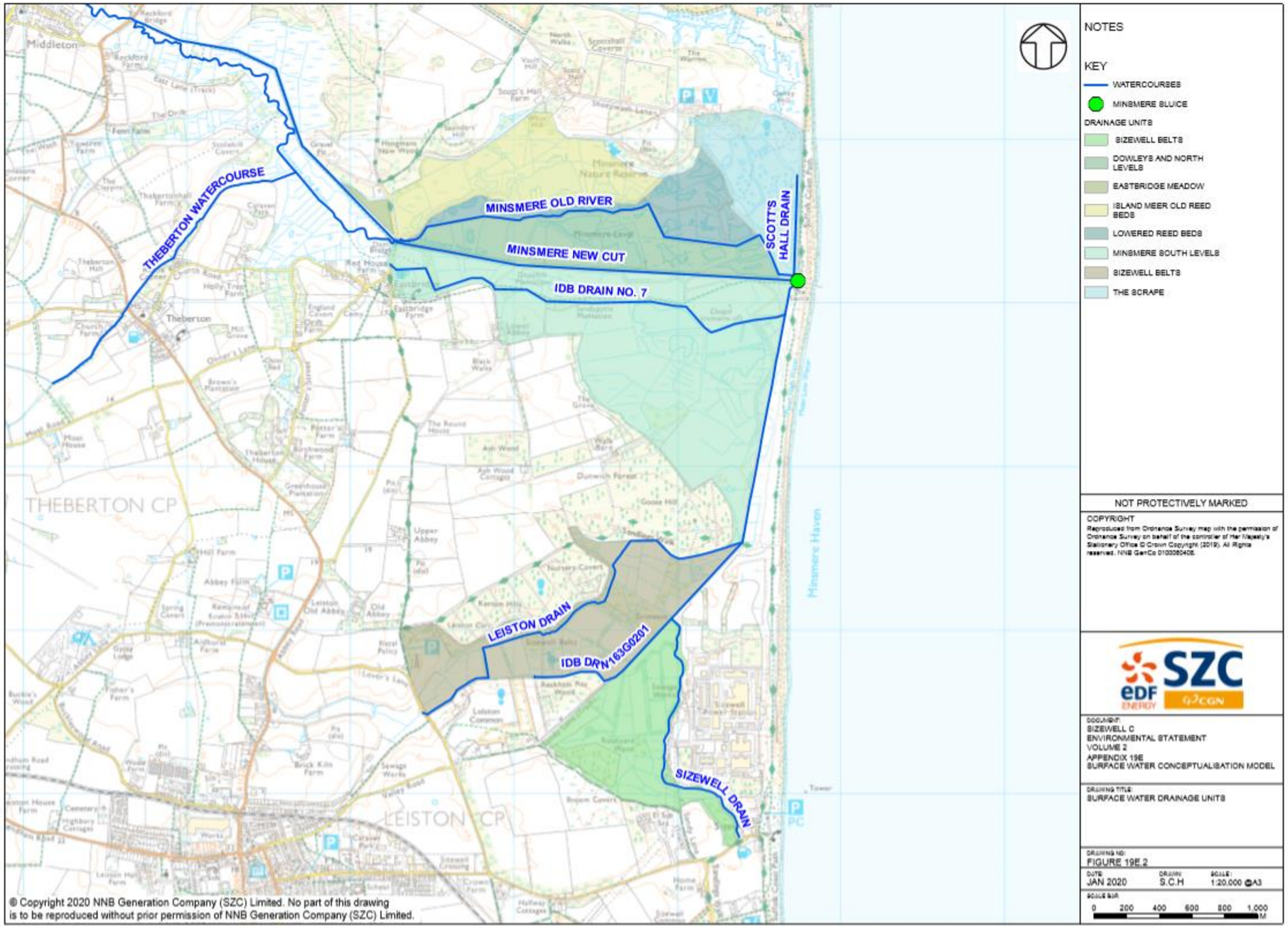
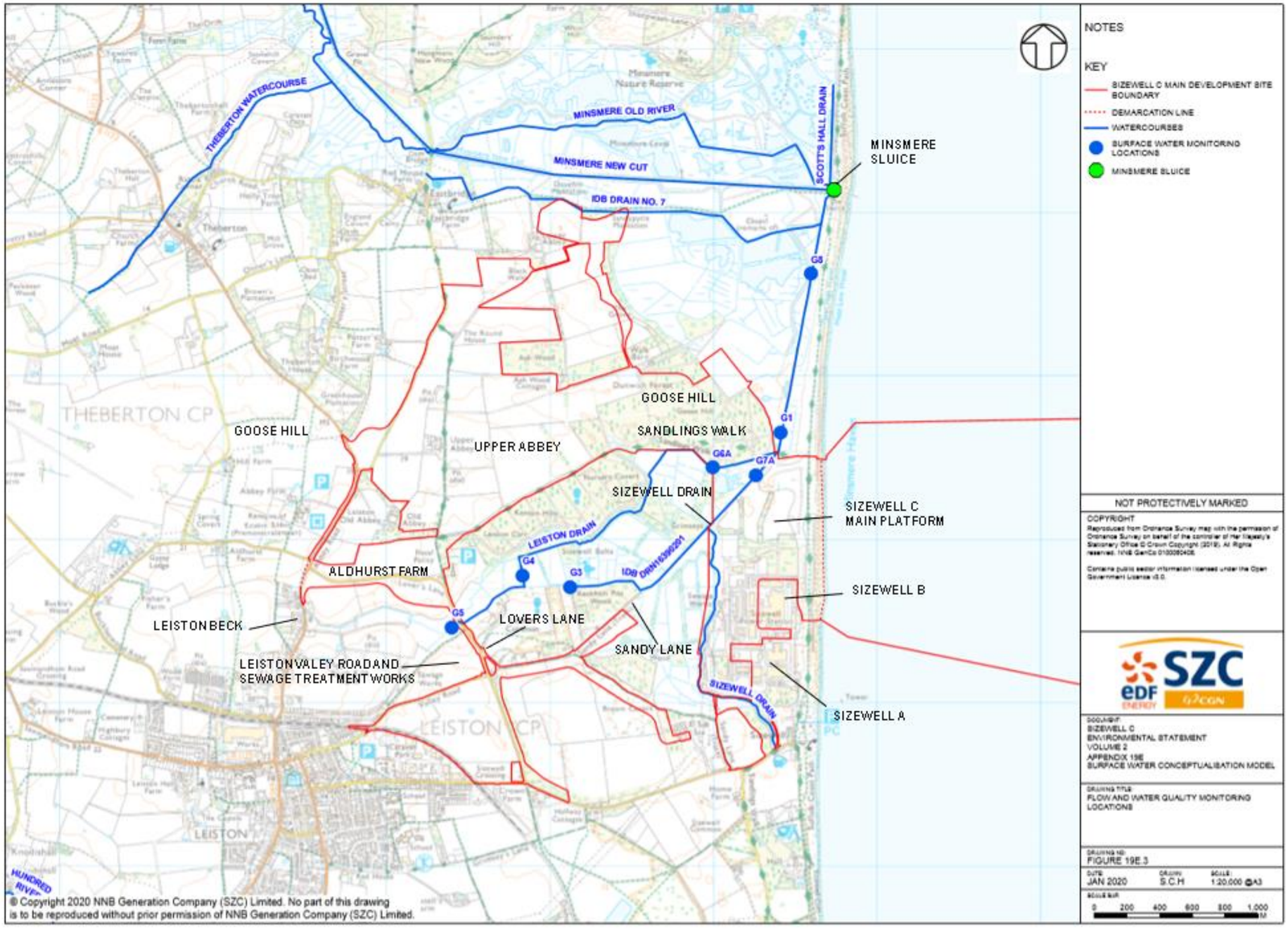


Plate 1.3: A Flow and water quality monitoring locations



Site of Special Scientific Interest crossing

1.3.104 The Environmental appraisal of the SSSI crossing options (Ref. 1.26) details a modelling exercise that was undertaken to assess the predicted changes in water levels as a result of constructing the crossing. This modelling predicted only a very small, highly localised effect, such that during construction there would be a temporary 2cm reduction in water levels to the east of the crossing and a 1cm reduction to the west. This effect would rapidly diminish over distance, not being apparent beyond a radius of 90m. During the operational phase, water levels would stabilise, and long-term changes are predicted to be less than a 1cm increase in levels to the west of the crossing (i.e. up-gradient), with a corresponding reduction to the east, with no change apparent 60m from the SSSI crossing on both sides.

1.3.105 The ecological impact arising from this minor predicted water level change would be upon those habitat types present within the ZOI identified above (i.e. within 90m during construction and 60m during operation); that is, ditch habitat, wet woodland and reedbed within Sizewell Marshes SSSI. No impacts upon fen meadow habitat are likely to occur, as this habitat type is located approximately 300m (at the nearest point) from the SSSI crossing location.

Construction of platform in north-east corner

1.3.106 Approximately 5ha of reedbed/wet woodland and 2km of ditch would be lost from Sizewell Marshes SSSI to accommodate the main platform.

1.3.107 Atkins have developed a hydrological model for the proposed development using the Finite Element Subsurface Flow model, in consultation with the Environment Agency and other stakeholders. The model setup, parameters and so forth are detailed within the Hydrological chapter of **Volume 2, Chapter 19** of the **ES**. Groundwater and surface water are not repeated here.

1.3.108 The model creates a synthetic hydrological baseline for Sizewell Marshes SSSI against which construction scenarios can be modelled. Initial scenario modelling, outlined in the revised approach for assessing hydrological impacts on the M22 vegetation (Ref. 1.28), was undertaken to determine the likely hydrological ZOI as a result of constructing the main platform and the cut-off wall. The ZOI was defined by considering the change in groundwater levels across the Sizewell Marshes SSSI between the baseline model and the construction scenario. The difference in groundwater levels was modelled using conditions in the Spring, Summer, and Winter. It is determined that localised changes in groundwater would

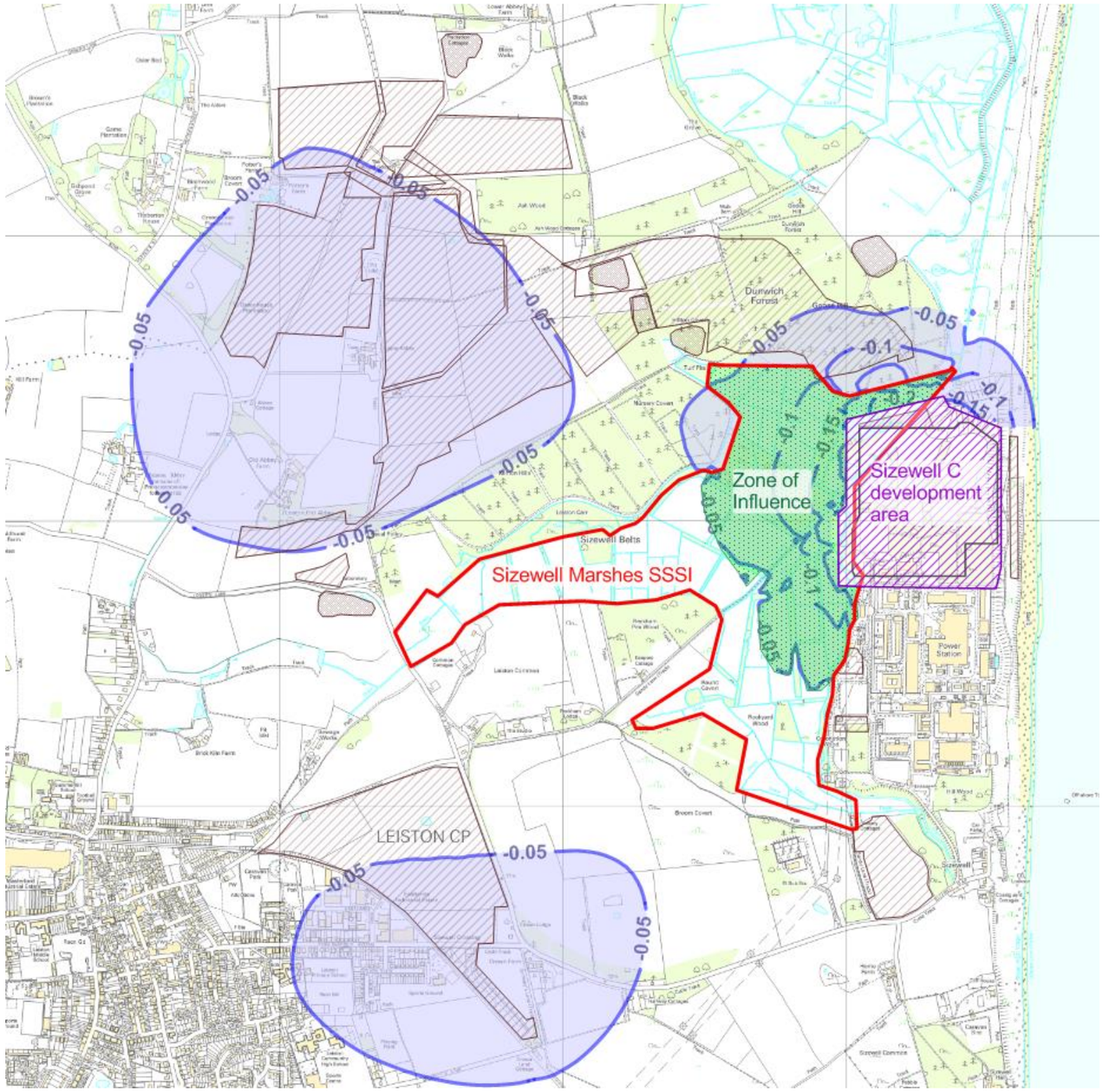
generate a slight rise in levels due to rebound from the construction of the cut-off wall.

1.3.109 The ZOI for any scenario was defined by the areas where the groundwater levels change by more than 5cm compared to the baseline. This threshold of 5cm was selected as the literature suggests that fen meadow habitat (NVC M22) (Ref. 1.29) typically occurs where summer water levels are 5-20cm below the ground surface; 5cm was therefore a reasonable figure with which to calibrate the model with respect to groundwater levels for the M22 community.

1.3.110 **Plate 1.3** and **Plate 1.4** show the defined ZOI based on the differences in groundwater levels in spring, summer, and winter between the baseline and scenario models.

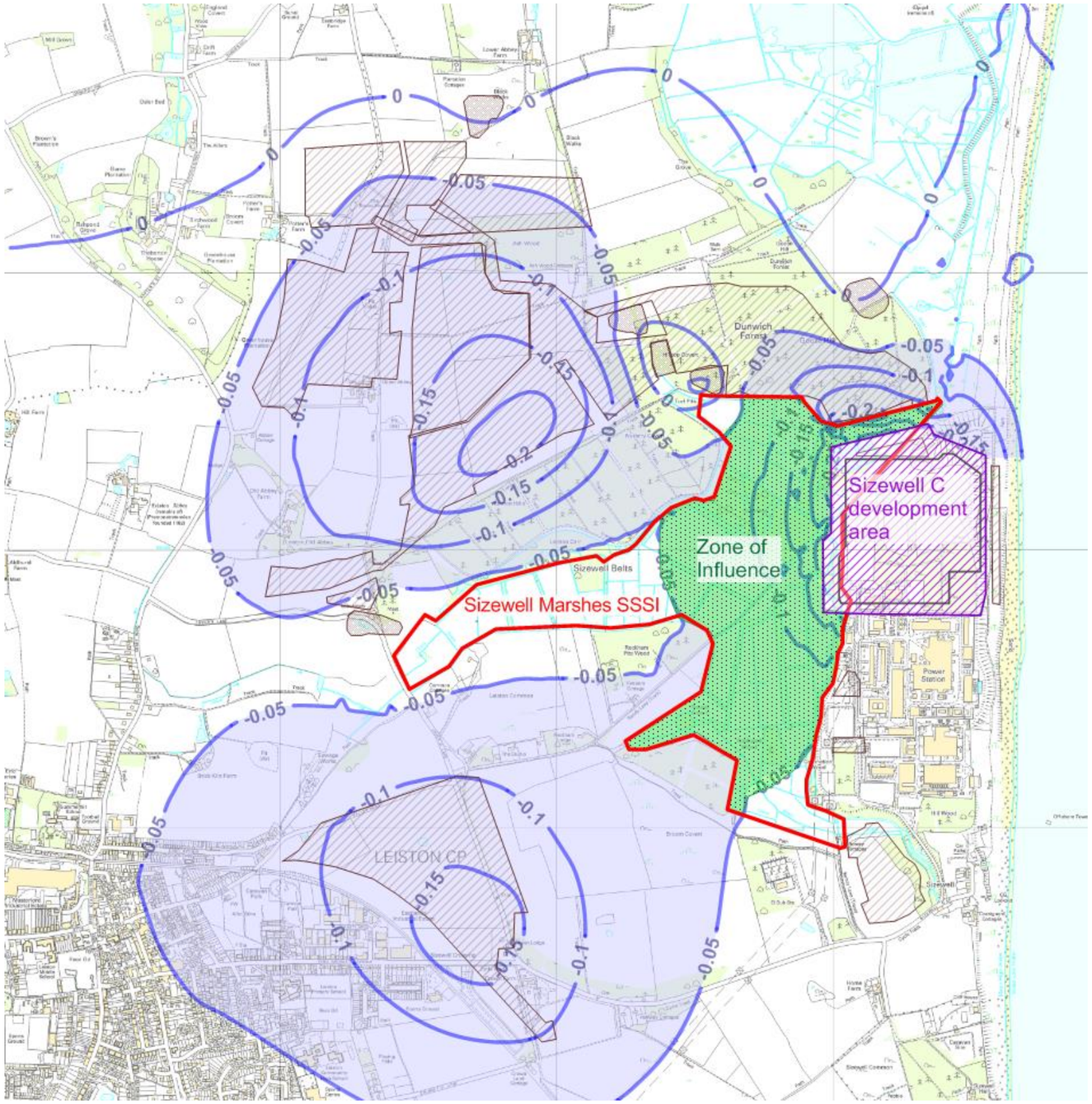
1.3.111 Both **Plate 1.3** and **Plate 1.4** show areas of change in groundwater levels greater than 5cm outside of the Sizewell Marshes SSSI as a result of reduced infiltration underneath the temporary construction areas. Mitigation in the form of water management zones would ensure that runoff from the temporary construction area is returned to groundwater at greenfield runoff rates. It should be noted that Minsmere South Levels lies outside the ZOI in all seasons. Note the site boundary is not correct as these figures were produced early in the assessment process, but sufficient to indicate the likely ZOI.

Plate 1.4: ZOI based on spring and summer water level difference contours.



Notes: Areas where water levels have decreased by greater than 5cm in the scenario run compared to the baseline are shown in blue. Contours lines are shown in 0.05m intervals. Defined ZOI is shown in green.

Plate 1.5: ZOI based on winter water level difference contours.



Notes: Areas where water levels have decreased by greater than 5cm in the scenario run compared to the baseline are shown in blue. Contours lines are shown in 0.05m intervals. Defined ZOI is shown in green.

1.3.112 Details on the eco-hydrological characteristics and hydrological sensitivity of fen meadow vegetation are outlined below, followed by the approach to assessment of effects on the fen meadow vegetation itself.

Sizewell Marshes site of special scientific interest - review of plant species composition and eco-hydrological characteristics of M22 fen meadow

1.3.113 Numerous, detailed botanical surveys have been undertaken across Sizewell Marshes SSSI. Survey data considered during these analyses has focused on NVC surveys**.**

1.3.114 Fen meadow communities are attributable to the NVC community 'M22', the Blunt-flowered Rush (*Juncus subnodulosus*) – Marsh Thistle (*Cirsium palustre*) mire community, of which four sub-communities are recognised (Ref. 1.28, Ref. 1.29). Surveys in 2007 and 2008 (Ref. 1.31, Ref. 1.32) identified the presence of two M22 sub-communities within Sizewell Marshes SSSI, namely M22b (*Briza media – Trifolium* spp. sub-community) and M22d (*Iris pseudacorus* sub-community).

1.3.115 M22 is the dominant vegetation community, with all the Fen Meadow stands being assigned to one or other of the M22 sub communities. Survey work established, however, that there was significant variation within the M22 communities present, with affinities to other vegetation communities identified, including MG8 *Cynosurus-Caltha* grassland and MG12 *Festuca arundinacea* grassland.

1.3.116 A detailed review of NVC data for Sizewell Marshes SSSI (Ref. 1.29) considered Principal Rich-Fen Indicator Species (Ref. 1.28). This review identified the range of fen meadow plant species that typically constitute a fen meadow assemblage. The number of Principal Rich-Fen Indicator Species was summed up for each fen meadow plot, and the average number of species per plot was then considered as a measure of the relative richness. Relative species-richness was assessed on an arbitrary scale from Grade 1 to 4, with Grade 1 indicative of the richest areas of fen meadow with Grade 4 the least rich, presented in **Table 1.6**.

Table 1.6: The four grades of M22 (fen meadow).

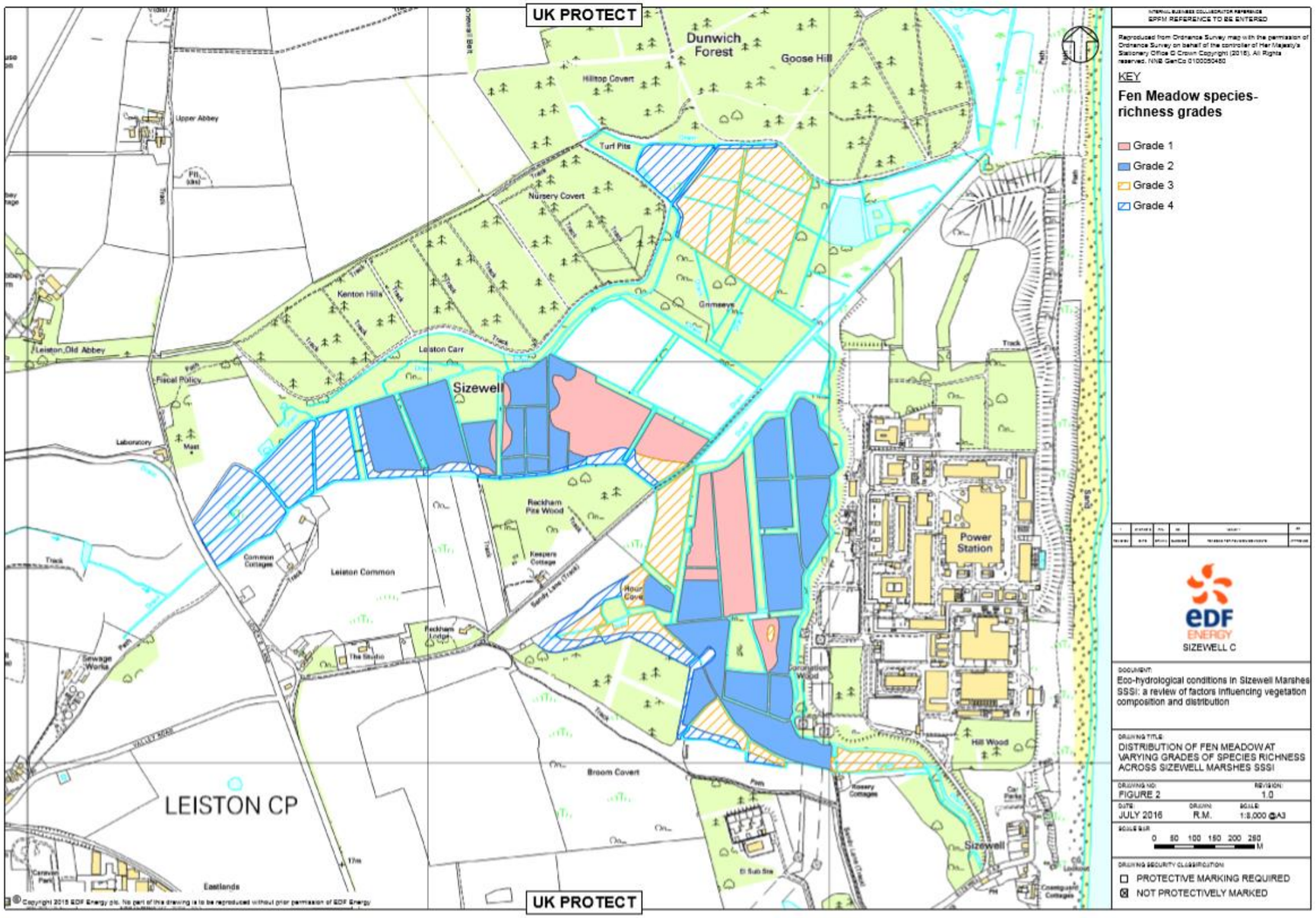
Grade of M22.	Rational
Grade 1.	Good quality fen meadow supporting relatively high numbers of Principal Rich-Fen Indicator Species and other mire species, including a suite of 'low fertility' indicators.
Grade 2.	Good quality fen meadow supporting and a suite of Principal Rich-Fen Indicator Species and other mire species, including a suite of 'low fertility' indicators.
Grade 3.	Fair quality fen meadow, support some Principal Rich-Fen Indicator

Grade of M22.	Rational
	Species and other mire species, with few 'low fertility' indicators.
Grade 4.	Drier fen meadow grading to rush pasture and dry grassland, supporting few Principal Rich-Fen Indicator Species and other mire species, with very few 'low fertility' indicators.

1.3.117 Sizewell Marshes SSSI is in favourable condition according to the last condition assessment carried out in 2009 by Natural England and that all the fen meadow habitat present forms part of the cited Sizewell Marshes SSSI interest feature (regarded to be of national importance), although some areas of fen meadow support more PRFS than other areas.

1.3.118 The distribution of the fen meadow grades is indicated on **Plate 1.5**.

Plate 1.6: Distribution of grades of fen meadow



1.3.119 By looking at the individual plant species composition within fen meadow plots in detail, a considerable understanding of the underlying eco-hydrological drivers for the plant species composition present has been derived. Full details of the methodology and results of the analyses undertaken is detailed within SZC Co.'s study, 'The M22 Vegetation Community: Hydrological tolerances and sensitivities: A proposed approach for assessing hydrological impacts' (Ref. 1.28). A summary of the key points is presented below:

- Areas of 'good quality' fen meadow (i.e. those identified as Grade 1 or Grade 2) show a strong correlation with soil wetness, circum-neutral to mildly calcareous reaction, and infertile conditions.
- The quality of fen meadow noted within areas designated as Grade 1 is considered to suggest the convergence of an optimal management regime and ideal growing conditions. These are the most species-rich areas.
- A brackish influence could be inferred from some of the analysis undertaken. This inference is likely to result from the presence of a low number and abundance of plant species able to tolerate saline conditions, rather than suggesting an actual underlying saline influence.
- A potential underlying acidic influence has been inferred. This is misleading since many plant species indicative of acidic conditions are also characteristic of low fertility conditions. The low fertility status of the Sizewell Marshes SSSI has been corroborated by all the analysis undertaken.
- Since initial mapping of the NVC communities commenced in 1993, an improvement in the quality of the habitats present in Sizewell Marshes SSSI seems to have occurred, with vegetation communities transitioning from rush pasture to species-rich fen meadow.
- The beneficial groundwater regime, in terms of an appropriate depth and stability of the water table, combined with effective conservation management, are key drivers in the determination of the character and composition of the fen meadow habitat.

Sizewell Marshes Site of Special Scientific Interest - review of sensitivity of M22 fen meadow to hydrological change

1.3.120 Detailed work has also been undertaken on establishing the sensitivity of the M22 fen meadow community to changes in underlying hydrological regime. The full methodology, results and references of this work are presented in a report produced by Arcadis and Atkins for SZC Co. 'The

M22 Vegetation Community: Hydrological tolerances and sensitivities: A proposed approach for assessing hydrological impacts' (Ref. 1.28), whilst the key points are summarised in the paragraphs below.

1.3.121 A review of recent literature confirms that fen meadows develop as groundwater-dependent peatland vegetation and are maintained in the long-term by grazing and/or mowing.

1.3.122 The water level is usually accepted as a master environmental factor controlling the habitat conditions; however, it is the extent of capillary rise in the underlying substrate, rather than the location of the water table, that determines the influence of groundwater within fen meadow stands.

1.3.123 Two plant species assemblages within the M22 fen meadow vegetation at Sizewell Marshes SSSI are particularly vulnerable to changes in the annual hydrological regime, these being:

- groups of low-growing ground-dwelling plant species; and
- plant species associated with low-nutrient and/or high lime content conditions.

1.3.124 These more sensitive plant species assemblages are largely restricted to good quality areas of fen meadow (Grades 1 and 2, as provided in **Table 1.6**) and have thrived in these areas since being recorded by the first NVC Survey in 1993.

1.3.125 The literature on water level requirements of these species confirms that both these two sensitive plant assemblages are reliant on groundwater influence throughout the growing season.

1.3.126 The national guidance for the optimum mean water table (for all fen meadows falling within the M22 community) of Summer (growing season) water levels of between about 5 and 18 cm below ground level (Ref. 1.28, Ref. 1.29) are likely to be broadly representative of hydrological conditions at the best fen meadow sites but should not be taken literally as actual site conditions may vary. Wheeler *et al.* (Ref. 1.34) also identified that sub-optimal or damaging water levels for the M22 community could entail the following:

- Very wet sites (where the summer water table is usually above the surface between tussocks) tend to be less species-rich. Prolonged, deep inundation, particularly in the growing season can be damaging, both because of direct effects on plant communities (e.g. on seed germination) and indirect effects resulting from impacts on vegetation management (too wet for stock to graze).

- Moderate reduction in water levels may actually increase species richness (Ref. 1.34), but a long-term reduction of the Summer water table beneath high-quality stands of M22 can be expected to result in some loss of botanical interest particularly of the most sensitive species; for example shallow rooting species such as Marsh Arrowgrass (*Triglochin palustris*), Lesser Spearwort (*Ranunculus flammula*), Ragged-Robin (*Silene flos-cuculi*) Marsh Pennywort (*Hydrocotyle vulgaris*), Bog Pimpernel (*Anagallis tenella*) and Marsh Lousewort (*Pedicularis palustris*).

- The impact of relatively modest reductions in the water table on species richness is moderated to some degree by the action of the capillary fringe.

1.3.127 A large-scale field experiment in base-rich fen meadow (Ref. 1.36) concluded that short periods of over-wetting or drying out (two weeks) were not damaging to the peatland; this supported by the work of Gowing *et al.* (Ref. 1.37). Both studies indicate that base-rich fen vegetation, such as M22, has some resilience to short periods of water stress, both wetting and drying.

1.3.128 Kotowski *et al.* (Ref. 1.38) has emphasised that fen species may be more sensitive to light availability than water table depth in some situations. This suggests that effective conservation management is also be a pre-requisite to maintaining a species-rich sward.

Hydrological modelling of construction impacts on fen meadow within Sizewell Marshes and vegetation within the Minsmere to Walberswick Heaths and Marshes Special Area of Conservation/Site of Special Scientific Interest

1.3.129 Note that the full detailed modelling and associated outputs would be presented in a modelling report. A limited number of the modelling outputs are presented here. The groundwater model created, would consider three scenarios: typical, dry (a drought year) and wet (wetter than average) and would present outputs for each of these. Only drought conditions are considered here as modelling indicates that this would be when the greatest change is likely to occur.

1.3.130 Modelling indicates that the greatest impacts would occur within one year from the start of dewatering from within the cut off wall. The following outputs are presented:

- **Plate 1.5:** Peat hydrographs relative to baseline;

- **Plate 1.6:** Maximum drawdown contours for the water table aquifer;

- **Plate 1.7**: Maximum drawdown contours for the top of the crag deposits; and
- **Plate 1.8:** A transient water budget for Sizewell Marshes SSSI.

1.3.131 The implications from these figures are discussed in detail below:

Plate 1.7: Peat hydrographs

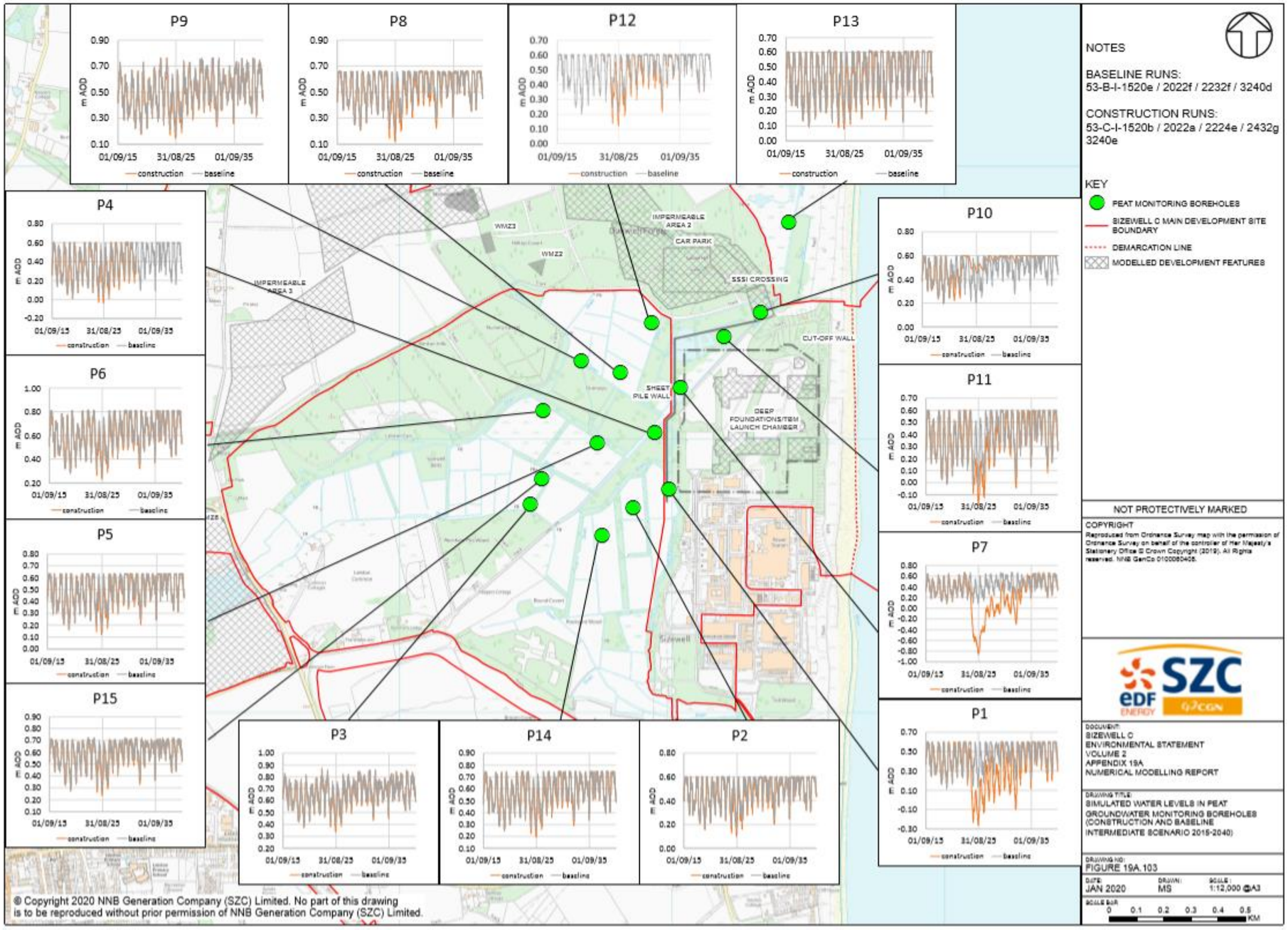


Plate 1.8: Maximum drawdown contours – water table aquifer.

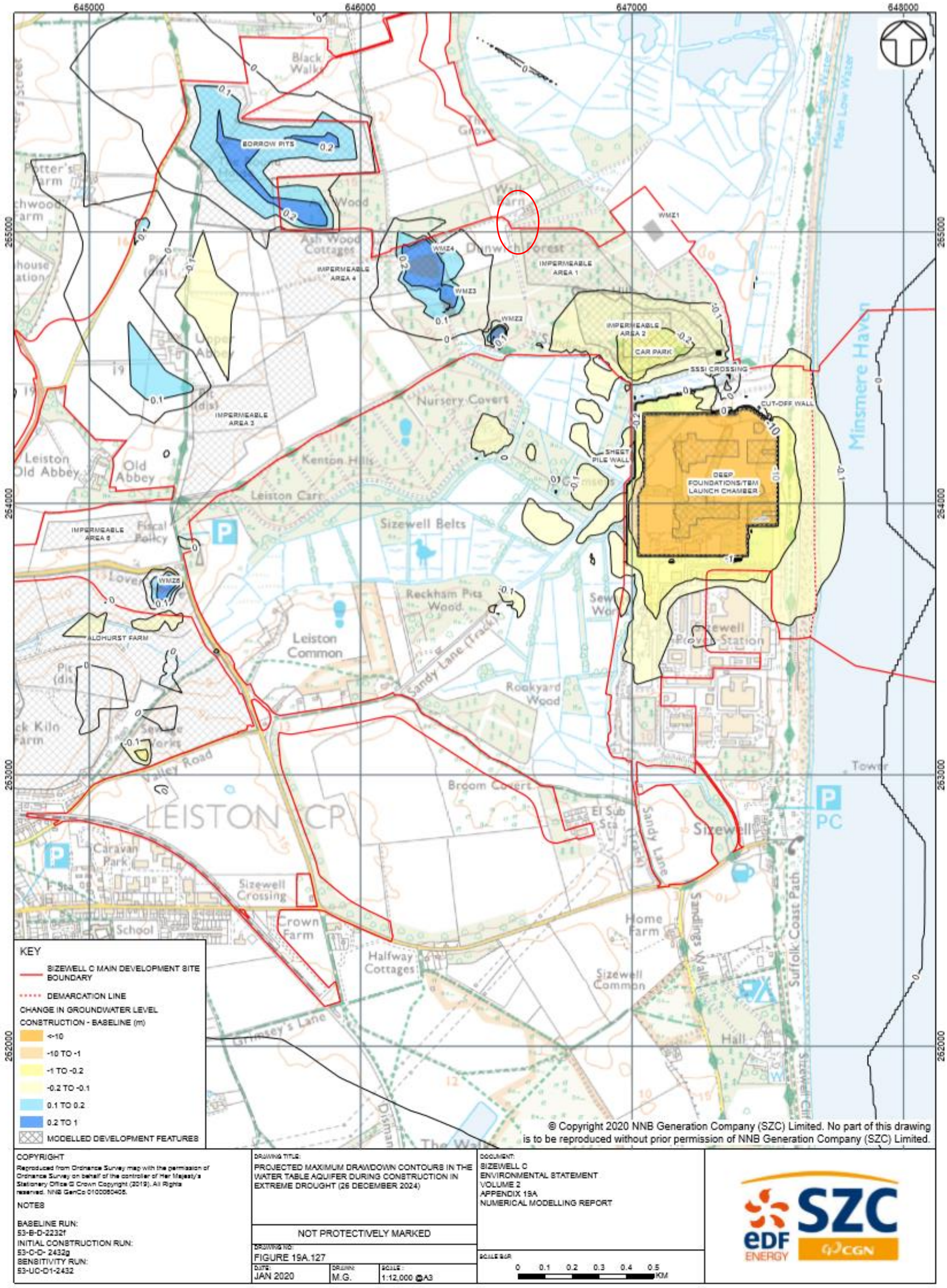


Plate 1.9: Maximum drawdown contour's – top of crag deposits.

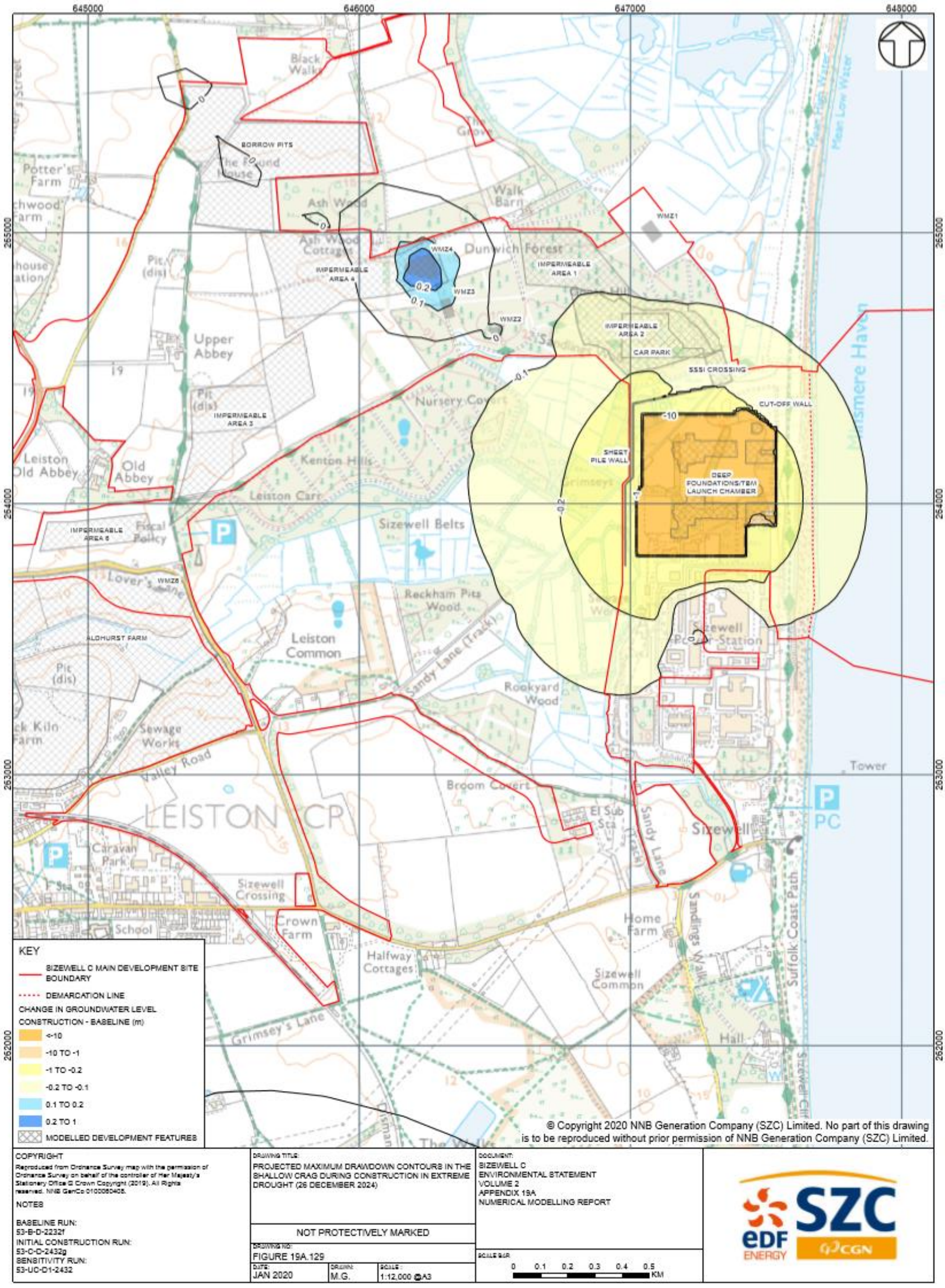
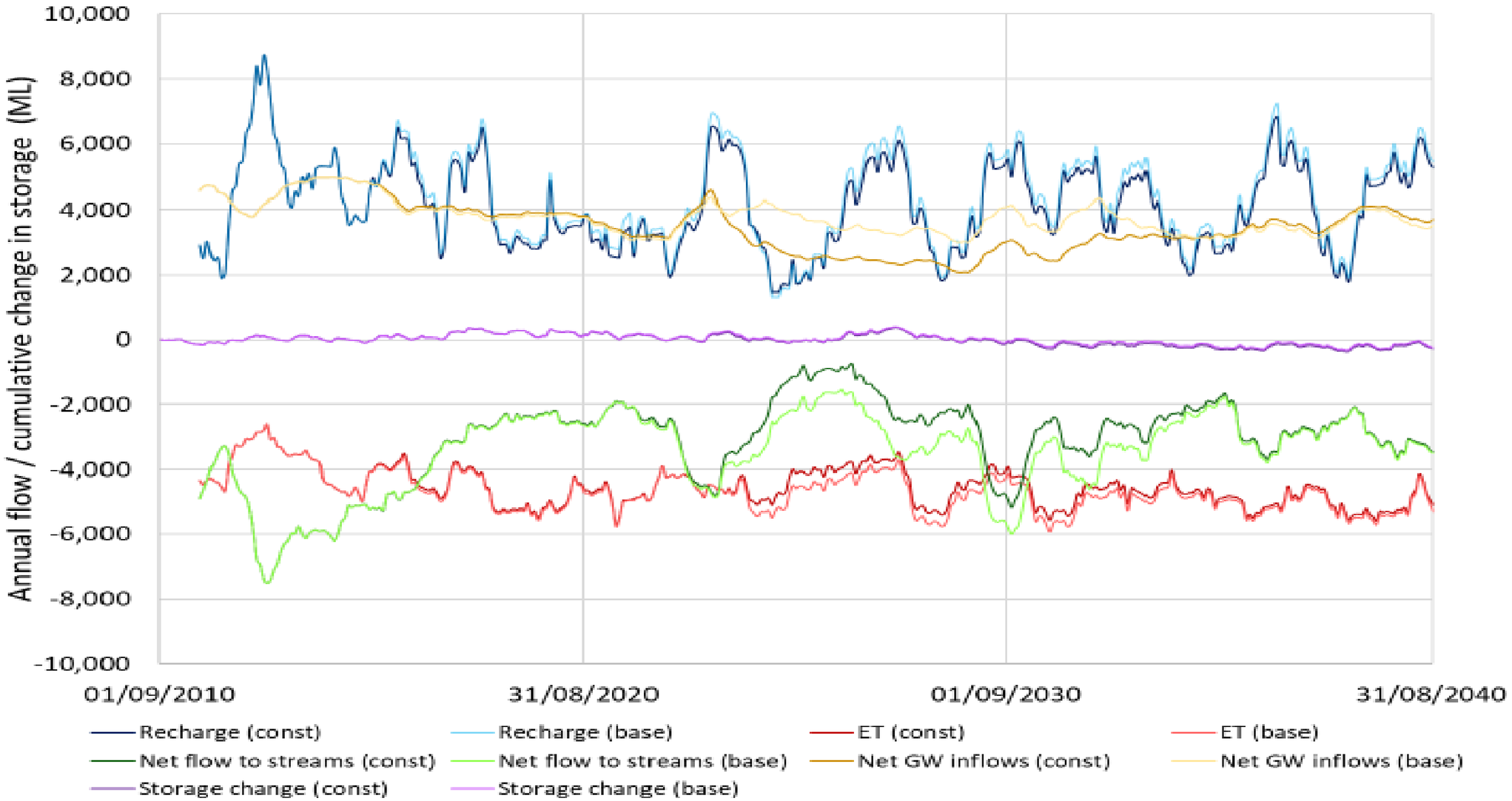


Plate 1.10: Transient water budget Sizewell Marshes SSSI



1.3.132 **Plate 1.6** the peat hydrographs indicate that during the construction phase there would be groundwater drawdown within Sizewell Marshes SSSI, the most significant change from boreholes P1, 7, 10, and 11 would be drawdown of up to 1m, but these locations would actually be outside of Sizewell Marshes SSSI within the cut off wall and form part of the main platform. This indicates the dewatering within the cut off wall and is why these hydrographs have been greyed out. Outside the cut off wall, modelling indicates drawdown of less than 10cm that decreases towards the west, the drawdown effect is **not significant** when the construction phase is complete.

1.3.133 Borehole location P13 also indicates groundwater drawdown of less than 10cm for the Minsmere to Walberswick Heaths and Marshes SAC/SSSI, albeit very localised.

1.3.134 Further clarity on the spatial distribution of the drawdown is provided by **Plate 1.7** and **Plate 1.8** showing the maximum drawdown contours in both the peat and crag deposits. Note that these contours represent the worst-case scenario, the largest modelled drawdown during drought conditions and it is not envisaged that these conditions would be maintained for the entirety of the construction phase. The drawdown within the peat reinforces the peat hydrographs, indicating a potential drawdown of 10cm along the edge of the main platform within Sizewell Marshes SSSI, the red circle indicates where drawdown may occur within the Minsmere to Walberswick Heaths and Marshes SAC/SSSI, which is very localised just to the north of the main platform and a short section either side of the Leiston drain. A measurement suggests that less than 0.6ha would be directly affected 0.025% of the Minsmere to Walberswick Heaths and Marshes SSSI total area of 2,300ha.

1.3.135 Drawdown with the crag shows a similar picture.

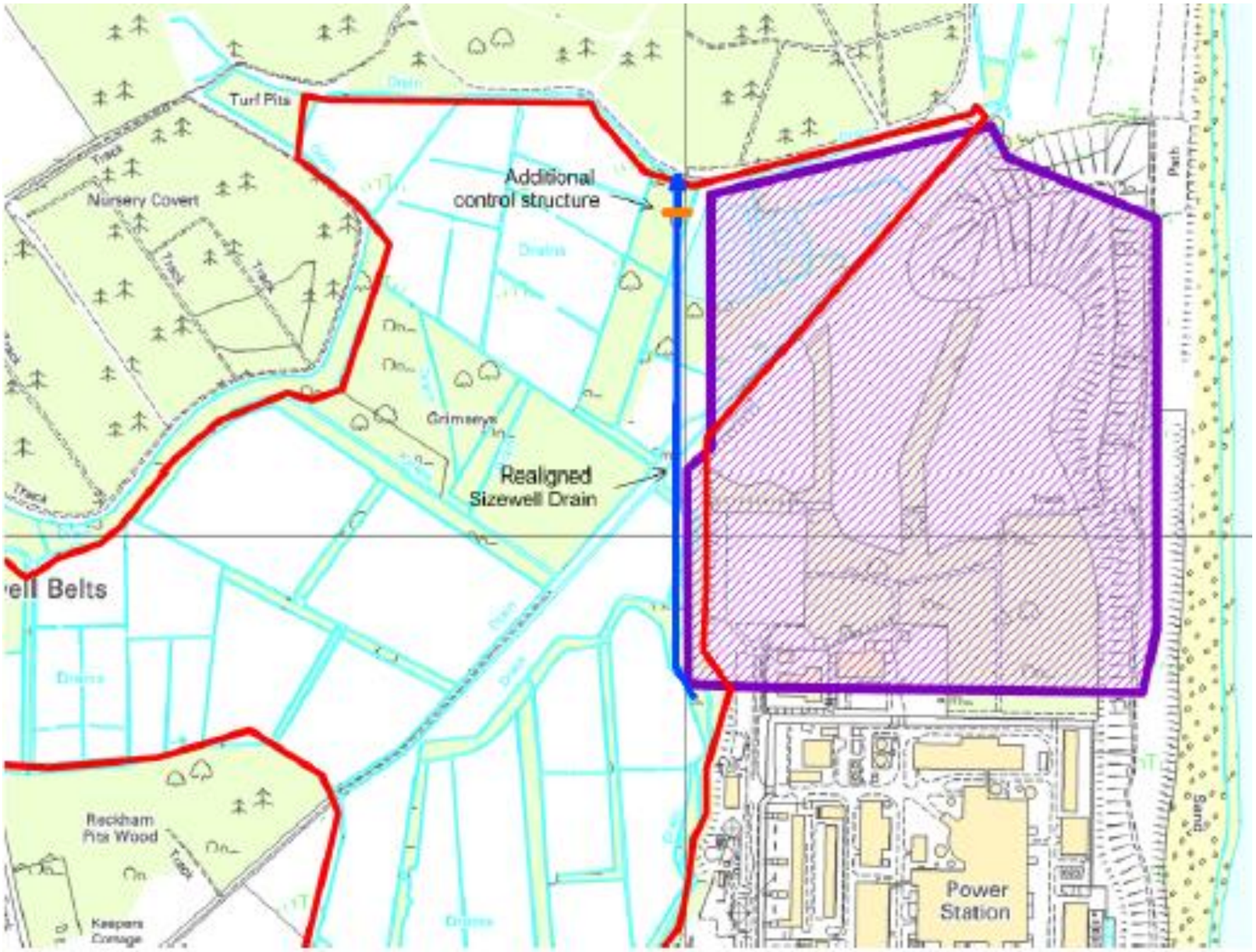
1.3.136 Importantly other than the small (0.6ha) localised area of groundwater drawdown within the Minsmere to Walberswick Heaths and Marshes SSSI/SAC, modelling does not indicate any other impacts on this designated site.

1.3.137 **Plate 1.9** shows the transient water budget for Sizewell Marshes SSSI showing both the synthetic baseline and the construction scenario baseline. This shows that during the construction period there would be a reduction in net groundwater inflows related to the groundwater drawdown and a net reduction in net flow to streams (the ditch network) which concludes a likely reduction in groundwater flooding during the construction period. But overall there is little change to the zero-line indicating that the net storage within the system does not change to a huge degree.

1.3.138 Mitigation in the form of a control structure located on the realigned Sizewell drain, shown in **Plate 1.10**, is proposed to offset the drawdown within Sizewell Marshes SSSI during the construction phase. Additional mitigation measures (discussed previously) in the form of a surface water management strategy and water management zones further ensure the maintenance of water quality and quantity within Sizewell Marshes SSSI.

1.3.139 As indicated above, maintenance of a nutrient poor status is important for some of the plant assemblages within Sizewell Marshes SSSI. The construction activities have the potential to cause a change in water chemistry and influence the current nutrient poor status. Each component of the water balance (up flow from crag, recharge from rainfall, interaction with surface water in the ditches) has a specific chemical signature and if the relative proportions of each component were to change chemical change may occur. Groundwater modelling was undertaken and showed little or no impacts to groundwater with primary mitigations, including code of construction practice and pollution prevention measures, provided in **Chapter 19** of this Volume of the **ES**: Groundwater and Surface Water.

Plate 1.11: Control structure on the realigned Sizewell Drain.



iii. Conclusions of evidence base

1.3.140 There is no identified impact pathway for hydrologically dependent habitats north of the Minsmere New Cut.

1.3.141 Groundwater dependent habitats would not be significantly affected as a result of the proposed development. Groundwater dependent habitats would be safeguarded through the provision of water management zones and swales which would ensure the treatment and infiltration of surface water.

1.3.142 The SSSI crossing is likely to cause a 1-2cm change in water levels within the Leiston drain both upstream and downstream of the SSSI crossing, but with no effects discernible 60m from the SSSI crossing point. There would, therefore, be no likely significant effects within the Minsmere South Levels (part of the Minsmere to Walberswick Heaths and Marshes SSSI) and no potential to effect fen meadow habitat within Sizewell Marshes SSSI, as both these features are located more than 60m from the SSSI crossing point.

1.3.143 Detailed hydrological modelling has established a ZOI indicating that during the construction works there would potentially be groundwater drawdown of less than 10cm within Sizewell Marshes SSSI to the west of the proposed main platform, an area supporting fen meadow habitat.

1.3.144 Drawdown of less than 10cm is also predicted for the southernmost portion of the Minsmere South Levels (part of the wider Minsmere to Walberswick Heaths and Marshes SAC/SSSI) estimated to be 0.025% of the Minsmere to Walberswick Heaths and Marshes SSSI. Hydrological change greater than 5cm is also predicted for parts of the temporary construction area due to reduced infiltration resulting from the campus development, but this would be mitigated by water management zones ensuring infiltration is returned at greenfield run-off rates.

1.3.145 Conservation management (cutting and grazing) as well as hydrological regime are important in maintaining the diversity of fen meadows.

1.3.146 Within Sizewell Marshes SSSI, four grades of fen meadow have been identified, with the most important areas (Grades 1 and 2) supporting assemblages of low-growing plant species and plant species indicative of high lime and / or low fertility, as provided in **Plate 1.5,** in **Section 1.3.118** of this Appendix.

1.3.147 Considering the evidence presented, M22 fen meadow is vulnerable to changes in the underlying hydrological regime, including: changes to water levels during the spring and summer during the plants growing season, i.e.

if conditions get significantly wetter or drier (drawdown and inundation) and if there is prolonged surface water inundation over winter, although moderate reduction in water levels may actually increase species richness but this would be to the detriment of some of the more characteristic M22 plant assemblage.

1.3.148 Hydrological modelling has indicated that construction of the proposed development may cause a drawdown of water levels within the fen meadow of less than 10cm. The control structure on the Sizewell drain would be effective in maintaining water levels. As the levels will be further managed and monitored via a Water Level Management Plan which will be coordinated with the vegetation monitoring strategy to confirm the favourable condition of the SSSI. Due to climate change and coastal erosion there is potential that the Water Level Management Plan would have a beneficial effect on the SSSI. A vegetation monitoring plan aligned with the WLMP would ensure that the communities remain at their current favourable status.

Relevant important ecological features

1.3.149 The habitat types most likely to be directly affected are wetland habitats; in particular, the fen meadow communities within Sizewell Marshes SSSI. Therefore, the IEFs relevant to this impact pathway are within Sizewell Marshes SSSI and comprise:

- fen meadow;
- reedbed;
- ditches and associated aquatic plant assemblage; and
- wet woodland.

Summary implications for Habitats Regulation Assessment

1.3.150 The hydrological modelling work has indicated that there is no direct hydrological connectivity between any areas of habitat located north of the Minsmere New Cut.

1.3.151 Hydrological change resulting from the Sizewell Marshes SSSI crossing would be in the region of 1-2cm and would not be discernible 60m from the crossing point, so significant effects on the Minsmere to Walberswick Heaths and Marshes SAC are not envisaged. The ZOI for the construction of the main platform indicated no significant change (less than 5cm); therefore, there would be no significant hydrological change to the majority of habitats located within the Minsmere to Walberswick Heaths and Marshes SAC.

1.3.152 During construction phase there would be ground water drawdown by up to 10cm within the southernmost portion of the Minsmere to Walberswick Heaths and Marshes SAC/SSSI, but the spatial influence of this is small affecting approximately 0.6ha (0.025% of the Minsmere to Walberswick Heaths and Marshes SSSI total).

Summary implications for Environmental Impact Assessment

1.3.153 The initial high-level modelling work has shown that construction activities do cause a minor change of water levels within fen meadow by up to 10cm. The introduction of a control structure, in the realigned Sizewell drain, would however raise water levels and bring the modelled change back within the baseline envelope for fen meadow, and thus maintain the status quo as seen in **Plate 1.10**. Overall, the construction scenario chosen predicted no negative effect on the M22 fen meadow community within Sizewell Marshes SSSI.

i) Air quality effects

i. Description of impact pathway

1.3.154 This impact pathway refers to any changes to air quality because of the emission and/or deposition of dust and other airborne pollutants. The deposition of airborne emissions can affect plants and habitats in several ways. Dust deposition can cover the surface of leaves and other vegetation preventing plants from photosynthesising, resulting in reduced growth and vigour and potentially death of individual plants and loss of areas of habitat. Deposition of pollutants can cause a localised alteration in the pH of soil and other substrate which, if large enough, can alter the type of plant community present, replacing an acidic grassland with species more characteristic of, for example, neutral grassland. Finally, deposition can cause localised nutrient enrichment favouring the growth of fast-growing competitive plant species at the expense of more sensitive slow-growing species, and, in some cases, smothering low-growing plants, including lichens and bryophytes.

1.3.155 The construction elements likely to cause changes in air quality are construction works likely to generate dust including:

- demolition works and on-site crushing and screening;
- earthworks, including soil stripping, stockpiling and excavation;
- on-site concrete batching;
- track-out (mud on the road from heavy goods vehicles (HGV) and other vehicle movements on site);

1.3.156 The operational project elements likely to cause air quality change are as follows:

- Operation of the twelve back-up diesel generators required for the nuclear reactors. The twelve diesel generators would comprise eight emergency diesel generators (EDGs), and four ultimate diesel generators (UDGs). Such activities are likely to also generate emissions to air, including nitrogen dioxide (NO_2), sulphur dioxide (SO_2), particulates (as PM_{10} and $PM_{2.5}$) and carbon monoxide (CO). Further information has been presented in **Volume 2, Chapter 12** of the **ES.**

ii. Evidence base

1.3.157 This section provides an overview of the evidence base for this potential impact pathway, and is drawn from the following elements:

- review of lichen and bryophyte survey carried out on coastal vegetation located to the east of the proposed main platform (Ref. 1.39, Ref. 1.40);
- detailed assessment and review of the Sizewell C Combustion Activity Assessment for Air Emissions as presented in **Volume 2, Chapter 12** of the **ES.**
- review of the Dust Impact Assessment as presented in **Volume 2, Chapter 12** of the **ES.**
- a review of the Air Pollution Information Website (APIS) (Ref. 1.41); and
- a review of additional scientific literature in relation to air quality effects on vegetation.

Lichens and Bryophytes

1.3.158 The Bryophyte Survey undertaken on the coastal vegetation to the east of the proposed main platform (Ref. 1.39) identified 26 species in total, of which the majority recorded were common and widespread in the UK. However, three species (*Cryphaea heteromalla, Orthotrichum striatum* and *Radula complanata*) had been identified as being sensitive to airborne SO_2 based on a national list produced by Blockeel *et al.* (Ref. 1.42). An assessment was made of the Ellenberg values for bryophytes published by the Centre for Ecology and Hydrology (Ref. 1.48); of relevance is the scale for nitrogen, which is a general indication of fertility. This identified that, of the 26 bryophyte species recorded, only eight were indicative of infertile or

moderately infertile sites. This suggests that the baseline bryophyte assemblage found close to the site is tolerant of nutrient conditions.

1.3.159 Similarly, whilst the lichen survey undertaken on the coastal vegetation to the east of the proposed main platform (Ref. 1.40) did not identify any lichen species of high nature conservation value, the lichen flora was well developed, with 69 taxa recorded. Only five of the species recorded were identified as being moderately sensitive to air pollution, including nitrogen deposition.

Air Pollution Information Service website

1.3.160 The APIS website brings together a suite of information pertaining to air pollution and habitat type. This information is then synthesised by APIS to provide a summary for individual statutory designated sites for five types of air pollutant: nutrient nitrogen deposition, acidity deposition, ammonia (NH_3), NO_x and SO_2. APIS provides a summary for each designated site, per habitat type, indicating whether the habitat type is sensitive to the pollutant, the impacts on the habitat type from exceedance of the pollutant and, where possible, assigning a critical load or critical level.

1.3.161 The Air Quality Strategy (AQS) for England (Ref. 1.44) defines critical levels for the protection of vegetation and ecosystems for NO_x (as NO_2) and SO_2.

1.3.162 'Critical levels' are defined as "*concentrations of pollutants in the atmosphere above which direct adverse effects on receptors, such as, plants, or ecosystems or materials, may occur according to present knowledge*" (Ref. 1.44). For example, two critical levels are given for SO_2, 10µg SO_2/m^3 annual mean for lichen species; and 20µg SO_2/m^3 annual mean for all other vegetation.

1.3.163 Critical levels for air pollutants are deliberately defined to be applicable to a broad range of habitats, unlike critical loads, which are defined for habitat types.

1.3.164 'Critical loads' are defined, for deposition of pollutants to land, as: "*a quantitative estimate of exposure to one or more pollutants, below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge*" (Ref. 1.44) and have been defined to cover broad vegetation types (e.g. forest, arable, semi-natural), sometimes with more stringent values set for sensitive lichens and bryophytes (as is the case for SO_2).

1.3.165 For most European and nationally designated habitat sites, critical loads are specified for nutrient nitrogen and acid deposition impacts. Critical loads are determined for the protection of specific habitat features, and therefore

the critical loads applied for the assessment can vary across the site being assessed, dependent on the different habitat features present.

1.3.166 Critical levels and critical loads are discussed in more detail in **Volume 2 Chapter 12** of the **ES.** Conclusions from the APIS website are described below.

1.3.167 For all habitat types two critical levels are given for NO_x, the annual mean which is set at 30µg/m^3, and a 24-hour mean set at 75µg/m^3.

1.3.168 For acid and nutrient deposition, APIS provides the following information:

- annual vegetation of drift lines is not a habitat type considered particularly sensitive to either acid or nutrient deposition.

j) Dust

1.3.169 Dust can physically coat and smother vegetation, reducing photosynthesis and, depending on the pH of the dust, potentially alter the chemical composition of soil and water chemistry. An increase in nutrient levels can cause an increase in growth in vigorous plant species that out-compete less vigorous plants and thereby alter the structure of the vegetation. A change in pH can also alter the compositional balance of a plant community, reducing the occurrence of those plant species restricted to a particular base status. The **Dust Impact Assessment** provided as part of **Volume 2 Chapter 12** of the **ES**, discusses the different forms of dust, micron sizes and distances it can travel when airborne.

1.3.170 The Institute of Air Quality Management (IAQM), indicates that:

> "*For locations with a statutory designation…consideration should be given as to whether the particular site is sensitive to dust and this will depend on why it has been designated…The level of dust deposition likely to lead to a change in vegetation is very high (over 1g/m^2/day) and the likelihood of a significant effect is therefore very low except on the sites with the highest dust release close to sensitive habitats.*" (Ref. 1.45)

1.3.171 A dust deposition rate of 0.5g/m^2/day has been agreed with consultees as the threshold level, with significant ecological effects from deposited dust predicted to occur above this threshold (Ref. 1.44). This deposition rate is based on values present in Farmer (Ref. 1.46).

1.3.172 For the purposes of this assessment, the lower ecological dust-deposition value (0.5g/m^2/day) has been adopted to represent the level below which insignificant impacts on vegetation are expected; whilst the upper value

(1g/m^2/day) is assumed to represent the level above which a change in vegetation may occur as a result of dust deposition.

Table 1.7: Baseline Dust Deposition Monitoring (2016–17).

Location	Deposited Dust (mg/m2/day).		
	Max 4-Week Average.	Min 4-Week Average.	Mean
1 – West of site access.	137	13	53
2 – Northwest of campus.	66	6	25
3 – North of borrow pit.	46	10	27
4 – Campus/site access hub.	327	11	53
5 – North-western edge of Minsmere to Walberswick Heaths and Marshes SSSI.	42	3	19
6 – Southern TCA.	93	5	39
7 – TCA/Sizewell Marshes SSSI.	55	5	23
8 – Lover's Lane/Sizewell Marshes SSSI.	57	9	26
Recommended site action level.	200 (4-week average).		

1.3.173 The results indicate some variation over the monitoring period, with several higher deposition rates recorded during the monitoring period, likely to be the result of localised sources or activities to the monitor, such as vehicle movement; of particular note is the maximum deposition rate at Location 4 that was higher than the recommended site action level. The monitoring indicates a general trend for lower dust deposition rates during the wetter, Winter months and an increase in the summer months, with winter and summer seasonal averages of 24mg/m^2/day and 40mg/m^2/day respectively (over the eight sites). The baseline dust deposition at the Minsmere to Walberswick Heaths and Marshes and Sizewell Marshes SSSIs is well below the ecological dust-deposition value of 0.5g/m^2/day (500mg/m^2/day), with further details provided in **Section 1.3.104** of this Appendix.

1.3.174 The construction of proposed development requires deep excavations for the main platform as well as the raising of land levels to achieve the permanent platform height. This would generate significant quantities of excavated spoil, as well as a need to import backfill material, all of which would require stockpiling at various periods over the construction phase. A range of bulk materials would therefore require management on-site.

1.3.175 The activities within each phase of construction works that could potentially generate dust have been identified and then further screened according to the inherent dust generation potential of the material; for example, excavation of wet materials has been screened out of further assessment,

but secondary handling of the same materials after a period of drying or vehicle movements over it has been included.

1.3.176 The Dust Impact Assessment has identified a number of potentially sensitive ecological receptors. A screening distance of 500m from the closest site boundary has been applied with to regards receptors, in accordance with IAQM guidance.

1.3.177 The detailed dust assessment identified that the Minsmere to Walberswick Heaths and Marshes SPA, SAC, Ramsar site and SSSI is of high sensitivity to dust deposition impacts being in close proximity and downwind of the main construction area and long-term works. In addition, Sizewell Marshes SSSI is of high sensitivity to dust deposition impacts due to track-out from vehicle movements.

1.3.178 The detailed dust assessment has identified, that unmitigated, there is a very high risk of the earthworks and track-out causing dust deposition impacts.

k) Combustion activity (diesel generators)

1.3.179 The Sizewell C Combustion Impact Assessment (Ref. 1.47) highlights that Sizewell C power station would be supported by up to twelve back-up diesel generators.

1.3.180 Air emissions from the diesel generators have been modelled to determine the likely worst-case process contributions. These have been added to the background pollutant concentrations to determine the overall predicted environmental concentration at sensitive ecological receptor locations, which have then been assessed against air quality standards. An assessment of the potential for air quality effects to have a likely significant effect on designated sites, including depositional impacts, has also been undertaken. Further information is presented in **Volume 2, Chapter 12** of the **ES.**

1.3.181 For European sites (SPA, SAC or Ramsar sites), an assessment is made as to whether the installation is likely to have a significant effect, and whether this could lead to an adverse effect on site integrity. For nationally designated SSSIs, the assessment determines whether the installation is likely to damage the site.

1.3.182 The Environment Agency's Risk Assessment Guidance screening criteria (Ref. 1.48) for significance of the emission has been applied to the outcome of the dispersion modelling for both European and National sites. The predicted process contributions have been compared with the appropriate critical level to determine the significance of the pollutant emission.

1.3.183 The total pollutant emission is defined in the Environment Agency's Risk Assessment Guidance (Ref. 1.48) as being insignificant where:

- process contribution less than 1% of the critical level, or the predicted environmental concentration less than 70% of critical level for long-term releases; and
- process contribution greater than 10% of the critical level for short-term releases.

1.3.184 For all other nature conservation sites, i.e. CWS, the assessment needs to determine whether the installation would result in 'significant pollution' i.e. where critical levels are exceeded. Therefore, if the long and short-term process contribution is less than 100% of the relevant standard, it is considered to be **not significant**.

1.3.185 As with critical levels of atmospheric pollutants, it has been agreed between the Environment Agency and Natural England that process contributions of less than 1% of the critical load for pollutant deposition (nitrogen and acid) can be considered to be insignificant, and that process contributions greater than 1% have the potential to be significant, depending upon the context.

1.3.186 A number of potential commissioning and operating scenarios have been modelled covering:

- both short-term commissioning and the longer-term operation of the diesel generators;
- during the operational life of the power station, the diesel generators would only operate in the event of a power failure, operational impacts have therefore been assessed for emergency backup operation (referred to as loss of on-site power event); and
- annual routine testing operations.

1.3.187 The specific habitat receptors included in the dispersion modelling assessment are presented in **Table 1.8** and the exact location of the points chosen for those receptors close to the site are also shown on **Plate 1.11.**

1.3.188 These receptors are within the cited screening distances detailed in the Environment Agency's Risk Assessment Guidance of 10km for internationally designated sites (i.e. SACs, SPAs and Ramsar sites) and 2km for locally and nationally designated sites (i.e. SSSIs and non-designated CWS).

l) Results

1.3.189 The maximum predicted ground level process contributions of pollutants at habitat receptors have been compared against the appropriate critical level

or critical load to assess whether the potential impacts are predicted to be insignificant, or whether the potential for any significant impact exists.

1.3.190 The results tables presented use a red, amber and green rated colour coding system, as follows:

- Green: process contribution/predicted environmental concentration can be screened as insignificant for SACs, SPAs, Ramsar sites and SSSIs where:
  - process contribution/critical level/load = less than 1% of long-term impacts and less than 10% for short term impacts; or
  - predicted environmental concentration/critical level = less than 70% of long-term impacts.
  - (for CWS, where long and short-term process contributions are less than 100% of the critical level, they are considered to be insignificant and are rated as green).
- Amber: Not screened as insignificant, but no exceedance of the critical level or load is predicted, or where an exceedance is already occurring due to high background concentrations, i.e. the exceedance is not considered to be due to the impacts of the proposed development.
- Red: process contributions/ predicted environmental concentrations indicate an exceedance of the critical level or load, where background concentrations are not predicted environmental concentrations already, causing the exceedance i.e. the exceedance is considered to result from the impacts of the proposed development.

1.3.191 The results from the air quality modelling of the diesel generators and the conclusions that have been reached are presented in this report. The full assessment of the diesel generator emissions is presented in **Volume 2 Chapter 12, Appendix C** of the **ES**.

m) Critical levels

1.3.192 As outlined above critical levels are where concentrations of pollutants in the atmosphere above which direct adverse effects on receptors, such as, plants, or ecosystems or materials, may occur according to present knowledge.

1.3.193 The impact of emissions against critical levels for NO_X and SO_2 has been assessed based on the scenarios detailed above, through comparison of the maximum predicted process contributions at each of the identified sensitive habitat receptors, with the critical levels.

i. Annual average NO_X impacts

1.3.194 Exceedance of NO_x critical levels can result in damage to lichens and bryophytes, changes in plant composition and leaf discoloration.

1.3.195 The air quality modelling undertaken has produced two sets of outputs:

- The maximum predicted annual average process contributions for NO_x for specific habitat receptors for which an exceedance is indicated by the modelling, for both commissioning and routine operating scenarios, along with a comparison against the relevant critical levels, are provided in **Table 1.9.**
- Plotting of isopleths for maximum predicted annual average process contributions for NO_x for both commissioning scenarios, over three types of habitat data: broad habitat types (obtained from Suffolk Biodiversity Information Service) Phase 1 habitat data and NVC community data. The plotting of isopleth contours over habitat data are provided in figures **Plate 1.12**.

1.3.196 The maximum predicted annual average process contributions for NO_x, are provided in **Table 1.8** for those habitat receptors where modelling indicates an exceedance, for both commissioning and routine operating scenarios, along with a comparison against the relevant critical levels.

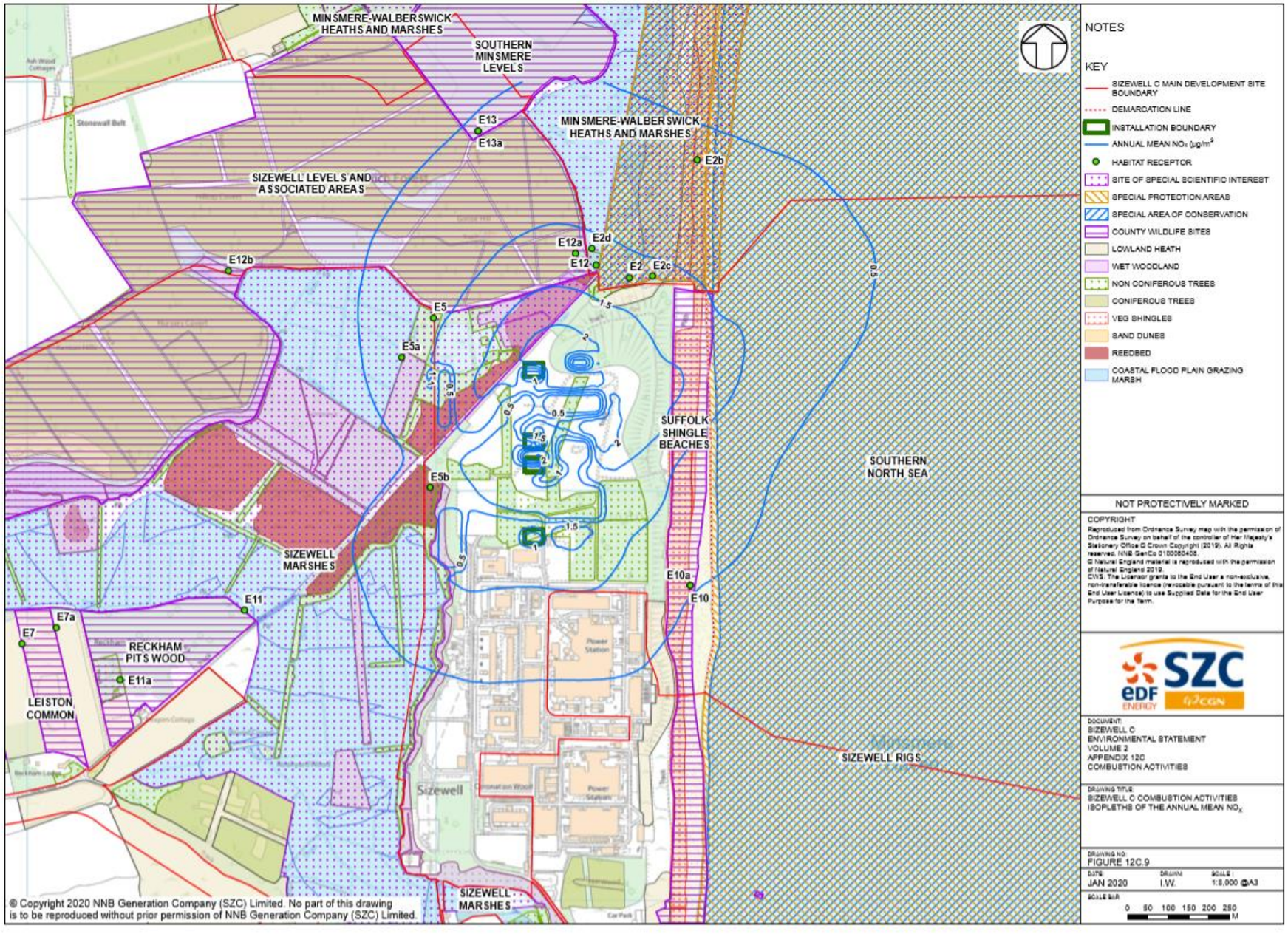
Table 1.8: Predicted annual average (long term) process contributions for NOx at all identified receptors (highest result shown in bold).

Receptor	CL (µg/m^3)	Commissioning				Routine Testing			
		PC (µg/m^3)	PC / CL	BC (µg/m^3)	PEC / CL	PC (µg/m^3)	PC / CL	BC (µg/m^3)	PEC / CL
E1 Alde Ore.	30	0.07	0.2%	7.6	26%	0.02	<0.1%	7.4	25%
E2 Minsmere.	**30**	**13.5**	**45.0%**	**7.7**	**71%**	**3.9**	**12.9%**	**7.5**	**38%**
E3 Orfordness.	30	0.05	0.2%	7.2	24%	0.01	<0.1%	7.0	24%
E4 Sandlings.	30	0.5	1.8%	7.7	27%	0.2	0.5%	7.5	26%
E5 Sizewell Marshes.	30	3.9	12.9%	7.5	38%	1.1	3.7%	7.4	28%
E6 Leiston and Aldeburgh, E8 and E9 Dower House.	30	0.3	1.1%	7.5	26%	0.09	0.3%	7.4	25%
E7 Leiston Common*.	30	0.6	1.9%	7.8	28%	0.2	0.6%	7.6	26%
E10 Suffolk Shingle Beaches*.	30	4.1	13.8%	9.5	45%	1.2	3.9%	9.3	35%
E11 Reckham Pits Wood.	30	1.2	4.0%	7.7	30%	0.4	1.2%	7.5	26%
E12 Sizewell Levels*.	30	13.3	44.3%	7.7	70%	3.8	12.7%	7.5	38%
E13 Minsmere South Levels.	30	3.2	10.6%	7.7	36%	0.9	3.1%	7.5	28%

*CWS.

CL = critical level (for the Protection of Vegetation and Ecosystems), PC = Process Contribution, BC = Background Concentration, PEC = Predicted Environmental Concentration.

Plate 1.12: Annual NOx for commissioning scenario overlaid on broad habitat data.



1.3.197 **Plate 1.11** shows that the predicted ZOI during both the commissioning and routine operation is relatively small and primarily centred on the location of the diesel generator stacks, but encompassing the southern end of the Minsmere to Walberswick Heaths and Marshes SAC/SSSI and northern section of Sizewell Marshes SSSI.

1.3.198 It can be seen from **Table 1.8** that the worst-case impacts are predicted to occur at Minsmere (receptor E2) and Sizewell Levels (part of the Minsmere to Walberswick Heaths and Marshes SAC/SSSI) (receptor E12), which are both predicted to experience annual NO_x concentrations that cannot be screened out as insignificant during the commissioning phase. The site experiencing the greatest impacts is Minsmere. When combined with background concentrations it representations 71% of the critical level during the commissioning period. It is not considered, based on **Volume 2 Chapter 12, Appendix C** of the **ES** that there will be an adverse effect as no exceedance is predicated. This is also applicable to the Sizewell Levels, capturing a 70% critical level.

1.3.199 The habitat mapping data shows that habitat types at receptor locations E2 (Minsmere) and E12 (Sizewell Levels) are as follows:

- coastal or floodplain grazing marsh;
- reed bed; and
- vegetated shingle and sand dune.

1.3.200 Of these habitat types annual vegetation of drift lines comprises large areas of shingle and sand which are sparsely vegetated and inundated during times of high-tide, therefore nutrients are less likely to affect this habitat type due to the paucity of the vegetation. However, vegetated shingle is more densely vegetated and supports less vigorous plant species, therefore nutrient enrichment may result in these plant species being outcompeted. Therefore, is considered most sensitive to an increase in nitrogen levels. However, given that critical levels are defined it is not considered that the predicted environmental concentration would have an adverse effect as no exceedance is predicted. Additionally, when taking into consideration the background NO_x concentration at this site, the predicted environmental concentrations show that exceedance of the annual critical level is unlikely.

1.3.201 For all results, it is important to note that the assessment has been based on the worst-case emissions from the EDGs, when emissions from the UDGs would lead to a lower level of impact. In addition, the commissioning times for the UDGs (738 hours x 2 UDGs equates to a total of 1,476 hours) are greater than commissioning times for the EDGs (242.5 hours x 4 equates to a total of 970 hours per reactor).

1.3.202 Commissioning operations would only occur for two years and the process contributions for the routine operating scenario are much lower; by that time, all predicted environmental concentrations are predicted to be below 70% of the annual average critical levels. Thus, all habitat receptors would experience impacts from process contributions that can be considered **not significant.**

ii. Daily NO_x impacts

1.3.203 There are no commissioning scenarios which could lead to emissions from the diesel generators occurring over a 24-hour period, and therefore impacts against the daily NO_x critical level have only been assessed for routine testing operations.

1.3.204 In line with the operating scenarios described for the installation, it has been assumed that one diesel generator is operational throughout the year. In fact, this is an over-estimate, as, routine testing operations for diesel generator would only occur for 60 hours over the year (720 hours of operation on an annual basis for all generators combined). As there are 8,760 hours in a common year, generators would only operate for 8.2% of a full common year.

1.3.205 As for the annual NO_x modelling the outputs of the daily NO_x have also been overlaid as isopleths on the habitat data. The mapping of isopleths against habitat data does provides a useful indication of the likely ZOI of any exceedance of daily NO_x. **Plate 1.12** shows the daily NO_x overlaid on habitat data.

1.3.206 Therefore, modelling results are also included for the point locations for habitat receptors identified. Maximum results of the daily NO_x modelling for all the habitat receptors where an exceedance is predicted are provided in **Table 1.9**.

Plate 1.13: Daily NOx for routine operations overlaid on broad habitat data.

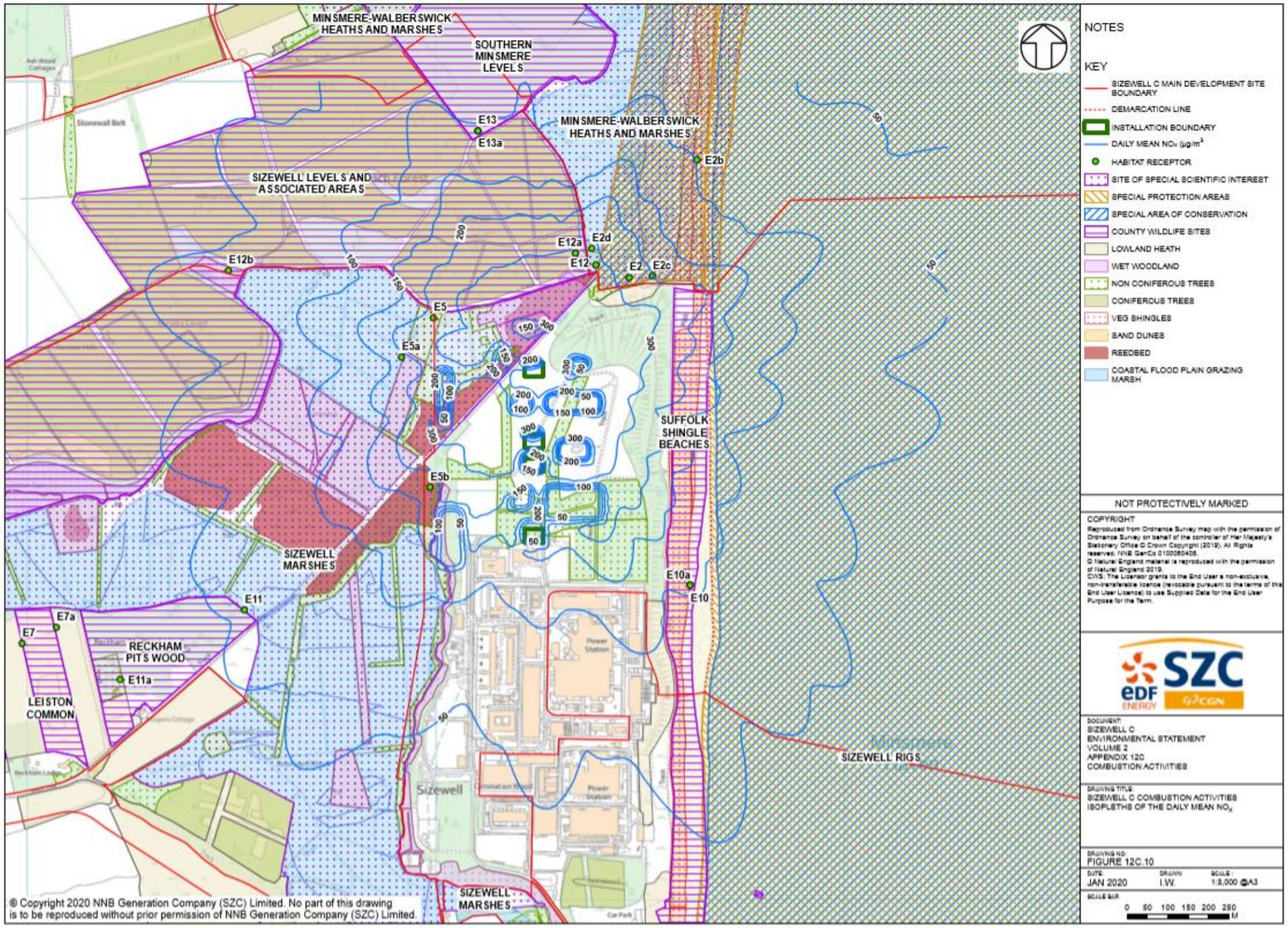


Table 1.9: Predicted daily average process contributions for NOx at all identified receptors (highest result shown in bold).

Receptor	CL (µg/m^3)	Routine Testing.			
		PC (µg/m^3)	PC / CL	BC (µg/m^3)	PEC / CL
E1 Alde Ore.	75	4.8	6%	11.1	21%
E2 Minsmere.	**75**	**303.6**	**405%**	11.3	420%
E3 Orfordness.	75	3.3	4%	10.6	18%
E4 Sandlings.	75	25.4	34%	11.3	49%
E5 Sizewell Marshes.	75	307.4	410%	11.0	425%
E6 Leiston and Aldeburgh, E8 and E9 Dower House.	75	20.7	28%	11.0	42%
E7 Leiston Common*.	**75**	41.4	55%	11.4	70%
E10 Suffolk Shingle Beaches*.	**75**	149.5	199%	14.0	218%
E11 Reckham Pits Wood.	75	70.5	94%	11.3	109%
E12 Sizewell Levels*.	**75**	**320.7**	**428%**	**11.3**	**443%**
E13 Minsmere South Levels.	75	111.6	149%	11.3	164%

*CWS

CL = critical level (for the Protection of Vegetation and Ecosystems), PC = Process Contribution, BC = Background Concentration, PEC = Predicted Environmental Concentration

1.3.207 It is reasonable to consider that the short-term (24 hour) mean for NO_x is of less importance than the annual mean, as vegetation exposed to levels of NO_x above the critical level would be more likely to recover from that exposure if the exceedance is for a short duration. A report from the Centre for Ecology and Hydrology (Ref. 1.43) states that the United Nations and Economic Committee for Europe working group on effects strongly recommended the use of the annual mean value, as the long-term effects of NO_x are thought to be more significant than the short-term effects.

1.3.208 **Plate 1.12** shows that the ZOI of any exceedance of daily NO_x is confined to a relatively small area encompassing the southern end of the Minsmere to Walberswick Heaths and Marshes SAC/SSSI and the northern end of the Sizewell Marshes SSSI. Also, within the ZOI are parts of the Sizewell Levels and Associated Areas CWS and the Suffolk Shingle Beaches CWS.

1.3.209 **Table 1.9** shows that six of the identified receptors could experience process contributions that would result in an exceedance of the daily critical level: Minsmere, Minsmere South Levels, Sizewell marshes, Sizewell Levels, Suffolk shingle beaches and Reckham Pits Wood. The habitat receptors experiencing the worst-case impacts are at Minsmere Walberswick heaths and marshes, Sizewell marshes, the Sizewell Levels (part of the Minsmere Walberswick Heaths and Marshes SAC/SSSI), Reckham Pits Wood (part of the Sizewell Levels and Associated Areas CWS) and the Suffolk Shingle Beaches CWS. These sites comprise areas of:

- coniferous trees;
- broadleaved and wet woodland;
- reedbed;
- coastal or floodplain grazing marsh; and
- vegetated shingle and sand dune.

1.3.210 Reedbeds are considered to be relatively insensitive to atmospheric NO_x concentrations, particularly over a short duration of time, and therefore it is not considered that adverse impacts would occur on this feature. Similarly, it is considered that both broadleaved and wet woodland would also be relatively insensitive. Although predicted concentrations for the vegetated shingle, sand dunes are lower, these habitats, such as the Suffolk Shingle Beaches CWS are likely to be more sensitive to elevated nitrogen, and the predicted NO_x levels would exceed the daily critical level for these features.

1.3.211 However, although the predicted atmospheric NO_x levels may be increased while the Installation is in operation, this is an overestimation as in reality the diesel generators would only operate for a maximum of 720 hours in the

year in total (8.2% of a full common year). It is therefore considered that these habitats would have time to recover from any short-term exposure.

1.3.212 Given the position stated above regarding the lower importance of the daily mean critical level than the annual mean, coupled with the conservative assumptions used in the assessment, it is considered that the actual level of impact would be lower than predicted in **Table 1.9**.

iii. Annual SO_2 impacts

1.3.213 As with NO_x, exceedance of SO_2 critical levels can result in damage to lichens and bryophytes, changes in plant composition, and result in leaf discoloration.

1.3.214 Maximum predicted annual average process contributions for SO_2 for the habitat receptors predicted for both commissioning and routine operating scenarios, compared to the critical level for higher plants (i.e. 20µg/m^3), are provided in **Table 1.10.**

Table 1.10: Predicted annual averages process contributions for SO_2 at identified receptors and operating scenarios (relative to the critical level for higher plants) (highest result shown in bold) (Ref. 1.45).

Receptor	CL (µg/m³)	Commissioning				Routine Testing.			
		PC (µg/m³)	PC / CL	BC (µg/m³)	PEC / CL	PC (µg/m³)	PC / CL	BC (µg/m³)	PEC / CL
E1 Alde Ore.	20	0.003	0.0%	2.2	11%	0.001	0.0%	2.2	11%
E2 Minsmere.	**20**	**0.5**	**2.3%**	**4.0**	**22%**	**0.1**	**0.7%**	**4.0**	**21%**
E3 Orfordness.	20	0.002	0.0%	2.5	13%	0.000	0.0%	2.5	13%
E4 Sandlings.	20	0.02	0.1%	2.7	1%	0.005	0.0%	2.7	14%
E5 Sizewell Marshes.	20	0.1	0.7%	2.7	14%	0.04	0.2%	2.7	14%
E6 Leiston and Aldeburgh, E8 and E9 Dower House.	20	0.01	0.1%	3.1	16%	0.003	0.0%	3.1	16%
E7 Leiston Common*.	20	0.02	0.1%	2.5	13%	0.006	0.0%	2.5	13%
E10 Suffolk Shingle Beaches*.	20	0.1	0.7%	2.4	13%	0.04	0.2%	2.4	12%
E11 Reckham Pits Wood.	20	0.04	0.2%	3.0	15%	0.01	0.1%	3.0	15%
E12 Sizewell Levels*.	**20**	**0.5**	**2.3%**	**4.0**	**22%**	**0.1**	**0.7%**	**4.0**	**21%**
E13 Minsmere South Levels.	20	0.11	0.5%	4.0	20%	0.03	0.1%	4.0	20%

*CWS

CL = critical level (for the Protection of Vegetation and Ecosystems), PC = Process Contribution, BC = Background Concentration, PEC = Predicted Environmental Concentration

1.3.215 A similar comparison has been made for the lower end of the relevant critical level range (i.e. 10µg/m³), and this is provided in **Table 1.11.**

Table 1.11: Predicted annual averages process contributions for SO_2 at identified receptors and operating scenarios (relative to the critical level for bryophytes and lichens) (highest result shown in bold) (Ref. 1.45).

Receptor	CL (µg/m³)	Commissioning				Routine Testing.			
		PC (µg/m³)	PC / CL	BC (µg/m³)	PEC / CL	PC (µg/m³)	PC / CL	BC (µg/m³)	PEC / CL
E1 Alde Ore.	10	0.003	0.0%	2.2	22%	0.001	0.0%	2.2	22%
E2 Minsmere.	**10**	**0.5**	**4.7%**	**4.0**	**45%**	**0.1**	**1.3%**	**4.0**	**41%**
E3 Orfordness.	10	0.002	0.0%	2.5	25%	0.000	0.0%	2.5	25%
E4 Sandlings.	10	0.02	0.2%	2.7	27%	0.005	0.1%	2.7	27%
E5 Sizewell Marshes.	**10**	0.1	1.3%	2.7	28%	0.04	0.4%	2.7	27%
E6 Leiston and Aldeburgh, E8 and E9 Dower House.	10	0.01	0.1%	3.1	31%	0.003	0.0%	3.1	31%
E7 Leiston Common*.	10	0.02	0.2%	2.5	25%	0.006	0.1%	2.5	25%
E10 Suffolk Shingle Beaches*.	10	0.1	1.4%	2.4	25%	0.04	0.4%	2.4	24%
E11 Reckham Pits Wood.	10	0.04	0.4%	3.0	30%	0.01	0.1%	3.0	30%
E12 Sizewell Levels*.	**10**	**0.5**	**4.6%**	**4.0**	**45%**	**0.1**	**1.3%**	**4.0**	**41%**
E13 Minsmere South Levels.	10	0.1	1.1%	4.0	41%	0.03	0.3%	4.0	40%

*CWS

CL = critical level (for the Protection of Vegetation and Ecosystems), PC = Process Contribution, BC = Background Concentration, PEC = Predicted Environmental Concentration

1.3.216 **Table 1.10** and **Table 1.11** show that habitat receptor Minsmere and Sizewell levels are predicted to experience SO_2 process contributions of 0.5 ($\mu g/m^3$) and the process contribution by the critical level is greater than 1%, although only during commissioning operations.

1.3.217 The habitat receptors experiencing the worst-case impacts are Minsmere and Sizewell levels. However, even during the commissioning phase, it is unlikely that an exceedance of the critical level would occur (predicted environmental concentrations are less than 45% of the critical level for more sensitive species, and therefore below the screening criteria of 70% for annual average impacts). After the two-year commissioning, all habitat receptors would experience impacts that are **not significant**.

1.3.218 In summary, the impacts from the operation of the diesel generators would not result in any exceedances of the SO_2 critical levels for either higher plants or bryophytes and lichens, during commissioning or routine operations.

n) Critical loads - depositional impacts

1.3.219 The assessment of depositional impacts considers the relevant interest features within each habitat receptor and compares predicted impacts against critical loads for the individual features therein.

1.3.220 An assessment against the relevant critical loads has been carried out for all relevant statutory and non-statutory habitat sites and the interest features present. This includes both nutrient nitrogen deposition due to emissions of NO_2, and acid deposition due to NO_2 and SO_2 emissions.

1.3.221 The interest features applicable to the assessment (i.e. those habitat types for which critical loads are available) have been identified through the www.apis.ac.uk website (Ref. 1.49). These are detailed in SZC Co.'s Sizewell C Combustion Activity Impact Assessment for Air Emissions which has been included as part of the documentation associated with **Volume 2, Chapter 12** of the **ES.**

i. Nutrient nitrogen

1.3.222 An assessment of nutrient enrichment has been undertaken by calculating nitrogen deposition from the dispersion modelling data (Ref. 1.50). This has been done by applying deposition velocities to the predicted annual average NO_2 concentrations determined through the modelling at the individual interest features. The deposition velocities have been taken from Environment Agency guidance AQTAG06 (Ref. 1.51) and have been selected for the appropriate interest features at the habitat receptor (0.0015m/s for grassland and 0.003m/s for woodland).

1.3.223 The predicted deposition rates (during both commissioning and routine operation) have then been converted to units of kg N/ha/year (kilograms of nitrogen per hectare per year). The resulting value has then been compared to the lower value in the range of relevant critical loads available for the interest features present within each habitat site and are presented in **Table 1.12**.

Table 1.12: Nitrogen deposition at identified habitat receptors (highest result shown in bold).

				Commissioning				Routine Operation			
Receptor	**Critical Load Class**	**CLd Range**	**BG N-DEP (kg N/ha/yr)**	**NO2 PC µg/m³**	**PC N-DEP (kg N/ha/yr)**	**PC / CLd[1]**	**PEC / CLd[1]**	**NO2 PC µg/m³**	**PC N-DEP (kg N/ha/yr)**	**PC / CLd[1]**	**PEC / CLd[1]**
E1a	Pioneer, low-mid, mid upper saltmarshes.	20 – 30	12.9	0.043	0.006	0.03%	65%	0.012	0.002	0.01%	65%
E1c	Pioneer, low-mid, mid upper saltmarshes.	20 – 30	12.9	0.049	0.007	0.04%	65%	0.014	0.002	0.01%	65%
E1d	Rich fens	15 - 30	11.2	0.032	0.005	0.04%	75%	0.009	0.001	0.01%	75%
E2b	Coastal stable dunes.	8 – 15	13.1	3.1	0.44	5.50%	169%	0.88	0.13	1.60%	165%
E2c	Dry heath.	**10 – 20**	**13.8**	**7.9**	**1.14**	**11.40%**	142%	2.3	0.33	3.30%	141%
E2d	Fen, marsh and swamp (rush pasture etc…)	15 – 25	13.1	7.6	1.09	7.30%	95%	2.2	0.31	2.10%	89%
E2e	Fen, marsh and swamp (swamp and reedbeds).	15 – 30	13.1	0.49	0.071	0.50%	88%	0.14	0.02	0.10%	88%
E3a	Coastal stable dunes.	8 – 15	8.3	0.034	0.005	0.06%	104%	0.009	0.001	0.02%	104%
E4a	Dry heath.	10 – 20	15	0.33	0.047	0.50%	150%	0.095	0.01	0.10%	150%
E5a	Fen, marsh and swamp (Fen meadow).	15 – 30	12	2	0.284	1.90%	82%	0.6	0.09	0.60%	81%
E5b	Fen, marsh and swamp (rush pasture etc…).	15 – 25	12	3.4	0.484	3.20%	83%	0.97	0.14	0.90%	81%
E6a	Dry heath.	10 – 20	11.5	0.33	0.047	0.50%	115%	0.09	0.01	0.10%	115%

				Commissioning				Routine Operation			
Receptor	**Critical Load Class**	**CLd Range**	**BG N-DEP (kg N/ha/yr)**	**NO2 PC µg/m³**	**PC N-DEP (kg N/ha/yr)**	**PC / CLd[1]**	**PEC / CLd[1]**	**NO2 PC µg/m³**	**PC N-DEP (kg N/ha/yr)**	**PC / CLd[1]**	**PEC / CLd[1]**
E7a*	Dwarf Shrub Heath.	10 – 20	12	0.43	0.062	0.60%	121%	0.13	0.02	0.20%	121%
E8a	Dwarf Shrub Heath.	10 – 20	12	0.23	0.033	0.30%	121%	0.066	0.01	0.10%	121%
E10a*	Coastal stable dunes – acid type.	8 – 10	12	0.53	0.154	1.50%	216%	0.16	0.04	0.40%	215%
E11a	Broadleaved, mixed and yew woodland	10 – 20	21.4	0.53	0.154	1.50%	216%	0.16	0.04	0.40%	215%
E12a	**Coniferous woodland**	**5 – 15**	**21.4**	**8**	**2.29**	**46%**	**474%**	**2.3**	**0.6**	**13%**	**441%**
E12b	Broadleaved, mixed and yew woodland	10 – 20	21.4	0.59	0.17	1.70%	216%	0.18	0.05	0.50%	215%
E13a	Dwarf shrub heath	10 – 20	12	**2.2**	0.321	3.20%	124%	0.64	0.09	0.90%	121%

*CWS.

Notes: [1]The most stringent (i.e. the lower range) Critical Load from the range provided has been used in the assessment.

CLd = Critical Load, PC = Process Contribution, BG = Background Nitrogen Deposition rate.

1.3.224 **Table 1.12** shows those habitat features where impacts cannot be considered insignificant and further consideration of the results is required. Further detailed information is presented in **Volume 2, Chapter 12** of the **ES**.

1.3.225 The average background deposition rates, at habitat receptors where exceedances are predicted, are in excess of the lower end of the critical load range, obtained from the data published by APIS to inform this assessment. In some cases, the critical loads exceed the higher end of the critical load range. The contributions from the proposed development do not result in an exceedance of the critical load that was not already occurring as a result of the existing background, at any site.

1.3.226 The maximum process contribution for nitrogen deposition, as a result of the diesel generators, represents an increase of 46% of the lower critical load during the commissioning phase and 13% during routine operation. This would be experienced by an area of coniferous woodland in the Sizewell Levels and Associated Areas CWS (i.e. Goose Hill). However, this is the only area that would experience such high increases and, the background nitrogen deposition for this location and habitat feature is already more than five times the lower end of the critical load range (and nearly twice the upper end figure). More importantly, the majority of this area would be cleared for the proposed development.

1.3.227 Three of the four habitats within Minsmere (the coastal dune habitat, the dry heath, and the fen/swamp) would also experience increases in nitrogen deposition of more than 1%, (at 5.5%, 11.4% and 7.3% for the three habitat sub-locations, respectively) though much less during routine operation. All three of these receptors are already receiving nitrogen inputs above the lower value of the relevant critical load range. Therefore, whilst the process contribution represent greater than 1% of the critical load for these features, it is very unlikely that this would lead to significant changes in species composition or to noticeable damage to the constituent plants, including any lichens and bryophytes (survey work has not indicated a lichen or bryophyte assemblage likely to be particularly sensitive to an increase in nitrogen deposition).

1.3.228 The two habitat areas within Sizewell Marshes SSSI (the fen meadow, and swamp/reedbed), are predicted to see nutrient increases of 1.9% and 3.2% respectively during the two-year commissioning period. For both of these areas, the background deposition levels are only just above the lower value of the relevant critical load range, suggesting that the predicted increases could have an effect. Changes in nutrient levels combined with hydraulic change may exacerbate changes in plant distribution and abundance. However, these are mesotrophic habitats that are relatively tolerant of

nutrient input. In addition, the reedbed component within these areas would be lost to the development.

1.3.229 The other locations where nitrogen deposition is predicted to be greater than 1% are the coastal dune habitat within the Suffolk Shingle Beaches CWS, the dry heath habitat within the Minsmere South Levels, two areas of broadleaved woodland at Reckham Pits Wood and within the Sizewell Levels. Both dune and heathland habitats are relatively sensitive to nitrogen deposition, owing to their low nutrient status. However, in both cases the background nitrogen deposition is already significantly above the Critical Load for these habitats, such that these relatively small percentage increases (1.1% and 1.7%, respectively) are considered unlikely to cause adverse effects.

1.3.230 Similarly, the small increases anticipated for the two areas of broadleaved woodland are considered likely to be insignificant, given that both are already significantly over the critical load for this habitat (almost three times the lower end of the range, and 50% higher than the upper limit).

1.3.231 Whilst an increase in the levels of nitrogen deposition is clearly predicted for a number of the habitats within the vicinity of the diesel generators, it is important to note that the process contributions discussed would be short-term and temporary (especially during commissioning operations) and are also set against a background of high chronic nitrogen deposition in the wider area. Therefore, the process contributions are considered unlikely to result in significant changes in species composition or habitat condition at any receptor.

ii. Acid deposition

1.3.232 Increases in acidity from deposition of SO_2 and NO_2 have also been considered (Ref. 1.47). This has been done by applying deposition velocities to the predicted annual average NO_2 and SO_2 concentrations determined through the modelling at the individual interest features. The relevant deposition velocities have been taken from Environment Agency guidance AQTAG06 (Ref. 1.51) (for NO_2: 0.0015m/s for grassland and 0.003m/s for woodland, for SO_2: 0.012m/s for grassland and 0.024m/s for woodland).

1.3.233 The resulting dry deposition flux (µg/m^2/s) has then been converted to keq/ha/year.

1.3.234 The predicted acidity deposition rates and background deposition rates have been used within the APIS Critical Load Function Tool (Ref. 1.49) to determine whether the contribution would result in exceedance of the defined critical loads for the features present.

1.3.235 The results from the APIS tool are presented in **Table 1.13**.

Table 1.13: Acid deposition at identified habitat receptors.

Receptor	Commissioning							Routine Operation					
	Process Contribution					Critical Load Function		Process Contribution					Critical Load Function
	NO_x PC µg/m³	SO_2 PC µg/m³	N keq ha/yr	S keq ha/yr	PC/CLd %	Back'gd /CLd %	PEC/CLd %	NO_x PC µg/m³	SO_2 PC µg/m³	N keq ha/yr	S keq ha/yr	PC/CLd %	PEC/CLd %
E2b	3.1	0.15	0.03	0.02	5.30%	193.70%	198.90%	0.9	0.043	0.009	0.005	1.80%	195.40%
E2c	7.9	0.39	0.08	0.05	10.50%	88.90%	99.40%	2.3	0.11	0.02	0.01	3.20%	92.20%
E2d	7.6	0.37	0.08	0.04	21.10%	193.70%	214.80%	2.2	0.11	0.02	0.01	7.00%	200.70%
E2e	0.49	0.024	0.005	0.003	1.80%	193.70%	195.40%	0.14	0.007	0.001	0.0008	0.00%	193.70%
E3a	0.034	0.0017	0.0004	0.0002	0.00%	18.40%	18.40%	0.0098	0.00048	0.0001	0.00006	0.00%	18.40%
E4a	0.33	0.12	0.003	0.01	1.50%	94.80%	96.20%	0.095	0.0047	0.001	0.0006	0.00%	94.80%
E5a	2	0.097	0.02	0.01	4.20%	154.30%	158.50%	0.6	0.03	0.006	0.004	1.40%	155.70%
E5b	3.4	0.17	0.04	0.02	8.40%	154.30%	162.70%	0.97	0.048	0.01	0.006	2.80%	157.10%
E6a	0.33	0.013	0.003	0.001	0.00%	72.90%	72.90%	0.095	0.0032	0.001	0.0004	0.00%	72.90%
E7a*	0.43	0.021	0.004	0.003	0.10%	4.30%	4.30%	0.13	0.0063	0.001	0.0007	0.00%	4.30%
E8a	0.23	0.011	0.002	0.001	0.30%	36.70%	36.70%	0.066	0.0033	0.0007	0.0004	0.10%	36.70%
E10a*	2.9	0.14	0.03	0.02	1.00%	10.50%	11.70%	0.83	0.041	0.008	0.005	0.50%	10.50%
E11a	0.53	0.026	0.01	0.006	0.40%	39.10%	39.60%	0.16	0.0077	0.003	0.002	0.20%	39.30%
E12a*	**8**	**0.39**	**0.2**	**0.09**	**7.60%**	**51.50%**	**59.10%**	**2.3**	**0.11**	**0.05**	**0.03**	**2.00%**	**53.50%**
E12b*	0.59	0.029	0.01	0.007	1.6%	139.7%	141.3%	0.18	0.0090	0.004	0.002	0.8%	140.5%
E13a	2.2	0.11	0.02	0.01	0.6%	7.70%	8.3%	0.64	0.032	0.007	0.004	0.2%	7.7%

**CWS*

1.3.236 **Table 1.13** shows those habitat receptors where the majority of the critical loads are already being exceeded due to high background levels of acid deposition. The highest predicted increase from process contribution occurs during the commissioning phase and would result in a 21.1% increase within the grazing marsh of Minsmere to Walberswick Heaths and Marshes SAC/SSSI; however, as background acid deposition already significantly exceeds the critical load, this increase would be expected to have only a minimal impact. Furthermore, grazing marsh would not be a particularly sensitive habitat to acid deposition, as the soils are likely to be well-buffered. Also, given that this change has been calculated for the closest part of the site to the diesel generators (and therefore represents worst case), the process contributions over the rest of the site would be below this value. During routine operation of the generators, the contribution to overall acid deposition levels is reduced to 7.0% of the critical load at this point.

1.3.237 Since all of the sites identified in the assessment above are subject to background acid deposition that is generally above the lower critical load value (and often also the upper figure), any additional impact from the installation is likely to be relatively minor. Furthermore, given the high buffer capacity of the grazing marsh, the predicted worst-case assumptions of process contribution to acid deposition are very precautionary, and are likely to be lower than presented. Since even these worst-case process contributions represent only a small proportion of the critical loads, compared to the current background deposition, any acid deposition resulting from the commissioning and/or routine operation phases is very unlikely to result in significant impacts at these receptors.

o) Conclusions of evidence base

i. Dust

1.3.238 Dust deposition rates in the order of 500mg/m^2 have been agreed with consultees as the threshold level for ecological effects from deposited dust, with significant effects predicted to occur above this threshold. Existing background levels of dust generation are well below this threshold.

1.3.239 The Dust Impact Assessment has identified that the Minsmere to Walberswick Heaths and Marshes SPA, SAC, Ramsar site and SSSI is of high sensitivity to dust deposition impacts being in close proximity and downwind of the site and long-term works.

1.3.240 Sizewell Marshes SSSI is also is of high sensitivity to dust deposition impacts being in close proximity to the site and long-term works including the movement of vehicles.

ii. Diesel generators

1.3.241 The bryophyte and lichen survey undertaken on the coastal vegetation to the east of the proposed main platform (Ref. 1.39, Ref. 1.40) identified that the species recorded were common and widespread in the UK, and not particularly sensitive to an increase in nitrogen deposition.

1.3.242 During commissioning operations (lasting two years only) annual levels of NO_x would be increased at both Minsmere and Sizewell Levels. During routine operations annual critical levels of NO_x would not be exceeded under permitted operating scenarios.

1.3.243 There would be predicted exceedances of the daily mean NO_x critical level over a number of designated ecological sites within close proximity to the diesel generators. However, the assessment carried out to determine the daily mean NO_x impacts was precautionary, given that any exposure to NO_x would actually be comparatively short term (worst case scenario would be 8.2% of a full common year), it is considered that the exposed habitats would have time to recover between events.

1.3.244 Nutrient nitrogen and acid deposition rates from the ongoing operation of diesel generators are also considered unlikely to result in significant impacts.

iii. Relevant important ecological features

1.3.245 The IEFs that are relevant to these impact pathways are all habitats within the likely depositional range of dust and other airborne pollutants. This includes Sizewell Marshes SSSI and the Minsmere to Walberswick Heaths and Marshes SPA, SAC, Ramsar site and SSSI.

p) Summary implications for Habitats Regulation Assessment

i. Critical levels

1.3.246 For both annual average NO_x and daily NO_x, the ZOI is restricted to a relatively small area of the Minsmere to Walberswick Heaths and Marshes SAC and the northern portion of Sizewell Marshes SSSI. Minsmere would receive an increase in annual NO_x levels during commissioning up to 74% of the critical level, but importantly not exceeding the critical level. Daily NO_x would exceed the critical level but only for short periods after which vegetation could be expected to recover.

1.3.247 Lowland heath vegetation is located outside of the indicated ZOI for an increase in annual and daily NO_x. The habitat features considered most vulnerable to any increase in NO_x levels is vegetated shingle and sand dune.

1.3.248 For annual SO_2, Minsmere would see an annual increase in annual SO_2 levels but importantly less than 45% of the critical level. Therefore, as defined in **Volume 2, Chapter 12** of the **ES**, this is not a level at which a significant effect would occur.

1.3.249 The Minsmere to Walberswick Heaths and Marshes SAC is the only European site likely to be directly affected by acid and nitrogen deposition.

1.3.250 Habitat features within parts of Minsmere would see an increase of nitrogen deposition greater than 1% but background levels of deposition already substantially exceed the critical load figure.

1.3.251 Habitat features within parts of Minsmere would see an increase of acid deposition greater than 1% but background levels of deposition already substantially exceed the critical load figure.

q) Summary implications for Environmental Impact Assessment

1.3.252 Mapping of isopleths provides a ZOI indicating that the only designated sites likely to be directly affected by annual and daily NO_x is the Minsmere to Walberswick Heaths and Marshes SAC/SSSI and Sizewell Marshes SSSI. The Suffolk Shingle beaches CWS and part of the Sizewell Levels and Associated Areas CWS may also be affected.

1.3.253 For both annual average NO_x and daily NO_x, the ZOI is restricted to a relatively small area of the Minsmere to Walberswick Heaths and Marshes SSSI and the northern portion of Sizewell Marshes SSSI but also encompassing the Suffolk Shingle Beaches CWS and part of the Sizewell Levels and Associated Areas CWS. Annual average NO_x Sizewell Marshes SSSI would receive an increase in annual NO_x levels during commissioning up to 71% of the critical level, but importantly not exceeding the critical level.

1.3.254 For Sizewell marshes, Sizewell levels, Suffolk Shingle Beaches CWS and Reckham Pits Wood, the daily NO_x would exceed the critical level for only for short periods after which vegetation could be expected to recover.

1.3.255 The Minsmere to Walberswick Heaths and Marshes SSSI and Sizewell Marshes SSSI are the only SSSIs likely to be affected by acid and nitrogen deposition. The Suffolk Shingle Beaches CWS and part of the Sizewell Levels and Associated Areas CWS may also be affected.

1.3.256 For annual SO_2, Minsmere to Walberswick Heaths/Marshes and Sizewell Marshes/levels would see an increase in annual SO_2 levels, however it is unlikely that an exceedance of the critical level will occur given that the PECs are less than 45% of the critical level.

1.3.257 Parts of Sizewell Marshes SSSI, and Suffolk Shingle Beaches CWS would see an increase of nitrogen deposition greater than 1% but background levels of deposition already substantially exceed the critical load figure

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