TABLE OF CONTENTS

TABLES

PLATES

There are no plates in this chapter.

VOLUME II: FIGURES (ES VOLUME II, EN070009/APP/6.3)

VOLUME III: APPENDICES (ES VOLUME III, EN070009/APP/6.4)

No appendices associated with this chapter.

Rev: 0

6.0 NEEDS, ALTERNATIVES AND DESIGN EVOLUTION

6.1 Introduction

6.1.1 This chapter of the Environmental Statement (ES) sets out a summary of the need case for the Proposed Development, and the alternatives that have been considered during the evolution of the design process as presented in Chapter 4: Proposed Development (ES Volume I, EN070009/APP/6.2).

6.1.2 The Infrastructure Planning (Environmental Impact Assessment (EIA)) Regulations 2017 (the 'EIA Regulations') state that an ES should contain "*A description of the reasonable alternatives (for example in terms of development design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen, option, including a comparison of the environmental effects"* (Regulation 14(2)(e)). This chapter recognises and fulfils this requirement in respect of the Proposed Development.

6.1.3 Under the EIA Regulations, there is no requirement to assess the alternatives, only a requirement to provide information regarding the alternatives that have been considered.

6.1.4 On the matter of alternatives, paragraph 4.3.15 of EN-1 (Department for Energy Security and Net Zero (DESNZ, 2024)) states that *"Applicants are obliged to include in their ES, information about the reasonable alternatives they have studied. This should include an indication of the main reasons for the applicant's choice, taking into account the environmental, social and economic effects and including, where relevant, technical and commercial feasibility".* Crucially, paragraph 4.3.22 of EN-1 also states: Given the level and urgency of need for new energy infrastructure, the Secretary of State should, subject to any relevant legal requirements (e.g. under the Habitats Regulations) which indicate otherwise, be guided by the following principles when deciding what weight should be given to alternatives: the consideration of alternatives in order to comply with policy requirements should be carried out in a proportionate manner; and only alternatives that can meet the objectives of the proposed development need to be considered.

6.1.5 Please refer to Chapter 7: Legislative Context and Planning Policy (ES Volume I, EN070009/APP/6.2) for further detail.

6.1.6 Paragraphs 4.3.18-4.3.29 of the NPS go on to set out the various considerations that the Secretary of State (SoS) should take into account in considering alternatives.

6.1.7 In this context, the consideration of alternatives and design evolution has been undertaken with the aim of avoiding and/or reducing adverse environmental effects (following the mitigation hierarchy of avoid, reduce and, if possible, remedy), while maintaining operational efficiency and cost-effectiveness, considering other relevant matters such as available land and planning policy, and taking into account the alternatives considerations that apply under the Water Environment (Water Framework Directive (WFD)) (England and Wales) Regulations 2017 (2000/60/EC) (HM Government, 2017a), the Conservation of Habitats and Species Regulations

2017 (Habitats Regulations) (HM Government, 2017b), common law and compulsory acquisition regimes.

6.1.8 The design of the Proposed Development has evolved through engineering design work, in response to consultation feedback, and with regard to survey data and environmental considerations. Detailed design work will proceed once the project moves into the 'Front End Engineering Design' (FEED) stage. The detailed FEED work will remain within the design parameters set out in the DCO Application and as assessed within the ES as secured through the DCO.

6.2 The Need for the Proposed Development

6.2.1 The UK Hydrogen Strategy (HM Government, 2021) identifies low-carbon hydrogen as being critical for meeting the UK's legally binding commitment to achieve net zero by 2050. NPS EN-1) states that "there is an urgent need for all types of low carbon hydrogen infrastructure to allow hydrogen to play its role in the transition to net zero" (para. 3.4.12). NPS EN-1 also makes clear that low carbon infrastructure, such as the Proposed Development, is considered to be a 'critical national priority'.

6.2.2 As outlined in Chapter 4: Proposed Development (ES Volume I, EN070009/APP/6.2), the Proposed Development comprises the construction, operation (including maintenance), and decommissioning up to 1.2 GWth Lower Heating Value (LHV[1]) (1, 600-megawatt thermal (MWth) LHV and Phase 2, 600 MWth LHV) Carbon Capture and Storage (CCS) enabled Hydrogen Production Facility ('the Production Facility') located in the Teesside industrial cluster area. This includes hydrogen (H_2) distribution pipelines to supply H_2 to various offtakers on Teesside and within the surrounding area.

6.2.3 bp is aiming to be a net zero company by 2050 or sooner. In support of this, bp is determined to advance the H_2 industry across the UK, Europe, Australia and US. H_2 is set to provide a low carbon energy for activities and processes that are difficult to electrify for high-temperature processes, especially in the chemical industry. It can also help to decarbonise long-distance transportation in marine, aviation and heavy-duty road transport.

6.2.4 'Blue hydrogen', or 'CCS-enabled hydrogen', is H_2 that is extracted from natural gas, but at least 95% of CO_2 produced during this process is captured and stored permanently. Blue hydrogen, integrated with CCS, can provide the scale and reliability needed by industrial processes. CCS is recognised in Government policy as being essential to achieving the UK Government's commitments to achieving net zero emissions by 2050.

6.2.5 As the NPS notes, the Government's approach to developing hydrogen production encompasses multiple production routes, including both CCS enabled (blue) and

[1] The lower heating value (also known as net calorific value) of a fuel is defined as the amount of heat released by combusting a specified quantity (initially at 25°C) and returning the temperature of the combustion products to 150°C, which assumes the latent heat of vaporization of water in the reaction products is not recovered.

electrolytic (green) hydrogen, provided they comply with the UK Low Carbon Hydrogen Standard (LCHS). The LCHS provides clarity about the types of hydrogen production Government wishes to bring forward in the developing UK hydrogen economy, and enables it to support investment, innovation and commercialisation of new production technologies which are consistent with the UK's net zero commitment.

6.2.6 The Government's *'Hydrogen Production Roadmap'* notes that analysis by both DESNZ and the Climate Change Committee has indicated that CCS-enabled *'blue'* hydrogen will be important in scaling up production into the 2030s and can be consistent with the UK's net zero commitments. Page 13 highlights that '*CCUS-enabled hydrogen plants currently offer the largest individual production capacities of any projects in the current UK pipeline, with the ability to produce hydrogen at consistent baseload from the mid-2020s onwards'*.

6.2.7 Low carbon H_2 can be used to decarbonise a range of carbon intensive sectors including industry (as a low carbon fuel and feedstock), power and steam generation, mobility and transport (heavy duty fleets, buses, rail, aviation and marine) and grid blending. H2Teesside H_2 demand will come from multiple end users, including to support fuel switching from natural gas to H_2 within process heat, steam raising and power generation applications, therefore reducing CO_2 emissions from these industries.

6.2.8 The Proposed Development would deliver low carbon H_2 production at scale. It is well placed to support large-scale industrial decarbonisation, being located in one of the UK's major industrial clusters, with the potential to supply H_2 to a number of industrial users/offtakers, while linking into the Northern Endurance Partnership (NEP) CCS infrastructure on Teesside for the transportation and offshore storage of the CO_2 generated during the H_2 production process. The NEP on-shore infrastructure was granted consent on 16th February 2024 as part of the Net Zero Teesside project.

6.2.9 Further information on the need for the Proposed Development is provided in the Planning Statement (EN070009/APP/5.2) submitted in support of the DCO Application.

6.3 The 'Do Nothing' Alternative

6.3.1 The 'Do Nothing' alternative would mean that the Proposed Development would not be developed, meaning that it would not produce nor distribute any low carbon H_2. There would not be opportunity for offtakers within the Teesside region to transition to this low-carbon alternative, generated at the Hydrogen Production Facility.

6.3.2 If the Proposed Development was not progressed, then the opportunity that it presents in helping to achieve those targets would not exist. For these reasons, the 'Do Nothing' alternative scenario is not considered appropriate. In any event, this scenario has implicitly been assessed as it represents the baseline conditions of the EIA, as outlined in ES Chapters 8 to 22 (ES Volume I, EN070009/APP/6.2).

6.4 Alternative Technologies

6.4.1 No alternatives to H_2 production have been considered given the need for the Proposed Development as outlined above. The consideration of alternative technologies has focused only on the means of delivering a low-carbon H_2 production facility. Blue hydrogen has been selected by bp as the product of H2Teesside as it uses proven and widely used technology for low-carbon H_2 production when combined with proven carbon capture technologies. The technology for blue hydrogen production is readily available and can be deployed at a large scale to meet Government ambitions, such as those outlined in the UK Hydrogen Strategy (HM Government, 2021). bp is also independently promoting the HyGreen green hydrogen development in Teesside to be constructed on land adjacent to H2Teesside.

6.4.2 Different syngas technologies have been evaluated to identify the preferred option for delivering this CCS enabled blue H_2 production facility. Two technology options for Syngas Generation were considered as part of the Proposed Development:

- autothermal reforming (ATR); and
- a proprietary low carbon syngas technology which combines the use of a Gas Heater Reformer with an ATR.

6.4.3 The Proposed Development selected the proprietary low carbon syngas technology based on improved energy efficiency and capture rate, lower associated emissions and beneficial safety outcomes through a lower operating temperature .

6.4.4 The selected syngas generation technology will be combined with the following technologies to remove CO_2 from the syngas and achieve the Hydrogen purity required by the users/offtakers:

- use of chemical solvents for Carbon Capture/Removal rather than alternatives such as cryogenic separation; and
- use of pressure swing adsorption for further purification.

6.4.5 Use of chemical solvents for carbon capture maximises the energy efficiency of the plant as it utilises the waste heat from the syngas for the amine stripper reboiler and flashes the solvent to lower pressure to minimise energy consumption. Chemical solvents also have lower compressor power demand compared with of cryogenic methods. Chemical solvents also minimise waste with the only waste stream, flash gas, utilised to raise steam in the syngas process and no liquid effluent treatment is required during normal operation. The risk of amine degradation is low due to the absence of oxygen and low carbon monoxide in the feed gas.

6.4.6 The use of pressure swing absorption for further purification has been carried forward as it is part of the design case for the licensor package selected.

6.4.7 Due to volume and continuous nature of supply of hydrogen to the offtakers and their geographical location, pipeline delivery has been chosen as the most efficient way of delivery when compared to alternatives such as use of road based tanker transport.

6.5 Alternative Sites

East Coast Cluster

6.5.1 The East Coast Cluster (ECC), which comprises industrial clusters on Teesside and Humberside, has the potential to capture half of the UK's industrial emissions of CO_2.. The NEP, as part of the ECC, is looking to enable the decarbonisation of carbon intensive industries on Teesside by abating their Greenhouse Gas Emissions using CCS technologies, either directly by carbon capture or indirectly using the blue hydrogen produced by H2Teesside as a fuel or feedstock. In both cases captured CO_2 will be transported and sequestered using NEP infrastructure. The East Coast Cluster is supported by Government as a 'Track 1' CCS Cluster to receive prioritised economic support.

6.5.2 Teesside was considered the most appropriate location for the Proposed Development due to:

- its location within the ECC and the number of potential industrial offtakers in Teesside to act as customers of the Proposed Development; and
- proximity to the NEP high-pressure compression facility and off-shore CO2 Export Pipeline to the Endurance Store.

6.5.3 The suitability of this site for the Proposed Development is reflected by the Government choosing the Proposed Development as a chosen anchor 'Capture project' within that Cluster to receive prioritised economic support.

Main Site Location

6.5.4 A number of sites within Teesside were then considered by the Applicant for the location of the Hydrogen Production Facility. The analysis of potential sites focused on identifying a site that supports the development of a viable blue hydrogen project that facilitates industrial connectivity and the path to decarbonisation. The sites that were initially identified and assessed are shown in Figure 6-2 (ES Volume II, EN070009/APP/6.3).

6.5.5 Various factors influenced the site selection process. The criteria that were considered as part of the site selection process included:

- process safety considerations;
- proximity to the east coast and NEP infrastructure, to enable high pressure CO_2 export to be quickly directed offshore to the Endurance storage facility;
- size – ensuring there is sufficient space for the Proposed Development, that it is safe for construction;
- utilising brownfield land where possible;
- remoteness from residential areas;
- proximity to industrial offtakers that could connect into the H_2 network;

- proximity to necessary connections including a gas network, electricity transmission network, potential use of existing oxygen and nitrogen supply, water supply and wastewater management options;
- minimising environmental/social effects or risks; and
- discussions with landowners.

6.5.6 Based on the above considerations, two sites were shortlisted for the Main Site location; known as "the Foundry" and "Redcar Bulk Terminal". These sites were selected primarily because they were judged to be more inherently safe than the alternatives; they are sufficiently remote from any safety sensitive receptors and the large size of the sites offers flexibility to optimise the layout and reduce process safety risk. In addition, both site options provide proximity to existing and potential future users of low carbon H_2 and access to the off-shore Endurance carbon store via NEP's nearby proposed infrastructure, and both Main Site options could be easily connected to the required infrastructure (including natural gas, water and electrical).

6.5.7 The EIA Scoping Report presented these two sites within Appendix 1A: Scoping Report (ES Volume III, EN070009/APP/6.4) as Main Site A (the Foundry) on part of the former Redcar Steelworks and Main Site B (Redcar Bulk Terminal (RBT)).

6.5.8 As identified in the EIA Scoping Report included at Appendix 1A: Scoping Report (ES Volume III, EN070009/APP/6.4), the environmental baseline conditions for both Main Site options are very similar. They are located in close proximity to each other and as such, are in similar proximity to sensitive receptors; although, Main Site B is closer to the River Tees and Teesmouth and Cleveland Coast Ramsar, SPA and SSSI. Main Site A is slightly closer to the nearest residential receptor (Marsh House Farm), but both Main Sites are generally remote from residential receptors. Marsh House Farm is located approximately 1.3 km and 2.2 km to the east of Main Sites A and B respectively. Both Main Sites have similar industrial histories, and similar topographies.

6.5.9 In June 2023, the Applicant decided to progress with Main Site A. Main Site A is directly adjacent to the NEP onshore facilities, thereby simplifying the CO_2 export Connection Corridor routing. Main Site A is large enough to accommodate Phases 1 and 2 of the H2Teesside project, as well as possible co-location with other proposed bp projects in Teesside. An example of the latter is HyGreen, which is a proposed green H_2 project (i.e. H_2 production from water by electrolysis using renewable electricity) to be located adjacent to the H2Teesside Main Site allowing potential synergies to be explored. Examples of synergies that are being considered include, common security, shared firewater and shared buildings, warehouses and workshops. Main Site A also offers greater opportunity to manage process safety risks; its larger size means that potential process safety impacts upon adjacent sites can be reduced.

6.6 Alternative Layouts within the Main Site

6.6.1 Design and assessment work is still ongoing to determine the most appropriate layout for the Main Site and flexibility for this has therefore been provided for in the limits of deviation shown on the Works Plans (EN070009/APP/2.4). Some of the factors that are being and will continue to be considered during this process are as follows:

- consideration of space available for the plant and temporary construction compounds;
- ground conditions;
- process safety;
- linkages to the access to water supply, as discussed in Section 6.7;
- the routeing of the electrical connection;
- linkages to the access to the proposed NZT effluent outfall to Tees Bay or proposed new South Tees Development Corporation (STDC) outfall for surface water drainage and process effluent discharge as discussed in section 6.7;
- construction access including jetties that could be used for the delivery of Abnormal Indivisible Loads (AILs); and
- relevant development plans (outlined in Chapter 7: Legislation and Planning Policy (ES Volume I, EN070009/APP/6.2)).
- the configuration of the structures and buildings within the Main Site; and
- maintaining flexibility in terms of O_2 and N_2 supply i.e. whether sourced by pipeline from suppliers within Teesside or produced on-site using an Air Separation Unit (ASU)).

6.7 Connection Corridor Routeing

6.7.1 At this stage, some options remain under consideration for the routeing of the Connection Corridors required for the Proposed Development. The routes of the Connection Corridors are shown on Figures 4-2 to 4-8 (ES Volume II, EN070009/APP/6.3). The final routeings take into consideration the location of sensitive environmental receptors including but not limited to statutory designated sites (Teesmouth and Cleveland Coast Ramsar, Special Protection Area (SPA) and Site of Special Scientific Interest) within the area. Where necessary, the selected routes seek to avoid environmentally sensitive areas by utilising existing established pipeline routes, and/or the least intrusive construction methodologies (e.g., trenchless methods, as opposed to use of open-cut trench techniques).

Hydrogen Pipeline Corridor

6.7.2 A number of options were considered for the routeing of the Hydrogen Pipeline Corridor (Work No. 6) to potential offtakers. After the preparation of the EIA Scoping Report (presented within Appendix 1A: Scoping Report (ES Volume III, EN070009/APP/6.4)), the route options were refined, informed by engineering

feasibility work, the outcome of environmental studies and consultation with statutory consultees such as Natural England and the Environment Agency (EA). This included the removal of a number of routeing option to the western extent of the Proposed Development Site, and alternate options for the crossing of Greatham Creek and the River Tees.

6.7.3 The alternative routing options to Greatham were removed due to proximity to a passenger railway and also, following consultation with the Environment Agency and Natural England, to avoid interaction with flood defences and environmentally sensitive areas in North Tees. The southern crossing of the Tees by the Hydrogen Pipeline Corridor has been removed due to constraints on routeing and constructability issues.

6.7.4 In addition to connections to potential industrial offtakers at Wilton, North Tees, Greatham and Billingham, the Hydrogen Distribution Network is also being routed to provide connections to the existing Gas Transmission System and Gas Distribution Networks. These connections would enable gas blending into the distribution network and transmission system and a connection to Project Union, the future hydrogen transmission system, and East Coast Hydrogen, its first regional development. East Coast Hydrogen is looking to repurpose existing natural gas pipelines in the area to hydrogen service and the applicant is looking to connect to this infrastructure.

6.7.5 The East Coast Hydrogen Project is being developed by a combination of transmission and distribution network operators, which will necessitate connections to both types of network. Therefore, the Applicant has sought flexibility in how this connection is delivered to connect to those networks, as those operators work with Government to determine the best technical way to deliver a national hydrogen network and blending, and work with the Applicant to identify the best approach that works for them in light of the constraints of each of their networks and existing AGI locations.

6.7.6 As such, the alternative connection locations being explored (and thus require allowance within the DCO for connecting pipeline corridors to them) include:

1. National Gas Grid AGI near Billingham Industrial Park – in addition to a connection to a potential offtaker, a connection to this location could also achieve a connection to Project Union and Natural Gas Transmission System;
2. National Gas Network natural gas AGI at Cowpen Bewley – a connection to this location would achieve a connection to Project Union, Natural Gas Transmission System, and Natural Gas Distribution Network; and
3. Northern Gas Networks AGI off the A178 Seaton Carew Road - a connection to this location would achieve a connection to Natural Gas Distribution Network.

6.7.7 Owing to the different requirements of transmission and distribution system connections, two combinations of these locations are being explored as options for the scheme in addition to the connection Location 1 (Work No. 6A.1) includes as part of the Billingham Industrial connection. These are:

- Option A - comprising a connection at Location 2, at Cowpen Bewley (Work No. 6A.2) above; and
- Option B - comprising a connection at Location 3, the AGI off Seaton Carew Road near Saltholme (Work No. 6A.3) above.

These are represented pictorially in Figure 4-2 (ES Volume II, EN070009/APP/6.3)

6.7.8 The final choice of approach and selection of options will be determined by the development of the Government's policy in relation to Project Union and hydrogen blending and how the Distribution and Transmission System Operators re-configure their systems to respond to this. The Applicant will keep engaging with the Distribution Network and Transmission System Operators to ensure connectivity to Project Union and the wider UK hydrogen infrastructure to enable the development of this.

6.7.9 The pipeline routeing to the Cowpen Bewley AGI also has a number of social, technical, and ecological constraints as such various routeing and connection options are still being explored to enable these connections and the final routeing decision will be made once a number of planned technical and archaeological surveys are completed.

Water Corridors

6.7.10 The options being considered in respect to the water management are outlined in Chapter 4: Proposed Development (ES Volume I, EN070009/APP/6.2). In summary:

- The raw water supply (for process and sanitary uses) (Work No. 4),will be from the existing Northumbrian Water Limited (NWL) raw water supply to the South Tees Development Corporation (STDC) Site, which is from an existing licensed abstraction from the River Tees upstream of the site;
- Two options are under consideration in terms of process effluent management. The first option is based on Minimalised Liquid Discharge (MLD) from the proposed Effluent Treatment Plant. In this scenario, treated process wastewater from the proposed Effluent Treatment Plant will be reused as makeup water in the Proposed Development's Water Treatment Plant. MLD concentrate will be treated in a manner consistent with nutrient neutrality requirements by either a) complete removal of nutrients and discharge of resultant effluent within the catchment area by a third party or b) disposal outside of the catchment, to an approved and licensed facility. The second option involves pre-treatment of the process effluent to remove nitrates and other contaminants and discharge to the NZT project outfall at Tees Bay (Work No. 5) (see Works Plans (EN070009/APP/2.4)).
- Clean surface water runoff (including stormwater) would also be discharged to the Tees Estuary or Tees Bay using connections within Work No. 5. The following options are being considered and are included in the DCO:
  - discharge via a connection from the Main Site to the NZT outfall to Tees Bay; or

- discharge via a connection from the Main Site to the STDC outfall to the Tees Estuary.

Electrical Connection

6.7.11 The options that are being considered for the Electrical Connection Corridor (Work No. 3) are:

- a connection to STDC's private wire electricity network; or
- supply via NZT Power's, or
- a direct connection to Tod Point sub-station.

The routeing associated with these options are depicted in Figure 4.6. The proposed connection to Grangetown substation has been removed since the submission of the PEIR.

Other Connections

6.7.12 Studies undertaken since the submission of the PEIR have also enabled the removal of optionality from the following corridors as described in Chapter 4: Proposed Development (ES Volume I, EN070009/APP/6.2):

- CO_2 Export Corridor (Work No. 7); and
- Natural Gas Connection Corridor (Work No. 2).

Ongoing Design Refinement

6.7.13 Ongoing design work will enable optionality to be further reduced including (but not limited to):

- the refinement of routes carried forward for connection to the electricity supply network within the proposed connection corridors based on technical-commercial considerations including narrowing of corridors based on a review of constructability, environmental constraints and land ownership boundaries;
- the refinement of routes for the H_2 pipeline within the proposed Hydrogen Pipeline Corridor including narrowing of corridors based on a review of constructability, environmental constraints and land ownership boundaries; and
- the options and refinement of routes for the water connection within the proposed Water Connections Corridor based on technical commercial considerations, including narrowing of corridors based on a review of constructability, environmental constraints and land ownership boundaries.

6.8 Connection Corridor Construction Methodologies

6.8.1 The proposed construction methodologies for each of the connection corridors are outlined in Chapter 5: Construction Programme and Management (ES Volume I, EN070009/APP/6.2). In summary, various options have been considered, including trenchless crossings (such as HDD, micro-bored tunnel, auger boring or a combination of these), below ground open cut trench, the installation of new or

existing above ground support structures in existing pipeline corridors, and the repurposing and reuse of existing pipelines (where possible). These decisions have been informed by design work, discussions with landowners and statutory consultees, and environmental constraints and survey information.

6.8.2 After the preparation of the EIA Scoping Report (Appendix 1A (ES Volume III, EN070009/APP/6.4)), the decision was made to utilise trenchless methods for the crossing by the hydrogen pipeline of the River Tees (either MBT or HDD) and Greatham Creek, given the environmental sensitivities of these locations; no other methodologies are being considered in these locations. Since the preparation of the PEI Report, the construction and routeing of the Hydrogen Pipeline Corridor have been refined further at Cowpen Bewley Woodland Park and Saltholme, informed by engineering feasibility work, the outcome of environmental studies and consultation with statutory consultees such as Natural England, the EA ,RSPB, the LPAs, Network Rail, and the public (see Chapter 5, ES Volume I, EN070009/APP/6.2).

6.8.3 The final construction methodologies take into consideration the location of sensitive receptors within the area. Where possible, existing established pipeline corridors are to be utilised, and/or the use of the least intrusive construction methodologies (i.e. use of trenchless methods, as opposed to open-cut trench for crossing watercourses for example).

6.9 Consideration of Alternative Design Options and Design Evolution

6.9.1 Throughout the ongoing design process, consideration has been given to a range of design options. These decisions have, where appropriate, been informed by environmental appraisal and assessment work and by consultation with stakeholders, and the design has evolved through a continuous process of environmental assessment, consultation, and development. The design will continue to be refined within the Rochdale Envelope parameters through the Front End Engineering Design process.

6.9.2 Aspects of design that have been determined and fixed in the draft DCO (and are as described in Chapters 4 and 5 (ES Volume I EN070009/APP/6.2)) include:

- the Proposed Development Site boundary;
- the Main Site boundary;
- selection of GHR-ATR H_2 production process (Case B in the PEI Report);
- access routes (for both construction and operation);
- the locations of temporary construction compound areas;
- location of hydrogen pipeline river Tees crossing;
- maximum heights for structures on the Main Site;
- maximum and minimum flare height and diameter;
- AGI heights;

- the proposed approach for water supply, including the routeing of the Water Connections Corridor; and
- use of water cooling in the hydrogen production plant;

6.9.3 Other aspects have not yet been finalised, pending the detailed design, therefore the draft DCO incorporates flexibility on these matters and the EIA has assessed the different options and/or 'worst-case' scenarios where relevant. These aspects include:

- a connection to STDC's private wire electricity network; supply via NZT Power; or a direct connection to Tod Point sub-station.
- River Tees crossing construction methodology (HDD or Micro tunnel);
- Oxygen and nitrogen supply – option retained for on-site ASU as an alternative to a pipeline connection to local supply;
- Waste Water Disposal Route – option retained for use of minimum liquid discharge plant onsite (with waste being trucked offsite) as well as the use of an alternative discharge via the NZT outfall after nitrate removal;
- Stormwater disposal– option retained for disposal via outfall at NZT site, but alternatively disposal may be provided using the South Tees Development Corporation (STDC) outfall; and
- Alternative routeing of the connection of the hydrogen pipeline to the national gas network (either to allow blending or connection to the proposed "Project Union" hydrogen network) either via a branch to an AGI within the Cowpen Bewley Woodland Park or an AGI in Satlholme off the A178 Seaton Carew Road via a spur off the Greatham branch.

6.9.4 The Rochdale Envelope approach has been applied to address this optionality, as set out in each technical chapter of this ES (ES Volume I, EN070009/APP/6.2).

6.9.5 The design and definition of the Proposed Development has continued to evolve since scoping and the publication of the PEI Report which incorporates responses to consultation responses, ongoing discussions with stakeholders (including landowners), ongoing design work and additional survey information. These changes are summarised in Table 6-1, below. This includes changes to the Proposed Development Site which are illustrated on Figure 6-1 (ES Volume II, EN070009/APP/6.3).

Table 6-1: Summary of Design Changes Between Preparation of the PEI Report and ES

TOPIC	RELEVANT FIGURE/S	REASON FOR CHANGE	SUMMARY OF CHANGES TO EFFECTS
Proposed Development Site Area (hectares)	Figure 4-1	Reduction in DCO Boundary, reduction in optionality	Environmental effects are reduced or the same due to overall reduction in Proposed Development Boundary
Proposed Development Site boundary (removals)	Figure 6-1	Reduction in DCO Boundary, reduction in optionality	Environmental effects are reduced due to reduction in Proposed Development Boundary
Proposed Development Site boundary (additions)	Figure 6-1	Modifications to DCO Boundary to allow for access for construction.	Additional land take restricted to improvements in access for construction. No change in Environmental Effects.
The Main Site boundary	Figure 4-1	Slight change in boundary to accommodate refined design and layout.	Environmental effects are reduced or the same due to slight reduction in Main Site Boundary
The Hydrogen Pipeline Corridor	Figure 4-4	Significant change in boundary following more detailed design.	Environmental effects are reduced due to significant reduction in Hydrogen Pipeline Corridor width and also routeing and construction methodology at Cowpen Bewley Woodland Park and Saltholme.
The Electrical Connection Corridor	Figure 4-6	Slight change in boundary to accommodate refined design and layout.	Environmental effects are largely reduced due to overall reduction in area of Electrical Connection Corridor. No additional significant effects associated with small addition to east of NZT main site.
The Water Connections Corridor	Figure 4-7	Change in boundary to accommodate refined design.	Environmental effects are reduced or remain the same due to overall reduction in area of Water Connections Corridor and refinement of wastewater and stormwater treatment and discharge options.

TOPIC	RELEVANT FIGURE/S	REASON FOR CHANGE	SUMMARY OF CHANGES TO EFFECTS
The CO_2 Export Corridor	Figure 4-3	Change in boundary to accommodate refined design.	Environmental effects are largely reduced due to overall reduction in area of CO_2 Export Corridor. No additional significant effects associated with small addition to south of Main Site.
The Natural Gas Connection Corridor	Figure 4-5	Change in boundary to accommodate refined design.	Environmental effects are reduced due to overall reduction in area of Natural Gas Corridor.
The Other Gases (O_2 and N_2) Connection Corridor	Figure 4-8	Slight change in boundary to accommodate refined design.	Environmental effects are the same due to no significant change in Other Gases Connection Corridor.
Temporary Construction Compounds	Figure 5-1	New boundary to accommodate updated design.	Environmental effects are reduced as potential for temporary construction compounds within entire PEI Report Boundary is significantly greater than proposed temporary construction compounds.

6.10 Conclusions

6.10.1 As outlined at Section 6.4, no alternatives to H_2 production have been considered given the need for the Proposed Development. Blue hydrogen production has been selected as it uses proven, widely used and readily available technology that can be deployed at a large scale to deliver low carbon H_2 in line with Government ambitions.

6.10.2 Different syngas technologies have been evaluated; two options were considered and a proprietary technology with combinations of Gas Heater Reformer and Autothermal Reformer was selected, offering the greatest advantage when considering energy efficiency, associated emissions, safety considerations and carbon capture rate.

6.10.3 As outlined at Section 6.5, the site selection process concluded that the Foundry Main Site is the most appropriate for the Production Facility, given its location on brownfield land suitable for redevelopment, its proximity to a number of existing industrial offtakers and to the proposed NEP infrastructure, and its remoteness from residential receptors. It is also sufficiently large to reduce process safety risks and to allow for potential synergies with other projects (such as HyGreen) to be explored.

6.10.4 As outlined in Sections 6.6 - 6.8, the layout of the Proposed Development (including the routing of the Connection Corridors), and the proposed construction methodologies have been developed taking into account the potential environmental effects, alongside other factors such as technical and commercial feasibility.

6.10.5 The final Rochdale Envelope design is reported in Chapter 4: Proposed Development (ES Volume I, EN070009/APP/6.2) and submitted as part of the DCO Application.

6.11 Consultation

6.11.1 An EIA Scoping Opinion was requested from the Inspectorate on 6 April 2023. A response was received on 17 May 2023. For the Scoping Opinion and the Applicant's responses to them, refer to Appendix 1E (ES Volume III, EN070009/APP/6.4).

6.11.2 The PEI Report was published for consultation on 14 September 2023 and the consultation period ended on 26 October 2023. For full consultation responses and the Applicant's responses to them, refer to the Consultation Report (EN070009/APP/5.1). A further consultation was held between 13 December 2023 and 23 January 2024. A targeted Consultation was held between 9 February 2024 and 10 March 2024.

6.12 References

- Department for Business, Energy and Industrial Strategy (2017). *Clean Growth Strategy*.
- Department for Energy Security and Net Zero (DESNZ) (2023). *Overarching National Policy Statement for Energy (EN-1).*
- The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (SI 2017/571) (2017). *London: The Stationery Office.*
- HM Government (2017a). *The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (2000/60/EC)*.
- HM Government (2017b). *The Conservation of Habitats and Species Regulations 2017*.
- HM Government (2021). *UK Hydrogen Strategy*.