HORIZON
NUCLEAR POWER

WYLFA NEWYDD

ENERGY WORKING FOR BRITAIN

Wylfa Newydd Project

HRA Stage 3 Assessment of Alternative Solutions

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Introduction

This report presents Horizon Nuclear Power Wylfa Limited's (Horizon) 'assessment of alternative solutions' for the Wylfa Newydd DCO Project. It has identified whether there are any 'alternative solutions'[1] to the Project proposals in the context of The Conservation of Habitats and Species Regulations 2017 (the Habitats Regulations) [RD1]. This represents Stage 3 of Horizon's shadow Habitats Regulations Assessment (Shadow HRA) process but is provided on a precautionary basis only at this stage; in that the outcome of Horizon's Stage 2 assessment is that an adverse effect on site integrity would not arise due to the Project.

On the 1 June 2018 Horizon applied for a Development Consent Order (DCO) for the Project as well as the following licences from the Ministers of the Welsh Assembly (with licensing delegated to Natural Resources Wales (NRW)) and permits from NRW directly, to which this assessment is relevant:

- A Marine Licence for the marine construction works and for dredging and dredged material disposal (two licence applications are to be made, but a single Marine Licence is to be issued for all of the marine works).
- An Environmental Permit under Schedule 21 of the Environmental Permitting (England and Wales) Regulations 2016 (EPR16) for water discharge activities that will occur during the construction phase of the Project.
- An Environmental Permit under Schedule 21 of the EPR16 for a water discharge activity during the commissioning and operational phases of the Project.
- An Environmental Permit under Schedule 1 of the EPR16 for a combustion activity during the commissioning and operational phases of the Project.

The term "Project" refers to all the works and activities to be consented by the Draft DCO, Marine Licence and Environmental Permits described above. Those parts of the Project which are to be consented by the DCO comprise the Power Station and other on-site development (which also require Environmental Permits); Marine Works; the Off-Site Power Station Facilities; and Associated Development, including Ecological Compensation Sites. The General Glossary for the Wylfa Newydd DCO Project [APP-006] defines terms used within this report.

The HRA Process

The HRA process follows a four-stage approach, as detailed in Planning Inspectorate (PINS) Advice Note 10 [RD6]:

1. Screening for Likely Significant Effects (LSE).
2. Appropriate Assessment.

[1] Definition of an alternative solution is based on paragraph 4 of page 9 in Methodological Guidance for the Habitats Regulations [RD2]: *"Alternative ways of achieving the objectives of the project or plan that avoid adverse impacts on the integrity of the Natura 2000 site*".

3. Assessment of Alternative Solutions.
4. Consideration of Imperative Reasons of Over-riding Public Interest (IROPI) and compensatory measures.

Stage 1 LSE

The Shadow HRA [APP-050] concludes that LSE could arise due to the Project for a number of the qualifying features (including migratory fish, breeding and migratory birds, designated habitats and marine mammals) of a number of European Designated Sites in the Project's zone of influence (ZOI). Therefore a Stage 2 Appropriate Assessment was required.

Stage 2 Appropriate Assessment

Following Appropriate Assessment, the Shadow HRA [APP-050] and Shadow HRA Addendum [AS-010] conclude that there would be no adverse effect resulting from to the Project on the integrity of the qualifying features of any European Designated Sites (including the Morwenoliaid Ynys Môn/Anglesey Terns Special Protection Area (SPA), the Dee Estuary SPA and the Bae Cemlyn/Cemlyn Bay Special Area of Conservation (SAC)) in the Project's ZOI. Therefore, based on the established HRA process, no further assessment (i.e. Stages 3 and 4) was undertaken.

Stage 3 Assessment of Alternative Solutions

NRW, as the Statutory Nature Conservation Body for the Project, have advised the Examining Authority that (in their view) an adverse effect on site integrity cannot be excluded in respect of the Morwenoliaid Ynys Môn/Anglesey Terns SPA as a result of potential disturbance (noise and visual stimuli) associated with the construction phase or the Dee Estuary SPA because of the relationship between it and the Anglesey terns SPA for passage Sandwich tern. Horizon does not agree with the position for the reasons presented Shadow HRA [APP-050] and Shadow HRA Addendum [AS-010], and with the suite of mitigation committed to. As such this report is provided without prejudice in response to the Examining Authority's written questions and requests for information - Q2.5.10.

The methodology to assess if there are any alternative solutions has been developed based on the European Commission and Defra guidance on the Habitats Directive 92/43/EEC [RD2, 4, 5, 9 and 10], the Planning Inspectorates Advice Note Ten [RD6], the Welsh Assembly Government Technical Advice Note 5 [RD7] and Tyldesley and Chapman's HRA Handbook [RD8].

A total of twenty-two alternative options were identified, ranging from doing nothing, alternative siting, alternative designs, alternative excavation methods, avoiding working during certain times and limiting noise levels. The majority of identified alternative options have been discounted as they do not meet the Project need and/or the Project's objectives.

The Stage 3 Alternative Solutions Assessment concludes that there are no feasible 'alternative solutions' to the Project proposals in the context of the Habitats Regulations [RD1] and predicted effects on the qualifying features of the Morwenoliaid Ynys Môn/Anglesey Terns SPA and Dee Estuary SPA.

1 Introduction

1.1 Purpose and scope of this document

1.1.1 This report presents Horizon Nuclear Power Wylfa Limited's (Horizon) 'assessment of alternative solutions' for the Wylfa Newydd DCO Project. This represents Stage 3 of Horizon's shadow Habitats Regulations Assessment (Shadow HRA) process but is provided on a precautionary basis only at this stage; in that the outcome of Horizon's Stage 2 assessment is that an adverse effect on site integrity would not arise due to the Project.

1.1.2 On the 1 June 2018 Horizon applied for a Development Consent Order (DCO) for the Project as well as the following licences from the Ministers of the Welsh Assembly (with licensing delegated to Natural Resources Wales (NRW)) and permits from NRW directly, to which this assessment is relevant:

- A Marine Licence for the marine construction works and for dredging and dredged material disposal (two licence applications are to be made, but a single Marine Licence is to be issued for all of the marine works).
- An Environmental Permit under Schedule 21 of the Environmental Permitting (England and Wales) Regulations 2016 (EPR16) for water discharge activities that will occur during the construction phase of the Project.
- An Environmental Permit under Schedule 21 of the EPR16 for a water discharge activity during the commissioning and operational phases of the Project.
- An Environmental Permit under Schedule 1 of the EPR16 for a combustion activity during the commissioning and operational phases of the Project.

1.1.3 The term "Project" in this report refers to all the works and activities to be consented by the Draft DCO, Marine Licence and Environmental Permits described above. Section 1.2 provides further information. The General Glossary for the Project [APP-006] defines terms used within this report.

1.1.4 This report has identified whether there are any 'alternative solutions' to the Project proposals in the context of The Conservation of Habitats and Species Regulations 2017 (the Habitats Regulations) [RD1].

1.1.5 The HRA process meets the requirements of the Habitats Regulations; further details are provided in chapter 3, section 3.2 of the Shadow HRA [APP-050].

1.1.6 This report focusses on those Project activities where NRW do not agree with Horizon's Stage 2 Appropriate Assessment conclusion that no adverse effect on the integrity of the qualifying features of the European Designated Sites in the Project's zone of influence (ZOI) is predicted. It is understood that this is limited to (a) the Morwenoliaid Ynys Môn/Anglesey Terns Special Protection Area (SPA) and relates to NRW's concerns about disturbance (due to noise and visual stimuli) to breeding terns associated with the construction phase from blasting and general construction[2]; and (b) the Dee Estuary SPA in relation to NRW's concern about Sandwich terns that breed at Cemlyn Bay also forming part of the Passage Sandwich tern feature of the Dee Estuary SPA.

1.2 The Wylfa Newydd DCO Project

1.2.1 For ease of reference, text from chapter 2 of the Shadow HRA [APP-050] is reproduced to describe that the Project consists of:

i. The Power Station: the proposed new nuclear power station at Wylfa, including two UK Advanced Boiling Water Reactors, the Cooling Water System (CWS), supporting facilities, buildings, plant and structures, radioactive waste and spent fuel storage buildings and the Grid Connection.

ii. Other on-site development: including landscape works and planting, drainage, surface water management systems, public access works including temporary and permanent closures and diversions of public rights of way, new Power Station access road and internal site roads, car parking, construction works and activities including construction compounds and temporary parking areas, laydown areas, working areas and temporary works and structures, temporary construction viewing area, diversion of utilities, perimeter and construction fencing, and electricity connections.

iii. Marine Works, comprising:

- Permanent Marine Works: the CWS, the Marine Off-loading Facility (MOLF), breakwater structures, shore protection works, surface water drainage outfalls, waste water effluent outfall (and associated drainage of surface water and waste water effluent to the sea), fish recovery and return system, fish deterrent system, navigation aids and dredging; and
- Temporary Marine Works: temporary cofferdams, a temporary access ramp, temporary navigation aids, temporary outfalls and a temporary barge berth.

iv. Off-site Power Station Facilities: comprising the Alternative Emergency Control Centre (AECC), Environmental Survey Laboratory (ESL) and a Mobile Emergency Equipment Garage (MEEG).

v. Associated Development: the Site Campus within the Wylfa Newydd Development Area (WNDA); temporary Park and Ride facility at Dalar Hir for construction workers (Park and Ride); temporary Logistics Centre at Parc Cybi (Logistics Centre); the A5025 Off-line Highway Improvements and wetland habitat creation and enhancement works as compensation for

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2 Chapter 4 of this report explains that the sources of the noise that the concern arises from would continue to Year 3 (i.e. would occur for the first 24 months).

any potential impacts on the Tre'r Gof Site of Special Scientific Interest (SSSI) at the following sites:

- Tŷ Du
- Cors Gwawr
- Cae Canol-dydd.

1.2.2 The following terms are used in this report when describing the geographical areas related to the Project:

i. Power Station Site – the indicative areas of land and sea within which the majority of the permanent Power Station, Marine Works and other on-site development would be situated; and

ii. WNDA – the indicative areas of land and sea including the Power Station Site and the surrounding areas that would be used for the construction and operation of the Power Station, the Marine Works, the Site Campus and other on-site development.

1.2.3 Figure 2-1 of the Shadow HRA [APP-050] provides an indicative distribution of the Project elements.

1.3 Report structure

1.3.1 An **Executive Summary** provides a high-level summary of the HRA process, the conclusions of Stages 1 and 2 of the Shadow HRA, the basis for the development of the Stage 3 assessment methodology and the conclusions of this assessment.

1.3.2 **Chapter 1** introduces the purpose and scope of this report. It also describes the Project in outline.

1.3.3 **Chapter 2** sets out the methodology adopted by Horizon for this Stage 3 HRA Assessment of Alternatives.

1.3.4 **Chapter 3** provides details of the Project need and defines its objectives.

1.3.5 **Chapter 4** describes the Project works that the Statutory Nature Conservation Body considers could have an adverse effect on the integrity of a European Designated Site. It summarises particular aspects of the Project works that relate to the envisaged potential for harm and presents the proposed mitigation for the potential harm.

1.3.6 **Chapter 5** produces a long list of potential alternative solutions to address the potential harm. The long list is screened to define a short list of those that would fulfil the Project need (in line with national policy and guidance) and key Project objectives.

1.3.7 **Chapter 6** considers whether any short listed potential alternative solutions are 'feasible' alternative solutions.

1.3.8 **Chapter 7** indicates whether any feasible alternative solutions would have a lesser effect on the integrity of the European Designated Site.

1.3.9 **Chapter 8** sets out the conclusions of the Stage 3 Assessment of Alternative Solutions.

1.3.10 **Chapter 9** provides details of the references used.

1.3.11 **Appendices A** and **B** present extracts from other documents for ease of reference.

2 Methodology

2.1 Introduction

2.1.1 The methodology adopted to assess alternative solutions has been developed based on guidance from a range of sources, including:

- the European Commission’s (EC) *Assessment of plans and projects significantly affecting Natura 2000 sites, methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive* (2000, “Methodological Guidance for the Habitats Directive” [RD2]);
- EC’s *Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora* (1992, (“Habitats Directive” [RD3])
- EC *Guidance Document on Article 6(4) of the 'Habitats Directive' 92/43/EEC* (2012, “EC Guidance” [RD4]);
- Defra Guidance, *Habitats and Wild Birds Directives: guidance on the application of article 6(4) Alternative solutions, imperative reasons of overriding public interest (IROPI) and compensatory measures* (2012, “Defra Guidance” [RD5]);
- the Planning Inspectorate’s *Advice Note Ten: Habitat Regulations Assessment relevant to Nationally Significant Infrastructure Projects* (2016, “PINS Advice Note 10” [RD6]);
- the Welsh Assembly Government’s *Technical Advice Note 5, Nature Conservation and Planning* (2009, “TAN5” [RD7]);
- Tyldesley and Chapman’s *Habitats Regulations Assessment Handbook* (2017, “HRA Handbook” [RD8]);
- the European Court of Justice (ECJ) decision and associated Advocate General (AG) opinion set out in C-239/04 (2006, [RD9]); and
- the approach taken in the Able Marine Energy Park Draft DCO application and examination (including the applicant's HRA report, Examining Authority report and the Secretary of States (SoS) decision) (2013, [RD10]).

2.1.2 The methodology consists of five steps, set out below, to establish the presence or absence of alternative solutions[3]:

i. Identify the need for the Project and define the Project objectives.

ii. Identify the potential harm the Project is predicted to cause to the integrity of European Designated Site(s).

[3] Definition of an alternative solution is based on paragraph 4 of page 9 in Methodological Guidance for the Habitats Regulations [RD2]: *“Alternative ways of achieving the objectives of the project or plan that avoid adverse impacts on the integrity of the Natura 2000 site*”.

iii. Produce a long list of potential alternative solutions to address the potential harm and screen these to produce a short list.

iv. Consider whether any short listed potential alternative solutions are 'feasible' alternative solutions.

v. Consider whether any feasible alternative solutions would have a lesser effect on the integrity of any European Designated Site.

2.1.3 Each step is explained below.

2.2 Step 1 – Identify the need for the Project and define the Project objectives

2.2.1 The need for the Project forms the overarching reason for the DCO application; this is set out in chapter 3. The response to the Examining Authority's Further Written Question 2.16.1 further confirms this ongoing need.

2.2.2 Defra Guidance [RD5], paragraph 14, says that:

"National Policy Statements and other documents setting out Government policy (e.g. the UK Renewable Energy Roadmap) provide a context for competent authorities considering the scope of alternative solutions they will assess."

2.2.3 In accordance with this chapter 3 also presents an overview of relevant Government policy included within the Overarching National Policy Statement (NPS) for Energy (NPS EN-1 [RD11]) and the NPS for Nuclear Power Generation (NPS EN-6 [RD12]). This is used to inform the process of screening the long list of alternative solutions in step 3.

2.2.4 The following guidance explains that it is important to define the Project's objectives in order to determine what constitute relevant alternatives [emphasis added]:

- EC Methodological Guidance [RD2], at part 3.3 (Stage Three: Assessment of Alternative Solutions) sets out the tasks to be carried out in assessing alternatives in "Box 14: How to assess alternative solutions". This includes "*Identify and characterise the **key objectives** of the project or plan*".

- Defra Guidance paragraph 11 [RD5] states "*The first step is to identify **the objective** of the plan or project to help frame the consideration of alternatives. Alternative solutions are **limited to those which would deliver the overall objective** as the original proposal*".

- TAN 5 paragraph 27 [RD7] states *"What constitutes an alternative solution, in any particular case, will depend on the circumstances, including the nature, scale, duration and location of the project, **its objectives** and who may be proposing it".*

2.2.5 Chapter 3 sets out Horizon's core Project objectives (including those consulted on during the Pre-application Consultation phase) and presents how they reflect and are supported by relevant National and local policies.

2.2.6 Defining the Project need and objectives enables a short list of relevant potential alternative solutions to be identified at step 3.

2.3 Step 2 – Identify the potential harm the Project is predicted to cause to the integrity of European Designated Site(s)

2.3.1 The outcome of Horizon's Stage 2 assessment is that an adverse effect would not arise on the integrity of any European Designated Sites due to the Project. Chapter 4, however, provides details of the Project works that the statutory nature conservation body, NRW, considers could have an adverse effect on the integrity of a European Designated Site.

2.4 Step 3 – Produce a long list of potential alternative solutions to address the potential harm and screen these to produce a short list

2.4.1 The first part of this step – covered in Chapter 5 – concerns identifying a list of potential alternative solutions in accordance with EC Guidance paragraph 1.3.1[4] [RD4], Defra Guidance paragraph 16[5] [RD5] and PINS Advice Note 10 paragraph 4.28[6] [RD6].

2.4.2 The Defra Guidance gives examples of how the competent authority should use its judgement to identify relevant alternatives (paragraph 13, [RD5]). In light of an example included in this Defra Guidance for an offshore wind renewable energy development[7], which concluded that its consideration of alternative solutions should be limited to offshore wind developments, alternative forms of energy generation have not been included in the long list of alternatives considered in this report.

2.4.3 In accordance with the guidance above the formulation of the long list of potential alternative solutions has not been constrained by economic considerations.

2.4.4 The second part of this step screens the long list of potential alternative solutions against the Project's need and core Project objectives (as defined in chapter 3); only alternatives that meet or deliver the Project need and its objectives are considered in step 4.

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[4] *"They could involve alternative locations or routes, different scales or designs of development, or alternative processes."*

[5] *"Alternatives must be considered objectively and broadly. This could include options that would be delivered by someone other than the applicant, or at a different location, using different route, scale, size, methods, means or timing. Alternatives can also involve different ways of operating a development or facility."*

[6] *"Alternative solutions could include a project of a different scale, a different location, and an option of not having the scheme at all – the 'do nothing' approach."*

[7] "*In considering alternative solutions to an offshore wind renewable energy development the competent authority would normally only need consider alternative offshore wind renewable energy developments. Alternative forms of energy generation (e.g. building a nuclear power station instead) are not alternative solutions to this project as they are beyond the scope of its objective."*

2.5 Step 4 – Consider whether any short listed potential alternative solutions are 'feasible' alternative solutions

2.5.1 The Defra Guidance paragraph 18 [RD5] states that [emphasis added]:

"*The consideration of alternatives should be* ***limited to options which are financially, legally and technically feasible****. An alternative should not be ruled out simply because it would cause greater inconvenience or cost to the applicant.* ***However, there would come a point where an alternative is so very expensive or technically or legally difficult that it would be unreasonable to consider it a feasible alternative*** *… If the authority considers an option is not feasible, it would not be necessary to continue to assess its environmental impacts.*"

2.5.2 As such the components of feasibility are:

Legal feasibility

2.5.3 Legal feasibility is considered to be where there is a legal impediment or where, from a legal or consenting perspective, it would be unreasonably difficult to deliver an alternative because it would have 'unacceptable' impacts.

Technical feasibility

2.5.4 A potential alternative would not be technically feasible where it is impractical, incapable of being implemented, technically unsound and/or would not meet nuclear safety and regulatory requirements (including health and safety).

Financial feasibility

2.5.5 A potential alternative would not be financially feasible where its cost is disproportionately high in the context of the scale of the reduction in the environmental effect that the alternative would achieve.

2.5.6 There are direct and indirect costs associated with potential alternative solutions.

2.5.7 Direct costs include the cost of using more expensive equipment or the additional costs of constructing the alternative solution.

2.5.8 Indirect costs would arise from the consequences of (for example) extending the Project construction schedule due to the adoption of an alternative methodology. In this assessment indirect costs have been derived based on an estimate of additional monthly Project running costs for different phases of construction for the supply chain (contractors and consultants) and Wylfa overhead costs[8]. Standby costs have also been included for retaining people and plant where it is not practicable to redeploy them elsewhere and/or so they are not redeployed elsewhere. The estimate does not allow for construction risks, the cost of delayed revenue or additional financing costs

[8] Horizon staff, facilities (office; Head Quarters and site), corporate functions (finance, human resources, legal, etc.), IT operations, security and insurances.

and, therefore, the estimated indirect costs represent a low precautionary estimate against the likely true costs.

2.5.9 Step 4 is presented in chapter 6.

2.6 Step 5 – Consider whether any feasible alternative solutions would have a lesser effect on the integrity of any European Designated Site

2.6.1 To inform the Competent Authority's assessment (as per Defra Guidance paragraph 15 [RD5]) this step – presented in chapter 7 – looks at any alternative solutions identified in step 4 and indicates whether they would have a lesser impact on European Designated Sites.

3 Step 1 – Project Need and Objectives

3.1 Introduction

3.1.1 This chapter sets out the need for the Project and Horizon's core Project objectives. It also presents how the Project objectives reflect and are supported by relevant National and local policies.

3.2 The need for the Project

3.2.1 The Wylfa Newydd DCO Project Planning Statement [APP-406] and Written Representation [REP2-003] provide details on the need for the Project; the urgent need for a number of new nuclear power stations at identified sites. Extracts from the Executive Summary of the Planning Statement are reproduced below.

3.2.2 There is strong legislative and policy support for new nuclear power in the UK and specifically at Wylfa. In 2008 the Department for Business, Enterprise & Regulatory Reform's "Meeting the Energy Challenge - A White Paper on Nuclear Power" [RD13] announced that nuclear should have a role to play in the generation of electricity, alongside other low carbon technologies.

3.2.3 The principle of the need for new nuclear power stations, and that this need is urgent, is firmly established in NPS EN-1 [RD11] and NPS EN-6 [RD12].

3.2.4 NPS EN-1 [RD11] establishes the urgent need for new energy infrastructure to meet energy security and carbon reduction objectives, to replace closing electricity generating capacity, and to support an increased supply from renewables and future increases in electricity demand.

3.2.5 NPS EN-6 [RD12] specifically sets out the Government's policy on the urgent need for nuclear power. NPS EN-6 included Wylfa as a potentially suitable site for the deployment of a new nuclear facility before the end of 2025, subject to certain matters that require further consideration through the DCO application. The UK Government (in including Wylfa in the NPS EN-6) concluded that none of these factors were sufficient to prevent the site from being considered potentially suitable.

3.2.6 In October 2017, the Department for Business, Energy & Industrial Strategy's (BEIS) Clean Growth Strategy [RD14] confirmed the Government's continued support for growing low carbon sources of electricity, specifically including a continued commitment to nuclear energy.

3.2.7 The UK Government is currently consulting on siting criteria and the process for a new NPS applicable to nuclear power plants deployed after 2025 and capable of deployment by the end of 2035. The consultation document ("Consultation on Siting and Process") published on 7 December 2017 by BEIS [RD15] states that, subject to the outcome of the consultation, the Government propose to carry forward the sites listed in NPS EN-6 (seven in total, including Wylfa, that have not applied for DCO) into the new NPS.

3.2.8 The Statement on Energy Infrastructure (the 'ministerial statement') [RD16], issued on the same date as the consultation document, makes it clear that the Government continues to give its strong in principle support to project proposals at those sites listed in NPS EN-6, including at Wylfa.

3.2.9 Further work carried out by Oxera since this time (appendix G of the Planning Statement [APP-406]) has established that the need for new nuclear power stations remains urgent. If anything, the need for new nuclear is now even stronger than before, as a result of an expected increase in electricity demand, retirement of electricity generating plant capacity, the lack of proven alternatives to nuclear power generation, and the constraints imposed by emission reduction obligations.

3.2.10 Further relevant details from the Wylfa Newydd DCO Project Planning Statement [APP-406] are reproduced below regarding the quantum and urgency of the need for electricity:

- Paragraph 5.2.2 – BEIS forecasts that electricity demand will increase by approximately 20% by 2035 [RD17].
- Paragraph 5.2.3 – a significant amount of electricity capacity is set to be retired over the next two decades, including almost 90% of existing nuclear capacity and coal capacity [RD18].
- Paragraph 5.2.4 – it is forecasted that there will be a generation shortfall which, according to the National Audit Office (NAO), will amount to 95GW by 2035 (i.e. 70% of UK's forecast energy needs in 2035) [RD19].
- Paragraph 5.2.8 – Consultation on Siting and Process [RD15] states that "*Currently all but one of the existing fleet of nuclear reactors are due to cease generating before 2030, so the need for new nuclear power remains significant […] it is important that there is a strong pipeline of new nuclear power to contribute to the UK's energy mix and security of supply in the future*".
- Appendix G paragraph 2.16 – According to the projections presented in the NAO's 'Nuclear Power in the UK' publication ([RD19]), only 3.6GW of existing nuclear capacity will remain operational in 2030.
- Appendix G paragraph 2.19 – As outlined in NPS EN-1 [RD11], reflecting (inter alia) the requirement to maintain security of supply while also meeting greenhouse gas emission commitments, the UK will require an additional 59GW of new build electricity capacity by 2025.
- Appendix G paragraph 2.38 – The required scale of nuclear new build is also confirmed by Energy Research Partnership, which shows that 20GW–25GW of nuclear is required to meet the emission targets, even if UK's National Renewable Energy Action Plan target for wind is met [RD20].
- Appendix G paragraph 2.41 – The need for nuclear may prove to be even greater and more urgent if the potential delay and uncertainty in the development of other low-carbon technologies is considered. In particular, the [National Grid's] 'Two Degrees' scenario [RD21] assumes that 74GW of low-carbon generation will be available by 2025. However, a recent publication from HM Treasury [RD22] indicates that only 48GW of low-carbon generation will be available by that date [2025]. This implies a further 26GW gap in the required low-carbon capacity. Furthermore, even

if all of the interconnector projects currently envisaged by Ofgem successfully start operations on time (reducing the need by c. 12GW), this would leave a further capacity gap equivalent to approximately four Hinkley Point C plants [RD23].

3.2.11 The Project need, therefore, can be summarised as the urgent need for new nuclear power, with Wylfa Newydd representing one of few new stations that can be brought forward now, in order to help meet the requirement for 59GW of new build electricity capacity by 2025.

3.2.12 Although on 17th January 2019 Hitachi, Ltd. (Horizon's ultimate parent company) announced that it was suspending its UK nuclear development programme, the fact remains that there is an urgent need for new nuclear power generation in the UK, and the Wylfa Newydd DCO Project at Wylfa presents the best opportunity of delivering this as soon as possible. The UK's urgent need for 59GW of additional electricity capacity by 2025 remains and any delay to delivery of Wylfa Newydd does not detract from the important contribution that new nuclear, including Wylfa Newydd, can and will make to the UK's future low-carbon energy mix.

3.3 The Project objectives

3.3.1 The core objectives for the Project are set out in paragraph 4.2.4 of the Planning Statement [APP-406]. These Project objectives were consulted on during the Pre-Application Consultation phase – via the Stage 2 Main Consultation Document (page 48 [RD24]).

3.3.2 Only two comments were received on these objectives, both from the Isle of Anglesey County Council (IACC), who raised the issue of sustainability of communities and requested that the Project objectives are aligned with the IACC's Supplementary Planning Guidance objectives (Appendix B10 of the Consultation Report [APP-037]). These comments were taken into account in the derivation of the final Project objectives.

3.3.3 Supporting objectives, specifically relating to development within the WNDA, are set out at paragraph 4.2.7 of the Planning Statement [APP-406] and paragraph 2.3.2 in the Design and Access Statement (Volume 1) [APP-407].

3.3.4 For ease of reference, table 3-1 reproduces these objectives (A1 to A10 were subject to consultation) and illustrates that they reflect and are supported by particular National and local policies.

3.4 Use of Project need and objectives in this assessment

3.4.1 As described in paragraph 2.2.13, the need for the Project and its objectives are used to screen the long list of potential alternative solutions identified in in step 3 of the assessment in order to derive a short list; see chapter 5.

3.4.2 Only alternatives that meet or deliver the Project need and objectives are considered in step 4, which determines whether any short listed potential alternative solutions are 'feasible' alternative solutions. That is, would the alternative deliver against the urgent need for new nuclear power to support the UK in meeting its’ requirement for 59GW of new build electricity capacity by 2025?

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Table 3-1 Overview of Project objectives

ID	Objectives	Basis for the objective
A. Project-wide		
A1.	Help to meet the energy challenge in the UK, by providing a reliable source of low carbon electricity.	**NPS EN-1** [RD11] at **para 3.3 (*The need for new nationally significant electricity infrastructure projects*)** and particularly para 3.3.15 and 3.3.22**,** and **para 3.5 (*The role of nuclear electricity generation*)** particularly para 3.5.9 (*The urgency of the need for new nuclear power*) This is reflected in **NPS EN-6** [RD12] including at **para 1.1.1** which states that "…*new nuclear power stations…will play a vitally important role in providing reliable electricity supplies and a secure and diverse energy mix as the UK makes the transition to a low carbon economy* ". The Wylfa Newydd Power Station Site (Wylfa NPS Site) is confirmed as a potentially suitable site in EN-6 and continues to be supported by the Government in its December 2017 'The Statement on Energy Infrastructure' (ministerial statement). **Planning Policy Wales (PPW)** [RD25] reflects the national policy of moving towards a low carbon economy in: • **Chapter 4 (*Planning for Sustainability*)** at **para 4.4.3** where the Broad Objectives include: "*Promot[ing] a low carbon economy*", and "*tackl[ing] the causes of climate change by moving towards a low carbon economy… facilitating development that reduces greenhouse gas emissions in a sustainable manner*". • **Chapter 12 (*Infrastructure and Services*)** at **para 12.1.4**: "*to promote the generation and use of energy from renewable and low carbon energy sources at all scales and promote energy efficiency, especially as a means to secure zero or low carbon developments and to tackle the causes of climate change*". This is also consistent with the Anglesey and Gwynedd Joint Local Development Plan (JLDP) [RD26] Strategic Objective 6 (SO6) to "*Minimize, adapt and mitigate the impacts of climate change… by promot[ing] renewable and low carbon energy production within the area*".
A2.	To be delivered in a safe and efficient manner.	Safety is an integral component of Horizon's corporate Project Values. These values were set out in pre-application documents including the **Wylfa Newydd DCO Project Pre-Application Consultation – Stage 2 Main Consultation Overview Document ([RD24])** at **paras 2.3** and **2.16** which provide: "*Safety is our fundamental guiding principle and central to everything we do. We recognise the specific challenges associated with the nuclear environment and the high levels of responsibility this entails. We will challenge unsafe behaviours. We will prioritise the safety, security and well-being of the public, our employees, the environment and our stakeholders."* **NPS EN-1** [RD11] at **para 3.5.9 (*The urgency of the need for new nuclear power*)** demonstrates the need for the Project to be delivered efficiently. **NPS EN-6** [RD12] at **para 2.6 (*The Regulatory Justification process and the planning regime*)** and **para 2.7 (*Relationship between the regulatory framework for nuclear power stations and the planning regime*)** reflects the relationship between the regulatory assessment of the safe operation of reactors with the Nationally Significant Infrastructure Projects (NSIP) and DCO process.
A3.	Reflect the importance of its setting in Anglesey.	**NPS EN-1** [RD11] establishes a need for good design which includes respecting its setting. See **para 4.5 (*Criteria for "good design" for energy infrastructure*)**, and particularly para 4.5.1 states "*Applying "good design" to energy projects should produce sustainable infrastructure sensitive to place, efficient in the use of natural resources and energy used in their construction and operation, matched by an appearance that demonstrates good aesthetic as far as possible.*" **Para 5.9 (*Landscape and visual*)** also recognises the need to consider impacts on landscape and visual amenity.
A4.	Uphold the unique culture and language of Anglesey.	**NPS EN-1** [RD11] at **para 5.8 (*Historic environment*)** recognises the need to consider impacts on heritage assets. **PPW** [RD25] is consistent with national policy at **Chapter 4 (*Planning for Sustainability*)** at **para 4.4.3** where the Broad Objectives include to: "*conserve the historic environment and cultural heritage*", which is further developed in **Chapter 6 (*The Historic Environment*)** particularly at **para 6.2.1** where the Broad Objectives include: "*conserve and enhance the historic environment, which is a finite and non-renewable resource and a vital and integral part of the historical and cultural identity of Wales*". Horizon recognises the importance and strength of the Welsh language as a defining characteristic for the heritage and culture of many Anglesey communities. This reflects **Chapter 4 (*Planning for Sustainability*)** at **para 4.4.3** where the Broad Objectives include to: "*Contribute positively to the well-being of the Welsh language and ensure any negative impacts on the use of the language are mitigated*", where this is supported in **para 4.13 (*Supporting the Welsh Language*)** and the goals set in the Well-being of Future Generations (Wales) Act 2015. This is also consistent with JLDP [RD26] SO1 to "*Safeguard and strengthen the Welsh language and culture and promote its use as an essential part of community life*".
A5.	Integrate sustainability into all physical designs.	**NPS EN-1** [RD11] at **para 4.5 (*Criteria for "good design" for energy infrastructure*)**, where good design includes sustainability (para 4.5.1). **NPS EN-6** [RD12] also sets out policy on consideration of good design at **para 2.8**. **PPW** [RD25] is consistent with national policy at **Chapter 4 (*Planning for Sustainability*)** at **para 4.4.3** where the Broad Objectives include to: "*Play an appropriate role to facilitate sustainable building standards (including zero carbon) that seek to minimise the sustainability and environmental impacts of buildings*". Also relevant is **para 4.11 (*Promoting sustainability through good design*)**. This is also consistent with JLDP [RD26] SO5 "*Ensuring that development in the Plan area supports the principles of sustainable development and creates sustainable communities whilst respecting the varied role and character of the centres, villages and countryside* " and SO7 to "*Ensure that all new development meets high standards in terms of quality of design, energy efficiency, safety, security (persons and property) and accessibility, relates well to existing development, enhances public realm and develops locally distinctive quality places*".
A6.	Develop a green and sustainable approach in the development and management of the buildings and operational activities.	See A5 above.

ID	Objectives	Basis for the objective
A7.	Be a good neighbour; keeping local disruption to a minimum throughout the Wylfa Newydd Project lifecycle.	**NPS EN-1** [RD11] at **para 4.1.4** provides additional policy on decision making and states that the decision-maker should take into account "*environmental, social and economic benefits and adverse impacts, at national, regional and local levels*". Policy on good design (**para 4.5**) includes at para 4.5.2 that " *Good design is also a means by which many policy objectives in the NPS can be met, for example the impact sections show how good design, in terms of siting and use of appropriate technologies can help mitigate adverse impacts such as noise*", while acknowledging at para 4.5.1 that "*...the nature of much energy infrastructure development will often limit the extent to which it can contribute to the enhancement of the quality of the area*." **NPS EN-1** [RD11] at **para 4.13 (*Health*)** recognises the potential of energy production to impact on the health and well-being of the population, and nuclear specific policy is set out in **NPS EN-6** [RD12] at **para 3.12 (*Nuclear Impact: human health and well-being*)**. **PPW** [RD25] is consistent with national policy at **Chapter 4 (*Planning for Sustainability*)** at **para 4.4.3** where the Broad Objectives include the need to: "*promote good environmental management and best environmental practice*", and "*Contribute to the protection and, where possible, the improvement of people's health and wellbeing […]*". This is also consistent with JLDP [RD26] SO9 to "*Support and capitalise on the development of the Wylfa Newydd Project and associated development to maximise socio-economic opportunities for local business and sustainable employment opportunities for local people, including facilitating a suitable network of Wylfa Newydd Project-related associated development sites while ensuring that adverse effects of the Wylfa Newydd Project on the local communities are appropriately avoided, or mitigated and where appropriate legacy benefits are provided.* "
A8.	Build on the legacy of the Existing Power Station and help to create a positive legacy for Anglesey; thinking about each significant investment and how it can create a positive future for the area, where appropriate.	**NPS EN-1** [RD11] at **para 5.12 (*Socio-economic*)** and **NPS EN-6** [RD12] at **para 3.11 (*Nuclear Impact: socio-economic*)** recognise that large scale projects may have both positive and negative socio-economic impacts that need to be considered. **PPW** [RD25] at **Chapter 4 (*Planning for Sustainability*)** at **para 4.4.3** where the Broad Objectives include the need to: "*[r]espect and encourage diversity in the local economy*" and to "*[p]romote quality, lasting, environmentally-sound and flexible employment opportunities*" (supported in para 4.6 and Chapter 7). This is also consistent with JLDP [RD26] SO9 (as above), SO11 "*Secure opportunities to improve the workforce's skills and education."* and SO12 "*Diversify the Plan area's rural economy, building on opportunities, offering local employment opportunities with good quality jobs that are suitable for the local community and respects environmental interests*."
A9.	Ensure that all the elements are designed to connect with the varied beauty and character of Anglesey and conserve and enhance the natural environment as far as possible.	**NPS EN-1** [RD11 at **para 5.3 (*Biodiversity and geological conservation*)** and **para 5.9 (*Landscape and visual*)**. **PPW** [RD25] at **Chapter 4 (*Planning for Sustainability*)** at **para 4.4.3** where the Broad Objectives include the need to: "*[c]ontribute to the protection and improvement of the environment, so as to improve the quality of life, and protect local […] ecosystems.*", to "*ensure that development does not produce irreversible harmful effects on the natural environment* ", and to promote "*the conservation of biodiversity, habitats and landscapes*". This is supported by policies including in para 4.11 (*Promoting sustainability through good design*). **PPW** [RD25] at **Chapter 5 (*Conserving and Improving Natural Heritage and the Coast*)** at **para 5.1.2** (broad objectives) sets out a number of objectives aimed at promoting and protecting the conservation of landscape and biodiversity. This is also consistent with JLDP [RD26] SO17 "*Protect, enhance and manage the natural and heritage assets of the Plan area, including its natural resources, wildlife habitats, and its landscape character and historic environment*". See also A3 above.
A10.	Respect communities and ensure that the effect of the Project on them is minimised and that opportunities to provide enhancements are taken, as far as possible.	See A7above.
B. For development within the WNDA		
B1.	Minimise visual impact as far as possible.	**NPS EN-1** [RD11] at **para 5.9 (*Landscape and visual*)**, particularly **para 5.9.8** "*Projects need to be designed carefully, taking account of the potential impact on the landscape. Having regard to siting, operational and other relevant constraints the aim should be to minimise harm to the landscape, providing reasonable mitigation where possible and appropriate*" and **para 5.9.22** "*Within a defined site, adverse landscape and visual effects may be minimised through appropriate siting of infrastructure within that site, design including colours and materials, and landscaping schemes, depending on the size and type of the proposed project. Materials and designs of buildings should always be given careful consideration*." However, **NPS EN-6** [RD12] at **para 3.10.8** recognises that "*The IPC should not expect the visual impacts associated with a new nuclear power station to be eliminated with mitigation. Indeed, the scope for visual mitigation will be quite limited. Mitigation should, however, be designed to reduce the visual intrusion of the project as far as reasonably practicable.*" **PPW** [RD25] **Chapter 4 (*Planning for Sustainability*)** at **para 4.11.9** states that "*The visual appearance of proposed development, its scale and its relationship to its surroundings and context are material planning considerations*."
B2.	Ensure that the design reflects the difference between immediate and longer distance views.	See A5 (which refers to policy on good design) and B1 above.
B3.	Reflect the importance of the human scale activities on the Power Station Site.	See A5 (which refers to policy on good design) and B1 above.
B4.	Respect our communities, and minimise impact on them as far as possible, particularly those very close to the Power Station Site.	See A7 above.

3.4.3 In this context, where a potential alternative solution would extend the construction schedule by more than 12 months (a 50% increase on an activity of 24 months), it is considered that the Project need would not be met. This is because:

- NPS EN-1 [RD11] explicitly identifies the ‘urgent’ need for new (low carbon) electricity NSIPs in the UK within the next 10-15 years, i.e. 2011 – 2025 (paragraphs 3.3.1 to 3.3.5) and the current BEIS forecast is that electricity demand will increase by approximately 20% by 2035 [RD14].
- Extensions to the construction programme further delay the date by which Horizon can deliver the urgent need for new low carbon electricity, contrary to both national policy and Horizon’s Project objectives (as set out in this section [3] and in Horizon’s IROPI report (submitted in parallel with this report at Deadline 5 (12 February 2019)).
- Short non-continuous delays to the construction process (e.g. not working during breeding seasons) are inefficient and have potential to result in cumulative schedule delays (in conjunction with working to agreed noise levels and visual, transport and worker constraints) that the Project may not be able to tolerate. The result would be compounded delays/stand-down periods with a significant impact on productivity that would be likely to lead to much longer overall construction periods, with corresponding effects on the local community and ecology resulting from longer exposure to noise, emissions, traffic, lighting, and other effects arising from additional year(s) of construction activity. Explanation of this compounding extension to construction periods is set out in more detail in table 5-2.

3.4.4 As such, alternative options which would create a 12 month or more extension to the construction schedule have not been progressed to step 4.

3.4.5 This approach remains currently valid; and in fact, the duration of the construction schedule becomes more critical in the context of delivering the Project need given the prospect of delay.

4 Step 2 – Envisaged Potential for Harm

4.1 Introduction

4.1.1 This chapter implements step 2 of the methodology by:

- Describing the envisaged potential for harm. That is, those activities where a Statutory Nature Conservation Body or key stakeholder believes the Project may cause an adverse effect on the integrity of a European Designated Site (or adverse effect on integrity cannot be ruled out, beyond reasonable scientific doubt).
- Summarising particular aspects of the Project works that relate to the envisaged potential for harm (why the works are needed, how the works are being constructed, when the works are occurring and where the works are to be located).
- Presenting the proposed mitigation for the potential harm, as described in chapter 11 of the Shadow HRA [APP-050].
- Identifying any residual potential for harm which requires assessment to determine if there are alternative solutions available.

4.2 What is the envisaged potential for harm?

Overview of the potential for harm

4.2.1 NRW, as the statutory nature conservation body, have stated (as set out in its Relevant Representation at paragraphs 4.3.1 to 4.3.7 [RR-088]) that they will advise the Examining Authority that an adverse effect on site integrity cannot be excluded in respect of the breeding features of the Morwenoliaid Ynys Môn/Anglesey Terns SPA at Cemlyn lagoon as a result of potential disturbance (due to noise and visual stimuli) associated with the construction phase and the Dee Estuary SPA because of the relationship between it and the Morwenoliaid Ynys Môn/Anglesey Terns SPA for passage Sandwich tern. That is, an effect on the Morwenoliaid Ynys Môn/Anglesey Terns SPA could affect the Dee Estuary SPA; however, no additional potential causes of harm (beyond disturbance due to noise and visual stimuli) need to be considered in the context of the Dee Estuary SPA. For the purpose of this assessment of alternative solutions Horizon have adopted, but not accepted, NRW's position.

Project works associated with noise and visual disturbance from construction

4.2.2 Noise from construction of the Power Station can be categorised as deriving from two different sources, due to the differing characteristics of the noise generated:

- blasting of hard rock associated with deep excavation; and
- other construction works.

4.2.3 Visual stimuli are covered below in relation to ‘other construction works’.

Blasting of hard rock

4.2.4 Appendix D1-1 Construction Method Statement of the Environmental Statement Volume D [APP-136] explains that blasting of rock faces is required for site grading, the Power block platform (the reactors and power generating plant and equipment), culverts, building foundations, and parts of the MOLF and CWS.

4.2.5 According to Appendix D1-1 the Construction Method Statement of the Environmental Statement Volume D [APP-136] the parts of the CWS that are likely to require blasting include:

- The cooling water intake structure and pump house (to draw cooling water in from the sea), including screening and fish recovery and return systems.
- The circulating water system pipes from the intake structure and pump house to the turbine buildings, which would be routed underground – there would be a set of these for each Unit.
- Two cooling water outfall tunnels, dependent upon depth and ground conditions. The interface of tunnels with the power island, and all tunnelling blasting activities, would be complete prior to commencement of nuclear construction works.

4.2.6 According to paragraph 3.2.20 from appendix D1-1 Construction Method Statement “*the blasting process would be designed to ensure that relevant [building] vibration thresholds are complied with, as set out in the Wylfa Newydd Code of Construction Practice (CoCP) (Application Reference Number: 8.6), Marine Works sub-CoCP (Application Reference Number: 8.8) and Main Power Station Site sub-CoCP (Application Reference Number: 8)”.* All CoCPs have been updated and resubmitted into the DCO examination process at Deadline 5 (12 February 2019).

4.2.7 Section 8.2 of The Main Power Station Site Sub-CoCP [REP2-032; to be resubmitted at Deadline 5(12 February 2019)] sets out relevant vibration thresholds that need to be complied with based on up to 3 blasting events[9] per day and in the circumstance that it may be necessary to conduct more (paragraph 8.2.3).

4.2.8 The largest proposed Maximum Instantaneous Charge (MIC) for assessment is 150kg (table 4-2 in the Shadow HRA [APP-050]) with a highly confined blast design[10] (Environmental Statement Volume D appendix D13.13 - Noise Modelling for Ecological receptors [APP-231]).

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[9] Typically a blast event would last less than a second (based on visits to several operational quarries).

[10] Confinement is the constraining effect of the environment on the explosive charge. The confinement of a charge depends on the characteristics of the surrounding rock and free faces, the distance from the blast hole to the free face, the amount of rock being broken and other factors (section 1.1 Glossary in the Environmental Statement Volume D appendix D13.13 - Noise Modelling for Ecological receptors [APP-231]).

4.2.9 Chapter D1 Proposed Development of the Environment Statement [APP-120] (first four bullets) and Appendix D1-1 Construction Method Statement of the Environmental Statement [APP-136] (last three bullets) provide further details on the construction schedule and deep excavations. Relevant extracts are included below:

i. Deep excavation works would use a range of construction methods including rock blasting and mechanical removal techniques (digging and ripping, see figure 4-1). Such activities would be strictly controlled to meet any vibration limits applicable to the works.

Figure 4-1 Illustration of equipment for ripping technique [RD27]

ii. Rock faces would be drilled and blasted to the final depth. This would vertically 'pre-split' the rock to further reduce risk of vibration migrating outside the excavation area during deep excavation activities. The material may be removed in 'benches' to support equipment and personnel access for excavation face preparation.

iii. Pre-split blasting would be carried out along the perimeter of the excavation area to full depth of the excavation to reduce damage on the rock surface and reduce vibration outside the excavation area. Sink blasting is proposed to loosen bedrock and bench blasting proceeding in layers (see figure 4-2), followed by excavation until the appropriate level is achieved.

iv. Pre-splitting of all deep excavations would commence after site grading of the power block area. First bench blasting would take place for the intake channel. Excavation for Unit 1 and Unit 2 would commence simultaneously and progress across multiple faces, followed by second bench blast and pinning.

v. The excavation approach (site grading) would be mechanical excavation for general soil and weathered rock. For hard rock, this would be achieved by ripping rock, fracturing and blasting.

vi. Construction of the cooling water intake would require significant rock excavation which would be completed in the dry behind cofferdams. The cooling water intake channel would be excavated to create a formation level of -11m AOD, to configure the seabed bathymetry in such a way that it would provide a uniform water input (flow rate) across the cooling water intake at all states of the tide.

vii. An additional cofferdam would be required in front of the intake to allow construction of the intake beyond the point when the marine facilities may commence operation to support the wider Project.

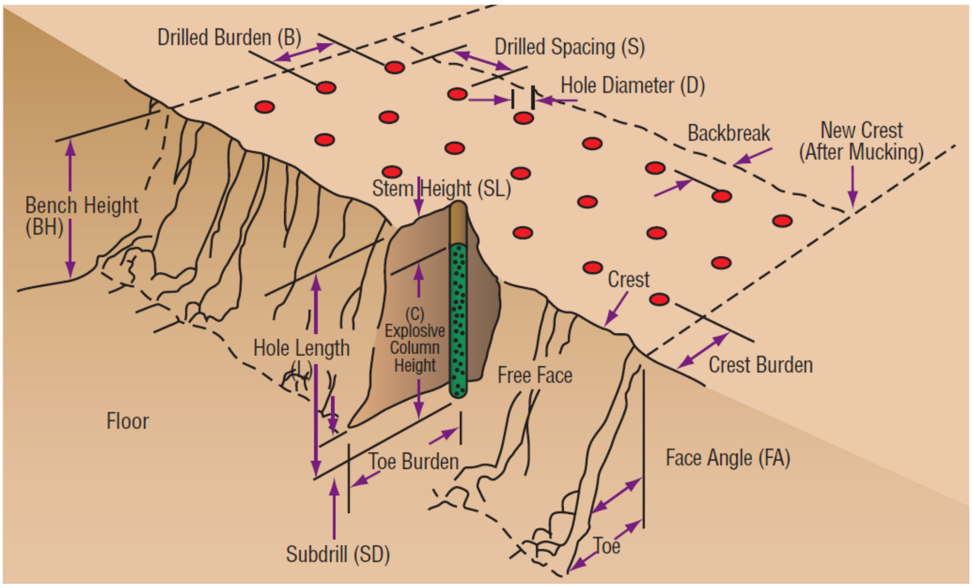


Figure 4-2 Illustration of bench blasting of rock [RD28]

4.2.10 An indicative construction timeline (section 1.5 in the Environmental Statement Volume D1 Proposed Development [APP-120], reproduced as figure 4-3 below) shows that the above Project works (highlighted by red boxes in figure 4-3) would continue into Year 3 (where time zero represents when the DCO is granted), directly affecting the start of the First Nuclear Construction (FNC) Unit 1 milestone.

4.2.11 The achievement of the construction schedule is highly dependent upon the use of Abnormal Indivisible Loads (AILs) and modularisation (part of the open top parallel construction methodology), as described in paragraph 3.2.32 of the Environmental Statement Volume D - WNDA Development Appendix D1-1 - Construction Method Statement [APP-136].

4.2.12 The blasting of rock faces is a potential source of disturbance (due to audible noise and air overpressure[11]) to the breeding tern colony (where terns are assumed to be present from 15 April to 15 August) (chapter 10 of the Shadow HRA [APP-050]).

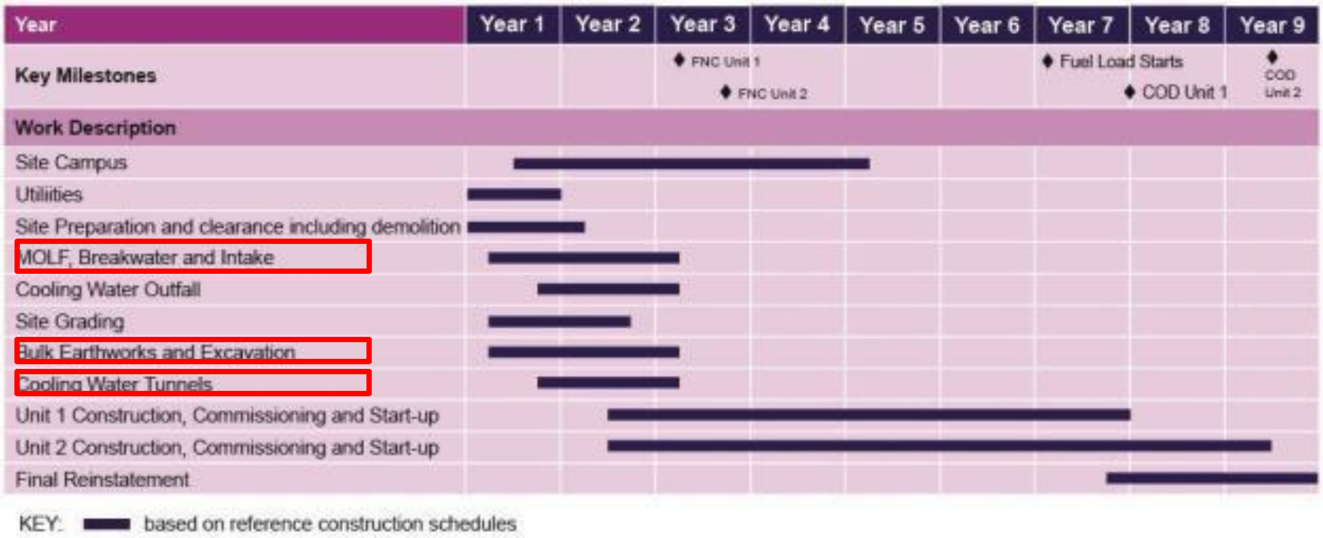


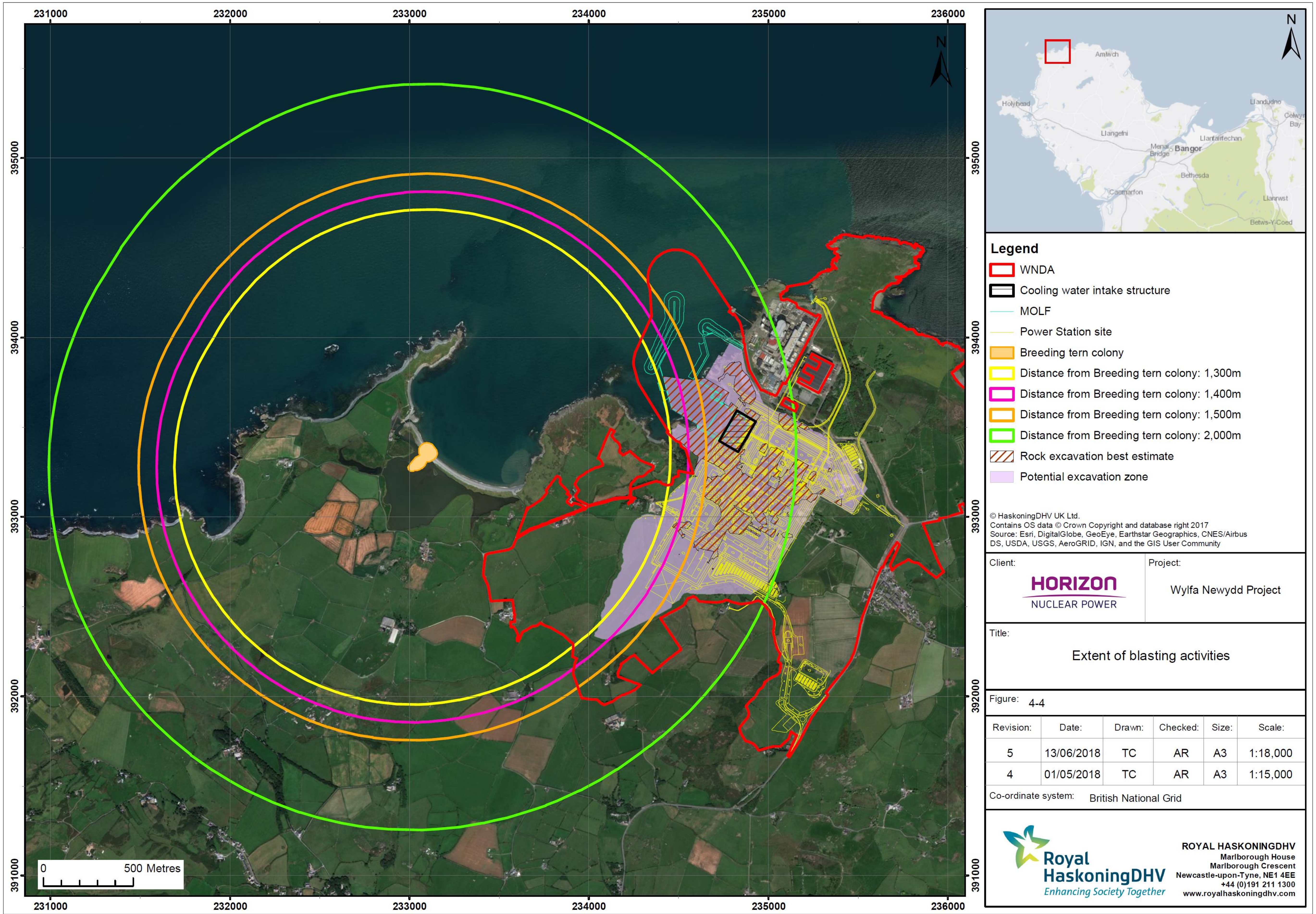
Figure 4-3 Indicative construction timeline (red box indicates potential source of disturbance)

4.2.13 There is no established method for estimating audible maximum blast noise (A-weighted maximum sound level, $L_{AF,\ max}$) and air overpressure. Consequently, Horizon developed a bespoke method for calculating this and subjected it to a surface blast field trial and independent third party review (Environmental Statement Volume D appendix D13.13 – Noise Modelling for Ecological receptors [APP-231]). The $L_{AF,\ max}$ noise prediction method performed well in the field trials; however, a small number of crosswind and upwind field trial results exceeded the calculated predictions and, therefore, +10dB has been added for face orientation (i.e. free face of blast oriented towards the tern colony) and +5dB has been added to all predictions as an uncertainty correction. Appendix A1 of this report shows the predicted received noise at different distances from the blast for a range of MIC.

4.2.14 Based upon the validated model predictions for blast noise, blasts in confined situations (i.e. where the surrounding rock and stemming material offer a high resistance to the expansion of the explosive) are predicted to produce noise levels of less than 60dB $L_{AF,\ max}$ in the large majority of cases at distances beyond 1.5km, not including wind factors. The Cemlyn Bay colony is more than 1.5km from the locations at which blasting is required, except for blasting sites for the MOLF and cooling water intake channel which would be around 1.3km from the colony; giving a predicted instantaneous noise level (i.e. the peak) of 61.3dB $L_{AF,\ max}$ at the colony based on blasting in confined situations with a 150kg charge weight (figure 4-4), not including wind factors.

[11] Air overpressure is a pressure wave that is formed in the atmosphere by the detonation of explosives. This consists of energy manifested as audible (noise) and largely inaudible ('infrasound', which is also known as 'concussion'). Appendix F of appendix D13.13 - Noise Modelling for Ecological receptors, [APP-231])

4.2.15 Wind direction would cause air overpressure at a receptor to be enhanced downwind up to 20dB $L_{AF, max}$ and, conversely, reduced by up to 10dB $L_{AF, max}$ in upwind conditions (Environmental Statement appendix D13.13 – Noise Modelling for Ecological receptors [APP-231]). Based on 10 years of wind data in Anglesey (since 2007), the following wind conditions have occurred during the proposed working hours (07:00 to 19:00) of the tern breeding seasons (15 April to 15 August):


231000
232000
233000
234000
235000
236000
395000
394000
393000
392000
391000
N
0
500 Metres
Legend
WNDA
Cooling water intake structure
MOLF
Power Station site
Breeding tern colony
Distance from Breeding tern colony: 1,300m
Distance from Breeding tern colony: 1,400m
Distance from Breeding tern colony: 1,500m
Distance from Breeding tern colony: 2,000m
Rock excavation best estimate
Potential excavation zone
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Contains OS data © Crown Copyright and database right 2017
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Client:
HORIZON NUCLEAR POWER
Project:
Wylfa Newydd Project
Title:
Extent of blasting activities
Figure: 4-4
Revision: Date: Drawn: Checked: Size: Scale:
5 13/06/2018 TC AR A3 1:18,000
4 01/05/2018 TC AR A3 1:15,000
Co-ordinate system: British National Grid
Royal HaskoningDHV
Enhancing Society Together
ROYAL HASKONINGDHV
Marlborough House
Marlborough Crescent
Newcastle-upon-Tyne, NE1 4EE
+44 (0)191 211 1300
www.royalhaskoningdhv.com

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i. Wind between 50 and 130 degrees – downwind towards the tern colony – 16% of the time.

ii. Wind between 210 and 330 degrees – upwind away from the tern colony – close to 50% of the time.

iii. The rest of the time crosswinds occurred when noise carry is as per the validated model predictions.

4.2.16 The trial blasts carried out at the Wylfa site elicited no response from black headed gulls below 68.2dB $L_{AF, max}$ (section 7.3 in [APP-231]). Results from observational work (section 5.2.2 in Environmental Statement appendix D13.7 – Seabird Baseline Review [APP-225]) indicated three instances of 'fly up' responses out of 40 instances of passing aircraft (often fast flying jets); the noise levels that resulted in 'fly up' responses ranged from 73dB to 89dB with an average of 79dB (rounded to the nearest whole number).

4.2.17 L_{A90} calculations (where the noise is above this level for 90% of time[12]) for the observational work varied between approximately 23dB and 61dB with an average of 45dB. L_{A10} calculations (where the noise is below this for 90% of time) varied between 39dB and 67dB with an average of 54dB. The ambient noise (L_{Aeq}) calculations showed that the background noise varied between 41dB and 68dB with an average of 55dB. Background noise therefore varied for 80% of the time between 45dB and 55dB. L_{A90}, L_{A10} and ambient noise levels all showed a gradual decline over the period of recording, with the ambient noise reducing from 65dB to 43dB (section 5.2.2 of Environmental Statement appendix D13.7 – Seabird Baseline Review [APP-225]).

4.2.18 Monitoring of baseline noise and visual disturbance and the associated tern responses at the Cemlyn Bay colony was undertaken during the 2017 breeding season, as detailed in chapter 6 of the Shadow HRA [APP-050] and Environmental Statement appendix D13.7 – Seabird Baseline Review [APP-225]. This monitoring involved a total of 38 surveys, each of two hours duration, encompassing the main egg laying to early chick-rearing period of the tern species breeding at the Cemlyn Bay colony.

4.2.19 Amongst the potential disturbance events which were recorded during the baseline disturbance observation surveys, three were identified as sources of impulsive noise with particularly sharp rise times, considered likely to be similar to rise times that would arise from surface rock blasting (section 5.2.2 of Environmental Statement appendix D13.7 – Seabird Baseline Review [APP-225]). No tern responses were recorded in relation to these events:

[12] This represents the noise without the presence of the breeding terns and other prominent sounds.

i. Distant gunshot (with no associated spike in the noise sonogram).

ii. Slamming of tractor door (with an associated spike of 75.6 dB $L_{AF,\,max}$ in the noise sonogram).

iii. Slamming of grain door[13] (with an associated spike of 65.3 dB $L_{AF,\,max}$).

4.2.20 To put the above into context, the Welsh Government's 2014 Sound Advice on Noise [RD29] states that the noise associated with a vacuum cleaner three metres away is about 70 dB(A)[14], a normal conversation [one metre away] is about 60 dB(A), a kettle boiling half a metre away is about 50 dB(A) and a refrigerator humming 2 metres away is about 40 dB(A).

Other construction works

4.2.21 Site Preparation and Clearance (SPC) Works would prepare the WNDA for Main Construction. Main Construction activities would follow, which would result in the completion of the Power Station, including final levelling and deep excavations for the Power Station foundations, civil construction activities, commissioning of both Units and site finishing (paragraph 1.1.7 in Environmental Statement Volume D, Chapter D1 Proposed Development [APP-120]).

4.2.22 Main Construction for the Power Station Site includes the following elements and is fully described in the Environmental Statement Volume D, appendix D1-1 Construction Method Statement [APP-136]:

i. Site access and security.

ii. Earthworks.

iii. Two cooling water tunnels.

iv. Marine works.

v. The Power block.

vi. Site Campus (a temporary facility not within the Power Station Site).

vii. Ancillary buildings, structures and features.

viii. Utilities.

4.2.23 The WNDA has been divided into 11 construction zones (see figure 4-5) with maximum parameters applied to each zone in relation to construction landform height and gradient, and maximum heights of temporary construction buildings and cranes. The construction phase parameters are included as table D1-4 of [APP-120]. Each zone is titled as follows:

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[13] Flap door of a metal grain/animal feed storage container situated in one of the fields immediately west of Cemlyn lagoon. The farmer uses the container from time to time but the slamming flap door incident was an isolated event.

[14] Measurements in dB(A) broadly agree with people's assessment of loudness.

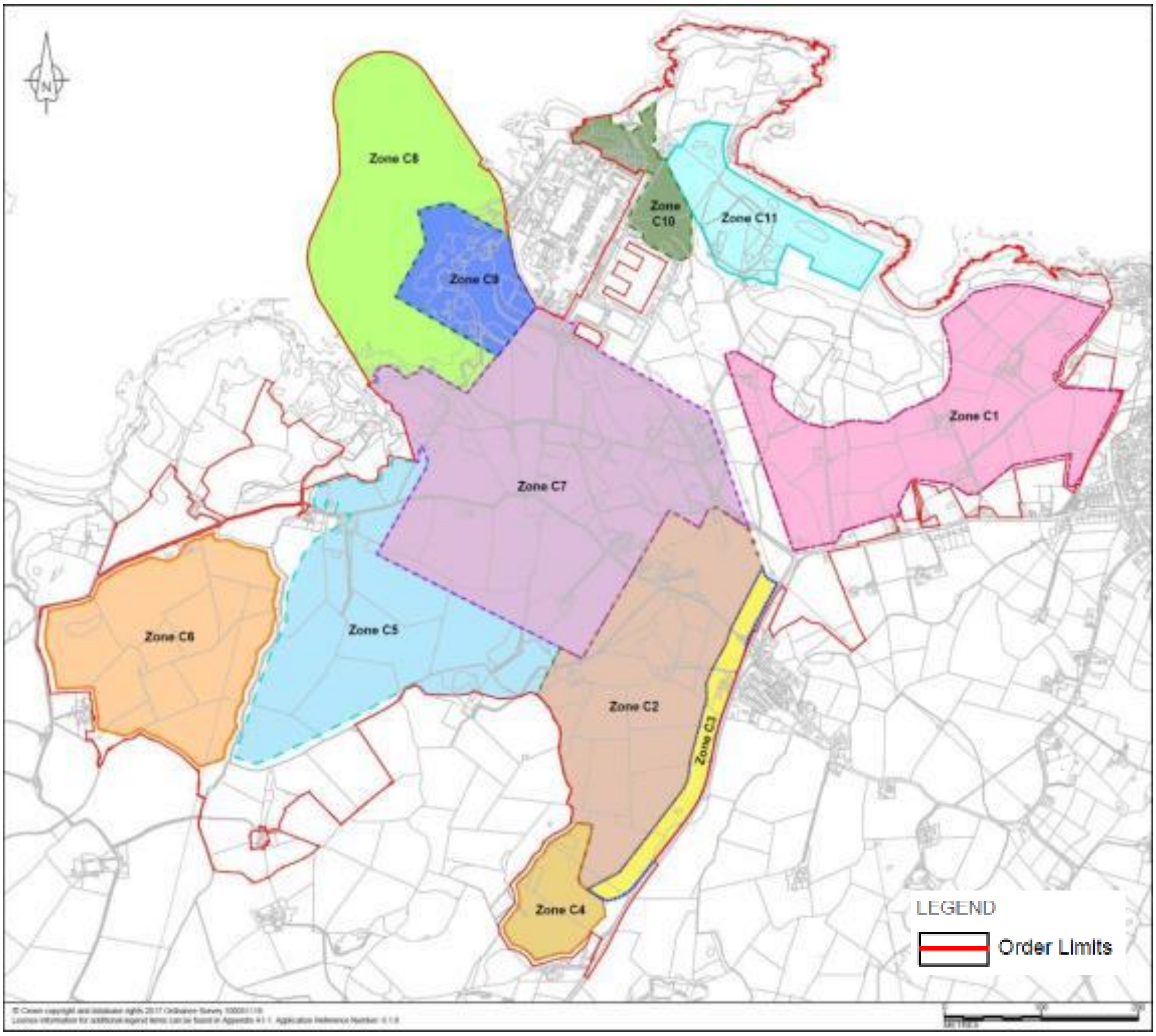

Figure 4-5 Power Station Site Construction Parameter Plan (figure D1-1 in [APP-237])

i. Zone C11 – Site campus.

ii. Zone C1 – Mound A.

iii. Zone C2 – Laydown area/Mound B.

iv. Zone C3 – Mound B.

v. Zone C4 – Mound C.

vi. Zone C5 – Laydown area/Mound D.

vii. Zone C6 – Mound E.

viii. Zone C7 – Power Station Site.

ix. Zone C8 – Breakwaters.

x. Zone C9 – MOLF.

xi. Zone C10 – Cooling water outfall.

4.2.24 Noise modelling has been undertaken for four points in time during the construction of the Wylfa Newydd Project, each representative of a three month period (one quarter of a year) for the human noise assessments presented in the Environmental Statement chapter D6 Noise and Vibration [APP-125].

4.2.25 The model which results in the greatest noise emissions at the receptors is that for the third quarter of Year 2. During this period the following activities would be ongoing: site grading, deep excavations, outfall tunnelling, Marine Works to create the MOLF, site logistics, the construction of the Site Campus, concrete production together with its distribution and pouring, the cranage of materials and equipment, and the use of mobile lifts to access structures that have been built.

4.2.26 Further modelling has been undertaken and described in appendix D13-13 Noise at Marine Ecological Receptors [APP-231] to represent the highest continuous equivalent noise levels that could theoretically occur for short periods of time, rather than typical noise levels over a quarter as presented in chapter D6 of the Environmental Statement.

4.2.27 The predicted worst case short-term ($L_{Aeq,\ 5min}$) noise level at the breeding tern colony due to construction noise (excluding blasting) is 58.6dB $L_{Aeq,\ 5min}$.

4.2.28 Impulsive noise calculations were prepared individually for mobile plant and rock breaking in different construction zones and impact piling in construction zone 10; values vary between 47.0 dB $L_{AF,\ max}$ and 58.4 $L_{AF,\ max}$.

4.2.29 The predictions of noise disturbance from construction plant and machinery are based upon the highly precautionary (and highly unlikely) scenario where all the plant is running (100% on time) and, for those working zones closest to the tern colony, is concentrated along the nearest boundary to the colony. Consequently, noise levels from the construction plant and machinery at the Cemlyn Bay colony are rarely, if ever, likely to be as high as the predicted values (paragraph 10.3.40 in the Shadow HRA [APP-050]).

4.2.30 Studies on the responses of breeding Sandwich terns to anthropogenic noise disturbance [such as set out in paragraph 4.2.16 of this report] suggest that terns at the breeding colony are highly unlikely to exhibit responses involving any temporary departure from their nests or chicks (invariably 'fly ups' or more extreme flight response in the case of terns) as a result of impulsive or non-impulsive noise generated by the operating plant and machinery during the construction period. The noise levels that are predicted to occur at the Cemlyn Bay colony from these sources are below 60 dB (paragraph 10.3.39 in the Shadow HRA [APP-050]).

4.2.31 The Shadow HRA [APP-050] states that birds, in general, tend to show a low to (at most) moderate degree of behavioural response to noise levels of 60 dB(A) or less, including from sources of impulsive noise. This evidence includes the documented responses of roosting black-headed gulls at Cemlyn Bay to the trial blasts (first bullet of paragraph 10.3.39 in the Shadow HRA [APP-050]).

4.2.32 Based on this, and other evidence, the Shadow HRA concludes that an adverse effect on the integrity of the SPA would not arise. However, NRW maintain the position that an adverse effect on integrity cannot be ruled out. For the purposes of this alternative solutions assessment, therefore, noise disturbance at the Cemlyn lagoon breeding tern colony due to Construction represents a potential for harm.

4.2.33 Visual stimuli and associated tern responses at the Cemlyn Bay colony, as observed from the 2017 monitoring, are described in paragraphs 6.5.28 and 10.3.73 of the Shadow HRA [APP-050]; paragraph 10.3.73 is repeated below for ease of reference (further detail is provided in Environmental Statement appendix D13.7 – Seabird Baseline Review [APP-225]):

- Of the 10 responses that were attributed to visual disturbance, seven involved people and/or dogs at distances of 0 to 50m from the colony. By contrast, the closest approach distances to the colony recorded for people and/or dogs in each of the 34 instances where there was no 'fly up' response ranged from 50 to 550m, averaging 74m (chapter 6 [APP-225]). Three instances where passing road vehicles were associated with 'fly up' responses each occurred at distances of approximately 150m from the colony (with no coincident spike in the sonograms occurring for any of these three events). By contrast, other events associated with road vehicles, agricultural activities or activities on the sea which did not appear to elicit responses occurred at distances of 150 to 875m (averaging 504m) from the colony (chapter 6 [APP-225]).

4.2.34 Based upon existing knowledge relating to responses by nesting terns to visual disturbance, the Shadow HRA concludes that it is highly unlikely that the construction works within the Wylfa Newydd Development Area would cause flight responses by breeding Sandwich terns at Cemlyn Bay, as these works would occur at a distance of more than 500m from the colony (paragraph 10.3.76). For the purpose of adding further precaution in relation to potential visual disturbance at the colony, mitigation regarding works on Mound E is proposed in paragraph 10.3.77 of the Shadow HRA [APP-050] and will be secured by the Main Power Station Site sub-CoCP (as updated at Deadline 5(12 February 2019)) and the Marine works sub-CoCP [APP-416], see paragraph 4.3.6 below for details.

4.2.35 The Shadow HRA [APP-050] also considers the visual disturbance to Sandwich terns when foraging offshore or when commuting between the colony and their foraging areas, see paragraphs 10.3.105 to 10.3.119. Similarly, based on the evidence and analysis, the Shadow HRA concludes that visual disturbance from construction activities is highly unlikely to have adverse effects on the SPA Sandwich tern population as a result of impacts in the offshore environment (paragraphs 10.3.118 and 10.3.119).

4.3 What are the proposed mitigation measures?

4.3.1 Paragraph 11.7.1 of the Shadow HRA [APP-050] states that the most significant potential effects on the tern populations of the Morwenoliaid Ynys Môn/Anglesey Terns SPA, particularly the Sandwich tern population that breeds on the islands within Cemlyn lagoon, are from noise disturbance during construction.

4.3.2 The Shadow HRA reached the conclusion that no adverse effect on the integrity of the Morwenoliaid Ynys Môn/Anglesey Terns SPA (or consequently the Dee Estuary SPA) would occur at any stage of the Project (either alone or in-combination with other plans and projects) irrespective of mitigation. On a precautionary basis, however, mitigation has been proposed for construction noise and visual disturbance.

4.3.3 Section 11.4 of the Main Power Station Site sub-CoCP (as updated at Deadline 5 (12 February 2019)) and section 8.3 of the Marine works sub-CoCP (as updated at Deadline 5 (12 February 2019).) present the proposed mitigation for the Main Construction phase. The pertinent points are:

- Noise level non-exceedance thresholds will be applied during the 'tern breeding period'. This being the period from the date on which the first terns begin to establish nests at the Cemlyn Lagoon tern colony until the point where chicks fledge and terns begin to leave the colony. These dates are anticipated to be 15th April to 15th August but will vary on an annual basis to take account of early or late arrivals and departures. Such variations will be agreed with the NWWT site managers and NRW.
- Noise levels will be monitored to enable mitigation actions to be taken before an exceedance occurs. This will be undertaken in conjunction with reactive monitoring of the colony to establish a real-time feedback mechanism between observers and the site manager.
- Blasting will only be undertaken when the predicted blast noise at the colony will be less than 60dB or daily ambient noise at the colony (whichever is higher).
- Day-time construction noise at the colony will not exceed 59dB $L_{Aeq,\ 1\text{-hour}}$. During night time, maximum construction noise at the colony will not exceed 43dB $L_{Aeq,\ 1\text{-hour}}$.
- During the terns 'establishment period' blasting and day time construction noise at the colony will not exceed than 55dB $L_{AF,max}$ or the daily ambient noise at the colony (whichever is higher).
- During the 'establishment period' there will be no works undertaken within 500m of the nesting islands and the areas on the shingle ridge that are known to be used occasionally by nesting terns. Thereafter, there will be no bulk earthworks undertaken within 500m of any known active tern nests within the Morwenoliaid Ynys Môn/Anglesey Terns Special Protection Area.

4.3.4 The Request for Non-Material Change No.1 Blasting Strategy [AS-020][15] also proposed no blasting after dusk between March and September (bullet 2 of para 2.5.1) and the hours of working have been modified accordingly in the Main Power Station Site Sub-CoCP [REP2-032].

4.3.5 Horizon's response to Written Representation - Natural Resources Wales [REP3-035] clarified, in para 7.33.2, that Horizon have not proposed this mitigation as a result of predicted disturbance to terns, but rather to ensure that noise levels at the colony from construction works (including blasts) remain below those considered likely to elicit flight responses by the terns at the Cemlyn Bay colony.

4.4 What is the residual potential for harm?

4.4.1 As set out above, NRW has advised the Examining Authority that an adverse effect on integrity cannot be excluded in respect of the Morwenoliaid Ynys Môn/Anglesey Terns SPA and Dee Estuary SPA. If the Examining Authority and/or SoS for BEIS reach the same conclusion as NRW, then the DCO can only be granted if the requirements of HRA Stages 3 and 4 can be demonstrated and the necessary compensation measures can be secured.

4.4.2 Considering the above, and notwithstanding the (no harm) conclusion of the Shadow HRA, it is considered that the residual potential for harm that needs to be examined in the Stage 3 HRA process is potential noise, vibration and visual disturbance to the breeding tern colony. However, if the assertion that there would, or could, be an adverse effect on the overarching integrity of the SPA is correct, it is apparent from the above analysis that any effect would be marginal at most.

4.4.3 Chapters 5 and 6 focus on this residual uncertainty regarding the potential for harm to the breeding tern colony due to noise and visual stimuli associated with the construction phase.

[15] The change request was accepted at the discretion of the Examining Authority on 31 October 2018.

5 Step 3 – Producing a Short List of Potential Alternative Solutions

5.1 Introduction

5.1.1 This chapter implements step 3 of the methodology by:

- Identifying a long list of potential alternative solutions for the potential residual harm.
- Screening the long list of potential alternative solutions against the Project need and objectives to produce a short list.

5.2 Long list of potential alternative solutions

5.2.1 For the purpose of this assessment, the position has been adopted that an adverse effect on the integrity of two European Designated Sites could result from the effect of construction noise and visual stimuli at the location of the breeding colony islands in the Morwenoliaid Ynys Môn/Anglesey Terns SPA.

5.2.2 Section 4.2 provides details on the Project works associated with this effect. This shows that there are a range of reasons for the predicted noise and visual stimuli from the construction phase, including:

- The need for cooling water.
- The need to import bulk materials and AILs.
- The need to excavate the site for the reactors and build screening mounds.
- The need for secure foundations for the nuclear reactors.
- The characteristics of the local geology.
- The need for construction works to be running concurrently.

5.2.3 Table 5-1 presents a long list of potential alternative solutions to these Project works according to the methodology described in section 2.2 of this report.

5.2.4 Raising the Power Station platforms is not included in long list as it would not reduce the noise from blasting and construction. The same amount of material would still need to be removed to enable deep excavation for the cooling water system. In fact, in order to raise the platforms at the end of the earthworks, additional material would be required; this would either need to be taken from the mounds or imported from off-site locations.

Table 5-1 Long list of potential alternative solutions

Type	Potential Alternative Solution	Further details	Effect at location of the tern colony
Do Nothing	Not progressing the Project	No Power Station and Associated Development	Removes noise and visual stimuli
Alternative locations	Progressing a different site to Wylfa	Locate Power Station elsewhere in the UK	Removes noise and visual stimuli
Alternative scales or designs	Fewer reactors	Have one nuclear reactor	Same level of noise and visual stimuli but over a shorter period
	Cooling via other technologies using freshwater or mains water	Other technologies include air cooled condensers, natural draught cooling towers, induced draught low level cooling towers, hybrid low plume level cooling towers and hybrid low plume Fan Assisted Natural Draught (FAND) cooling towers	Reduces amount and duration of noise from blasting (by removing the cooling water intake channel, intake structure and pipes)
	Use road/rail for importing AILs and bulk materials	Instead of a MOLF	Reduces noise and visual stimuli associated with blasting and construction associated with the MOLF
	No deep excavation (for the cooling water circulation and reactor foundations)	Requires running 3 x 2.8m diameter circulation mains on pipe bridges from the cooling water intake	Reduces amount and duration of noise and visual stimuli associated with blasting
	Alternative layout for the Power Station within the WNDA	Locate the Power Station Site further away from the terns but within the WNDA (e.g. to the east or south-east of the Existing Power Station)	Reduces amount of noise and visual stimuli from blasting and construction
	A different location for the MOLF	Locate the MOLF further to the east	Reduces amount of noise and visual stimuli associated with blasting and construction
	Different cooling water intake location	Locate intake further to the east either offshore or onshore	Reduces amount of noise and visual stimuli associated with blasting and construction
	Reduce the scale of the MOLF	Either fewer berths or smaller vessels but berths still sufficiently sized for AILs	Reduces amount and duration of noise and visual stimuli associated with blasting and construction
	Smaller cooling water intake	A narrower and shallower intake	Reduces duration of noise from blasting
	Do not construct Mound E but take material to other on-site locations	Avoid having plant on Mound E and place material on other mounds	Reduces noise and visual stimuli associated with the construction of Mound E
	Blasting noise mitigation (acoustic barrier)	Install an acoustic barrier to reduce air overpressure from the blasting	Reduces amount of noise from blasting

Type	Potential Alternative Solution	Further details	Effect at location of the tern colony
Different method/means (of excavation) in breeding seasons	Digging and ripping	Instead of blasting, only use mechanical methods	Remove noise from blasting
	Non-traditional techniques	Non-traditional refers to methods which are not typically used in major earthworks	Changes the type of noise and visual stimuli
Different magnitude (of noise)	Limiting the noise at the tern colony islands to not exceed L_{A90} average[16] (45 dB $L_{Aeq,\ 5min}$) during the breeding seasons (see paragraph 4.2.14 for source of value)	This means that no blasting would be possible during this period as the minimum distance from the terns using the smallest effective MIC of 25kg would be 4km (appendix A1) No construction works would be possible	Removes noise and visual stimuli associated with blasting and general construction
	Limiting the noise at the tern colony islands to +5 dB above L_{A90} average during the breeding seasons (see paragraph 4.2.14 for source of value)	This would mean limiting noise to 50 dB, which would only be achieved with 25kg MIC blasting more than 2.4km from the tern colony islands (appendix A1); effectively removing the possibility of blasting Marine and deep excavation works would both have to cease	Removes noise and visual stimuli associated with blasting Reduces noise and visual stimuli associated with general construction
	Limiting the noise at the tern colony islands to the average ambient level (55 dB $L_{Aeq,\ 5min}$) during the breeding seasons (see paragraph 4.2.14 for source of value)	In order to achieve this lower noise threshold, the MIC would have to be restricted across the site according to distance from the tern colony islands (appendix A1) Haulage of bulk material from the Unit 1 deep excavation (construction zone 4) to Mound E would also have to cease, and no heavy plant could be used on Mound E Drilling rigs, rock breakers, impact breakers, eccentric rippers and impact piling associated with the marine works would similarly have to cease	Reduces noise and visual stimuli associated with blasting and general construction
Different timing	Avoid blasting and construction during the tern breeding seasons	No construction works would be able to take place between 15 April and 15 August	Removes noise and visual stimuli during the breeding period
	Avoid blasting and construction in a one-month establishment period	No construction works would be able to take place between 15 April and 15 May (period to be confirmed)	Removes noise and visual stimuli during the critical period
	Avoid blasting and construction in a two-month establishment period	No construction works would be able to take place between 15 March and 15 May (period to be confirmed)	Removes noise and visual stimuli during an extended critical period

[16] Section 5.2.2 of the Environmental Statement appendix D13.7 - Seabird Baseline Review [APP-225] states that the LA90 calculations (where the noise is above this for 90% of time) varied between approximately 23dB and 61dB with an average of 45dB.

Type	Potential Alternative Solution	Further details	Effect at location of the tern colony
	Extend establishment period to eight weeks	Start the noise constraint thresholds as set out in bullet five paragraph 4.3.3 sooner for blasting and other construction	Further reduces noise and visual stimuli associated with blasting and general construction for a period of time

5.3 Screening the long list of potential alternative solutions

5.3.1 This section assesses whether the potential alternative solutions set out in table 5-1 could meet or deliver the need for the Project (as explained in section 3.2) and the Project objectives (as introduced in table 3-1).

5.3.2 Table 5-2 presents the findings; where helpful, drawings and information from other Draft DCO application documents are reproduced in appendix B.

5.4 Short list of alternative options

5.4.1 The screening exercise set out in table 5-2 reveals that the following potential alternative solutions need to be assessed in step 4 (chapter 6) to determine if they are feasible alternative solutions:

- 13. Blasting noise mitigation – constructing an acoustic screen to deflect pressure wave of blasting.
- 20. Avoid blasting and construction in the establishment periods
- 22. Extend establishment period to eight weeks.

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Table 5-2 Screening the long list of potential alternative solutions

Potential Alternative Solutions	Does the option meet/deliver the Project need?	Does the option meet/deliver the Project objectives?	Why and how?	Take to Step 4? (i.e. passes Step 3)
1. Not having the Project	No	No	Contrary to national policy – The need for new nuclear power stations is explained in NPS EN-1 [RD11] and specifically at Wylfa in NPS EN-6 [RD12], as summarised in section 3.2 of this report and described more fully in the Project Planning Statement [APP-406]. The Government continues to give it's strong in principle support to project proposals at the sites listed in NPS EN-6, including at Wylfa (the 2017 ministerial statement [RD16]). Therefore the Project need would not be met by this option and nor would two of the Project objectives: **A1.** *Help to meet the energy challenge in the UK, by providing a reliable source of low carbon electricity*. **A8.** *Build on the legacy of the Existing Power Station, and help to create a positive legacy for Anglesey; thinking about each significant investment and how it can create a positive future for the area, where appropriate*.	No
2. A different site to Wylfa	No	No	Contrary to national policy – NPS EN-6 [RD12] explains that all eight sites that made it through the NPS site selection appraisal are required, as summarised in section 3.2 of this report and described more fully in the Project Planning Statement [APP-406]. The Government continues to give it's strong in principle support to project proposals at the sites listed in NPS EN-6, including at Wylfa (the 2017 ministerial statement [RD16]). Therefore the Project need and **Project objective A1**would not be met by this option and nor would two other Project objectives: **A4.** *Uphold the unique culture and language of Anglesey*. **A8.** *Build on the legacy of the Existing Power Station,and help to create a positive legacy for Anglesey; thinking about each significant investment and how it can create a positive future for the area, where appropriate*.	No
3. Fewer reactors	No	Yes	The need for low carbon electricity generation is explained in NPS EN-1 [RD11] and the level covered by NPS EN-6 [RD12] and appendix G of the Project Planning Statement [APP-406], see extracts in section 3.2 of this report. Therefore the Project need would not be met by this option.	No
4. Cooling via other technologies, using freshwater or mains water	No	No	Section 4.3.1 of the Wylfa Newydd Project Water Discharge Activity – Environmental Permit Application Supporting Document (reproduced in appendix B1, [RD30]) compared the proposed direct cooling with seawater against other technologies that were identified as credible for cooling two 1,350 MW_e (net) UK ABWR units at the Power Station: air cooled condensers, natural draught cooling towers, induced draught low level cooling towers, hybrid low plume level cooling towers and hybrid low plume FAND cooling towers. Direct cooling with water other than seawater was not considered as the quantities of other water sources would provide lower net power output; a flow rate of 113 m^3/s (the flow at Lowest Astronomical Tide) is required, along with optimum temperature values, to maximise the Power Station's electrical output (section 4.3.2 of the [RD30]). All of the other technologies would also provide lower net power output (table B1-2), require more land and large towers, up to 165m high (table B1-1). Therefore the Project need would not be met by this option (with lower net power output) and nor would three Project objectives: **A9.** *Ensure that all the elements are designed to connect with the varied beauty and character of Anglesey and conserve and enhance the natural environment as far as possible* – as cooling towers could protrude 20 – 165m above the platform level and not enhance the natural environment. **A10.** *Respect communities and ensure that the effect of the Project on them is minimised and that opportunities to provide enhancements are taken, as far as possible* – as the scale of some cooling towers would cause a larger visual impact on communities in Tregele and Cemaes. **B1.** *Minimise visual impact as far as possible* – see response to Objectives A9 and A10.	No
5. Use road/ rail for importing AILs and bulk materials	No	No	For transporting AILs, it is Government policy to avoid road transport as far as possible by using alternative transport modes, such as water (paragraph 2.2.3 of [RD35]). Responses received during Pre-Application Consultation Stage 1 revealed support for the MOLF and the use of sea transport [RD36]. A Horizon study reviewed potential alternative methods of transporting construction materials (appendix 10-1 of the Integrated Traffic and Transport Strategy [APP-107]), including sea and rail via Holyhead, then by road to site. Pertinent extracts from the study include: • The MOLF is an essential part of the freight transport infrastructure to import major reactor components, classed as AILs. *"Alternative routing for a large proportion of these components is not possible due to constraining factors on the road network which provides connections to port or rail terminal facilities"* (paragraph 10-1.1.2). • It is estimated that up to 800 AILs would arrive via the MOLF (section 7.6 of the Integrated Travel and Transport Strategy). • Transporting raw bulk materials by rail would require up to three trains per day during peak construction. A lack of existing rail infrastructure in the vicinity of Wylfa Newydd would also require onward transport to the WNDA via road (paragraph 10-1.1.8 of the Integrated Travel and Transport Strategy). • Transporting bulk materials by road would add substantial volumes of lorries to the road network; it is estimated that around 238,000 HGV deliveries would be required over the duration of the project to deliver the equivalent of the materials that could be delivered to the MOLF, once the MOLF is complete (paragraph 10-1.1.9 of the Integrated Travel and Transport Strategy). • Due to proposals by Network Rail to increase passenger services (trains per hour), night time deliveries would be relied upon, which could result in unacceptable noise levels for unloading and transporting of material (paragraph 10-1.1.15 of the Integrated Travel and Transport Strategy). In addition, based on the proposed design/construction, not all AILs would fit on the roads, so redesign would be necessary and more time to build up modules on site, as well as the provision of sufficient space. This alternative method for importing bulk materials and AILs would extend the construction schedule beyond 2030 (see appendix B2) and so not deliver the Project need.	No

Potential Alternative Solutions	Does the option meet/deliver the Project need?	Does the option meet/deliver the Project objectives?	Why and how?	Take to Step 4? (i.e. passes Step 3)
5. Use road/ rail for importing AILs and bulk materials [continued from above]	See above	See above	Furthermore, three Project objectives would not be met: **A2.** *To be delivered in a safe and efficient manner* – the extension to the construction schedule would be inefficient in comparison to the proposed construction schedule. **A7.** *Be a good neighbour; keeping local disruption to a minimum throughout the Wylfa Newydd Project lifecycle* – local disruption from road and rail would increase significantly during construction, as offline and online road improvements would be necessary. **A10.** *Respect communities and ensure that the effect of the Project on them is minimised and that opportunities to provide enhancements are taken, as far as possible* – the effect upon Anglesey communities would not be minimised due to the additional volume of rail and road transportation required.	See above
6. No deep excavation (for the cooling water circulation and reactor foundations)	No	No	There is an International Atomic Energy Agency (IAEA) requirement for power stations not to be sited on a capable fault ([RD38] and [RD39]). It is essential that foundations are on good quality (unweathered) rock, hence deep excavation is required. Fundamentally, the Power Station could not be built as it would contravene IAEA safety requirements, therefore the Project could not be delivered and the need would not be meet. Furthermore, three Project objectives would not be met: **A2.** *To be delivered in a safe and efficient manner*. **A9.** *Ensure that all the elements are designed to connect with the varied beauty and character of Anglesey and conserve and enhance the natural environment as far as possible* – space above ground to route the cooling water circulation pipes would be an issue. The circulation water mains are likely to be 3 x 2.8m diameter per unit. To accommodate them within the current plot plan would need to run them on pipe bridges for their full length, which would have visual impacts. **B1.** *Minimise visual impact as far as possible* – see response to Objectives A9.	No
7. Alternative layout for the power station within the WNDA	No	No	In order to be further from the breeding tern colony, but within the WNDA, the Power Station would need to be located further to the east or south-east of the Existing Power Station, but also closer to Cemaes and Tregele. If the Power Station is more than 2km from the breeding tern colony, the predicted modelled blast noise with 150kg and 75kg MIC is 57.2 dB and 55 dB $L_{AF,\ max}$ respectively. Paragraph 2.3.13 in chapter D2 Alternatives and Design Evolution in the Environmental Statement [APP-121] provides reasons as to why this is not advocated; these are reproduced below in italics and, where relevant, expanded to indicate the impact on delivering the Project need (see figure 2-22 in appendix B3 for locations of the constraints). This alternative would: • *Require re-routing of the existing 400kV overhead transmission lines* – This would involve raising the pylons along one short stretch of the transmission lines to provide safe passage underneath. This could be part of National Grid Electricity Transmission's infrastructure upgrades but there would be a consenting risk associated with an application being made by another body in a different timeframe (without the same vested interests), which is likely to cause a delay of 12-18 months. The option would also mean that modules would need to be reduced in size to pass underneath the lines, as it is unlikely that the lines would be more than 25m above the ground (the likely maximum height of some modules), which would not only increase the construction duration but would also have H&S implications for the construction site; whereby more workers in a relatively small construction area would be required, thus increasing safety risks. • *Be closer to, or encroach on, the Tre'r Gof SSSI, which could result in adverse impacts on its hydrological regime and/or ecology;* • *Be closer to the villages of Cemaes and Tregele, which could result in adverse noise and vibration and landscape and visual impacts for residents.* To reduce noise and vibration to acceptable levels for the local communities at Cemaes and Tregele, the intensity of earthworks, productivity, plant movements and construction would need to decrease dramatically. If this decreased by half, this would double the Project's construction schedule. Overall, this alternative option would extend the Project's construction schedule beyond 2030, thus delaying the provision of low carbon electricity and so would not meet the Project need. Furthermore, four Project objectives would not be met: **A2.** *To be delivered in a safe and efficient manner* – the extension to the construction schedule would be inefficient in comparison to the proposed construction schedule. With smaller modules there would be more workers in a relatively small construction area, therefore increasing safety risks. **A9.** *Ensure that all the elements are designed to connect with the varied beauty and character of Anglesey and conserve and enhance the natural environment as far as possible* – as it could encroach on the Tre'r Gof SSSI and effect the hydrological regime. **A10.** *Respect communities and ensure that the effect of the Project on them is minimised and that opportunities to provide enhancements are taken, as far as possible* – the Project effect on Anglesey communities would be enhanced due to the extended construction schedule beyond 2030 and the Power Station would be closer to Cemaes and Tregele, with noise, vibration, landscape and visual effects. **B1.** *Minimise visual impact as far as possible* – see response to Objectives A9 and A10.	No

Potential Alternative Solutions	Does the option meet/deliver the Project need?	Does the option meet/deliver the Project objectives?	Why and how?	Take to Step 4? (i.e. passes Step 3)
8. A different location for the MOLF	No	No	There are three other potential alternative sites for a MOLF that would be further away from the breeding tern colony. Appendix B4 illustrates these and contains relevant extracts from Chapter 10 of the Wylfa Newydd DCO Project Pre-Application Consultation – Stage One Main Consultation Document [RD40]. The three other sites were investigated through a strategic study in 2010 and the outcomes are summarised in paragraphs 2.3.41 to 2.3.45 of chapter D2 Alternatives and Design Evolution in the Environmental Statement [APP-121]. The following reasons explain why the alternative locations would not meet the Project need and some Project objectives (see appendix B3 for locations of the constraints): • Require re-routing of the existing 400kV overhead transmission lines – see expanded text for potential alternative solution 7 (alternative layout for the power station within the WNDA) • Require building a 50m wide heavy haul route from the MOLF to the construction site, up to approximately 1km long – the heavy haul route and its use during construction could impinge on both the Tre'r Gof SSSI and landscaping mounds to the east of the Existing Power Station. Blasting would be required to create access down to the sea • Require the exclusion of the public from the Wales Coast Path and restricting public access to Wylfa Head. • Increase visual impact from many parts of the Wales Coast Path around Cemaes Bay and out to Llanbadrig Point. Overall, this alternative option would be likely to extend the Project's construction phase by significantly greater than 15 months (increasing the length of a 24-month activity by more than 60%) thus delaying the provision of low carbon electricity and so would not meet the Project need. Furthermore, four Project objectives would not be met: **A2.** *To be delivered in a safe and efficient manner* – With smaller modules there would be more workers in a relatively small construction area, therefore increasing safety risks. The extension to the construction schedule would be inefficient in comparison to the proposed construction schedule. **A9.** *Ensure that all the elements are designed to connect with the varied beauty and character of Anglesey and conserve and enhance the natural environment as far as possible* – the land to the east of the Existing Power Station is of higher ecological and environmental value than the farm land to the west (bullet 7, paragraph 5.4.4 of the Site Selection Reports Volume 2 [APP-437]) and breakwaters to the east would be more visually imposing. **A10.** *Respect communities and ensure that the effect of the Project on them is minimised and that opportunities to provide enhancements are taken, as far as possible* – the blasting would be closer and the construction schedule would be extended, which would increase Project effects on communities. **B1.** *Minimise visual impact as far as possible* – as other sites for the MOLF would increase the visual impact from many parts of the Wales Coast Path around Cemaes Bay and out to Llanbadrig Point.	No
9. Different cooling water intake location	No	No	Various offshore and onshore locations for the cooling water intake further away from the tern colony islands have been appraised (appendix B5). Chapter D2 Alternatives and design evolution in the Environmental Statement [APP121] provides details on the assessment of alternative locations (paragraphs 2.3.55 to 2.3.58). Reasons to discount the other locations include: • Longer biocide exposure times for entrained organisms. • Long tunnels (up to 1,250m) underneath the seabed introduce significantly increased health and safety risks during construction (fire hazards in confined spaces) and maintenance (due to working offshore). An offshore geology ground investigation (referenced in table D7-1 of the Environmental Statement volume D, chapter D7 – Soils and geology [APP126]) indicates the possible presence of major structural features and/or poorer quality ground that could affect tunnel design. Also there are Regionally Important Geodiversity Sites (RIGS) to the north and north east of the site, Porth Wnal Granite and Cemaes Bay (figure D7-8 in the Figure Booklet-Volume D, Application Reference Number 6.4.101). Therefore an intake in these areas would have a significant impact on these RIGS. A concept design study investigated open and closed faced tunnel boring machines for sub-surface construction or construction from above sea level using shaft drilling from jack-up platforms. The additional safety challenges specific to the construction of offshore intakes and outfalls include the risk of fire in confined tunnel spaces, the provision of adequate ventilation in confined tunnel spaces and flooding of the tunnel works, particularly challenging in the complex offshore geological conditions existing at Wylfa. If an offshore intake location was chosen, requiring tunnels with a diameter range of 6 to 8 meters, then the construction schedule would be over 900 days. Excluding float for risk, the construction schedule for the Project's onshore cooling water intake is close to 500 days. Assuming 22 working days in a month, the construction schedule would be extended by around 19 months (increasing the length of a 24-month activity by almost 80%) due to sub-sea construction and complex offshore geology, which would not meet the Project need. Furthermore, three Project objectives would not be met: **A2.** *To be delivered in a safe and efficient manner* – sub-sea intake tunnels would introduce significantly increased health and safety construction risks and the extension to the construction schedule would be inefficient in comparison to the proposed construction schedule. **A9.** *Ensure that all the elements are designed to connect with the varied beauty and character of Anglesey and conserve and enhance the natural environment as far as possible* – the RIGS would not be conserved. **A10.** *Respect communities and ensure that the effect of the Project on them is minimised and that opportunities to provide enhancements are taken, as far as possible* – an extended construction schedule would not minimise impacts on communities in Tregele and Cemaes, as well as those in Anglesey affected by traffic, as the period of disruption would be longer.	No

Potential Alternative Solutions	Does the option meet/deliver the Project need?	Does the option meet/deliver the Project objectives?	Why and how?	Take to Step 4? (i.e. passes Step 3)
10. Reduce the scale of the MOLF	No	No	The MOLF would be approximately 1,500m from the tern colony, reducing the scale of the MOLF to only support smaller vessels would reduce the amount of noise from blasting and construction. However, the scale of reduction would be small as the MOLF would need to be sufficiently sized for AILs. Smaller vessels are more inefficient and so would require more trips to transport materials, which would extend the construction schedule and increase marine disturbance. If all 8,000 tonne vessels are replaced with 5,000 tonne vessels and the baseline frequency of 1.3 vessels per day per 3 berths is maintained, then the MOLF operational period would extend from 6 years to approximately 7 years. If all 8,000 tonne and 5,000 tonne vessels are replaced with 1,500 tonne vessels and the baseline frequency of vessels per day is maintained, then the MOLF operational period extends by approximately 14 years. An extended construction schedule would delay the provision of low carbon electricity beyond 2030 and so would not meet the Project need. Furthermore, two Project objectives would not be met: **A2.** *To be delivered in a safe and efficient manner* – smaller vessels are less efficient and the extension to the construction schedule would be inefficient in comparison to the proposed construction schedule. **A10.** *Respect communities and ensure that the effect of the Project on them is minimised and that opportunities to provide enhancements are taken, as far as possible* – an extended construction schedule would not minimise impacts on communities in Tregele and Cemaes.	No
11. Smaller cooling water intake	No	Yes	A smaller cooling water intake means that a sufficient volume and rate of water could not be obtained for the reactors, so the size of the reactors would need to be reduced. A smaller intake would also compromise the design intake flow velocity of 0.3m/s (linked to minimising fish entrainment). Therefore this alternative option would not meet the Project need (reduced power output).	No
12. Do not construct Mound E but take material to other on-site locations	Nos	No	The Mound E landform has been designed to help to screen the development from the coastal path and better integrate the development into the landscape, helping to protect views of the main and ancillary buildings into the site from the south and west (paragraphs 5.4.6 and 6.3.21 in the Landscape and Habitat Management Strategy [REP2-039]); for ease of reference figure 6-8 in [REP2-039] has been reproduced in appendix B3. Therefore not having Mound E would have a detrimental effect on the visual impact of the Power Station. The anticipated volume of loose material to be excavated from the WNDA is 10.2 million cubic meters. The maximum capacity available for the placement of loose material within the WNDA is approximately 10.3 million cubic meters, according to the proposed Project parameters for the mounds, which take into account space constraints, health and safety maintenance factors and slope stability. The values illustrate that there is only 0.1 million cubic meters of excess capacity available compared to the 1.7 million cubic meters on Mound E. In other words, the material designated for Mound E cannot be placed elsewhere on-site. In order to take the material offsite without increasing the traffic effects of the Project on local communities, the MOLF could be used. However, the material could not be transported until the MOLF has been constructed, so the construction schedule would be extended by approximately 5 months (a fifth of the 24 months). Taking the material offsite would also require a change to the existing DCO application, which would either mean that a request for non-material change or re-submission would have to occur, consequently delaying the start of the construction schedule by 12-18 months. Overall, this alternative option would be likely to extend the Project's construction phase by more than 12 months (increasing the length of a 24-month activity by greater than 50%), thus delaying the provision of low carbon electricity, and so would not meet the Project need. Furthermore, the following four Project objectives would not be met: **A9.** *Ensure that all the elements are designed to connect with the varied beauty and character of Anglesey and conserve and enhance the natural environment as far as possible* – excluding Mound E would not allow the Power Station to connect with the landscape and remain in keeping with the existing surrounding drumlins. **A10.** *Respect communities and ensure that the effect of the Project on them is minimised and that opportunities to provide enhancements are taken, as far as possible* – excluding Mound E would not screen the development from the coastal path and minimise the effects on local communities. Transporting the material offsite would not minimise impacts on the Isle of Anglesey. **B1.** *Minimise visual impact as far as possible* – see response to Objectives A9 and A10. **B2.** *Ensure that the design reflects the difference between immediate and longer distance views* – see response to Objective A10.	No
13. Blasting noise mitigation (acoustic barrier)	Yes	Yes	Constructing an acoustic barrier to reduce air overpressure from the blasting would not affect the Project need or hinder any of the Project objectives. Due to potential noise and visual impacts to tern breeding colony, the barrier would have to be built in the winter months and before any blasting could start. This alternative solution would extend construction schedule but unlikely to be greater than 12 months. This would be in addition to the embedded mitigation associated with the strategic placement of material when building Mounds A and C to create noise barriers for construction plant to work behind (bullet 2 of paragraph 8.3.3 of the Main Power Station Site sub-CoCP [REP2-032][]).	Yes

Potential Alternative Solutions	Does the option meet/deliver the Project need?	Does the option meet/deliver the Project objectives?	Why and how?	Take to Step 4? (i.e. passes Step 3)
14. Digging and ripping in breeding seasons instead of blasting	No	No	This alternative option is dependent on the strength of the local geology. Mechanical methods can be mostly used down to around 10m and 0m AOD; appendix B6. Digging and ripping might be possible in the first breeding season depending on the strength of the rock in the upper levels but would result in a significantly lower productivity rate (estimated to be 40%). Due to the higher strength of the rock deeper down, digging and ripping would not be possible in the subsequent breeding seasons, i.e. no rock excavation would occur in year 2 and for every breeding season affected thereafter. In addition, due to reduced sunlight and adverse weather conditions in winter, the productivity of the displaced excavation would be optimistically 50% or pessimistically 33%. This would mean that an additional fourth breeding season would be affected, and the effect of this alternative would be to add 36 months optimistically or 44 months pessimistically to the construction schedule (increasing the length of a 24-month activity by 150 to 180%). The extended construction schedule would delay the provision of low carbon electricity and so would not meet the Project need. Furthermore, two Project objectives would not be met: **A2.** *To be delivered in a safe and efficient manner* – the extension to the construction schedule would be inefficient in comparison to the proposed construction schedule. **A10.** *Respect communities and ensure that the effect of the Project on them is minimised and that opportunities to provide enhancements are taken, as far as possible* – an extended construction schedule would not minimise impacts on communities in Tregele and Cemaes, as well as those in Anglesey affected by traffic, as the period of disruption would be longer.	No
15. Non-traditional techniques during the breeding seasons	No	No	The following non-traditional techniques are available: • Hydraulic splitting – An advancement of the traditional 'plug and feather' technique for rock splitting in quarries. The splitting apparatus is inserted into predrilled boreholes. A piston pushes a plug into the borehole, which forces the feathers apart and splits the rock. Fractures are typically generated in 10-60 seconds. The technique is very quiet apart from drilling the holes, with limited air overpressure. However, it is complicated, a slow operation and depth of splits are limited by plug length. • Non-explosive chemical demolition agents – Chemical agent mixed with water to form slurry and poured into pre-drilled holes. On hardening it expands and generates fractures in the rock. Time taken varies between 6 to 20 hours, depending on temperature. The higher the temperature, the quicker the reaction. Whilst it produces limited air overpressure it is a very slow process due to preparation and hardening time. Furthermore, it is largely unproven method for major earthworks. • Penetrating cone fracture (PCF) – Technique uses a smokeless propellant that, on ignition, produces high pressure gas that induces fracturing. Cartridges are inserted into boreholes, containing the propellant and a self-stemming mechanism. The generated gas penetrates into microfractures created from the percussive drilling process. The gas forces the microfractures to dilate and propagate fractures. The 'cone' refers to the distinctive spherical fracture shape. The 'cone' / spherical fracture propagates 45° from the base corner of the drill hole. It produces lower energy than traditional blasting explosives. However, there is only one (patent owned by Brandrill Limited), it is slow, it produces potentially harmful gas in an enclosed space, and requires specialist transport, training, storage and application. • Controlled foam injection (CFI) – Uses high-pressure foam to cause controlled fracturing in rock. Apparatus is mounted on a mechanical backhoe arm to inject foam into the bottom of a pre-drilled borehole via a barrel that seals the bottom of the hole. May be mounted alongside a percussive drill on the same arm to speed up production. The benefits are that it is faster than other non-traditional methods and there is minimal air overpressure and low noise. However, only shallow excavation depths are possible (typically less than 0.5m) and so has a slow production rate compared to blasting whose depths typically are 6-8m in quarries. • Hydro-fracturing (fracking) – The rock mass is broken by the injection of water under high pressure through boreholes. The high pressure water initiates fracturing of the rock by exceeding the confining pressure. Granular additives may be used to prop open the fractures once formed. There are many disadvantages: the size of fragments produced cannot be controlled, it is likely to require secondary breaking, it requires highly specialized equipment, it has negative connotations with the general public, and a potential environmental impact on groundwater. • Pulse plasma fragmentation – A high power electric pulse is supplied to cells filled with aluminum and copper oxide (thermite) powder installed into pre-drilled boreholes. The reaction generates a plasma field resulting in a shock wave causing fragmentation. Whilst the manufacturers claim low sound and vibration, it is a poorly understood technique and there is a single supplier (patented by Korea Accelerator and Plasma Research Association). • Carbon dioxide rapid reaction (CARDOX) – Developed for coal mining applications, also successfully used in quarrying for dimension stone and opencast and underground mining. Liquid carbon dioxide filled tubes are inserted into pre-drilled boreholes and energized with a small electrical charge. Carbon dioxide is instantly converted to gas and the pressure increase is discharged at the end of the tube. The rock mass splits along planes of weakness in the rock mass. The advantages are no stemming is required and there is minimal noise and ground vibration. The disadvantages are that it does not fragment the rock, it is difficult and slow to load out, it cannot create a precise final face in well fractured rock and it has a limited working face height.	No

Potential Alternative Solutions	Does the option meet/deliver the Project need?	Does the option meet/deliver the Project objectives?	Why and how?	Take to Step 4? (i.e. passes Step 3)
15. Non-traditional techniques during the breeding seasons (see above)	See above	See above	Two non-traditional excavation techniques that have low noise, vibration and air overpressure are non-explosive chemical demolition agents and controlled foam injection (CFI). Even if these techniques took the same amount of time to set up, the chemical agents require 6-20hrs to harden before fracturing the rock, while blasting only take milliseconds after detonation. Section 8.2 of The Main Power Station Site Sub-CoCP [REP2-032](to be re-submitted at Deadline 5 (12 February 2019)) sets out relevant vibration thresholds that need to be complied with based on up to 3 blasting events per day. With a chemical demolition agent, it is possible that only 1 “fracture” would occur each day. This indicates that productivity during breeding seasons could be a third of the required rate, meaning that displaced months would be pushed into the winter where productivity is also reduced. So the impact per breeding season could be 6 to 8 months, which would mean that a third and fourth breeding season is overlapped and the overall Project construction schedule would extend by 24 to 32 months (increasing the length of a 24-month activity by 100% to 130%). CFI detonates quicker than non-explosive chemical demolition agents but, due to the shallow excavation depths compared to blasting, it has a slow production rate. Therefore, the construction schedule impact would be comparable to that for non-explosive chemical demolition agents. It is worth noting that these two techniques are not commonly used in quarries or for major earthworks. The extended construction schedule would delay the provision of low carbon electricity and so would not meet the Project need. Furthermore, the following Project objectives would not be met: **A2.** *To be delivered in a safe and efficient manner* – the non-traditional techniques are inefficient and, in some cases, less safe in comparison to the proposed blasting. **A10.** *Respect communities and ensure that the effect of the Project on them is minimised and that opportunities to provide enhancements are taken, as far as possible* – the duration of the construction phase would not be minimised for communities in Tregele and Cemaes, as well as those in Anglesey affected by traffic, as the period of disruption would be longer.	See above
16. Limiting the noise at the tern colony islands to not exceed L_{A90} average (45 dB) during breeding seasons	No	No	This alternative option removes the possibility of blasting, as the minimum distance from the terns using the smallest effective MIC of 25kg would be 4km (appendix A1), which is beyond the Power Station platform. If no blasting occurred during two breeding seasons during the 24 months of earthworks, then 8 months of works (i.e. the approximate duration of two breeding seasons) would be displaced, consequently overlapping with a third breeding season and extending the construction schedule by another 4 months. No blasting during breeding seasons would extend the construction schedule by at least 12 months in total. To achieve 45 dB $L_{Aeq,\ 5min}$ no construction works could happen during tern breeding seasons. Due to weather conditions and local geology characteristics, the most productive time of the year for construction is spring/summer (March to October) and the least productive period is winter (November to February), being potentially a third productive compared to summer (see appendix B7). Hence the effect of this option on the earthworks and marine works would be to add 10-12 months each year to the construction schedule. Subsequently, the construction schedule would overlap with a third and fourth breeding season. Overall, the construction schedule would be extended by 40-48 months (not taking into account other construction schedule risks or wind conditions[17]); increasing the length of a 24-month activity by 170% to 200%. The extended construction schedule would delay the provision of low carbon electricity and so would not meet the Project need. Furthermore, the following Project objectives would not be met: **A2.** *To be delivered in a safe and efficient manner* – the extension to the construction schedule would be inefficient in comparison to the proposed construction schedule. **A10.** *Respect communities and ensure that the effect of the Project on them is minimised and that opportunities to provide enhancements are taken, as far as possible* – the duration of the construction phase would not be minimised on communities in Tregele and Cemaes, as well as those in Anglesey affected by traffic, as the period of disruption would be longer.	No
17. Limiting the noise at the tern colony islands to +5 dB above L_{A90} average during the breeding seasons	No	No	This alternative option would effectively remove the possibility of blasting as the minimum distance from the terns using the smallest effective MIC of 25kg would be 2.4km (appendix A1), which is beyond the Power Station platform. If no blasting occurred during two breeding seasons during the 24 months of earthworks then 8 months of works would be displaced, consequently overlapping with a third breeding season and extending the construction schedule by another 4 months; so no blasting would add at least 12 months. To achieve 50 dB $L_{Aeq,\ 5min}$ marine and deep excavation works would both have to cease. This potential alternative would have a similar effect on the construction schedule as limiting the noise to not exceed L_{A90} average (45 dB) at the tern colony during breeding seasons (potential alternative solution 16). Overall, the construction schedule would be extended by 40-48 months (not taking into account other construction schedule risks or wind conditions); increasing the length of a 24-month activity by 160% to 200%. The extended construction schedule would delay the provision of low carbon electricity and so would not meet the Project need. Furthermore, the following Project objectives would not be met: **A2.** *To be delivered in a safe and efficient manner* – the extension to the construction schedule would be inefficient in comparison to the proposed construction schedule. **A10.** *Respect communities and ensure that the effect of the Project on them is minimised and that opportunities to provide enhancements are taken, as far as possible* – the duration of the Project construction phase would not be minimised on communities in Tregele and Cemaes, as well as those in Anglesey affected by traffic, as the period of disruption would be longer.	No

[17] The ISEE Blasters’ handbook [RD42] states that wind direction will cause air overpressures to be enhanced downwind: “*For a 32 kilometre/hour (20mph) wind, an additional 10 to 20 decibels may be received downwind, or a lower 10 to 20 decibels upwind compared to a no wind situation. Mild crosswinds do not have a significant effect, but strong turbulent winds may mask the sound as well as disrupt the continuity of the air overpressures*.”

Potential Alternative Solutions	Does the option meet/deliver the Project need?	Does the option meet/deliver the Project objectives?	Why and how?	Take to Step 4? (i.e. passes Step 3)
18. Limiting the noise at the tern colony islands to the average ambient level (55 dB $L_{Aeq,5min}$) during the breeding seasons	No	No	In order to achieve this lower noise threshold, the MIC would have to be restricted across the site according to distance from the breeding tern colony (appendix A1); the MIC below do not take into account wind conditions: • 75kg MIC greater than 2km away – the ambient noise level means that 75kg MIC cannot be used over the majority of the blasting area; • 50kg MIC between 1.7km and 2km away – this covers about 25% of the blasting area; • 25kg MIC between 1.3km and 1.7km away – this covers the majority of the blasting area; and • No blasting within 1.3km (where no blasting is proposed anyway). To achieve 55 dB $L_{Aeq,5min}$ from other construction works, the following would need to occur: • cease haulage of bulk material from the Unit 1 deep excavation (construction zone 4) to Mound E and no heavy plant on Mound E; • cease using drilling rigs, rock breakers, impact breakers, eccentric rippers and impact piling associated with the marine works; • prevent heavy plant operating on Mound E; and • halve the amount of vehicle movements from Unit 2 deep excavation to Mound A. It is estimated that productivity would be affected by around 50% during the tern breeding season. Losing two months in spring/summer would push the works into the winter. Due to winter conditions and local geology a third of production rates would be achieved (appendix B7). Hence the effect each year would be to add approximately 5-6 months. Subsequently, the construction schedule would overlap with a third and fourth breeding season. Overall the Project schedule would be extended by up to 20-24 months; increasing the length of a 24-month activity by 80% to 100%. The extended construction schedule would delay the provision of low carbon electricity and so would not meet the Project need. Furthermore, the following Project objectives would not be met: **A2.** *To be delivered in a safe and efficient manner* – the extension to the construction schedule is deemed inefficient in comparison to the proposed construction schedule. **A10.** *Respect communities and ensure that the effect of the Project on them is minimised and that opportunities to provide enhancements are taken, as far as possible* – the duration of the construction phase would not be minimised on communities in Tregele and Cemaes, as well as those in Anglesey affected by traffic, as the period of disruption would be longer.	No
19. Avoid blasting and construction during the tern breeding seasons	No	No	This alternative option would result in all construction works pausing for about 4 months each breeding season. It would have a similar effect on the construction schedule as limiting the noise to not exceed L_{A90} average (45 dB) at the tern colony during breeding seasons (potential alternative solution 16). Overall, the construction schedule would be extended by 40-48 months (not taking into account other risk factors or wind conditions); increasing the length of a 24-month activity by 160% to 200%. The extended construction schedule would delay the provision of low carbon electricity and so would not meet the Project need. The following Project objectives would also not be met: **A2.** *To be delivered in a safe and efficient manner* – the extension to the construction schedule is deemed inefficient in comparison to the proposed construction schedule. **A10.** *Respect communities and ensure that the effect of the Project on them is minimised and that opportunities to provide enhancements are taken, as far as possible* – the duration of the construction phase would not be minimised on communities in Tregele and Cemaes, as well as those in Anglesey affected by traffic, as the period of disruption would be longer.	No
20. Avoid blasting and construction in a one-month establishment period	Yes	Marginally no	The minimum (optimistic) schedule impact of this alternative would be to add two months for each establishment period affected (due to the nature of glacial till, unfavourable weather and limited sunshine, see appendix B7). This would result in the works encroaching upon a third breeding season and so another establishment period. The overall minimum impact, therefore, would be 7 months, but pessimistically there could be a 10 month extension. This would increase the length of a 24-month activity by 30% to 40%. The extended construction schedule would delay the provision of low carbon electricity. However, the delay would not be more than 12 months and so would not compromise the Project need. Marginally the following Project objective would not be met: **A10.** *Respect communities and ensure that the effect of the Project on them is minimised and that opportunities to provide enhancements are taken, as far as possible* – the duration of the construction phase would not be minimised on communities in Tregele and Cemaes, as well as those in Anglesey affected by traffic, as the period of disruption would be longer.	Yes
21. Avoid blasting and construction in a two-month establishment period	No	No	The effect of pausing for two tern breeding establishment months each year for the construction schedule would be an extension of 4-6 months, resulting in an overall extension of 16-24 months because of the overlap with a fourth breeding season; increasing the length of a 24-month activity by 60% to 100%. Essentially this would have the same construction schedule impact as limiting noise at the tern colony islands to the average ambient level (55 dB $L_{Aeq,5min}$) during the breeding seasons. The extended construction schedule would delay the provision of low carbon electricity and so would not meet the Project need. Furthermore, two Project objectives would not be met: **A2.** *To be delivered in a safe and efficient manner* – the extension to the construction schedule is deemed inefficient in comparison to the proposed construction schedule. **A10.** *Respect communities and ensure that the effect of the Project on them is minimised and that opportunities to provide enhancements are taken, as far as possible* – the duration of the construction phase would not be minimised on communities in Tregele and Cemaes, as well as those in Anglesey affected by traffic, as the period of disruption would be longer.	No

Potential Alternative Solutions	Does the option meet/deliver the Project need?	Does the option meet/deliver the Project objectives?	Why and how?	Take to Step 4? (i.e. passes Step 3)
22. Extend establishment period to eight weeks	Yes	Marginally no	Extending the establishment period to eight weeks would start the noise constraint period sooner for blasting and other construction. Potential Alternative Solution 18 explains how this would affect productivity. Subsequently the duration of the earthworks would extend by between 6 weeks (if the works occur during the summer months of the year) to 4.5 months (if the displaced works are affected by reduced winter productivity) over three breeding seasons. The extended construction schedule would delay the provision of low carbon electricity. However, the delay would not be more than 12 months and so would not compromise the Project need. Marginally the following Project objective would not be met: **A10.** *Respect communities and ensure that the effect of the Project on them is minimised and that opportunities to provide enhancements are taken, as far as possible* – the duration of the construction phase would not be minimised on communities in Tregele and Cemaes, as well as those in Anglesey affected by traffic, as the period of disruption would be longer.	Yes

6 Step 4 – Are there any Feasible Alternative Solutions

6.1 Introduction

6.1.1 This chapter implements step 4 of the methodology by assessing the feasibility of each short listed potential alternative solution.

6.1.2 The short listed potential alternative solutions are set out in paragraph 5.4.1 above; each one is assessed below in turn according to the methodology described in chapter 2.

6.2 Potential alternative solution 13 – blasting noise mitigation (acoustic screening)

6.2.1 This potential alternative solution concerns constructing acoustic barriers to reduce air overpressure from blasting.

Legally feasible

6.2.2 There are no legal impediments associated with this potential alternative solution and it is feasible from a consenting perspective. This potential alternative solution is, therefore, legally feasible.

Technically feasible

6.2.3 According to Horizon's specialist technical advisor on noise (Sine Acoustics), in order to reduce air overpressure, substantial barriers are necessary; such as a series of quarry faces (as described in a Scottish Planning Advice Note [RD43]).

6.2.4 The effectiveness of a barrier to reduce the effect of noise and air overpressure is dependent on the spatial relationship between the blast site, the barrier and the receptor location.

6.2.5 Air overpressure and noise can be marginally reduced when a substantial barrier is located between the blast site and the receptor. However, it is noted that the effectiveness of topographic and man-made noise barriers in reducing low frequency noise (which dominates air overpressure) is far less than their effectiveness at reducing higher frequency noise from more common transportation and anthropogenic sources.

6.2.6 Sensitivity analysis by Sine Acoustic indicates that a 40m tall earth mound around the deep excavations would only reduce low frequency blasting noise by about 2.5dB at the tern nesting islands.

6.2.7 Furthermore, when a high face is present in the pit on the opposite side from the blast site, it (the face) will reflect the higher frequencies of air overpressure back towards the blasting face [RD44].

6.2.8 As the configuration of the deep excavation in this case makes the presence of opposite high faces unavoidable, a barrier is highly likely to be ineffective at reducing air overpressure at the breeding tern colony.

6.2.9 Therefore, this alternative is deemed not to be feasible.

6.2.10 See appendix C1 for a more in-depth technical explanation.

Financially feasible

6.2.11 As this alternative is not technically feasible, its financial feasibility has not been considered.

6.3 Potential alternative solution 20– avoid blasting and construction in the breeding tern colony one month establishment period

6.3.1 This potential alternative solution concerns avoiding blasting and construction during the breeding tern colony establishment periods (assuming only one each breeding season).

Legally feasible

6.3.2 There are no legal impediments associated with this alternative and it is feasible from a consenting perspective. This potential alternative solution is, therefore, legally feasible.

Technically feasible

6.3.3 This alternative requires no technology and is, therefore, technically feasible.

Financially feasible

6.3.4 Table 5-2 explains that this alternative would result in the Project construction schedule extending by seven to ten months, effectively increasing the length of a 24-month activity by 30% to 40%.

6.3.5 The cost of a seven month extension would be at least £160 million based on:

- An additional seven months of overhead costs (see paragraph 2.2.22).
- Three months of stand down (cost of retaining people and plant as cannot be re-deployed elsewhere). The duration of no activity represents each establishment period for three breeding seasons.
- An additional seven months of additional earthworks (contractors and plant).

6.3.6 If this alternative was to be adopted the absolute level of noise during the establishment periods would be reduced but, as demonstrated in chapter 4, because the construction phase noise effect would be *de minimis* in any case (with predicted blast noise at the colony of 60dB $L_{AF, max}$ during the breeding seasons and 55dB $L_{AF, max}$ during the establishment periods), the implications for the integrity of the Morwenoliaid Ynys Môn/Anglesey Terns SPA and the Dee Estuary SPA would not change (i.e. an environmental benefit would not arise).

6.3.7 Given this, the cost of adopting this alternative is considered to be disproportionate and this potential alternative solution is deemed not to be financially feasible.

6.4 Potential alternative solution 22– extend establishment period to eight weeks

6.4.1 This potential alternative solution concerns extending the establishment period from four weeks to eight weeks; enforcing a noise constraint threshold of 55dB $L_{AF,max}$ for blasting and 55dB $L_{AF,max}$ for other construction works (or the daily ambient noise at the colony, whichever is higher) during this period.

Legally feasible

6.4.2 There are no legal impediments associated with this alternative and it is feasible from a consenting perspective. This potential alternative solution is, therefore, legally feasible.

Technically feasible

6.4.3 This alternative requires no technology and is, therefore, technically feasible.

Financially feasible

6.4.4 Table 5-2 explains that this alternative would result in the Project construction schedule extending by 6 weeks to 4.5 months.

6.4.5 The cost of this to the Project would be at least £37 million and up to £100 million (based on additional monthly Project running costs for the supply chain and overhead costs, but not allowing for construction risks, the cost of delayed revenue or additional financing costs). Therefore, the true costs are likely to be higher.

6.4.6 Given this, the cost of adopting this alternative is deemed to be disproportionate and this potential alternative solution is considered not to be financially feasible.

7 Step 5 – Are there any Feasible Alternative Solutions that have a Lesser Effect on the Integrity of any European Designated Site?

7.1 Introduction

7.1.1 This chapter implements the final step of the Stage 3 alternatives solutions assessment, whereby any feasible alternative solutions have to be assessed in accordance with Stage 2 of the HRA.

7.2 Step 5 assessment

7.2.1 The previous steps reveal that there are no feasible alternative solutions to the Project proposal in the context of construction phase disturbance to the breeding terns of the Morwenoliaid Ynys Môn/Anglesey Terns SPA due to acoustic stimuli (and thereby potential disturbance to passage Sandwich tern in the Dee Estuary SPA).

8 Conclusion

8.1.1 Twenty-two potential alternative solutions have been identified and considered as part of the Stage 3 HRA assessment; table 8-1 summarises these alternatives and provides details of why they were discounted.

Table 8-1 Summary of considered alternative solutions

Type	Potential Alternative Solution	Why Alternative Discounted
Do Nothing	1. Not progressing the Project (no Power Station and Associated Development)	Does not meet the Project need nor two Project objectives
Alternative locations	2. Progressing a different site to Wylfa (locate Power Station elsewhere in the UK)	Does not meet the Project need nor three Project objectives
Alternative scales or designs	3. Fewer reactors (have one nuclear reactor)	Does not meet the Project need
	4. Cooling via other technologies using freshwater or mains water	Does not meet the Project need nor three Project objectives
	5. Use road/rail for importing AILs and bulk materials (instead of a MOLF)	Does not meet the Project need nor three Project objectives
	6. No deep excavation (for the cooling water circulation and reactor foundations)	Does not meet the Project need nor three Project objectives
	7. Alternative layout for the Power Station within the WNDA (locate the Power Station Site further away from the terns)	Does not meet the Project need nor four Project objectives
	8. A different location for the MOLF (further to the east)	Does not meet the Project need nor four Project objectives
	9. Different cooling water intake location (further east onshore or offshore)	Does not meet the Project need nor three Project objectives
	10. Reduce the scale of the MOLF (either fewer berths or smaller vessels but berths still sufficiently sized for AILs	Does not meet the Project need nor two Project objectives
	11. Smaller cooling water intake (narrower and shallower)	Does not meet the Project need
	12. Do not construct Mound E but take material to other on-site locations (avoid having plant on Mound E and place material on other mounds)	Does not meet the Project need nor four Project objectives
	13. Blasting noise mitigation (acoustic barrier)	Not technically feasible
Different method/ means (of excavation)	14. Digging and ripping (instead of blasting, only use mechanical methods) in breeding seasons	Does not meet the Project need nor two Project objectives
	15. Non-traditional techniques (not typically used in major earthworks) in breeding seasons	Does not meet the Project need nor two Project objectives
Different magnitude (of noise)	16. Limiting the noise at the tern colony islands to not exceed L_{A90} average (45 dB $L_{Aeq,\ 5min}$) during the breeding seasons (essentially no blasting or construction works)	Does not meet the Project need nor two Project objectives
	17. Limiting the noise at the tern colony islands to +5 dB above L_{A90} average during the breeding seasons (effectively ceases blasting, Marine and deep excavation works)	Does not meet the Project need nor two Project objectives
	18. Limiting the noise at the tern colony islands to the average ambient level (55 dB $L_{Aeq,\ 5min}$) during the breeding seasons (significantly restricted blasting, haulage of bulk material and marine works)	Does not meet Project need nor two Project objectives

Type	Potential Alternative Solution	Why Alternative Discounted
Different timing	19. Avoid blasting and construction during the tern breeding seasons (between 15 April and 15 August, to be confirmed through engagement with the NWWT)	Does not meet the Project need nor two Project objectives
	20. Avoid blasting and construction in a one-month establishment period	Is not financially feasible
	21. Avoid blasting and construction in a two-month establishment period	Does not meet the Project need nor two Project objectives
	22. Extend establishment period to eight weeks	Is not financially feasible

8.1.2 The assessment of alternative solutions provided in this report demonstrates that there are no feasible alternative solutions to the Project proposals.

9 References

ID	Reference
[RD1]	HM Government. 2017. *The Conservation of Habitats and Species Regulations 2017.30 November 2017.* (“**Habitats Regulations**”)
[RD2]	European Commission. 2000. Assessment of plans and projects significantly affecting Natura 2000 sites. Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC. (“**Methodological Guidance for the Habitats Directive**”)
[RD3]	European Commission. 1992. *Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora*. 21 May 1992. (“**Habitats Directive**”)
[RD4]	European Commission. 2007/2012. *Guidance document on Article 6(4) of the ‘Habitats Directive’* 92/43/EEC. (“**EC Guidance**”)
[RD5]	Defra. 2012. *Habitats and Wild Birds Directives: guidance on the application of article 6(4) Alternative solutions, imperative reasons of overriding public interest (IROPI) and compensatory measures.* December 2012. (“**Defra Guidance**”).
[RD6]	Planning Inspectorate. 2017. *Advice Note Ten: Habitat Regulations Assessment relevant to Nationally Significant Infrastructure Projects*. November 2017, Version 8. (“**PINS Advice Note 10**”).
[RD7]	Welsh Assembly Government. 2009. Technical Advice Note 5, Nature Conservation and Planning. Sept 2009. Annex 3. (“**TAN 5**”).
[RD8]	Tyldesley, D. and Chapman C. 2018. *The Habitats Regulations Assessment Handbook*, November 2018 edition UK: DTA Publications Limited. (“**HRA Handbook**”)
[RD9]	European Court of Justice (ECJ) decision and associated Advocate General (AG) opinion in C-239/04: Opinion Advocate General Kokott delivered on 27 April 2006 Judgement of the Court (Second Chamber) on 26 October 2006.
[RD10]	Able Marine Energy Park DCO application and examination (including the applicant’s HRA report, ExA report and SoS decision): The Able Marine Energy Park Order 201X Panel’s Findings and Recommendations to the Secretary of State – October 2013 TR030001-002225-SoS Decision letter with annexes – December 2013.
[RD11]	Department of Energy and Climate Change. 2011a. *Overarching National Policy Statement for Energy (EN-1).* London: The Stationery Office.
[RD12]	Department of Energy and Climate Change. 2011b. *National Policy Statement for Nuclear Power Generation (EN-6). Volume I and Volume II.* London: The Stationery Office.
[RD13]	Department for Business, Enterprise & Regulatory Reform. 2008. *Meeting the Energy Challenge – A White Paper on Nuclear Power*. January 2008.
[RD14]	Department for Business, Energy & Industrial Strategy. 2017a. *The Clean Growth Strategy*. October 2017.

ID	Reference
[RD15]	Department for Business, Energy & Industrial Strategy. 2017b. *Consultation on the siting criteria and process for a new National Policy Statement for nuclear power with single reactor capacity over 1 gigawatt beyond 2025.* December 2017.
[RD16]	Secretary of State for Business, Energy and Industrial Strategy. 2017. *Statement on Energy Infrastructure: Written statement – HLWS316*. 7 December 2017.
[RD17]	Department of Business, Energy and Industrial Strategy. 2018a. *Updated energy and emissions projections 2017*, pp. 7 and 9 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/671187/Updated_energy_and_emissions_projections_2017.pdf, accessed 18 January 2018. Tab 'Reference scenario' in Annex F shows that final consumption of electricity amounts to 26,370ktoe and 31,539ktoe in 2017 and 2035 respectively. The resulting increase therefore amounts to 20% (100·(31,539/26,370) – 100).
[RD18]	Department for Business, Energy and Industrial Strategy. 2018b. *Implementing the end of unabated coal by 2025*, para. 21 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/672137/Government_Response_to_unabated_coal_consultation_and_statement_of_policy.pdf, accessed 15 January 2018, p. 8, and Department for Business, Energy and Industrial Strategy. 2018. 'The future of coal generation in Great Britain –Impact assessment', p. 8, para. 13 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/671959/FINAL_updated_unabated_coal_Impact_Assessment_Jan_2018.pdf, accessed 15 January 2018.
[RD19]	National Audit Office. 2016. *Nuclear power in the UK*.
[RD20]	Energy Research Partnership. 2015. Managing flexibility whilst decarbonising the GB electricity system. August 2015, p. 14.
[RD21]	National Grid. 2017. *Future Energy Scenarios*. July 2017. http://fes.nationalgrid.com/media/1256/2017-fes-charts-v22.xlsx http://fes.nationalgrid.com/media/1253/finalfes-2017-updated-interactive-pdf-44-amended.pdf. Accessed 9 January 2018.
[RD22]	HM Treasury. 2017. Control for low carbon levies. Table 1.B, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/660986/Control_for_Low_Carbon_Levies_web.pdf. Accessed 2 February 2018.
[RD23]	Ofgem, electricity interconnectors, https://www.ofgem.gov.uk/electricity/transmission-networks/electricityinterconnectors accessed 2 February 2018
[RD24]	Horizon. 2016. *Wylfa Newydd Project Pre-Application Consultation – Stage 2 Main Consultation Overview Document*. WN031-S9-PAC-REP-00003
[RD25]	Welsh Government. 2016. Planning Policy Wales. Edition 9, November 2016.

ID	Reference
[RD26]	Isle of Anglesey County Council and Gwynedd Council. 2017. Anglesey and Gwynedd Joint Local Development Plan. 31 July 2017. [Online] https://www.gwynedd.llyw.cymru/en/Council/Documents---Council/Strategies-and-policies/Environment-and-planning/Planning-policy/Anglesey-and-Gwynedd-Joint-Local-Development-Plan-Written-Statement.pdf
[RD27]	Creative Commons image title “Cat D8R with ripper SCAN0104.JPG”. Taken from: http://tractors.wikia.com/wiki/File:Cat_D8R_with_ripper_SCAN0104.JPG [Downloaded 17 May 2018].
[RD28]	Dyno Nobel. 2010. *Blasting and Explosives Quick Reference Guide* https://www.leg.state.mn.us/docs/2015/other/150681/PFEISref_1/Dyno%20Nobel%202010.pdf [Downloaded 24 September 2018].
[RD29]	Welsh Government. 2014. Sound Advice on Noise. Digital IBSN 978 1 4734 2593 4. WG23198. [Online] https://gov.wales/docs/desh/publications/141127noisesoundadviceen.pdf
[RD30]	Horizon. 2018. Wylfa Newydd Project Water Discharge Activity – Environmental Permit Application Supporting Document.WN0908-HZCON-PAC-REP-00002
[RD31]	Environmental Permitting (England and Wales) Regulations 2016 (as amended). SI 2016/1154.
[RD32]	Environment Agency. 2010. Cooling Water Options for the New Generation of Nuclear Power Stations in the UK. SC070015/SR3.
[RD33]	European Commission. 2001. IPPC Reference Document on the Application of Best Available Techniques to Industrial Cooling Systems.
[RD34]	UK ABWR GDA (Generic Design Assessment), *Other Environmental Regulations.* GA91-9901-0027-00001.
[RD35]	Highways England. 2016. Water preferred policy guidelines for the movement of abnormal indivisible loads. January 2016.
[RD36]	Horizon. 2016. Summary of Pre-Application Consultation Stage One Feedback. HNP-S5-PAC-REP-00044 https://consultation.horizonnuclearpower.com/stage-1/consultation-documents
[RD37]	Network Rail. 2008. Route Utilisation Strategy. [Online]. Available at http://archive.nr.co.uk/browseDirectory.aspx?root=&dir=%5cRUS%20Documents%5cRoute%20Utilisation%20Strategies%5cWales
[RD38]	International Atomic Energy Agency. 2016. *Site Evaluation for Nuclear Installations. Safety requirements*. No. NS-R-3 (Rev.1) https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1709web-84170892.pdf
[RD39]	International Atomic Energy Agency. 2010. *Seismic Hazards in Site Evaluation for Nuclear Installations*. Specific Safety Guide No. SSG-9 https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1448_web.pdf
[RD40]	Horizon. 2014. Wylfa Newydd Project Pre-Application Consultation – Stage One Main Consultation Document. https://consultation.horizonnuclearpower.com/stage-1/consultation-documents

ID	Reference
[RD41]	Met Office. 2016. Historical monthly data for meteorological station Valley [Online]. [Downloaded 20 April 2018] https://data.gov.uk/dataset/historic-monthly-meteorological-station-data/resource/c6876eb0-8b51-4a8e-96f6-cf034d575d79
[RD42]	International Society of Explosives Engineers. 2011. Blasters' Handbook. 18th Edition. 31 January 2011 ("**ISEE Blasters' Handbook**")
[RD43]	The Scottish Office Development Department. 2000. Surface mineral workings: control of blasting, an Annex to Planning Advice Note 50 *'Controlling the Environmental Effects of Surface Mineral Workings'.* 1 Feb 2000. [Online] [Downloaded 20 April 2018] https://beta.gov.scot/publications/blasting-surface-mineral/
[RD44]	Siskind, D.E., Stachura, V.J., Mark S. and Kopp, J.W. 1980. '*Report of Investigations 8485 Structure Response Damage Produced by Airblast from Surface Mining*', Bureau of Mines, United States Department of the Interior, Avondale, Maryland, United States of America [Online]. Available: http://www.osmre.gov/resources/blasting/docs/USBM/RI8485StructureResponseDamageProducedAirblast1980.pdf. [Accessed: 20-Jul-2017]
[RD45]	Dowding, Charles H, Construction Vibrations, 2nd ed. Ohio, United States of America: International Society of Explosives Engineers, 2000.
[RD46]	Watanabe, Toshio and Møller, Henrik, "Low Frequency Hearing Thresholds in Pressure Field and in Free Field," J. Low Freq. Noise Vib. Act. Control, vol. 9, no. 3, pp. 106--115, 1990 [Online]. Available: http://journals.sagepub.com/doi/abs/10.1177/026309239000900303 [Accessed: 16-Jul-2017]
[RD47]	Alan B. Richards and Adrian J. Moore, "Airblast control techniques in open cut mines," Terrock Consulting Engineers Pty Ltd, Victoria, Australia, 2006 [Online]. Available: https://miningandblasting.files.wordpress.com/2009/09/airblast_-control_techniques_in_open_cut_mines.pdf

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Appendix A – Supporting information for chapter 4

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Appendix A1 – Predicted $L_{AF, max}$ noise levels from blasting of rock

The table below presents predictions for a 'highly confined' construction blast and an 'average confinement' construction blast, extracted from Environmental Statement appendix D13.13 - Noise Modelling for Ecological receptors, [APP-231]. The noise predictions are based on cross wind conditions and include (1) a +10dB correction for face orientation (i.e. free face of blast oriented towards the tern colony) and (2) a +5dB correction for potential error in the methodology. The prediction methodology has been peer reviewed by AmecFW and it performed well in the surface blast trials.

Wind direction would cause air overpressure at a receptor to be enhanced downwind up to 20dB $L_{AF, max}$ and, conversely, reduced by up to 10dB $L_{AF, max}$ in upwind conditions (Environmental Statement appendix D13.13 - Noise Modelling for Ecological receptors, [APP-231])

Distance m	Predicted $L_{AF, max}$ for highly confined construction blast, dB						Predicted $L_{AF, max}$ for average confinement construction blast, dB					
	Maximum instantaneous charge weight, kg						Maximum instantaneous charge weight, kg					
	150	125	100	75	50	25	150	125	100	75	50	25
100	85.8	85.2	84.5	83.6	82.3	80.1	108.8	108.2	107.5	106.6	105.3	103.1
200	79.2	78.6	77.9	77.0	75.7	73.5	102.2	101.6	100.9	100.0	98.7	96.5
300	75.3	74.7	74.0	73.1	71.8	69.6	98.3	97.7	97.0	96.1	94.8	92.6
400	72.6	72.0	71.3	70.4	69.1	66.9	95.6	95.0	94.3	93.4	92.1	89.9
500	70.4	69.9	69.2	68.2	67.0	64.7	93.4	92.9	92.2	91.2	90.0	87.7
600	68.7	68.1	67.4	66.5	65.2	63.0	91.7	91.1	90.4	89.5	88.2	86.0
700	67.2	66.7	65.9	65.0	63.7	61.5	90.2	89.7	88.9	88.0	86.7	84.5
800	66.0	65.4	64.7	63.8	62.5	60.3	89.0	88.4	87.7	86.8	85.5	83.3
900	64.8	64.3	63.5	62.6	61.3	59.1	87.8	87.3	86.5	85.6	84.3	82.1
1,000	63.8	63.2	62.5	61.6	60.3	58.1	86.8	86.2	85.5	84.6	83.3	81.1
1,100	62.9	62.3	61.6	60.7	59.4	57.2	85.9	85.3	84.6	83.7	82.4	80.2
1,200	62.1	61.5	60.8	59.9	58.6	56.4	85.1	84.5	83.8	82.9	81.6	79.4
1,300	61.3	60.7	60.0	59.1	57.8	55.6	84.3	83.7	83.0	82.1	80.8	78.6

Distance m	Predicted $L_{AF, max}$ for highly confined construction blast, dB						Predicted $L_{AF, max}$ for average confinement construction blast, dB					
	Maximum instantaneous charge weight, kg						Maximum instantaneous charge weight, kg					
	150	125	100	75	50	25	150	125	100	75	50	25
1,400	60.6	60.0	59.3	58.4	57.1	54.9	83.6	83.0	82.3	81.4	80.1	77.9
1,500	60.0	59.4	58.7	57.7	56.5	54.2	83.0	82.4	81.7	80.7	79.5	77.2
1,600	59.3	58.8	58.0	57.1	55.8	53.6	82.3	81.8	81.0	80.1	78.8	76.6
1,700	58.8	58.2	57.5	56.5	55.3	53.1	81.8	81.2	80.5	79.5	78.3	76.1
1,800	58.2	57.6	56.9	56.0	54.7	52.5	81.2	80.6	79.9	79.0	77.7	75.5
1,900	57.7	57.1	56.4	55.5	54.2	52.0	80.7	80.1	79.4	78.5	77.2	75.0
2,000	57.2	56.6	55.9	55.0	53.7	51.5	80.2	79.6	78.9	78.0	76.7	74.5
2,200	56.3	55.7	55.0	54.1	52.8	50.6	79.3	78.7	78.0	77.1	75.8	73.6
2,400	55.5	54.9	54.2	53.3	52.0	49.8	78.5	77.9	77.2	76.3	75.0	72.8
3,000	53.3	52.7	52.0	51.1	49.8	47.6	76.3	75.7	75.0	74.1	72.8	70.6
4,000	50.6	50.0	49.3	48.4	47.1	44.9	73.6	73.0	72.3	71.4	70.1	67.9

Appendix B – Supporting information for chapter 5 (screening the long list of potential alternative options)

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Appendix B1 – Wylfa Newydd Project Water Discharge Activity - Environmental Permit Application Supporting Document [RD30]

The document forms the supporting document for an application by Horizon Nuclear Power Wylfa Limited (hereafter referred to as Horizon) for an Environmental Permit (EP) under Schedule 21 of the Environmental Permitting (England and Wales) Regulations 2016 (as amended) (SI 2016 No.1154) (EPR16)[RD31]. The application is for a water discharge activity at a new nuclear power station to be built on the north coast of Anglesey (referred to subsequently as the Power Station). The supporting document supplements the information provided in the application forms for the Water Discharge Activity EP.

Section 4.3.1 is reproduced below for ease of reference.

4.3.1 Cooling water system technology selection

188. The purpose of the assessment of cooling water system technologies was to review credible cooling technologies from an environmental and economic perspective, and to establish whether direct cooling with seawater is the most appropriate cooling technology for the Power Station.

189. Cooling is required to condense the exhaust steam and create a vacuum within the steam circuit, and enable the low pressure turbine to operate as efficiently as possible. A cooling system is therefore required that is capable of continuously and consistently condensing the exhaust steam, and subsequently removing the waste heat load [RD32]. Such cooling is required by all thermal power stations.

190. It was noted from the outset that direct cooling with seawater was expected to be the most appropriate technology for the cooling of the Power Station, on the basis of the Power Station being located on a coastal site, in a temperate climate, and with access to deep sea water with tidal currents to aid dispersion of cooling water discharges. In the optioneering assessment undertaken, direct cooling with seawater was therefore set as the baseline against which other options were assessed.

191. The selection of direct cooling with seawater is in line with guidance presented by the EA [RD32] which reports that a properly designed direct cooling system may be the best environmental option for the dissipation of the heat loads associated with new nuclear plants situated on the coast or estuaries (subject to current best planning, design and operational practice and mitigation methods being put in place) [RD32]. This is supported by the EC which also states that for major cooling loads such as power plants direct cooling is an option [RD33].

192. It is also noted that the Existing Power Station has operated for over 40 years with direct cooling with seawater and low reported environmental effects, and that all the UK's Advanced Gas Cooled Reactor stations, and the Sizewell B Pressurised Water Reactor are sited at coastal locations and use direct cooling. In addition, the large nuclear plants in northern France at Gravelines, Paluel and Flamanville also use direct cooling systems in similar circumstances to the existing and proposed plants in the UK. Hinkley Point C has been authorised to use direct cooling with seawater. Pembroke Power Station, a combined cycle gas turbine plant, is located

on a coastal site in southwest Wales (Pembrokeshire) and also uses direct cooling with seawater.

193. In addition to direct cooling with seawater, the following technologies were identified as credible for cooling two 1,350 MWe (net) UK ABWR units at the Power Station. These units were selected as indicative sized plants for this assessment. The technologies were compared against direct cooling with seawater as the base case[18], and are described in more detail in the following sections:

- Air cooled condensers.
- Natural draught cooling towers.
- Induced draught low level cooling towers.
- Hybrid low plume low level induced draught cooling towers.
- Hybrid low plume Fan Assisted Natural Draught (FAND) cooling towers.

4.3.1.1 Direct cooling with seawater

194. The system draws water from the sea, through screens, and pumps it through the condensers and cooling system heat exchangers. Heat is transferred from the condensers and heat exchangers to the seawater which is then discharged directly to the sea where the heat is dispersed.

4.3.1.2 Air cooled condenser

195. Takes the steam from the turbine and condenses it directly by passing air over the heat exchangers. Air flow is created by large electrically driven fans. The system operates at a higher temperature than water cooled systems, and consequently the turbine generator is less efficient resulting in a lower power output (MWe) to the grid [table B1-1].

4.3.1.3 Cooling towers

196. The cooling water is heated as it passes through the condenser and heat exchangers and then subsequently cooled in the cooling towers by adiabatic evaporation of the water. The cooled water is then returned to the condensers and the cycle is repeated. Four main types of cooling towers were considered:

- Natural draught cooling towers.
- Induced draught low level cooling towers.
- Hybrid low plume level cooling towers.
- Hybrid low plume FAND cooling towers.

4.3.1.3.1 Natural draught cooling towers

197. The cooling water is sprayed into fine droplets inside the cooling tower. Whilst pumps are required to lift the cooling water partway up the cooling tower, natural draught means that there is no power consumption required to create the flow of cooling air.

198. Seawater can be used, but results in significant corrosion problems. Also, because salt water has a lower vapour pressure and does not evaporate as easily as freshwater, it is a less efficient coolant than freshwater in a cooling tower. Consequently the cooling tower has to be slightly larger and its cooled water

[18] Direct cooling with water other than seawater was not considered as an option as sufficient quantities of other water sources are not available at the Power Station.

temperature (and therefore the plant efficiency), is slightly lower than for a freshwater system.

4.3.1.3.2 Induced draught low level cooling towers

199. Induced draught low level cooling towers are reduced height versions of natural draught towers, with fans used to create part of the draught. The tower has a number of self- contained cells, each of which can cool up to around 50 MWth. Approximately fifty cells would be required for the duty required for each UK ABWR.

200. The smaller height of the tower means that the plume generated is at a much lower level. This can cause ground level fogging in humid conditions.

4.3.1.3.3 Hybrid low plume low level cooling towers

201. The hybrid low plume low level system is designed to reduce the visible vapour plume by using some of the heat in the cooling water to heat the saturated air leaving the cooling tower. The system has a lower water demand than the natural draught and induced draught towers, but does have a greater negative impact on the power output of the Power Station compared to non-hybrid systems.

4.3.1.3.4 Hybrid low plume FAND cooling towers

202. The hybrid low plume FAND system provides a combined version of the induced draught and hybrid low plume towers. It has a similar performance to the hybrid low plume tower system.

4.3.1.4 Comparison of options

203. Each technology was assessed in terms of its:

- Performance, using the Steam Pro[19] thermodynamic model.
- Relative capital cost, using the PEACE[2] costing model.
- Water requirement.
- Land area requirement (physical footprint).
- Visual impact, in terms of the height of the cooling structure, and the generation of a visible plume to air.
- Maintenance costs and technical suitability in terms of the Power Station's requirements and geographical location.

204. Table B1-1 and table B1-2 and summarise the characteristics of the cooling technologies considered:

- Power output to the grid - the effect of cooling technology on the amount of power the Power Station is able to export to the National Grid is a result of the condensation temperatures achieved in the condensers and the power consumption of the cooling system. As shown in table B1-2, direct cooling achieves the lowest condensation temperatures and power consumption of the cooling technologies, and consequently can facilitate the export of 42-82 MWe more than the other systems.
- Land area requirement - direct cooling requires the lowest land requirement of the options considered.

[19] Steam Pro and PEACE are part of the Thermoflow group of commercially available software tools.

- Potential visual impact - in terms of the size and height of the cooling towers, and the visibility of the plume - direct cooling does not require cooling towers.
- Seawater abstraction - direct cooling requires significantly more seawater than the other options.

Table B1-1 Comparison of land area requirement, potential visual impact and seawater abstraction

Cooling option (and assumption on set up)	Indicative additional land area (ha) *	Indicative overall height (m)**	Indicative seawater abstraction (m^3/s)
Direct cooled with seawater with a 12°C temp difference Cooling water intake and discharge structures, pump house and large cooling water culverts. (Note a similar pump and culvert installation is required for all cooling tower systems).	Base case	Not applicable	115
Air cooled condenser Around 175 m x 175 m for each reactor plus 30% area without structures to allow clear air flow.	8	35	0.6***
Natural draught Two towers, 152 m in diameter with air intake clearance of 15 m.	7	165	9
Induced draught low level 100 Single Cell Towers. Plant area assumed to require 100% of cell area for pipework clearance from air intakes and access roads.	6	20	9
Hybrid low plume low level Similar to induced draught towers.	6	25	7
Hybrid low plume FAND	13	60	7

Table Notes:

* It is assumed that the land area required for the cooling system pump house, switchboards and culverts will be similar for all systems. The cooling tower systems will require cooling water pump houses and culverts to the cooling towers and will also require a make-up pump house pipework and a purge system and outfall. The air cooled condenser will require a separate additional cooling water system with small cooling towers for reactor and turbine auxiliary cooling.

** Indicative height (m) of the cooling towers required.

*** Abstraction for the Reactor and Turbine auxiliary cooling systems.

Table B1-2 Effect of cooling option on power output to the grid (for two UK ABWRs)

Cooling option	MW_e generated	Overall works power (MW_e)	Power output to grid (MW_e)	Output loss for the Power Station (MW_e)
Direct cooled with seawater with a 12°C temp difference	2,700	63	2,637	Base (zero)
Air cooled condenser	2,636	70	2,566	71
Natural draught	2,668	73	2,595	42
Induced draught low level	2,668	96	2,572	65
Hybrid low plume low level	2,668	113	2,555	82
Hybrid low plume FAND	2,668	93	2,575	62

4.3.1.5 Conclusion - Cooling water system technology

205. Horizon considers that once through direct cooling with seawater is the best option for the technology to be used for the cooling water system at the Power Station. The reasons for this are:
- The coastal location of the Power Station ensures ready access to seawater for cooling.
- Direct cooling using seawater provides the greatest net power output to the National Grid and has the lowest capital and operating costs.
- Direct cooling with seawater does not incur the land take requirements and potential visual impacts arising from the need for cooling towers.
- The use of direct cooling has both environmental and commercial benefits, provided that the effects of the water abstraction and the thermal discharge on the local environment are minimised.

206. Once through direct cooling with seawater has therefore been adopted as the cooling water system technology at the Power Station. This technology is also:
- The generic design for the UK ABWR [RD34].
- In line with all power stations operating on coastal sites in the UK and Europe [RD32].
- In line with the EA's conclusion on what is BAT for large power stations sited on the coast [RD32], as cooling water supply is not limited; once through direct cooling is more efficient than the other cooling water technologies; the extension of heat plume in the surface water leaves passage for fish migration; the cooling water intake is designed to reduce fish entrapment; and the heat load does not interfere with other users of receiving surface water.

Appendix B2 – Further evidence for potential alternative solution 5

B2.1 Introduction

This appendix elaborates on the statements in table 5-2 regarding potential alternative solution 5 – use road/ rail for importing AILs and bulk materials (instead of a MOLF), in particular that the construction schedule would be extended beyond 2030.

B2.2 Potential options for transportation of materials

An assessment of potential options for the transportation of materials associated with the construction stage of the Wylfa Newydd Power Station has been made and presented in Appendix 10-1 of the Environmental Statement Volume C - Road traffic-related effects (project-wide) Appendix C2-4 - DCO TA Appendix F - Integrated Traffic and Transport Strategy [APP-107]. Relevant extracts are presented below. It should be noted that all of the assessed transport options include delivery of AILs (modular components for the power station) via the MOLF to deliver the Project construction schedule, for example some modules could be around 35m wide and 25m high. Also the "Impact on programme for Wylfa" in Tables 10-2 to 10-7 describes the time to construct the infrastructure associated with the transport route, not the impact of using the transport route to deliver the construction materials.

Construction is highly dependent on modularisation and the use of AILS and that these are both optimised and facilitated by the open top parallel construction method, as described by paragraph 3.2.32 in the Environmental Statement Volume D - WNDA Development Appendix D1-1 - Construction Method Statement [APP-136].

Sea via Holyhead, then road to site

The Port of Holyhead is located approximately 18 miles from Wylfa. It lies in a well-protected position due east of Holyhead Mountain, shielded from the Irish Sea by the historic Breakwater which is 1.5 miles in length. Holyhead is a 24 hour, deep water, lock–free port, centrally located on the Irish Sea coast. The port was used during the construction of the Wylfa 'A' station for the delivery of both bulk materials and AILs. The port is owned by Stena Ports who also act as statutory harbour authority. The port is primarily a ro-ro facility with numerous daily sailings to and from Ireland.

The port is currently at capacity and would require new land being reclaimed or purchased in order to avoid affecting the port's operations, as well as transfer facility to road for transfer along A5025 to Wylfa. The scheme would need to be delivered by Stena, as operators of the port, which risks a delay to the Project construction schedule.

The road to site from Holyhead would not accommodate a number of the AIL deliveries due to their physical size and the constraints along the A5025 (table 10-4 in [APP-107]). Therefore significant improvements would be required, potentially in the centre of town and need to demolish existing properties to widen the road. This would have to be consented and likely to need compulsory purchase of properties, which extends the construction schedule.

Road via Britannia Bridge and A5025

In the event Holyhead port could not be used then an alternative would be transportation along the A55, across the Britannia Bridge, and along an improved A5025 with on-line improvements and new off-line alignments. Traffic modelling already shows that the

Britannia Bridge is a pinch point (Environmental Statement Appendix C – Road traffic-related effects (project-wide) Appendix C2-4 – DCO Transport Assessment, [APP-101].

This route would require purchase of land and/or Compulsory Purchase Orders on either side of on-line sections for minor widening and for new sections of off-line carriageway.

The environmental and community impact of such a scheme would be significant, as would the noise and environmental impact. This would have to be consented and likely to need compulsory purchase of properties, which extends the construction schedule. This option would also incur significant costs and affect the Project viability.

Rail via Valley Station, then road to site

This option would require purchasing new land and additional rail siding provided at Valley with loading facilities to transfer from rail to lorry to WNDA using A5025 with on-line improvements and new off-line alignments. It would be reliant on Network Rail negotiations and Network Rail securing significant investment, posing a significant risk of delay to the Project schedule. Restricted availability of train paths could also lead to risks to the programme for critical concrete production. Availability of low-loader wagons for container deliveries could also affect the programme.

Use of rail is also limited by the loading gauge. A loading gauge defines the maximum height and width for railway vehicles to ensure that they can pass through bridges, tunnels and other structures on the route. The current loading gauge of W7 (2.44 x 2.5m in ISO containers), as indicated in Network Rail's 2008 Wales Route Utilisation Strategy [RD37], means that many of the larger containers used in deep-sea and short-sea shipping cannot be used as they require the W10 gauge (2.9m x 2.5m). These containers can be moved on special low-loader wagons where the loading gauge is less than W10 but there are limited numbers of such wagons available and their use adds cost and complexity. Alternatively, smaller containers could be used but this would increase the number of trains required and there are already limited slots.

Rail via Holyhead Station, then road to site

This option would require new freight handling facilities at Holyhead port, purchasing new land adjacent to railway siding together with transfer facility to road for transfer along A5025 with new off-line improvement works. It would be reliant on Network Rail negotiations and Network Rail securing significant investment, posing a significant risk of delay to the Project schedule. Restricted availability of train paths could also lead to risks to the programme for critical concrete production. Availability of low-loader wagons for container deliveries could also affect the programme.

The size of the Holyhead Station would also limit the amount of material that could be stored and this would make logistics in the context of movement to the Wylfa site harder to manage and subsequently affect the programme.

B2.3 Impact on construction schedule

All of the options above contain significant risks that would extend the Project schedule. However, the additional volume of HGV deliveries using roads would irrefutably extend the construction schedule.

The proposed Project schedule is based on 60-80% of construction materials being delivered via the MOLF (paragraph 2.4.18 of the Environmental Statement Volume C – Project-wide effects C2 – Traffic and Transport, [APP-089]). It is estimated that around

238,000 HGV deliveries would be required over the duration of the project to deliver the equivalent of the materials that could be delivered to the MOLF, once the MOLF is complete (paragraph 10-1.1.9 of the Integrated Traffic and Transport Strategy, [APP-107]). If the same rate of HGV deliveries were maintained (3,500 per month[20]), this equates to 68 months (over 5 years) being added to the construction schedule.

Therefore overall the construction schedule would be extended beyond 2030.

[20] Paragraph 7.5.5 in the Environmental Statement Appendix C – Road traffic-related effects (project-wide) Appendix C2-4 – DCO Transport Assessment, .[APP-101].

Appendix B3 – Extracts from the revised Landscape and Habitat Management Strategy [REP2-039]

Relevant extracts to support the Stage 3 HRA process are reproduced below.

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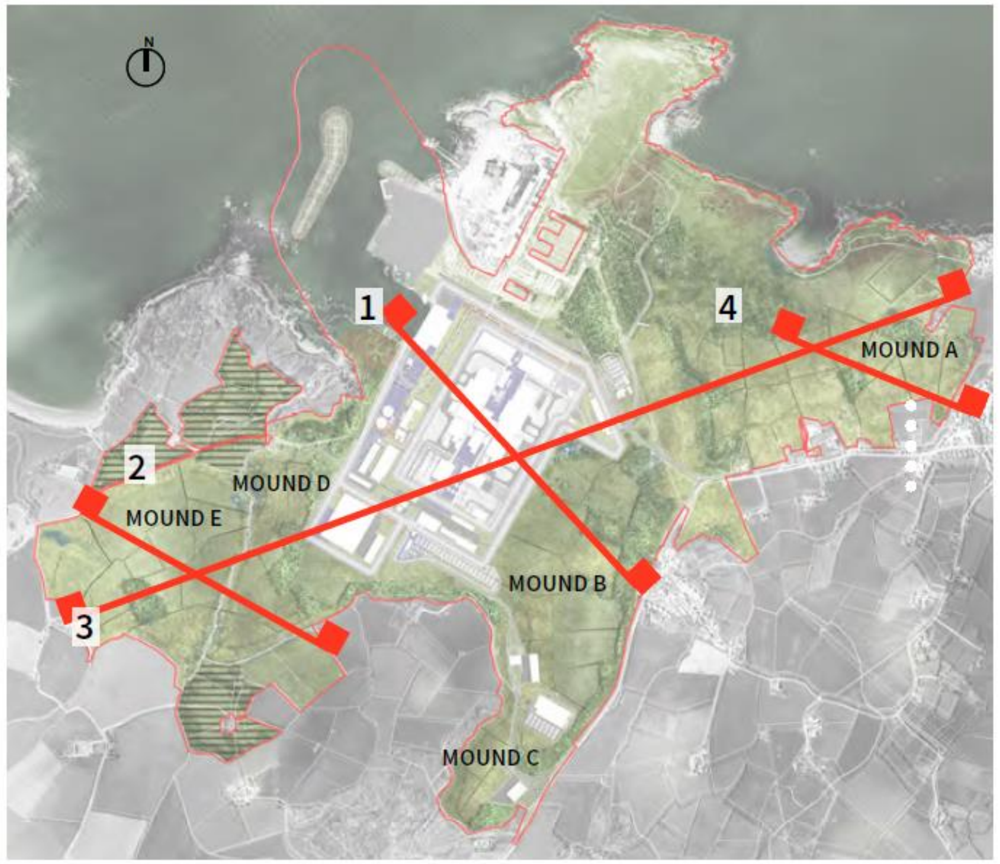
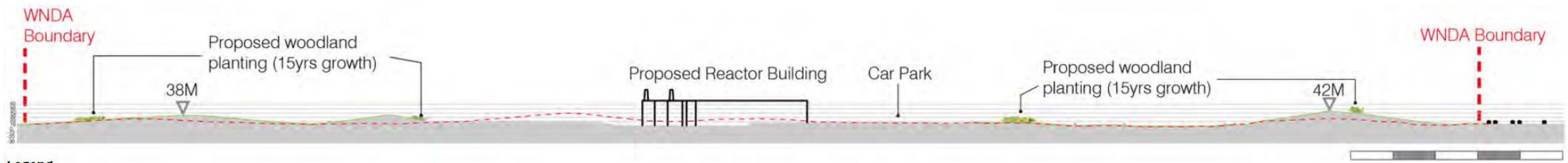
Reproduction of figure 6-8 Illustrative sections through landform on restoration:



Location plan

IMAGE SOURCED FROM GOOGLE



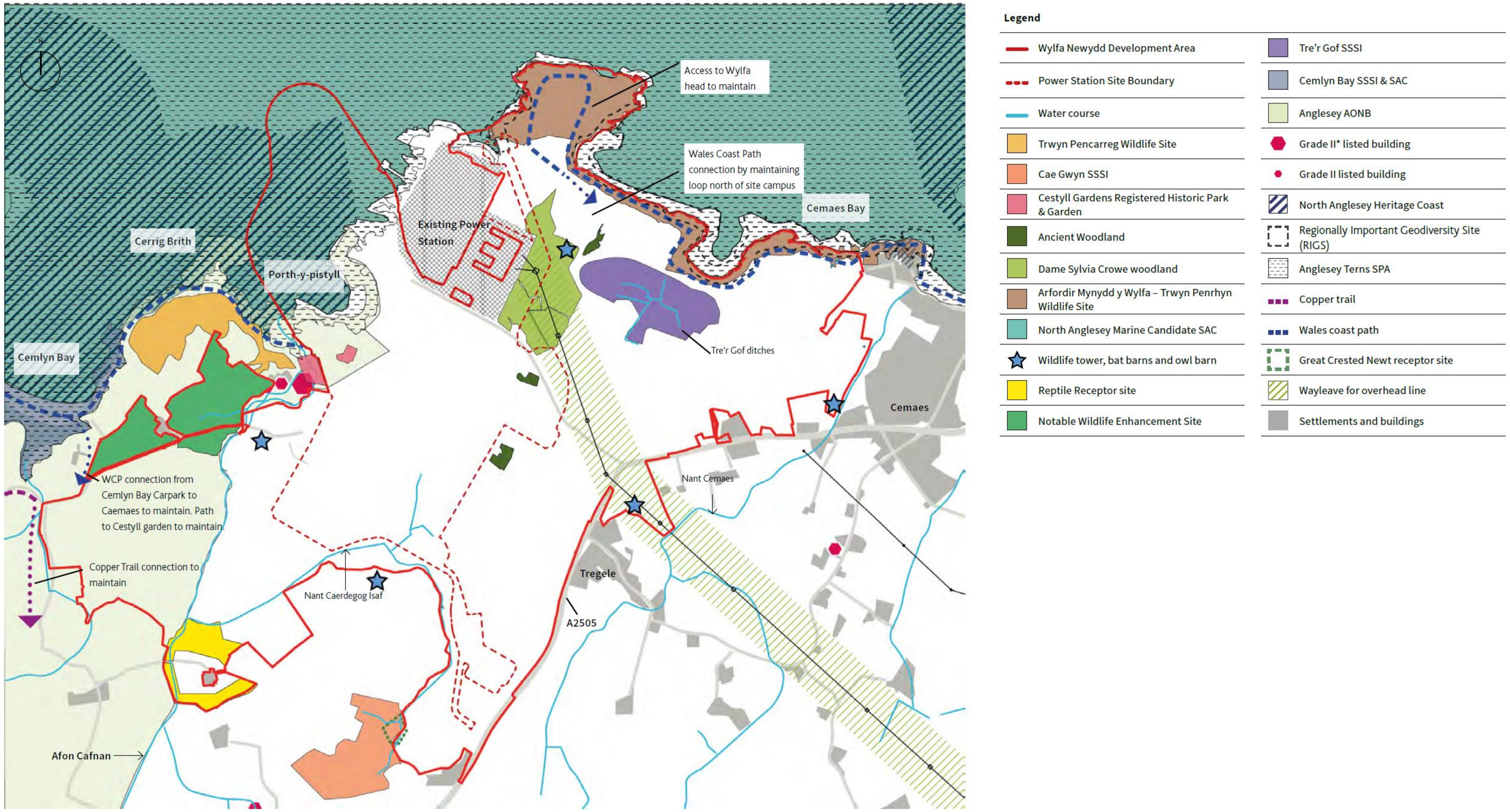
Legend

Proposed Landform

Existing Landform

Section 3 : Mounds A, D and E section

Reproduction of figure 2-22 Constraints summary



Appendix B4 – Extracts from Wylfa Newydd Project Pre-Application Consultation – Stage One Main Consultation Document [RD40]

10.45 Horizon has explored potential options for a MOLF, drawing on the indicative layout of the Power Station and potential locations for positioning of construction compounds for the Power Station. Taking these factors into account, Horizon envisages that a MOLF structure and location should meet the following criteria:

- Be easily accessible to vessels in terms of navigation and water depth (draught clearance), and offer a space adequate to manoeuvre vessels safely;
- Be available in time to support the Main Construction activities;
- Offer protection to ensure that vessels can reach the MOLF for off-loading of freight. This is referred to as the 'availability' to accept vessels for off-loading;
- Be positioned to bring freight ashore as close to the construction compounds for the Power Station as possible;
- Be capable of handling AILs and bulk materials deliveries required for the Wylfa Newydd DCO Project;
- Seek to avoid or mitigate potential adverse impacts on international, national and locally sensitive environmental receptors, particularly within the marine environment (refer to Chapters 17 and 18 of the PEI [Preliminary Environmental Information] Report for further information on Horizon's current understanding of the baseline conditions and potential impacts); and
- Be available for the operational lifetime of the Power Station, allowing for the occasional delivery of AILs and replacement parts in operation, if required.

10.46 Horizon initially identified four potential locations for a MOLF in the vicinity of Wylfa and has considered these against the MOLF criteria. (Further information relating to the consideration of alternatives in the development of the Wylfa Newydd Project is provided in Chapter 5 of the PEI Report). These include:

- Site 1: at Porth-y-pistyll, within the western part of the Power Station Site;
- Site 2: located just north of Site 1 at Porth-y-Gwartheg, to the west of the Existing Power Station;
- Site 3: Porth-yr-Ogof to the east of Wylfa Head; and
- Site 4: Porth-y-Wylfa, approximately 500m to the east of Porth-yr-Ogof.

10.47 These locations are shown in Figure 10.2.

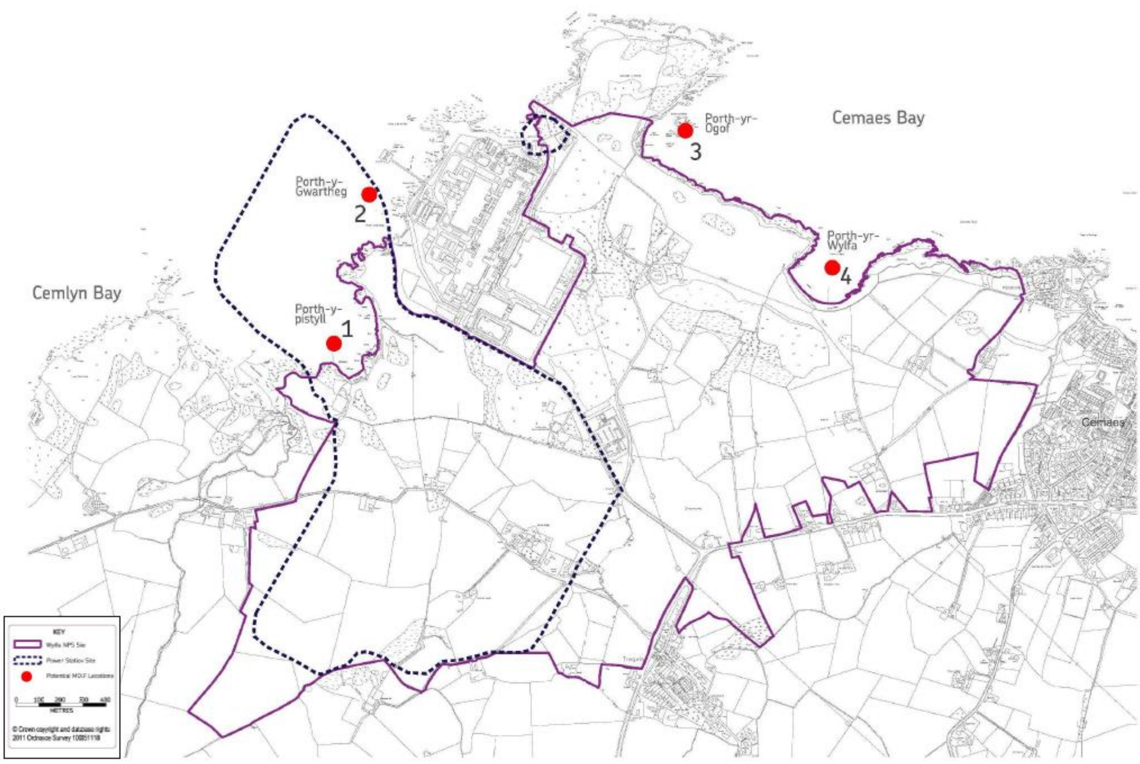


Figure 10.2 Potential MOLF Locations

Appendix B5 – Extracts from the Environmental Statement Figure Booklet-Volume D, Part 1 of 2 [APP-237]

Relevant extracts to support the Stage 3 HRA process are reproduced below.

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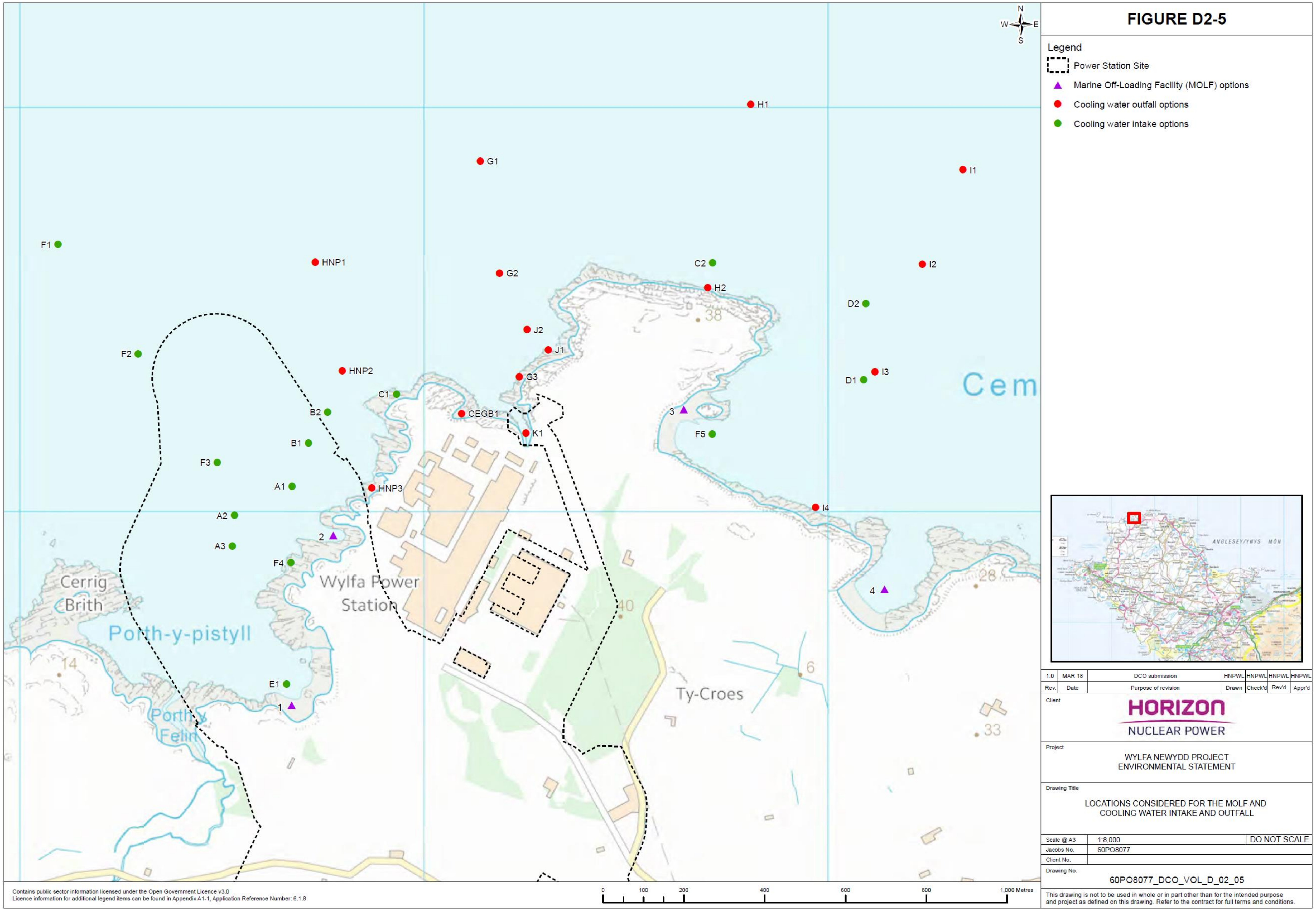
Reproduced figure D2-5: Locations considered for the MOLF and CWS intake and outfall.



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Appendix B6 – Recommended methods for excavation

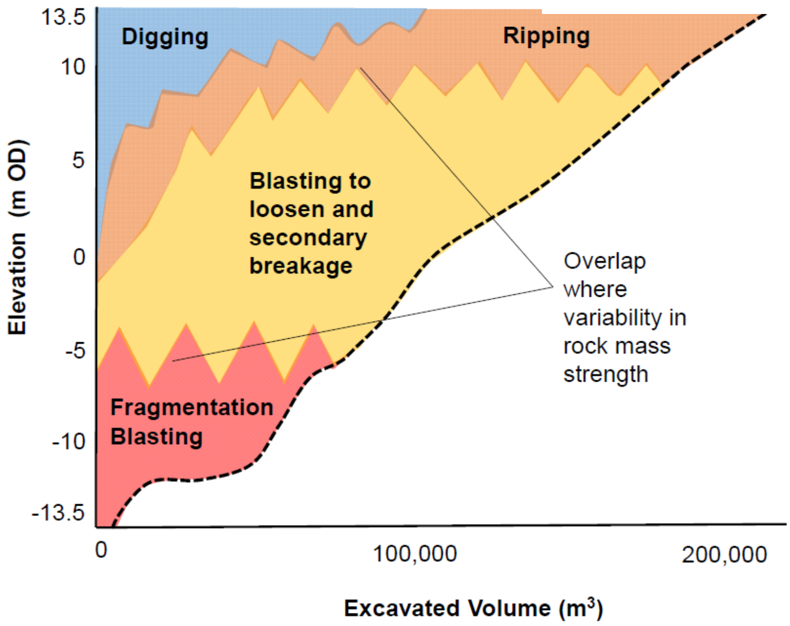
A study assessed the suitability and capability of different excavation methods by considering a number of factors such as rock strength. This resulted in recommending digging and ripping to their capability limits before blasting, see below.

At bedrock level ripping is likely to be possible where the rock mass is more weathered and the fractures are more frequent.

Blasting to loosen and secondary breakage will be required for the bulk of the excavation

Fragmentation blasting is likely to be required at depth and when localised thick units of psammite are encountered.

There is anticipated to be some overlap in the use of these excavation techniques due to local variability in rock mass strength



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Appendix B7 – Weather impacts

B7.1 Introduction

This appendix elaborates on the statements in table 5-2 on the impacts of weather on earthworks and productivity.

B7.2 Impact on Glacial Till

A significant proportion of the fill to be used in the early phase of earthworks will be predominantly plastic Group 2 Glacial Tills with a high silt and clay content. Figure D7-4 of the Environmental Statement Figure Booklet for Volume D [APP-237] reveals the extensive coverage of Glacial Till. The results of the various ground investigations indicate that small changes in moisture content can have a big impact on the strength of the Glacial Till, its acceptability as fill, and its ability to be re-used. Studies on material suitability explained that in sustained wet weather it is likely that the Glacial Till will make trafficking of normal earthmoving plant very difficult. Conversely, in extended hot and dry weather, the moisture content of the Till may reduce too much and render the material difficult to compact. The Site Selection Reports Volume 2 [APP-437] recommended concentrating the excavation and placement of Glacial Till into the drier and warmer months of the year, typically from and including around April to October. Figure B7-1 illustrates the mean monthly rainfall from the Met Office RAF Valley station (Anglesey Airport).

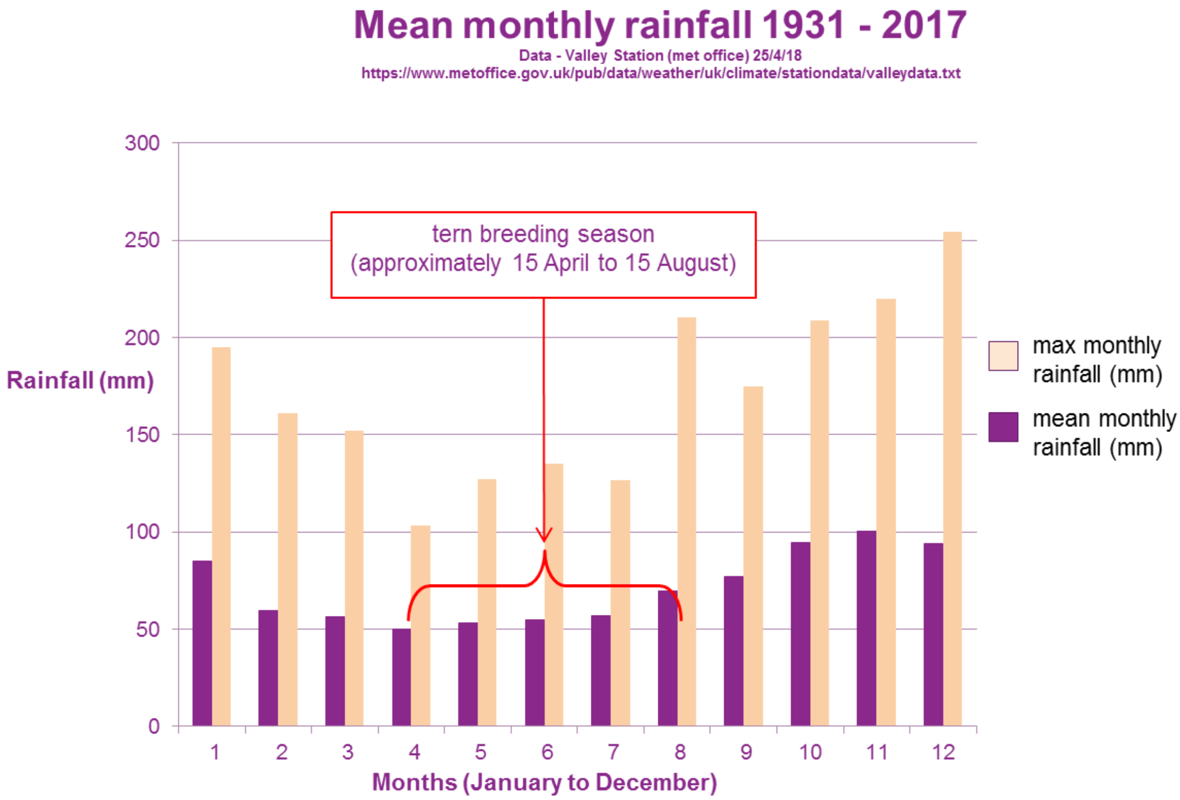

Figure B7-1: Monthly rainfall statistics from the Met Office RAF Valley station ([RD41])

B7.3 Impact on Productivity

The earthworks program was established to move large volumes of material in support of critical Project milestones. The excavation, placement, and compaction of soils are planned to take advantage of months with favourable conditions for air temperature, light, and precipitation.

The volume of earthwork that can be completed (i.e. excavated, hauled, and placed) is directly proportional to the hours of sunlight available and inversely proportional to the number of rain days in any month. These factors influence moisture content soil as well as the ability to 'dry out' overly saturated material. The glacial soils at the Wylfa site are particularly difficult to move and place when over-saturated with the only practical working method being to wait for the soil to dry out. As a result, contractors avoid major earthmoving operations during wet and rainy months whenever possible.

It is estimated by Project contractors that productivity during winter compared to in the summer could vary from 0% to 50%. The analysis below using historical climate data illustrates that the productivity could be in the middle.

Figure B7-2 shows the historical monthly averages of key climate data over a recent 30-year period at the Met Office RAF Valley station. The relevant data for predicting impact on earthwork operations are: sunshine (hours), rainfall, and days of rainfall >=1mm. In all cases, the values indicate more favourable weather conditions during the tern breeding establishment period (highlighted yellow) than winter (highlighted red).

The percentage difference shown in table B7-1 illustrates that winter experiences half as much sunshine and has almost a third more days of rainfall compared to the summer, which directly influences the productivity.

Table B7-1: Calculating the productivity factor

Climate Data	Monthly average in the winter (1)	Monthly average in the tern breeding season (2)	Percentage Difference
Sunshine (hours)	91.9	206.1	55%
Rainfall (mm)	80	54.6	47%
Days of rainfall >= 1mm (days)	13.3	9.8	37%

Climate station map | Averages maps | Averages table | Averages graphs | Location comparison

Valley (Nearest climate station to Holyhead Bay)
Climate period: 1981-2010

Station: Valley	District: England NW & Wales N	Region: Wales	UK

Month	Max. temp (°C)	Min. temp (°C)	Days of air frost (days)	Sunshine (hours)	Rainfall (mm)	Days of rainfall >= 1 mm (days)	Monthly mean wind speed at 10m (knots)
Jan	8.2	3.6	5.3	62.3	75.5	14.4	15.1
Feb	8.1	3.0	6.1	86.5	54.8	11.1	13.6
Mar	9.6	4.5	2.2	123.1	62.8	12.0	13.1
Apr	11.8	5.7	0.5	177.8	55.2	10.9	11.0
May	14.9	8.2	0.0	231.8	48.4	9.3	10.9
Jun	17.1	10.7	0.0	207.8	53.5	9.6	10.2
Jul	18.8	12.8	0.0	201.1	54.0	9.3	10.2
Aug	18.8	12.9	0.0	189.5	69.9	10.8	10.5
Sep	17.1	11.4	0.0	146.7	71.5	10.7	11.5
Oct	14.1	9.0	0.1	109.7	101.4	14.6	13.3
Nov	11.1	6.3	1.0	63.6	103.5	15.7	13.4
Dec	8.7	3.9	5.1	51.6	90.6	14.8	13.7
Annual	13.2	7.7	20.3	1651.4	841.1	143.0	12.2

Climate period:
1981-2010

Please note that station averages are only available for 1981-2010.

legend

tern season

winter

Averages are available for official Met Office stations only.

All values are given to one decimal place. For 'Days of' elements, 0.1 equates to one day every ten years, 0.5 to one day every two years, 2.5 to five days every two years, and so on.

Please note that units of measurement shown may not reflect those chosen in customise settings e.g. Temperature is given in °C.

Sunshine and wind averages are not available for all stations.

Holyhead Bay site information:
Location: 53.358, -4.632
Altitude: 0.0 m above mean sea level

Valley site information:
Location: 53.252, -4.537
Altitude: 10.0 m above mean sea level
Distance: 13.4 km from Holyhead Bay

Figure B7-2: Historical monthly averages of key climate statistics from the Met Office RAF Valley station ([RD41])

Appendix C – Supporting information for chapter 6 (legal, technical and financial feasibility)

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Appendix C1 – Ineffectiveness of acoustic barrier

C1.1 Introduction

This appendix elaborates on the statements in section 6.2 regarding potential alternative solution #13 – Blasting noise mitigation (acoustic barrier).

C1.2 Air overpressure characteristics and acoustic barrier limitations

Air overpressure

Air overpressure (also known as 'air blast' or 'airblast') is a pressure wave that is formed in the atmosphere by the detonation of explosives. This consists of energy manifested as audible (noise) and largely inaudible ('infrasound', which is also known as 'concussion'). Air overpressure differs from noise from other construction activities which do not normally contain the low-frequency pressure-wave components associated with explosive sources [RD45].

Infrasound is often described as sound that is lower in frequency than 20 Hz. The frequency of 20 Hz used to be regarded as the lower threshold of hearing, however, more recent research has demonstrated that the threshold of hearing may be as low as 4 Hz in special listening conditions if the level is sufficient [RD46]. Infrasound is primarily sensed by the ear, the sensitivity of which decreases with frequency. To be perceived, the sound pressure level of the infrasound must exceed the threshold of hearing. At higher intensities, infrasound may also be felt as vibrations in other parts of the body.

Frequency distribution

Air overpressure comprises energy over a wide frequency range. Generally, energy above 20 Hz is perceptible to the human ear as sound, whilst that below 20 Hz is inaudible but can be sensed in other ways. The inaudible component of air overpressure is often referred to as 'concussion'.

Propagation of air overpressure

Air overpressure is transmitted through the atmosphere, and so the prevailing meteorological conditions at the time of the blast are important. Wind speed, wind direction, the amount of cloud cover, humidity levels and temperature inversions will all affect the intensity and phase of the pressure wave at the receptor. The effects of these factors can alter the air overpressure at receptors by up to 20 dB. Some of these factors can vary rapidly with time, with height above ground and with horizontal distance from the blast site. Unlike predicting equivalent continuous sound levels, it is not possible to determine 'average' atmospheric propagation conditions for a given moment in time.

The topography between the blast site and the receptor location can affect propagation by providing a shielding effect; the walls of deep excavations, hilly terrain or site barriers can partially obstruct the propagation of air overpressure. However, the lower frequency pressure waves associated with concussion are much less attenuated by distance, buildings and natural barriers.

Effect of barriers

The effectiveness of a barrier (be it a natural terrain feature or man-made obstruction) to reduce air overpressure is dependent on the spatial relationship between the blast site, the barrier and the receptor location. Air overpressure can be reduced when a substantial barrier is located between the blast site and the receptor.

Richards and Moor [RD47] developed a method of predicting the attenuation effect provided by a barrier on air overpressure at receptors. The shielding terminology is demonstrated in figure C1-1 below and the relationships between the parameters are shown in figure C1-2.

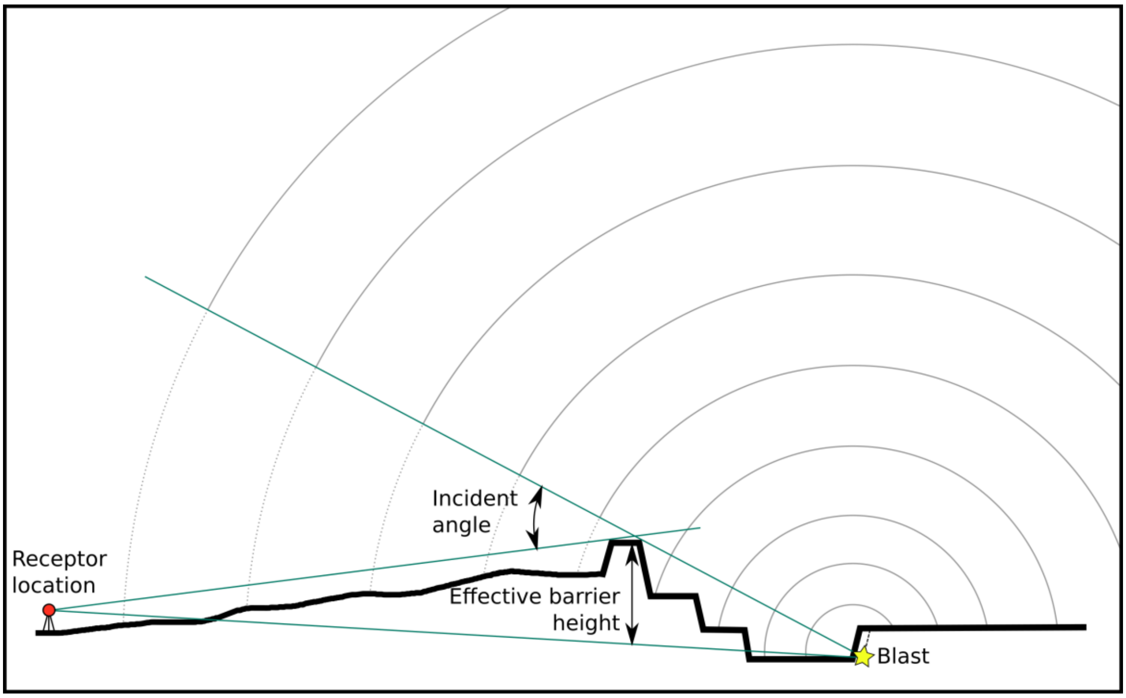

Figure C1-1: Shielding terminology

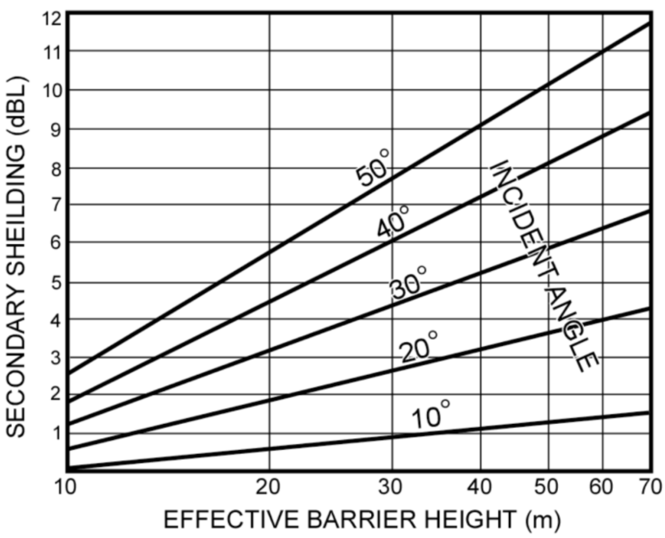

Figure C1-2: Secondary shielding relationships.

When considering blasting at the existing surface level in the centre of the deep excavation area, a 20m tall obstruction (38m AOD top edge) will typically only provide 1dB attenuation. If a 40m tall barrier (58m AOD top edge) is considered, then the potential attenuation would be around 2.5dB.

As the deep excavations progress and the height of the face to be blasted decreases relative to the top edge of the barrier and existing ground level, increased attenuation of air overpressure may occur. However, the relationship developed by Richards and Moor [RD47] does not take into consideration the potential reflections of high frequency air overpressure on the opposite high walls of a deep excavation.

'Report of Investigations 8485 Structure Response Damage Produced by Airblast from Surface Mining' [RD44] notes that opposite high walls can reflect the higher frequencies of air overpressure (i.e. the audible components) towards the blasting face. Similar reflections of air overpressure from opposite walls can be expected in a deep excavation, as illustrated in figure C1-3.

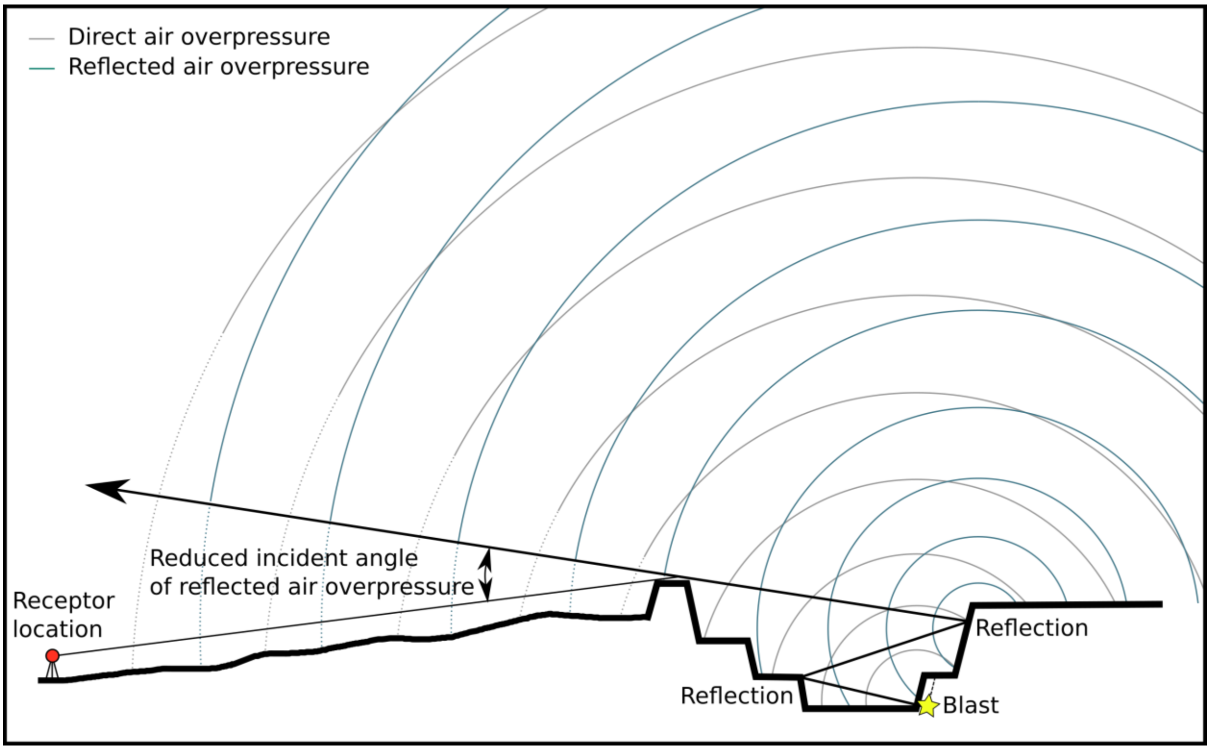

Figure C1-3: Air overpressure reflection within a deep excavation

Therefore in situations where there is a high wall opposite, the attenuation provided by a barrier may not be as high as predicted by the relationship developed by Richards and Moor [RD47] as reflected sound is not considered. Since the range of attenuations predicted using the secondary shielding relationships for 20 – 40m barriers are modest, and are unlikely to be fully realised in practice, it is concluded that providing a barrier is likely to achieve only limited reductions in air overpressure level at the nesting islands.

Other air overpressure control measures which would have more significant effects include the careful design of: instantaneous charge mass, face height, burden, borehole spacing, initiation sequence (soft start, avoiding wavefront reinforcement, slow finish by increasing delays on the final 4-6 boreholes), stemming height and stemming type.

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