H2East Pipeline
Humber to
Nottinghamshire

H2East Pipeline: Humber to Nottinghamshire

Powering Industry

Design Evolution Report

March 2026

Cadent
Your Gas Network

H2East Pipeline
Humber to
Nottinghamshire

Design Evolution Report

H_2 East Pipeline: Humber to Nottinghamshire

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Acronyms and Abbreviations

Acronym	Meaning (if known from context)
BESS	Battery Energy Storage System
BMV	Best and Most Versatile (Agricultural Land)
BPD	Building Proximity Distance
BVI	Block Valve Installation
CCP	Carbon Capture Pipeline (Humber CCP project)
CNP	Critical National Priority (EN-1 policy)
DESNZ	Department for Energy Security and Net Zero
ECH2	East Coast Hydrogen
EIA	Environmental Impact Assessment
NPS EN-1 / EN-4	National Policy Statements for Energy / Gas & Oil Pipelines
FEED	Front End Engineering Design
GIS	Geographic Information System
HAGI / HAGIs	Hydrogen Above Ground Installation(s)
HDD	Horizontal Directional Drilling
IGEM	Institution of Gas Engineers and Managers
IROPI	Imperative Reasons of Overriding Public Interest
NGN	Northern Gas Networks
NGT	National Gas Transmission
NPPF	National Planning Policy Framework
NPS	National Policy Statement
NSIP	Nationally Significant Infrastructure Project
PINS	Planning Inspectorate
SAC	Special Area of Conservation
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
TD	Transmission & Distribution (IGEM/TD standards)
UK	United Kingdom

1 Introduction

1.1 Overview

1.1.1 The H2East Pipeline: Humber to Nottinghamshire (the Project) is a proposal by Cadent Gas Ltd (Cadent) (the Applicant) to construct, operate, maintain and decommission a hydrogen pipeline. The purpose of the Project is to transport low carbon hydrogen between hydrogen production facilities and high demand industrial users, providing an essential route to decarbonisation for industry and supporting economic prosperity through job creation/ retention and the attraction of inward investment to the Humber, Lincolnshire and Nottinghamshire.

1.1.2 Cadent has requested a direction from the Secretary of State, under Section 35 of the Planning Act 2008, for the Project to be classed as a Nationally Significant Infrastructure Project (NSIP) under the Planning Act 2008. An application for development consent will then need to be submitted and determined by the Secretary of State (SoS) for Energy Security and Net Zero (DESNZ).

1.1.3 The Project is part of a wider 'East Coast Hydrogen' (ECH_2) collaboration between Cadent Gas, National Gas Transmission (NGT) and Northern Gas Networks (NGN). ECH_2 was established with the objective of identifying and ultimately delivering the network infrastructure required to support the deployment of low-carbon hydrogen, facilitating the decarbonisation strategies of energy generators and industrial users in the East Coast region.

1.1.4 Cadent's role and contribution to the ECH_2 project focuses on the current Cadent distribution area south of the Humber to transport low carbon hydrogen to Cadent's industrial users with the primary focus being principally on those industrial users with the highest gas demand and, therefore, the largest current carbon emissions. Cadent has undertaken preliminary studies to investigate the feasibility of developing a new hydrogen network across its East Midlands distribution area and to determine the location of this Project. Following these preliminary studies, Cadent submitted a funding application to The Office of Gas and Electricity Markets (OFGEM) to progress more detailed feasibility studies and to commence the consenting and Environmental Impact Assessment (EIA) process. OFGEM awarded Cadent, and other ECH_2 partners, funding to progress studies for the Project. The award of funding supports Cadent to undertake a Front End Engineering Design (FEED) for the Project and commence the process towards gaining consent.

1.2 Design Evolution Report

1.2.1 This report (Design Evolution Report) provides a description of how Cadent has started to develop the Project for which it has received OFGEM funding. It specifically looks at strategic options for the pipeline and also initial pipeline route corridors for the selected strategic option based on project objectives, set out later in this report. Additional pipeline schemes are being considered by Cadent within the East Midlands, however, the Project that is the subject of this report is the greatest in maturity and will act as a 'backbone' for other future projects in this region.

1.2.2 This report is being made available for the Project's first round of consultation with stakeholders, referred to as Consultation One. The feedback from Consultation One will be used to further develop and refine the Project, alongside other ongoing studies being carried out by Cadent.

1.2.3 Further iterations of this report will be made available as the Project progresses through the pre-application phase.

1.3 Project Team

1.3.1 The Project team that are involved in the development of the Project comprises:

- Cadent as the promoter of the Project;
- Worley– managing the Front-End Engineering Design (FEED);
- SLR Consulting – managing environmental and consenting aspects;
- Camargue – co-ordinating stakeholder management and communications;
- Fisher German – managing land ownership inputs; and
- Murphy – providing pipeline construction advice.

1.4 Report Structure

1.4.1 This report is structured as follows:

- **Section 2 Project Background** – provides a more detailed description of the Project and its initial evolution;
- **Section 3 Policy Context** – summarises the key policy drivers for pipeline development and development consent approval;
- **Section 4 Approach to Routeing and Siting** – sets out the approach which is being adopted to develop the eventual route of the pipeline and the location of Hydrogen Above Ground Installations (HAGIs);
- **Section 5 Stage Zero: Project Initiation** – summarises the results of initial considerations on forming the Project;
- **Section 6 Strategic Options Appraisal** – provides the results of the strategic options appraisal;
- **Section 7 Route Corridor Appraisal** – set out the results of the route corridor appraisal, including the preferred corridor route, which is to be investigated further and eventually refined into a pipeline route; and
- **Section 8 Next Steps** – summarises the further work that will be carried out to develop the Project design.

2 Project Background

2.1 Introduction

2.1.1 To contribute to the Climate Change Act 2008, the Government's 10-point plan for a green industrial revolution and ultimately the 2050 Net Zero target, in October 2021 they announced that HyNet and East-Coast Cluster as the first track 1 clusters to be deployed through the CCS infrastructure fund. They are crucial for industrial decarbonisation, low carbon power, engineered greenhouse gas removal technologies and delivering the UK government target of 10GW of low carbon hydrogen production by 2030.

2.1.2 The East Coast Cluster has three anchor points that form the Track 1 cluster: Northern Endurance Partnership, Net-Zero Teesside and Zero Carbon Humber. Zero Carbon Humber, which is located within Cadent's East Midlands distribution area, aims to capture at least 17 million tonnes of CO_2 emissions per year and supply up to 10GW of hydrogen across industrial and power projects across the Humber by the mid-2030's. This could reduce the UK's annual emissions by 15%.

2.2 East Coast Hydrogen (ECH2)

2.2.1 Following the announcement of the East Coast cluster, Cadent formed a collaborative partnership with Northern Gas Networks (NGN) and National Gas Transmission (NGT) called East Coast Hydrogen (ECH_2) to connect planned hydrogen production and storage with industrial users across the East Coast region. This region comprises the industrial clusters of Teesside and Humber, the north-east of England, Yorkshire and the East Midlands and connects the three anchor points for the East Coast Track 1 cluster.

2.2.2 By supplying hydrogen to industrial users, ECH_2 will play an important role in supporting hard to electrify industries by delivering low-carbon hydrogen which will support the government working towards the UK's 2050 Net-Zero target. ECH_2 will also support economic prosperity through job creation/retention and the attraction of inward investment to the East Coast region.

2.2.3 The collaboration aims to start by connecting the industrial clusters of Teesside and the Humber followed by connecting hydrogen demand across the East Midlands, Yorkshire and Tyneside. This will further facilitate the development of a regional hydrogen market throughout the East Coast region and enable future network connections further afield across the UK.

2.2.4 ECH_2 will deliver the following:

- Connect hydrogen supply with demand across the East Coast region, including hydrogen to power and hard to electrify industry;
- Transport hydrogen through repurposed and new build pipelines;
- Build resilience with interconnectivity and access to storage facilities; and
- Balance supply and demand to support effective market growth.

2.2.5 The ECH$_2$ collaboration produced an East Coast Hydrogen Delivery Plan which was launched at the end of 2023, following studies by Cadent, NGN and NGT. These studies illustrate preliminary findings regarding how a hydrogen network could be rolled out across the East Coast region. The findings of the studies, carried out by the ECH$_2$ collaboration, were summarised in a delivery plan[1].

2.3 Cadent's H2East Hydrogen Pipeline Programme

2.3.1 As a partner in the ECH$_2$ collaboration, Cadent has been examining how to develop a new 100% hydrogen pipeline network to deliver hydrogen to its industrial customers across its current distribution network in the East Midlands (Figure 1). Cadent has worked with its current industrial customers to understand hydrogen demand and timescales for transitioning to hydrogen.

Figure 1: Cadent East Midlands Distribution Area

2.3.2 As part of preliminary studies, Cadent has considered how best to bring forward its first hydrogen pipeline project to meet customer demand across its distribution area, with a focus being on connecting those with the highest demand and readiness to convert to hydrogen. The Project also seeks to

[1] https://www.eastcoasthydrogen.co.uk/east-coast-hydrogen-delivery-plan/

meet the objectives of the ECH_2 collaboration, alongside project development objectives of its own (see **Section 4.2**).

2.3.3 As stated previously, the Project has secured funding from OFGEM to start the consenting process and to develop the Project further through a FEED study.

2.3.4 Cadent's hydrogen pipeline network for its East Midlands distribution area is called H_2East.

3 Policy Context for Pipeline Development

3.1 Introduction

3.1.1 This section provides an overview of the planning policy context relating to pipeline routing and design evolution. The policy landscape for consenting hydrogen distribution infrastructure is evolving as the UK progresses towards its statutory net-zero targets. While dedicated hydrogen policy is still emerging, the planning and assessment of major energy and gas infrastructure are guided primarily by National Policy Statements (NPSs), supported by broader Government strategies on decarbonisation, energy security, and industrial transition.

3.1.2 As highlighted in **Section 1.1**, the Project has requested a direction from the Secretary of State, under Section 35 of the Planning Act 2008, for the Project to be classed as an NSIP. An application for development consent will then be submitted and determined by the SoS for DESNZ. In determining an application, the SoS would need to have regard to designated NPSs in effect at the time, in accordance with Section 104 of the Act.

3.1.3 The Overarching NPS for Energy (EN-1) provides the statutory framework for assessing need, routeing, design evolution, and environmental effects for major energy infrastructure, including hydrogen distribution. EN-1 establishes a Critical National Priority (CNP) framework, reflecting the urgent national need for low-carbon infrastructure to support security of supply and net-zero objectives. It provides a strong presumption in favour of consenting qualifying infrastructure, provided statutory and policy requirements, including environmental protections and the mitigation hierarchy, are met.

3.1.4 The NPS for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4), while originally drafted for natural gas, does provide relevant guidance on pipeline routeing, alignment selection, safety and construction practices that are relevant to hydrogen. Therefore, EN-4 has been considered where applicable, while recognising that EN-1 provides the primary policy basis for development consent.

3.1.5 The Government's 2025 NPSs strengthen support for low-carbon infrastructure and embed Clean Power 2030 objectives. While these drafts are not yet designated and carry no statutory weight, they provide context on emerging policy direction for hydrogen infrastructure.

3.1.6 Taken together, the NPSs and wider Government energy policies set out overarching expectations for routeing, design, and environmental assessment. These include demonstrating the mitigation hierarchy, avoiding sensitive areas where practicable, and providing clear justification for any residual impacts in the context of national need.

3.2 National Policy Statements

3.2.1 This section summarises the statutory NPSs relevant to the Project, focusing on EN-1 as the primary basis for consent and EN-4 as an informative reference for routeing and pipeline design principles.

National Policy Statement for Energy (EN-1), December 2025

3.2.2 EN-1 sets out the UK Government's overarching policy for major energy infrastructure and is underpinned by the principle that significant amounts of new large-scale energy infrastructure are urgently required to meet national energy objectives. Paragraph 2.16 confirms that such infrastructure is needed to ensure a secure, reliable and affordable energy supply, while also meeting statutory decarbonisation targets. Part 3 of EN-1 further establishes the urgent need for nationally significant energy infrastructure to support these objectives.

3.2.3 EN-1 confirms that, for the purposes of the NPS, "gas" includes natural gas, biomethane and hydrogen. Section 3.4 specifically addresses the need for new nationally significant gas infrastructure, with paragraphs 3.4.12 to 3.4.23 confirming the urgent need for low-carbon hydrogen infrastructure to enable hydrogen to play its role in the transition to net zero.

3.2.4 Hydrogen distribution infrastructure is identified in EN-1 as CNP infrastructure, reflecting its strategic importance in delivering decarbonisation, security of supply and long-term energy resilience. EN-1 establishes a strong presumption in favour of granting consent for energy NSIPs, given the level and urgency of need, unless more specific and relevant policies clearly indicate that consent should be refused. The urgent need for CNP infrastructure will generally outweigh residual adverse impacts, except in clearly defined exceptional circumstances.

3.2.5 CNP status does not remove the requirement for robust assessment. EN-1 requires applicants to demonstrate that alternatives have been considered, impacts have been avoided and minimised where practicable, and that any remaining adverse effects are genuinely unavoidable and appropriately mitigated, in accordance with the mitigation hierarchy.

3.2.6 Where development affects nationally designated landscapes, heritage assets or environmental designations, EN-1 confirms that CNP infrastructure is capable of meeting the relevant policy tests, provided that the public benefits clearly outweigh any identified harm. For internationally designated nature conservation sites, including Special Areas of Conservation (SACs) and Special Protection Areas (SPAs), impacts must be assessed under the Habitats Regulations, with consent only granted where there are no feasible alternatives, imperative reasons of overriding public interest (IROPI) are demonstrated, and compensatory measures are secured.

National Policy Statement for Natural Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4), November 2023

3.2.7 NPS EN-4 sets out principles for the design, construction and routeing of nationally significant gas and oil pipelines. While EN-4 applies formally to pipelines transporting natural gas or oil, many of its principles are relevant to linear infrastructure more broadly, including hydrogen distribution projects.

3.2.8 EN-4 confirms that, although it has statutory effect only for natural gas and oil pipelines, its guidance may be useful in identifying impacts and considerations relevant to pipelines transporting other substances. In this

context, EN-4 explicitly references hydrogen infrastructure, recognising the applicability of its principles to emerging pipeline technologies and uses.

3.2.9 Of particular relevance to the Project are EN-4 principles relating to site and route selection, pipeline safety, and the interaction of pipeline infrastructure with environmental constraints. EN-4 also provides informative guidance on the assessment of environmental topics commonly associated with linear infrastructure, including noise and vibration, biodiversity, landscape and visual effects, water quality and resources, and soils and geology.

3.2.10 Accordingly, EN-4 has been considered as an informative policy where its guidance is applicable to hydrogen pipeline development. Additionally, while recognising that the statutory policy tests for development consent are governed by EN-1, in accordance with Section 104 of the Planning Act 2008, the SoS can have regard to other matters they think important, which could include NPS EN-4.

3.3 National Planning Policy Framework (NPPF) (2025)

3.3.1 The National Planning Policy Framework (NPPF, December 2025) sets out the Government's overarching planning policies for England and the principles for achieving sustainable development. Although it does not contain policies specific to NSIPs, the NPPF provides important context for infrastructure planning, including the delivery of low-carbon energy infrastructure such as hydrogen distribution pipelines. The inclusion of hydrogen as low-carbon energy has also been strengthened in the NPPF draft for consultation which was released in December 2025.

3.3.2 At its core, the NPPF is underpinned by a presumption in favour of sustainable development, integrating economic, social and environmental objectives. Economic objectives include supporting the delivery of infrastructure necessary for energy security, decarbonisation and industrial transition. Social objectives seek to support strong, resilient communities, while environmental objectives focus on protecting and enhancing the natural, built and historic environment, mitigating climate change and adapting to its effects.

3.3.3 While designated NPSs form the primary basis for decision-making on NSIPs under the Planning Act 2008, the Secretary of State may treat the NPPF as an important and relevant matter when determining an application for development consent. In this context, the NPPF supports infrastructure development that contributes to net-zero objectives and climate resilience, provided it is planned and delivered in a sustainable manner.

3.3.4 The NPPF also provides relevant guidance on land use and environmental protection that complements the NPS framework. This includes expectations to avoid, mitigate or compensate for adverse effects on biodiversity, landscape character, heritage assets and other environmental receptors, and to ensure that development responds appropriately to climate change considerations. Where relevant, statutory environmental regimes, including the Habitats Regulations, continue to apply.

3.4 Local Planning Policy

3.4.1 Local planning policies may also be considered where relevant to the assessment of landscape, amenity, land use and environmental effects. While such policies are not determinative for NSIPs, they provide material considerations and will inform the identification and refinement of the route corridors and alignments, alongside the NPS framework and environmental assessment process.

4 Approach to Routeing and Siting

4.1 Introduction

4.1.1 The routeing and siting approach has been developed to meet technical, environmental, and planning requirements whilst also considering and balancing the deliverability and cost-effectiveness of the Project. This section sets out the methodology used to identify, appraise, and refine pipeline route corridors and HAGI[2] search areas, and which later in the Project will be used to select a preferred pipeline route and HAGI locations for development.

4.1.2 The routeing and siting approach follows a staged process aligned with Cadent's project development framework and industry good practice for linear infrastructure projects, including the Planning Inspectorate's (PINS) advice on linear projects[3]. The stages followed comprise the following:

- Stage Zero, Project Initiation – which evaluates the options for transporting hydrogen gas;
- Stage One, Strategic Options Appraisal – which considers the strategic options for pipeline network development across Cadent's East Midlands distribution area;
- Stage Two, Route Corridor Appraisal – which assess route corridors and HAGI search areas for a selected strategic option;
- Stage Three, Pipeline Routing Methodology – which describes the development of routing alternatives and above ground infrastructure siting with a preferred corridor;
- Stage Four, Proposed Route Alignment Development – which further develops the routing and above ground infrastructure siting in response to consultation wit landowners, communities and consultees as well as feeding in results from EIA and other Project studies.

4.1.3 Each stage progressively narrows the options, moving from high-level strategic opportunity corridors to route corridor options and eventually to detailed route alignments, while incorporating feedback from engineering, environmental, and planning assessments. The methodology is underpinned by the principles of Inherently Safe Design and As Low As Reasonably Practicable (ALARP[4]), ensuring that safety, constructability, and consentability are embedded throughout.

4.1.4 Key considerations in the routeing and siting process include:

- Safety – complying with required UK regulations, industry codes and safety standards, including ALARP, and potential land use planning zones;

[2] Within a hydrogen pipeline network, a number of Hydrogen Above Ground Installations (HAGIs) will be required to monitor, operate, maintain and inspect the network at key points along the proposed pipeline

[3] https://www.gov.uk/guidance/nationally-significant-infrastructure-projects-advice-on-preparing-applications-for-linear-projects

[4] Inherently Safe Design is an approach that seeks to eliminate and reduce safety hazards and risks at source through the design of a project. ALARP refers to safety risks which are As Low As Reasonably Practicable.

- Environmental and planning constraints – avoidance or minimisation of impacts on environmental features including designated sites, sensitive habitats and cultural heritage sites;
- Engineering feasibility – constructability, accessibility, operability and maintainability;
- Economic efficiency – minimising pipeline length and crossings while maintaining flexibility for future expansion; and
- Stakeholder input – incorporating feedback from consultation and early engagement with regulators, landowners and communities.

4.2 Project Aim and Objectives

4.2.1 The aim of the Project is to develop a new 100% hydrogen pipeline network, transporting hydrogen from sources of production to high demand industrial users, to support their transition towards a low carbon economy. Ultimately, the Project will form the first part of a wider network for the East Midlands region connecting other industrial users and hydrogen producers over time. This first project aims to develop a degree of future proofing that will enable projects under development to be efficiently and logically connected to the proposed Project. Therefore, Cadent will consider foreseeable future demand when considering the size and route of the Project.

4.2.2 Cadent established the following objectives prior to investigating routing options to guide the evaluation and development of the Project. These objectives underpin the routeing and siting methodology so that the design will meet technical (e.g., safety, construction and operational needs), environmental constraints and stakeholder requirements, be those concerns of communities or needs of consultees (e.g. to protect the environment). The objectives are as follows:

- Design a viable hydrogen pipeline project that connects production sources to industrial customers within the Cadent East Midlands distribution footprint who have expressed an interest in being supplied hydrogen and are ready to connect within the timescales of the Project;
- Enable future expansion by incorporating flexibility for phased development, and supporting efficient and progressive future rollout across the region;
- Provide resilience and security of supply, ensuring the network can operate reliably under varying demand and system conditions;
- Ensure safety and constructability, designing a pipeline system that can be built and operated in accordance with industry standards and best practice; and
- Balance environmental and community considerations with technical and economic performance minimising impacts while delivering an optimal solution.

4.3 Spatial Constraints for Routeing and Siting

4.3.1 The development and refinement of pipeline alignments and above ground infrastructure are informed by a comprehensive review of spatial constraints. These constraints include environmental designations, land use considerations, and engineering factors such as topography and existing infrastructure. The routeing and siting process relies on extensive Geographic Information System (GIS) datasets to identify areas of sensitivity and to guide the alignment towards corridors that balance constructability with minimisation of environmental and planning impacts.

4.3.2 The constraints applied in this study align with those specified in NPS EN-1 and based on experience from other linear routing infrastructure projects. They represent features that could influence the safety, feasibility, consentability or cost of pipeline and above ground infrastructure construction. The following sections set out the primary constraint categories and the datasets used to inform the routeing and siting methodology.

Environmental and Planning Constraints

4.3.3 Environmental and planning constraints considered relevant to the consenting process, due to their importance in national policy, have been incorporated into the routeing and siting methodology. These constraints include statutory designations and sensitive receptors that require avoidance or mitigation. A full list of constraints is provided in Appendix A, while the key constraints and their planning policy context are summarised in **Table 4.1**.

Table 4.1: Environmental and Planning Constraints

Constraint	Policy context and consideration for the study
European Sites (Special Area of Conservation (SAC), Special Protection Area (SPA), Ramsar)	These sites have the highest level of biodiversity protection under The Conservation of Habitats and Species Regulations 2017. In accordance with NPS EN-1, a Habitats Regulations Assessment (HRA) is required where a project may give rise to a likely significant effect on an internationally designated site. NPS EN-1 paragraph 5.4.4 advises that the highest level of biodiversity protection is given to sites identified through international conventions like these. Development may only proceed where it can be demonstrated that there will be no adverse effect on site integrity, or where the statutory derogation tests are met: • No feasible alternatives • Imperative Reasons of Overriding Public Interest (IROPI) • Compensatory measures secured Hydrogen distribution infrastructure is identified in EN-1 as Critical National Priority; however, the statutory requirements of the Habitats Regulations remain determinative. Routeing will, therefore, avoid internationally designated sites wherever practicable. Where crossings are unavoidable, trenchless techniques may be required to minimise disturbance. .
Designated Landscapes – National Parks and National Landscapes	National Parks and National Landscapes are afforded the highest level of landscape protection. NPS EN-1 (para. 5.10.7) confirms that projects should be designed sensitively, with measures that are sufficient,

Constraint	Policy context and consideration for the study
	appropriate, and proportionate. Development consent in these areas may only be granted in exceptional circumstances (para. 5.10.32). While hydrogen pipelines are identified as CNP infrastructure, careful routeing and design are required to avoid or minimise impacts on designated landscapes. Where permanent above-ground infrastructure is necessary, it should, wherever practicable, be located outside protected landscapes in line with EN-4 (para. 2.21.21) and incorporate mitigation to reduce visual and environmental impacts. Routing will seek to avoid designated landscapes, where possible.
National Conservation Designations including Sites of Special Scientific Interest (SSSI), and National Nature Reserves (NNR)	Sites such as SSSIs and NNRs are nationally important for biodiversity and geology. Such designations may also support protected species. NPS EN-1 (para. 5.4.8) states that development likely to adversely affect such sites should not normally be permitted, unless the benefits and national need clearly outweigh the impacts on the site and broader network. For CNP projects, there is a starting presumption that need and benefits generally outweigh residual impacts; however, the mitigation hierarchy must still be applied and the Project would also need to meet legislative requirements with respect to protected species. Routeing will avoid SSSIs and NNRs where practicable, with trenchless techniques (e.g. Horizontal Directional Drilling (HDD)) employed for crossings to minimise impact.
Ecological features, such as ancient woodland and priority habitats	Routeing will consider key ecological features, including legally protected habitats such as ancient woodland and trees subject to Tree Preservation Orders. NPS EN-4 (para. 2.22.7) advises that woodland and trees should be avoided or crossed using trenchless methods where feasible. Routeing will prioritise avoiding habitats that are highly valuable or difficult to replace, such as ancient woodland and hedgerows (protected under the Hedgerows Regulations 1997), or utilises trenchless techniques to minimise impacts.
High value heritage assets	Some heritage assets are legally protected from direct and indirect harm, such as Scheduled Monuments, Listed Buildings, World Heritage Sites, Historic Parks and Gardens and Battlefields. EN-1 paragraph 5.9.29 states that considerable importance and weight is given to preserving all heritage assets and any harm or loss of significance must have a clear and convincing justification. Additionally, paragraph 5.9.28 states that the more important the asset the more weight should be given to its protection. Furthermore, paragraph 5.9.30 and 5.9.31 advises that substantial harm or loss of high value heritage assets should be wholly exceptional. Routeing and above ground infrastructure will seek to avoid these assets and other heritage assets, where possible.
Grade 1, 2 and 3a Agricultural Land	Best and Most Versatile (BMV) land, grades 1,2 and 3a, is a nationally important resource for food security. NPS EN-1, paragraph 5.11.12, states that Projects should minimise impacts on the BMV agricultural land and preferably use land in areas of poorer quality (i.e., grades 3b, 4 and 5). Pipeline construction may cause temporary impacts lasting one or more growing seasons, while permanent infrastructure, such as HAGIs, would result in permanent loss. Routeing and siting aim to avoid BMV land where possible. However, differentiation between Grade 3a and 3b is not available in public mapping and can only be determined through site specific soil surveys. This means initial routing is based on avoiding grade 1 and 2. Soil surveys later in the process will inform whether areas of grade 3a are present and can be avoided by the pipeline route.
Water resources and the water environment	This comprises rivers, canals, lakes, wetlands, reservoirs, ponds and groundwater. Section 5.16 of NPS EN-1 sets out policy for the protection of the water environment. EN-1 Paragraph 5.16.3 states assessments of

Constraint	Policy context and consideration for the study
	the water environment should consider the existing status of, and impacts on, water quality and water resources. Where possible sensitive water resources, such as those used for drinking water will be avoided (e.g., close to and upstream of reservoirs, groundwater source protection zones). However, NPS EN-1 states in paragraph 5.16.10 indicates the risk of impacts on the water environment can be reduced through careful design and adherence to good pollution control practice. Therefore, water resources and the water environment is considered less sensitive than other constraints set out here. For example, whereas for some constraints, like European sites and high value heritage sites which are avoided where possible, water resources and the water environment is only avoided if avoiding such features is practical when balanced against engineering and cost implications.
Flood risk	New development should ideally avoid areas of flood risk. Paragraph 5.8.6 of NPS EN-1 states flood risk should be taken into account to avoid inappropriate development in flood risk areas. The pipeline routeing will consider whether flood risk areas can be avoided if practical, but flood zones are not considered a major constraint to routeing. Therefore, routing will only avoid flood risk areas if when balanced against other constraints and engineering and cost requirements it makes sense to avoid. Once constructed, the pipeline would not create conflict with areas of flood risk and construction methods can be developed to manage flooding impacts. However, permanent (e.g., HAGIs) and temporary (e.g. construction compounds) above ground features should ideally be located outside areas prone to flooding.
Green Belt	The Project will consider Green Belt which is designated to prevent urban sprawl into the countryside. If possible, permanent above ground infrastructure will be located outside the Green Belt, although Grey Belt areas within Green Belt would be seen as appropriate (as per reference 226 in paragraph 5.11.36 of EN-1). However, NPS EN-1 paragraph 5.11.22 indicates that *energy infrastructure, such as an underground pipeline, may not be inappropriate in Green Belt, as long as it preserves the openness of the Green Belt and does not conflict with the purposes of Green Belt designation.'* Additionally, as a CNP project the SoS will take as a starting point (as set out in para. 4.2.17 of EN-1) that the Project has met the 'very special circumstances to justify development' in the Green Belt. Therefore, whilst the Project will seek to avoid permanent above ground infrastructure in the Greenbelt, if possible, pipeline routing will not avoid the Greenbelt.
Amenity space such as green space and open space	National policy sets out the importance of protecting green space and open space (e.g., public gardens, public recreation areas such as sports fields, and country parks). Paragraph 5.11.6 for example, states *'The government's policy is to ensure there is adequate provision of high-quality open space and sports and recreation facilities to meet the needs of local communities. Connecting people with open spaces, sports and recreational facilities all help to underpin people's quality of life and have a vital role to play in promoting healthy living.'* The routeing of the pipeline and siting of above ground infrastructure will consider sports fields, parks, woodland, gardens and other open areas used by the public.
Peat soils	Peat is a carbon-rich soil that plays an important role in climate regulation and biodiversity. EN-1 highlights the need to minimise soil disturbance and protect carbon stores as part of climate change mitigation and environmental protection. Applicants should apply the mitigation hierarchy and consider opportunities for habitat restoration and carbon offsetting.

Constraint	Policy context and consideration for the study
	Routeing will seek to avoid deep peat areas where possible. Where unavoidable, design should minimise excavation, maintain hydrology, and incorporate restoration measures. Peat areas often overlap with sensitive habitats, so trenchless techniques may be appropriate.

Engineering and Land Use Constraints

4.3.4 From an engineering perspective, the routeing and siting methodology considers built infrastructure and land use constraints which could give rise to different levels of difficulty or add excessive cost to pipeline construction. The key engineering constraints considered are listed in **Table 4.2**. **Appendix A** provides a full list of constraints.

Table 4.2: Engineering and Land Use Constraints

Topic	Constraints
Major highway crossings	Motorways, Strategic Road Network, A roads
Rail line crossings	Railway network
Watercourse crossings	Main rivers, estuaries below Normal Tidal Limits, reservoirs, ponds, lakes, canals and ordinary and Internal Drainage Board watercourses
Ground conditions	Marshland or peat soils; steep slopes (>1 in 3); challenging topography; Agricultural Land Classification; unstable land or geology (e.g. fault lines)
Populated areas and land uses	Settlements and suburban areas (defined by IGEM/TD/1 population density)
Existing/ future, built developments	Residential properties (including proximity and views); planning permissions/applications (e.g., solar farms, large residential developments); policy allocations (e.g., areas allocated for residential development); outdoor leisure facilities; industrial developments
Gas Pipelines	Existing Cadent network and NGT pipelines
Electricity power lines	Overhead and underground power lines
Other utilities	Water pipelines and telecommunications cables
Minerals / mining extraction / landfill sites	Mine risk zones; historic/current/future mineral extraction; opencast high walls; contaminated land; existing/former landfills
Hazardous Sites	Control of Major Accident Hazards (COMAH) sites, Defence sites, Nuclear power plants, Airports
Land uses	Inalienable land, such as National Trust and Crown land, common land, public open space

4.4 Stage Zero: Project Initiation

4.4.1 The Project Initiation stage focuses on evaluating the technical options for transporting hydrogen across Cadent's East Midlands region, as part of the ECH$_2$ collaboration.

4.4.2 The Project Initiation considers the following:

- Repurposing existing natural gas pipelines;

- Alternative transport methods; and
- New pipelines.

4.4.3 This technical review draws upon a high-level appraisal of the Project need, objectives and the long-term aspirations for a hydrogen network across Cadent's East Midlands region. It also considers the customer demand and spatial distribution together with technical matters with regards to hydrogen transportation and storage. A review of UK government plans also informed this early stage review .

4.4.4 The outputs of this stage are presented in Section 5 Project Initiation of this report.

4.5 Stage One: Strategic Options Appraisal Methodology

4.5.1 The strategic options appraisal is undertaken to establish the most effective high-level configuration for the Project before moving into route corridor development for the preferred strategic option. This stage focuses on identifying broad opportunity corridors connecting hydrogen production sites with major industrial demand clusters across the Cadent East Midlands distribution area. Furthermore, consideration is given to future expansion and integration with potential future hydrogen projects.

4.5.2 The strategic options appraisal is purposely kept at a high-level and conceptual; it aims to investigate potential connections between areas of hydrogen production and clusters of hydrogen demand. Limited consideration is given to precise start and end points, precise routes or to geographical and environmental constraints, except for major constraints, such as cities or large towns or geographically larger constraints outlined by national policy (i.e. NPS EN-1 and EN-4) such as designated sites like national parks and European conservation sites if deemed to have significant influence on future routing of pipelines. Additionally, limited consideration is given to the location or positioning of HAGIs.

4.5.3 The strategic options appraisal also considers the scale of project, noting that the Study Area for the Project is Cadent's East Midlands distribution area (as shown in **Figure 1** in **Section 2.3**). Given the wide geographical coverage of Cadent's East Midlands distribution area, the wider hydrogen pipeline network will need to be developed progressively in phases (i.e., several separate projects). The first phase or pipeline project is determined by the scale of a project that could realistically be designed, consented and delivered by the early 2030's. At this stage of the Project, a pipeline between 100 to 150 km is considered to be a realistic target.

4.5.4 The following sub-sections describe the methodology which will be applied at each stage of the appraisal.

Strategic Options Identification

4.5.5 The first step is to define the key fixed points for the network, which are the hydrogen production sites and major industrial demand clusters across the East Midlands distribution area. The industrial demand clusters are spatial groupings of industrial users found across the Study Area. Using these

demand clusters, rather than each individual industrial user, as end points and areas of hydrogen production as the start points, several high-level network scenarios are developed.

4.5.6 Routeing at this stage is conceptual, using connections between fixed points adjusted only to avoid obvious barriers such as large urban areas, water bodies or national designations. No detailed alignment or micro-siting is undertaken as the lines at this stage do not represent pipeline routes.

4.5.7 The methodology focused on creating options that aligned to the Project objectives set out in **Section 4.2** as follows:

- Connect producers to multiple clusters or clusters with the highest demand;
- Connecting demand clusters that provided opportunities for future phased expansion of Cadent's hydrogen network in the East Midlands region;
- Supported potential integration with future hydrogen projects coming forward through the ECH_2 collaboration and being developed by others; and
- Delivery of a project of a scale which could be consented and delivered in readiness for operation in the early 2030's.

Strategic Options Evaluation

4.5.8 The evaluation of strategic options is carried out with reference back to the objectives for the Project, as set out in **Section 4.2**. These objectives are used to develop a set of evaluation criteria which were defined through a series of workshops. The strategic options are then compared qualitatively against these criteria to determine the preferred strategic option to take forward to route corridor appraisal.

4.5.9 The criteria used to qualitatively evaluate the strategic options are as follows:

- Hydrogen production and customer demand profile;
- Operational considerations such as safety, integration with ECH_2, resilience and security of supply, and future expansion opportunities;
- Constructability considerations, such as major crossings or terrain challenges;
- Potential environmental and planning constraints;
- Cost;
- Length of main pipeline; and
- Hydrogen demand/ km length of pipeline.

4.5.10 The evaluation process is qualitative and comparative rather than prescriptive, enabling the Project team to identify which option offers the most balanced and deliverable configuration. This approach ensures that decisions are informed by strategic priorities while maintaining flexibility for refinement during subsequent route corridor appraisal.

4.5.11 The outputs of this stage (i.e. the preferred strategic option) are presented in **Section 6** Strategic Options Appraisal of this report and forms part of Consultation One. This stage also relates to work that was carried out as part of Pre-Feed which fed into the funding application and subsequent award of funding made by OFGEM.

4.6 Stage Two: Route Corridor Appraisal Methodology

4.6.1 The route corridor appraisal is undertaken to move from a single preferred strategic option to a set of broad corridors that could, at a later date, accommodate potential pipelines. This stage marked the transition from high-level optioneering to a more detailed, spatially defined approach that begins to consider more detailed engineering and environmental constraints, with a focus on those constraints outlined within national planning policy (i.e., NPS EN-1 and NPS EN-3). The output from this stage of the appraisal is a preferred route corridor which is used for environmental scoping and early consultation.

4.6.2 The purpose of this stage is to demonstrate that the preferred strategic option could be delivered in principle within corridor options, while maintaining flexibility for refinement in later stages. Rather than fixing a single route, the approach focuses on defining corridors wide enough to allow alternative pipeline alignments within them, whilst ensuring that localised constraints could be avoided without fundamental redesign.

4.6.3 The methodology for identifying corridors combines GIS-based constraint analysis with specialist judgment based on the following guiding principles, which reflects standard industry approaches to corridor routing studies:

- The general alignment of the corridor follows the preferred strategic option;
- Avoids areas of highest engineering, land use and environmental constraint density in line with the requirements set out in **Section 4.3** particularly those constraints highlighted in national policy, while maintaining a direct route to minimise length;
- Incorporates search areas for HAGIs, which are needed to enable pipeline connections to hydrogen producers and industrial users;
- Includes indicative spur corridors to connect industrial customers and hydrogen producers; and
- Corridors are approximately 2 km wide, a distance considered wide enough to accommodate several pipeline alignments given much of the Study Area is rural agriculture

HAGI Search Areas

4.6.4 HAGIs are required to provide connections to both hydrogen producers and industrial users, enabling monitoring, maintenance and inspection of the network during operation. A HAGI is expected to be between 0.5 ha and 2 ha in size depending on site specific operational requirements. GIS is used to select areas of sufficient size in known HAGI search areas based on the constraints outlined within **Section 4.3** which are summarised as follows:

- Adequate safety separation from sensitive receptors such as residential areas, schools, hospitals and offices;
- Access to the highway network for construction, operation and maintenance;
- Environmental constraints, particularly designated nature conservation sites, such as SSSI, SACs and SPAs; areas of woodland and priority habitats; landscape and land use designations, such as Registered Parks and Gardens, Country Parks, greenspace, as directed by national policy (i.e., NPS EN-1 and EN-4);
- Potential views from residential receptors or other sensitive viewpoints;
- Engineering constraints, such as buildings and other built infrastructure like roads, rail and major utilities like overhead power lines; and
- Planning constraints such as flood risk areas; Greenbelt; and BMV agricultural land.

4.6.5 The purpose was to establish viable areas for above-ground infrastructure without fixing precise locations at this stage, allowing flexibility following detailed environmental surveys and stakeholder feedback from this consultation.

4.6.6 The outputs of this stage are included in **Section 7** Route Corridor Appraisal of this report and forms part of Consultation One. This stage also relates to work that was carried out as part of earlier studies which fed into the funding application and subsequent award of funding made by OFGEM.

Route Corridor Evaluation

4.6.7 The evaluation of route corridors follows a similar approach to that of the strategic options evaluation, with reference back to the objectives for the Project, as set out in **Section 4.2**. These objectives were used to develop a set of evaluation criteria, based on a standard industry approach to pipeline routing, which would enable the Project team to test each corridor against the Project objectives. The route corridor options were then compared qualitatively against these criteria to determine the preferred route corridor to take forward for pipeline routeing.

4.6.8 The criteria used to qualitatively evaluate the route corridor options, including HAGI search areas, is as follows:

- Operational considerations such as safety;
- Constructability considerations, such as major crossings or terrain challenges;
- Potential environmental, land use and planning constraints; and
- Factors influencing cost, such as length, number of HAGIs, complex crossings.

4.6.9 The evaluation process is qualitative and comparative rather than prescriptive, enabling the project team to identify which option offers the most balanced and deliverable configuration, whilst also complying with planning policy tests as far as they are applicable at this stage. This approach ensures

decisions are informed by strategic priorities while maintaining flexibility for refinement during subsequent pipeline routeing studies.

4.6.10 The outputs of this stage are presented in **Section 7** Route Corridor Appraisal of this report and forms part of Consultation One. This stage also relates to work that was carried out as part of Pre-Feed which fed into the funding application and subsequent award of funding made by OFGEM and also marks the extent of work currently completed on the Project.

4.7 Stage Three: Pipeline Routeing Methodology

4.7.1 Stage Three represents the transition from the broad preferred route corridor to defined pipeline route alignment options and locations of above ground infrastructure (e.g., HAGI and BVI) within the preferred corridor. This phase will draw on comments from Consultation One (i.e., this consultation), ongoing consultation with landowners and environmental scoping with external stakeholders. It will also incorporate findings from ongoing environmental studies and detailed technical/ engineering assessments. The objective will be to select a 'preferred route alignment' and narrower corridor, which will begin to reflect a set of preliminary order limits for the Project. The selection of this alignment will be set out in an update of the Design Evolution Report, which will be provided for further consultation ie Consultation Two.

4.7.2 The preliminary order limits and preferred route alignment will also be presented for consultation at a later date in the pre-application process, Consultation Two.

4.7.3 Feedback from consultation on the preferred route alignment will be fed back into the final design prior to submission of the development consent application, with amendments made as necessary, as described in **Section 4.8**.

4.7.4 The Design Evolution Report will be updated further following additional consultation to ensure all routing information, such as pipeline alignment options and HAGI locations, is included in the Development Consent Order (DCO) application.

Pipeline Design Parameters

4.7.5 The detailed routeing process will apply defined engineering parameters to ensure safety, constructability, and compliance with industry standards. These parameters are based on industry standard practice, guidance and experience and a starting principle of taking the shortest and most direct route, subject to constraints and technical requirements. Key design considerations will include the following:

- Pipeline diameter and pressure:
  - Main pipelines: typically larger diameter pipe used to distribute hydrogen across the network, up to 42-inch diameter, operating at high pressure (above 7 barg) to provide sufficient capacity and flexibility for future ramp-up; and
  - Pipeline spurs: Spurs are typically smaller in diameter, ranging from 4" to 16", and can be High, Intermediate or Medium pressure. The

pressure and diameter of each spur is determined by the pressure and volume of hydrogen each industrial user will require.

- Safety distances (Building Proximity Distances (BPD)):
  - Main pipelines: appropriate clearances from occupied buildings; and
  - Spur pipelines: 3 m clearance.
- Pipelines would typically avoid slopes greater than 1 in 3 (or 18 degrees);
- Typical Working width for construction:
  - Main pipelines: typically 36 m working width, however, this could extend to 50 m working width in some areas; and
  - Spur pipelines: up to 22 m working width.
- Crossing requirements:
  - Sensitive features such as major roads, railways, rivers, and ancient woodland will be crossed using trenchless techniques (e.g., HDD); and
  - Crossing angles will be maintained as close to 90° as possible (minimum 60°) to reduce engineering complexity.

4.7.6 These parameters will guide alignment selection and ensure that the route can be constructed and operated safely while maintaining flexibility for refinement during FEED.

Pipeline Routeing and Use of GIS

4.7.7 As outlined in the previous section, the general approach to pipeline routeing will be to develop the shortest route possible, between above ground infrastructure connection points, whilst seeking to avoid a range of engineering, land use and environmental constraints (see **Section 4.3**). The determination of the above ground infrastructure connection points for the pipeline routing is an iterative exercise to select the best site and balance that with ultimately the best pipeline route. This results in many iterations of pipeline route and above ground infrastructure siting locations being examined and a balanced decision being made by the Project team to select the best pipeline route and above ground infrastructure locations.

4.7.8 The routeing approach will use GIS, complemented by the project team's review of constraints and engineering requirements, and will be supported by in-field vantage point surveys of key locations. GIS will be used to assimilate and analyse large volumes of constraints data (as per **Appendix A**) and their relative sensitivity and policy importance, enabling creation of a constraints heat map for the Project.

4.7.9 Using this heat map and applying engineering parameters such as BPD and maximum slopes, a 'path of least resistance' algorithm will be used to generate pipeline route options within the preferred route corridor. This process will generate the shortest possible paths between selected points while avoiding more constrained areas.

4.7.10 The ability to generate multiple route options will allow the project team to critique alignments and, where necessary, run alternative routeing scenarios

or adjust constraints weightings to test the implications for alignment selection.

4.7.11 Following generation of GIS-based route options, the project team will undertake a thorough review of environmental effects, buildability, and cost. Manual adjustments may be made, including localised straightening, changes to accommodate constructability requirements, or use of trenchless crossings to avoid specific constraints, such as watercourses, roads, or woodland.

4.7.12 Feedback from ongoing discussions with stakeholders and landowners, including the feedback from Consultation One, will also be taken into consideration. Together with the potential constraints identified through ongoing environmental and engineering studies in the field, potential changes to emerging routes, including any amendments driven by changes to the location of HAGIs or BVIs, will be considered by the project team through a design review process.

4.7.13 For the preferred pipeline alignment and AGI siting, the Project will identify and select locations with regards to construction accesses, Temporary Construction Compounds (TCCs), laydown areas and areas required for landscape, visual mitigation and biodiversity benefit. These selections will be based on constraints mapping and the specific functional requirements of each activity.

Above Ground Infrastructure Siting Study

4.7.14 This stage also involves the refinement of the HAGI search areas identified during Stage Two, alongside the consideration of the pipeline alignments, into specific HAGI site options. As highlighted previously, the selection of HAGI locations will happen alongside the consideration of the pipeline alignment so that a balanced decision is made on the optimum location for both the above ground infrastructure and the pipeline alignment. For example, if the best HAGI location requires a much longer pipeline or compromises in the pipelines environmental performance, then overall for the Project it may be better to select an alternative HAGI location.

4.7.15 The Project will also start investigating the siting of Block Valve Installations (BVIs) at this stage once there are some emerging pipeline alignments and the Engineering team has determined the need and approximate locations for the BVIs. At this stage in the design process, it is not confirmed whether block valves will be buried or above ground. The design process is ongoing and further studies will confirm the final design. BVIs allow the isolation of a section of pipeline to limit any loss of gas released during a number of events, such as a repair, maintenance or a failure of the pipeline section. BVIs have a smaller footprint than HAGIs (typically less than 0.5 ha in size) and are located along main pipeline sections. Their location will be influenced by the routeing of the pipeline, although flexibility will remain as to the exact siting along suitable route sections. This is why BVIs are considered for the first time at this stage.

4.7.16 The siting of HAGIs will be a critical element of the pipeline, as these facilities provide pressure control, isolation and operational flexibility within the network. The methodology for identifying suitable HAGI locations will continue

to combine spatial analysis with engineering and environmental considerations and will be considered alongside the evolution of the pipeline alignments.

4.7.17 At this stage, appraisal will draw on additional data gathered from environmental surveys, engineering studies and consultation feedback from landowners and other relevant stakeholders.

4.7.18 As with the HAGI search area study, refinement of these search areas into specific site options will be driven by the pipeline routeing requirements and by review of the following aspects which is based on industry standard approach to siting studies:

- **Safety and compliance:**
  Sites must comply with IGEM/TD/13 and Cadent's internal specifications for layout and separation distances, including BPD and operational safety zones;
- **Constructability and Access:**
  Suitability for construction (e.g., topography, utilities). Sites will be assessed for safe and efficient construction and maintenance access, ideally with direct access to the public highway and sufficient space for temporary work;
- **Environmental and Planning Constraints:**
  HAGIs will be sited to avoid flood zones, statutory nature conservation designations, and high-sensitivity landscape or heritage areas;
- Where avoidance is not possible, mitigation measures such as visual screening or design adaptation will be considered;
- **Land Use and Future Flexibility:**
  Sites will be positioned to minimise permanent loss of BMV agricultural land and avoid areas allocated for future development. Flexibility for future network expansion will also be considered; and
- **Landowner and stakeholder feedback:**
  Feedback collected from Consultation One and any subsequent feedback will be feed into decision making.

4.7.19 Each potential HAGI site option will be assessed against these criteria to identify preferred locations that will be presented for consultation as part of subsequent stages of the Project, ie Consultation Two of the Project.

Pipeline Route Alignment Evaluation

4.7.20 This phase in the pipeline routeing methodology will evaluate and also balance the preferred and alternative pipeline routeing along with other Project infrastructure (e.g., HAGIs, BVIs, TCCs) preferred siting locations that have been investigated within the preferred corridor from Stage Two. The preferred route alignment and siting locations and alternatives considered will emerge once the project team has considered the GIS supported routeing process, field visits, EIA studies, results from geotechnical investigations and consultation feedback. As previously highlighted, the selection of a preferred and optimal alignment and above ground infrastructure locations is based on

professional judgement of the project team by balancing the constraints (set out in **Section 4.3**) previously outlined alongside the engineering requirements (set out in **Section 4.7.5**, such as creating the shortest route possible), the Project objectives (set out in **Section 4.2**) and national policy, principally from NPS EN-1 and NPS EN-4. NPS EN-1 sets out the planning tests for constraints and energy development that will be used by the SoS when considering the development consent application.

4.7.21 It is also important for the Project to review previous decisions, which may have been made without full details, to verify those decisions and to ensure that the pipeline alignments and above ground infrastructure locations remain the optimum and preferred.

4.7.22 Further investigation of this balanced judgement is made as further information is collect on the Project.

4.7.23 An environmental assessment of the preferred route alignment and alternatives will be presented for consultation (Consultation Two) at the end of Stage Three along with an updated version of this Design Evolution Report. The feedback from landowners, communities and other stakeholders will be reviewed and considered and taken into Stage Four for final route alignment and above ground infrastructure siting consideration and optimisation.

4.8 Stage Four: Proposed Route Alignment Development

4.8.1 Following the feedback from future consultation on the Project, further refinement and adjustments may be needed to the preferred pipeline route alignment. This stage of the Project involves finalising the route alignment, HAGI and BVI locations and the associated infrastructure necessary for its construction.

4.8.2 The final route alignment will likely include limits of deviation which give the detailed design some flexibility to move the alignment within a set boundary. For example, this could be the ability to move the working width (up to 50 m) within a wider corridor, say 100 m in width. The limits of deviation will be included in the final proposed order limits which will be submitted with the application for development consent.

5 Stage Zero: Project Initiation

5.1 Introduction

5.1.1 As outlined in **Section 2**, this Project is driven by the UK government strategy of delivering 10 GW of low carbon hydrogen by 2030 and the focus on developing the East Coast Track 1 cluster, part of which is located within Cadent's East Midlands distribution area. This led to the ECH_2 collaboration between Cadent, NGT and NGN and ultimately the need to investigate the need to develop this Project within the East Midlands distribution area i.e., the Cadent network that covers part of the Net-Zero Humber anchor point for the East Coast Track 1 cluster.

5.1.2 Before investigating the specific location of the Project, Cadent undertook studies to investigate some of the technical aspects of the Project. The Project Initiation considered the following aspects:

- Alternative hydrogen transport methods;
- Repurposing existing natural gas pipelines; and
- New pipelines.

5.2 Alternative Hydrogen Transport Modes (road, rail, or waterways)

5.2.1 Consideration was given as to whether hydrogen could be transported using high-pressure tube trailers by road, rail or via ship tankers as an alternative to pipeline infrastructure by the Project team. These methods were assessed as potential interim solutions for early hydrogen market development, particularly for small-scale or dispersed users. However, they were discounted for the larger industrial users where hydrogen demand is greatest and which are dispersed across the East Midlands distribution area. It is these potential hydrogen users that the Project will need to connect to have an appreciable impact on delivering low carbon hydrogen and reducing carbon emissions.

5.2.2 Furthermore, at the time of development the UK Government had a 'minded to position' for the requirement of large scale hydrogen infrastructure to focus on the development of large-scale pipeline infrastructure to transport hydrogen[5]. This is largely based on the need to meet its 10 GW of low carbon hydrogen by 2030 objectives.

5.2.3 In addition, the volume limitations of road and rail transport are considered to make them impractical for sites with a continuous, high volume hydrogen demand, as the number of vehicle movements required would be significant, have increased safety risks and be inefficient (e.g. be subject to delays or breakdowns). Rail and transport by waterways would also be limited to the spatial coverage of railway and navigable waterway networks, which do not fully correspond with areas of hydrogen demand on the Humber and industrial centres surrounding cities and towns without also the need, in the case of rail and waterways, for a network of local distribution pipelines or transport by road.

5.2.4 Safety considerations increase substantially over long distances with road and rail, with a higher possibility of there being accidents. Additionally, more handling and logistics is introduced which would rely on human interventions and be subject to greater risk of human error than compared to pipelines.

5.2.5 For these reasons, road, rail and waterways transport were not considered viable long-term solutions for the Project compared to cross country pipelines.

[5] Department for Energy Security & Net Zero: Hydrogen transport and storage infrastructure: minded to positions - Minded to government positions on business model designs, regulatory arrangements, strategic planning and the role of blending. August 2023

5.3 Repurposing Existing Natural Gas Pipelines

5.3.1 Cadent undertook a detailed review of its existing pipeline assets to assess whether they could be converted for hydrogen transportation. While repurposing offers potential cost and time savings compared to new construction, the review identified several limitations. Firstly, the existing pipelines lack the capacity and connectivity to meet projected hydrogen demand from multiple industrial clusters alongside the current need to also continue to deliver natural gas within the current pipeline network at the same time as needing to deliver hydrogen to industrial users.

5.3.2 Additionally, technical considerations such as material compatibility, pressure ratings, and safety standards for hydrogen transport introduce further complexity and cost, reducing the viability of repurposing. Where pipelines were deemed unsuitable for repurposing, they would need to be excavated and replaced and this would lead to environmental impact, stakeholder disruption and potentially greater cost in the long run, subject to how much pipe had to be replaced across the network. For these reasons, the option of re-purposing existing pipelines was discounted.

5.4 New Hydrogen Pipeline Infrastructure

5.4.1 Following the assessment of repurposing and alternative transport modes, a new-build hydrogen pipeline emerged as the most technically and strategically viable solution to meet the objectives of the Project. A dedicated pipeline network offers the capacity to deliver hydrogen at scale to multiple industrial clusters, ensuring that large-volume users can transition away from natural gas efficiently. Unlike existing assets, a new pipeline can be designed to provide network resilience and security of supply, incorporating redundancy and flexibility for future operational needs. Once constructed, a new pipeline would also have limited additional construction requirement other than routine low level maintenance for around its 40 year or more lifetime. It also enables phased expansion and integration with other hydrogen projects.

5.4.2 Network infrastructure to allow hydrogen to be transported to storage points and end users is central to the expansion of the hydrogen economy as outlined in the Government's UK Hydrogen Strategy (DESNZ: 2021). In a consultation document (Hydrogen transport and storage infrastructure, DESNZ, November 2022), the UK government has set out its vision for hydrogen transport as follows:

'*Hydrogen transport from the mid-2030s onwards is for a large, integrated, and resilient hydrogen network with multiple entry and exit points within and across regions and/or nationally*'

5.4.3 Government policy clearly states hydrogen networks will have to grow and diversify significantly over the 2020s to enable the UK to meet the Government's 2030 ambitions (DESNZ, 2021: UK Hydrogen Strategy). It is generally accepted that widespread deployment of hydrogen at scale to large industrial users will need to be via pipelines.

5.5 Conclusion

5.5.1 Stage Zero, Project Initiation has concluded that in order to support the UK Government targets of delivering 10GW of hydrogen by 2030 and supporting greenhouse gas reduction on the Humber and across wider industry, a new pipeline is the most feasible option for the transportation of hydrogen to industry. This conclusion is in line with current UK Government minded to positions, which has been reinforced by OFGEM funding for the development of this Project through to FEED. It is also considered the most practical option with concerns relating to safety and logistics for rail, road and waterway, and potentially costly and problematic pipeline replacements for a repurposing option.

6 Stage One: Strategic Options Appraisal

6.1 Introduction

6.1.1 The identification of strategic options for the Project was guided by the approach set out in **Section 4.5** and focused on aligning hydrogen supply with potential and anticipated hydrogen industrial demand across Cadent's East Midlands distribution area. This process began with a spatial review of confirmed and potential hydrogen production sites alongside hydrogen demand clusters. The demand clusters were based on existing Cadent customers who have expressed interest in transitioning to hydrogen grouped by geographical area across Cadent's distribution area.

6.1.2 Hydrogen production was the primary driver for defining strategic options, as the location of supply points determines the feasible entry points for a new distribution network. Three key production areas across the East Midlands distribution area were identified as forming the backbone of the network:

- Two hydrogen production facilities at North Killingholme, on the Humber in North Lincolnshire;
- One hydrogen production facility at High Marnham, in Nottinghamshire; and
- Hydrogen production to the south of Nottingham.

6.1.3 Hydrogen production from the west, as part of Cadent's HyNet project, was discounted early on in the review of potential strategic options. This was due to the engineering complexity and environmental designations associated with crossing the Peak District National Park.

6.1.4 The hydrogen demand clusters identified across the East Midlands region comprised the following areas:

- North Lincolnshire towns of Immingham, Grimsby and Scunthorpe;
- South Yorkshire towns of Doncaster, Rotherham, and Barnsley and the city of Sheffield;
- The cities of Nottingham, Derby and Leicester; and
- Some more dispersed demand clusters in the central part of the study area in Nottinghamshire (e.g., Newark and Mansfield) and Derbyshire (e.g., Chesterfield)

6.1.5 **Figure 3** illustrates the distribution of the hydrogen production locations and potential customer locations within the East Midlands distribution study area.

6.1.6 Using the supply locations and the mapped distribution of customer demand shown in **Figure 3**, four strategic options were developed to explore different configurations for connecting producers to industrial users. These options are described in detail in the following sections.

6.2 Description of Strategic Options

Strategic Option 1: Humber to Scunthorpe

6.2.1 This option focuses on creating a hydrogen distribution route originating from the North Killingholme production hub on the Humber, initially based on hydrogen production from two hydrogen production plants: Humber H_2ub Green and Humber H_2ub Blue. The proposed network would distribute hydrogen to major industrial users in Immingham and Grimsby before extending westwards to serve demand concentrated between Immingham and Scunthorpe and within Scunthorpe. This strategic option is illustrated in **Figure 4**.

6.2.2 The rationale for this option is its ability to connect the largest confirmed hydrogen production plants with a cluster of high-demand customers located in close proximity, enabling early decarbonisation of heavy industry and supporting the Government's ambition for a Humber-based hydrogen economy. The route alignment would primarily traverse rural areas, reducing interaction with heavily built-up zones and minimising engineering complexity.

6.2.3 Although predominantly rural, localised aspects of the pipeline development near the Humber would interact with an already industrial area, although main pipeline and HAGI locations would likely be located in adjacent agricultural land. This could interact with other proposals for development or land which is important for birds associated with the Humber Estuary SPA for birds.

Strategic Option 2: Humber to South Yorkshire

6.2.4 This option builds on Strategic Option 1 by extending the hydrogen network beyond North Lincolnshire to high demand clusters in South Yorkshire, enabling supply to major industrial centres around Doncaster, Rotherham, Sheffield, and Barnsley. The configuration would provide a continuous distribution link from Immingham to Scunthorpe and onward to South Yorkshire, creating a backbone for future network expansion to several smaller demand clusters to the north and south of Sheffield. This strategic option is illustrated in **Figure 5** and illustrates how this option could present several routeing possibilities.

6.2.5 A pipeline route connecting Doncaster, Rotherham and Sheffield introduces greater complexity compared to Option 1, as the route interacts with more densely developed areas with a higher number of main road and motorway crossings. Therefore, routeing would likely be more complex and require careful consideration of engineering and planning constraints. South Yorkshire is also a former coal mining area which could increase construction risk to the Project.

6.2.6 Accessing some customers located within built up areas would potentially be challenging with limited options for routeing, due to limited gaps between built development and the need to potentially route spur pipelines within roads or roadside verges where available.

6.2.7 This strategic option would also need to consider a number of potential routeing options, including:

- A shorter northern alignment routeing to Doncaster passing through flood risk areas, low lying land drained farmland and soils high in peat content and of high grade BMV agricultural land; or
- A more southerly alignment, which could avoid low-lying floodplain areas, peat soils, and land drainage systems but at the expense of a much longer pipeline. This option would be easier to construct and be a better entry point into Sheffield. However, it would introduce harder connection options into Doncaster and Rotherham where there is limited space to find pipeline corridors.

Strategic Option 3: Humber to Nottinghamshire

6.2.8 This option also builds on Strategic Option 1 by extending the network south-west from Scunthorpe towards additional hydrogen production at High Marnham and high industrial demand in Newark and Kirton. It also opens up the central part of the study area, which whilst having fewer high demand clusters, does give future options to link to the south connecting Strategic Option 4 or enabling a future connection to South Yorkshire, either from Scunthorpe (as per Strategic option 2) or from a route further south. This strategic option is illustrated in **Figure 6**.

6.2.9 South of Scunthorpe, the route predominantly traverses rural areas, avoiding complex urban environments. This option is, therefore, more straight forward from a constructability perspective although will interact with productive agricultural land. However, there are potentially several river crossings and flood risk areas to navigate, in particular the crossing of the River Trent.

Strategic Option 4: Nottingham, Derby and Leicester

6.2.10 This option focuses on developing a hydrogen network centred on hydrogen production south of Nottingham. It is the only strategic option considered which is completely separate from Strategic Option 1. A network would extend north-east to Nottingham, west towards Derby and Burton upon Trent and south towards Leicester. Industrial customers to the north of Nottingham would likely be challenging to connect via a route through Nottingham and would require a route that circumnavigated the city through less developed areas to the east of the city. This strategic option is illustrated in **Figure 7**.

6.2.11 It is assumed that this option would rely upon a single hydrogen production plant, although there is strong demand in the region and potentially significant future demand from East Midlands Airport. Hydrogen production would be progressively phased. This would result in relatively limited demand being met in the early 2030's with demand ramping up in 2035 and beyond.

6.2.12 There are several constraints that add complexity to routeing for this option. This comprises the concentration and distribution of built-up areas, large areas of woodland, and multiple major transport corridors (including the M1 and A50) which would lead to a more complex network of main pipeline and spur connections. Crossings of the River Trent would also be needed with this option and there are several areas of minerals working to navigate.

6.3 Comparison of Strategic Options

6.3.1 **Table 6.1** sets out a comparison of the four strategic options considered as part of the Project at Pre-FEED. The comparison is based on the criteria listed in **Section 4.5**.

Table 6.1: Strategic Options Evaluation

	Option 1 Humber to Scunthorpe	Option 2 Humber to South Yorkshire	Option 3 Humber to Nottinghamshire	Option 4 Nottingham, Derby & Leicester
Hydrogen Production	Two initial hydrogen production plants. Additionally, Immingham is expected to host significant future hydrogen production capacity, making it a reliable anchor point for the network.	As per **Option 1.**	As per **Option 1**, plus additional hydrogen production at High Marnham.	Single hydrogen production
Customer Demand	Concentration of industrial users in Immingham, Grimsby, and Scunthorpe. Lower hydrogen demand than Option 2 and 3, but greater than Option 4.	As per **Option 1** plus demand concentration from a cluster of industrial customers, located in Doncaster, Rotherham and Sheffield. Highest customer demand option.	As per **Option 1** plus customer demand from a small number of high demand users. Marginally lower demand than Option 2.	Industrial customers spread across Nottingham, Derby, Burton on Trent and Leicester. This option has the lowest customer demand.
Operation considerations (safety, integration with ECH_2, resilience and security of supply, and future expansion opportunities)	Aligns with the broader objectives of ECH_2. Future connections southwards or westwards to link additional clusters.	As per **Option 1** plus provides a strong foundation for connecting high-demand region in and around South Yorkshire. Onward connections to the south of the region connecting to Option 4 would be a long connection.	As per **Option 1** plus the following: Adds hydrogen production at High Marnham which would add further resilience to a pipeline network. Creates a backbone for future southern extensions, including potential links to South Yorkshire or south towards Nottingham, Derby and Leicester.	Creates a southern spine for a hydrogen network, enabling future connections across Nottingham, Leicester, Derby, and potentially Northampton. However, does not provide an immediate link or meet the broader objectives of ECH_2. Such a link would need to come in later phases of development.
Constructability	Relatively straightforward construction, largely due to being much shorter in length, though	As per **Option 1**. Some customers would prove challenging to reach, particularly in Sheffield, and	As per **Option 1**. More straightforward to construct than Option 2 and 4 due to mostly rural land.	Some challenging urban areas for routeing spurs.

	Option 1 Humber to Scunthorpe	Option 2 Humber to South Yorkshire	Option 3 Humber to Nottinghamshire	Option 4 Nottingham, Derby & Leicester
	some spurs would need to negotiate industrial areas. Likely to be challenges with crossing utilities and other developments.	would require routeing within highways or wide verges to reach users in built up areas. Increased interaction with flood zones, dense network of land drainage, built-up areas and main road and motorway crossings. Potential for mining ground conditions risk.	Crossing of the River Trent and its floodplain required.	Some major crossings to negotiate including the River Trent. Some areas of mining ground conditions risk and mineral workings to consider in routeing.
Potential environmental and planning constraints	While the corridor is relatively unconstrained, the alignment must address flood risk areas near the Humber and River Trent, and avoid sterilising land allocated for future development. Proximity to the Humber Special Protection Area is also an important environmental consideration. No other significant environmental designations that would restrict pipeline routeing.	As per **Option 1**. Areas of flood risk and peat soils between Scunthorpe and Doncaster; areas of BMV agricultural land including areas of grade 2. Hatfield Moor and Thorne Moor Special Area of Conservation (SAC) located to the north-east of Doncaster. No significant environmental designations that would restrict pipeline routeing.	As per **Option 1**. Some areas of flood risk along the River Trent valley; Areas of BMV agricultural land, but could potentially avoid grade 2 areas. No significant environmental designations that would restrict pipeline routeing.	Extensive woodland, minerals extraction and built up area coverage, flood risk areas along the River Trent. No significant environmental designations that would restrict pipeline routeing.
Approximate Length (based on straight lines between start and end points)	42 km Main pipeline 26 km Spurs 68 km Total	110 km Main pipeline 30 km Spurs 140 km Total	100 km Main pipeline 30 km Spurs 130 km Total	120 km Main pipeline 40 km Spurs 160 km Total
Total Installed Cost	Least expensive option	+ circa £200 m over Option 1	+ circa £180 m over Option 1	+circa £300 m over Option 1
Hydrogen (GWh)/km	30	19	22	15

6.4 Preferred Strategic Option

6.4.1 All strategic options, with the exception of Option 4 start at proposed hydrogen production on the Humber. This supports the objectives of ECH$_2$ allowing for potential connectivity between other hydrogen projects at some point in the future and the development of a wider East Coast hydrogen network. Option 4 does not immediately contribute to this strategy as it does not build out from the Humber. Additionally, as Option 4 is reliant on a single hydrogen producer, it is less resilient than other options. It is also the option with the lowest demand and the lowest hydrogen per kilometre. As a result, Option 4 has been discounted.

6.4.2 Option 1 represents a project that connects users between the Humber and Scunthorpe and users within Scunthorpe. There is reasonable demand from users on the Humber and in Scunthorpe and the pipeline is relatively short in length. There are no environmental or constructability concerns especially as Option 1 is also common to both Option 2 and 3. Therefore, environment and constructability are not a differentiating factor for Option 1.

6.4.3 However, Options 2 and 3 are both longer and have the potential to connect more customers resulting in projects with higher customer demand. Therefore, both these options have a greater decarbonisation impact, and provide better future connection opportunities than compared to Option 1.

6.4.4 As reflected in **Table 6.1**, Strategic Option 2 had the highest customer demand of the strategic options considered. However, as the studies progressed, there was a significant change to the hydrogen demand profile within the South Yorkshire cluster. This was due to a change in the operational circumstances for one of the largest industrial customers in the South Yorkshire cluster. As a result of the changing operational circumstances of this customer, the Project could no longer rely on this future demand. As a consequence, this customer was removed from the assessment. Given the reduction in customer demand, which resulted in Strategic Option 2 no longer having the highest hydrogen demand option and due to some of the more challenging construction and environmental issues, as highlighted in **Table 6.1**, Option 2 was discounted.

6.4.5 It was decided to take Option 3 forward as the Preferred Strategic Option. Option 3 is preferred over Option 1, even though it delivers more hydrogen per km compared to Option 3, as it connects more potential customers, offers better future connection opportunities, which is supported by national policy[6], and greater flexibility to help accelerate the transition to hydrogen. It therefore has a greater potential decarbonisation impact. This option also aligns with the objectives of ECH$_2$ by building out and connecting production/customers in the East Coast area and the Humber industrial cluster. This option also benefits from additional hydrogen production at High Marnham, which gives the pipeline additional resilience. Furthermore, Option 3 does not appear to present any significant construction challenges with

[6] Paragraph 3.4.22 of NPS EN-1 states “In considering applications, the Secretary of State will expect applicants to consider foreseeable future demand when considering the size and route of their investments.

most of the route being flat and rural, plus there are no significant environmental designations (e.g., no nature conservation European sites, no designated landscapes).

7 Stage Two: Route Corridor Appraisal

7.1 Introduction

7.1.1 Using the Preferred Strategic Option identified in **Section 5.5.1**, a route corridor and HAGI search area appraisal was undertaken, based on the methodology described in **Section 4.6**. The appraisal focused on defining corridors that minimised interaction with potential constraints and provided sufficient space to generate and investigate several potential pipeline route alignments within them. Corridors approximately 2 km in width are considered wide enough to investigate potential routing alternatives, but are sufficiently narrow to focus the area of possible future development and to avoid the most significant constraints, such as villages and towns. Additionally, search areas have been defined for locating HAGIs. The HAGI search areas are wide and indicate approximate areas where it is considered several suitable sites could exist, and which will be subject to further investigation at the next stage of the Project (Stage Three: Pipeline Routing). Neither the corridors nor the HAGI search areas reflect the land take requirements of the Project. At this stage of the Project, they are reflective only of the search areas being used by the Project to find the optimum locations for the pipeline, HAGIs and other required infrastructure.

7.2 Description of Route Corridors

7.2.1 A total four corridors have been developed and investigated for the Preferred Strategic Option from the Humber to Nottinghamshire.

7.2.2 To help describe the corridor options, the Project has been divided into four sections (A to D), for ease of describing corridor options. It should be noted, only Section B and C have four options and all other sections have three options. The combination of section options that make up the Corridors Options 1 to 4 are illustrated in **Table 7.1**. The corridors are illustrated in **Figure 8**.

Table 7.1: Section Options used to form Corridor Options

	Corridor Option 1	Corridor Option 2	Corridor Option 3	Corridor Option 4
Section A: Immingham to Grimsby	A-1	A-2	A-3	A-1
Section B: Immingham to Scunthorpe	B-1	B-2	B-3	B-4
Section C: Scunthorpe to High Marnham	C-1	C-2	C-3	C-4
Section D: High Marnham to Kirton and Newark	D-1	D-2	D-3	D-1

7.2.3 For each section, a description of the considered route corridor options and HAGI search areas is provided. Key engineering, environmental and planning constraints have been identified and used to influence the selection of corridors considered within each section. The sections are described below.

Section A: Immingham to Grimsby

7.2.4 The Immingham to Grimsby corridor forms the northern and easternmost section of the proposed hydrogen pipeline and represents the starting point for distribution from the Humber production hub. Its primary purpose is to connect hydrogen production located in North Killingholme to industrial customers in Immingham and Grimsby, creating an anchor for the wider network. It includes two Hydrogen Production Plants, Humber H_2ub Green and Humber H_2ub Blue, that will be located to the north of the Total Lindsey Oil Refinery site near North Killingholme. This section will connect the following customers:

- Lenzing Fibers located in Grimsby;
- Knauf located in Immingham; and
- Tronox Stallingborough Plant located in Immingham.

7.2.5 Although this section represents a relatively short section of the pipeline network, three principal route corridor options have been identified within the Immingham to Grimsby corridor.

7.2.6 **Figure 9** illustrates the corridor options, HAGI search areas and the key constraints for Section A.

Section A Route Corridor Options

7.2.7 Option A-1 is routed inland of industrial development and residential areas of North Killingholme and Immingham. It interacts with the proposed Humber Carbon Capture Pipeline (CCP) project around north and South Killingholme. This alignment also gives better separation from residential properties, and areas allocated within current and emerging local planning policy than Option A-2 but passes through agricultural areas and some areas of flood zone 2 and 3. There are some consented solar and Battery Energy Storage System (BESS) developments south of Immingham located within the corridor.

7.2.8 Option A-2 is located closer to the Humber and industrial areas of Immingham and Grimsby. This corridor is the shortest route between the hydrogen production cluster and the industrial demand and minimises impacts on agricultural land. However, it interacts with the draft boundary of the proposed Humber CCP project more so than Option 1 and is closer to residential areas. There are also a number of planning allocations in the local plan and planning permissions for a data centre, housing and solar/ BESS development.

7.2.9 Option A-3 tracks in a more south westerly direction from the north of the Total Lindsey Oil Refinery site and minimises interaction with the Humber CCP proposals through a perpendicular crossing, but it is the longest corridor thus increasing potential costs. This corridor also passes through some areas of grade 2 BMV agricultural land.

7.2.10 As highlighted in **Table 7.1**, there is no Option A-4 in Section A.

7.2.11 All options converge to the south of Immingham where customer spurs will be needed. There are several constraints in this area, including proximity to the Humber Estuary SPA, flood risk zones, planned and built development, several road crossings and existing utilities.

Section A HAGI Search Areas

7.2.12 In Section A, the following HAGIs will be required, including:

- A HAGI will be required to connect the two hydrogen production plants at North Killingholme
- A HAGI to provide a junction for a main pipeline to Section B and main pipeline to a further HAGI for customer spurs south of Immingham;
- A HAGI for customer spur connections; and
- HAGIs to be located at each of four industrial customers.

7.2.13 The HAGI search areas that have been identified based on the above requirements are shown in **Figure 9**.

7.2.14 HAGI Search Area A-I is to combine connections from the hydrogen production spurs to form a single main pipeline south towards Immingham. The search area is not particularly constrained by environmental constraints other than its proximity to the Humber SPA, and two scheduled monuments (that have been removed from the search area). The search area is located outside of the Humber Estuary floodplain. However, there are constraints in the form of scattered residential buildings, listed buildings and industrial development to consider in its siting.

7.2.15 HAGI Search Area A-II is needed to enable the main pipeline to split into two, with one pipeline tracking west into Section B and the other continuing towards industrial customers south and east of Immingham. The search area is located between Ulceby and Habrough. The search area is split by the M180 motorway with the junction to the A160 and there are also railway lines passing through the search area. Space for a HAGI would be limited to open agricultural land. Some of this is grade 2 BMV land nearer to Ulceby. Views of the HAGI would also need to be considered from residential receptors at Ulceby and Habrough.

7.2.16 Finally, HAGI Search Area A-III is located near to Stallingborough and Healing in open agricultural land. The search area has been located outside of the Humber Estuary floodplain and there are few other environmental constraints in this area, other than being within 3.5 km of the Humber SPA. The nearby residential areas of Stallingborough and Healing and some dispersed farm buildings are also located close to the search areas. Whilst safety distances would be achieved in the final location, views of the HAGI in the open landscape will need to be considered.

Section B: Immingham to Scunthorpe

7.2.17 The Immingham to Scunthorpe corridor extends west from the Humber production hub and Immingham industrial customers to connect the North Lincolnshire demand cluster in and to the east of Scunthorpe.

7.2.18 This section will connect the following customers:

- Singleton Birch, located north east of Barnetby le Wold;
- British Steel, located in Scunthorpe;
- Tayto Group, located in Scunthorpe; and
- Heidelberg, Calumite located in Scunthorpe.

7.2.19 Four broad corridor options have been considered for approaching Scunthorpe and enabling the route to continue southwards to Section C.

7.2.20 **Figure 10** illustrates the corridor options, HAGI search areas and the key constraints for section B.

Section B Route Corridor Options

7.2.21 Immediately west of Section A and leading from HAGI Search Area A-II, three options from Section A (Option B-1 to B-3) converge to follow the same corridor tracking the M180 motorway in a westerly direction for approximately 7.5 km. From this point on the three options for approaching industrial customers in Scunthorpe and for continuing south into Section C vary in alignment.

7.2.22 Option B-1 follows a relatively direct route westward from Immingham, following the M180 motorway. There are some woodland constraints, including several SSSI to the south-east of Scunthorpe. Further constraints comprise the town of Brigg and Scawby and several areas of former mineral working to the south of Scunthorpe. There is also low-lying land around Brigg and the River Ancholme and New River Ancholme, which is flood risk zone 2 and 3. Option B-1 also includes a small area of deep peat to the south of Brigg, but route alignments could avoid this area by routeing elsewhere within the corridor. Due to the constraint outlined, this corridor has been widened beyond 2 km to approximately 4 km to allow for flexibility with regards to future pipeline routeing. However, this corridor does offer the shortest route to Scunthorpe from Immingham, reducing overall pipeline length and construction costs.

7.2.23 Corridors to the north of Option B-1 were considered but discounted as not being viable due to constraints on the east side of Scunthorpe which would restrict the ability to find a feasible main pipeline route to industrial users and then south into Section C. These constraints comprised significant areas of woodland and built development. Such a corridor would also result in a longer pipeline route and higher cost for the Project.

7.2.24 Option B-2 tracks south of Option B-1, and facilitates an onward southerly pipeline corridor into Section C. The purpose of this is to principally avoid the low-lying land, flood risk and deep peat soils and minimise interaction with Grade 2 BMV agricultural land in Section C. Within Section B, Option B-2 tracks south passing through some grade 2 BMV agricultural land. There are some limited areas of flood risk, but the corridor is generally quite rural with limited development. South of North Kelsey, a main pipeline would be needed to enable a connection to industrial users in Scunthorpe. This main pipeline spur would track due west passing through areas of deep peat, flood zones 2

and 3 and an area of grade 2 BMV agricultural soils. Eventually this connection joins Option B-1, from the south of Scunthorpe just to the north of Kirton in Lindsey, providing a connection to industrial customers in Scunthorpe from the south. The main benefit of this approach would be the avoidance of the woodland and SSSI areas to the south east of Scunthorpe which sit within Option B-1.

7.2.25 Option B-3 tracks south west at Barnetby le Wold and continues south west into Section C. As it tracks south west through Section B, it crosses areas of deep peat, flood zone 2 and 3 and some small areas of grade 2 BMV agricultural land. Other than these constraints the corridor is largely rural open agricultural land. As with Option B-2, a main pipeline to spur connection would be needed to connect industrial users in Scunthorpe. This main pipeline occurs to the east of Kirton on Lindsey passing through grade 2 BMV agricultural land, before joining Option B-2, from the south of Scunthorpe just to the north of Kirton in Lindsey and approaching Scunthorpe from the south.

7.2.26 Option B-4 takes an entirely different corridor to the other options. It is the most southerly route of all options tracking from the HAGI Search Area A-III in the south of the corridor search areas. This option tracks through open agricultural land much of which is grade 2 BMV agricultural land. This option would also interact and need to cross through Brocklesby Park Registered Park and Garden. This generally comprises an area of woodland which in places is relatively narrow and could be crossed using trenchless techniques. This corridor would also require a spur pipeline connection to the industrial customer north east of Barnetby le Wold. This spur pipeline could use the same corridor as Option B-2 to avoid grade 2 BMV agricultural land. However, the length of this spur pipeline would make this the longest corridor option in Section B.

7.2.27 All four options approach the industrial customers in Scunthorpe from the south-east side of the town (which is where the industrial customers in Scunthorpe are located). As mentioned previously, there are constraints in this area including woodland, some smaller areas of which are designated. There is also some designated public open space, including Holme Hall Golf Club, a solar farm and Ashby Ville Local Nature Reserve.

Section B HAGI Search Areas

7.2.28 In Section B, the following HAGIs would be required, including:

- HAGI to allow the main pipeline to continue into Section C and to provide a connection for customer spurs for industrial customers in Scunthorpe;
- HAGI on the main pipeline to allow a spur pipeline to be created to the industrial customer north east of Barnetby le Wold; and
- HAGIs to be located at each industrial customer in Scunthorpe.

7.2.29 The HAGI search areas that have been identified based on the above requirements are shown in **Figure 10**.

7.2.30 HAGI Search Area B-I is needed for the HAGI to provide a spur pipeline, from Options B-1 to B-3, for the industrial customer to the north-east of Barnetby le Wold and continue the main pipeline to Scunthorpe and southwards. The

search area is located in open agricultural land, which is mostly grade 2 BMV land, with some grade 1. To avoid the grade 1 and 2 BMV land, the HAGI would need to be located towards the east and west of the search area.

7.2.31 HAGI Search Area B-II comprises a wide search area for a HAGI location for a pipeline in corridor Option B-1, that will allow customer spurs to feed industrial customers in Scunthorpe and allow the main pipeline to continue southwards into Section C. The search area accounts for the different corridor options in the locality and also the potential for future routeing options within corridors. On the south side of Scunthorpe, as previously discussed, there are areas of woodland, several SSSIs and some existing, former and planned mineral workings. The villages of Messingham and Scooter and scattered buildings present a further constraint. Suitable HAGI areas comprise open agricultural fields, most of which in the search area are located outside Grade 2 BMV agricultural land, with the exception of an area to the south-east of the search area.

7.2.32 HAGI Search Area B-III would be needed to locate a HAGI for a spur pipeline from the Option B-2 corridor to customers in Scunthorpe. This search area is largely unconstrained and is located in open agricultural land.

7.2.33 HAGI Search Area B-IV would be needed to locate a HAGI for a spur pipeline from the Option B-3 corridor to customers in Scunthorpe. This search area is also located in open agricultural land, a large proportion of which is grade 2 BMV agricultural land. There are no other significant environmental constraints identified at this stage.

7.2.34 HAGI Search Area B-V would be needed for a HAGI to provide a spur pipeline from Option B-4 to the industrial customer north-east of Barnetby le Wold. The search area has been located in a rural area outside of nearby grade 2 BMV agricultural land.

Section C: Scunthorpe to High Marnham

7.2.35 The Scunthorpe to High Marnham corridor extends southwards to connect to the HyMarnham hydrogen production facility proposed at High Marnham. No industrial users are connected within this section.

7.2.36 Four broad corridor options have been considered for this section. **Figure 11** illustrates the corridor options, HAGI search areas and the key constraints.

Section C Route Corridor Options

7.2.37 Option C-1 is a continuation of Option B-1 which turns southwards, south of Scunthorpe. It travels through largely unconstrained open rural areas for approximately 10 km passing only a small section of flood risk 2 and 3. After 10 km, it encounters some large consented solar developments including Tillbridge, Cottam, and West Burton . The corridor seeks to minimise interaction with the consented solar developments by avoiding the main solar array areas and keeping to areas designated for access, and electric cables. As the corridor passes the consented solar developments the corridor is also constrained by several small villages, though the corridor is wide enough to provide alternative potential routeing alignments to avoid these. South-west of Saxilby and the A57 the corridor enters the floodplain of the River Trent which

is flood risk zone 2 and 3. The corridor turns due west to the south of Thorney before having to cross the River Trent to connect into the proposed hydrogen production facility at High Marnham.

7.2.38 Option C-2 is a continuation of Option B-2 and takes a much more easterly approach to High Marnham. It does this to avoid the low-lying land in the River Ancholme valley which includes flood risk zones 2 and 3 and a large area of deep peat. It is also generally unconstrained for a large part of its southerly route, but as it turns west towards High Marnham, it crosses grade 2 BMV agricultural land and interacts with the consented West Burton solar development. Option C-2 then crosses Option C-1 and provides an alternative corridor entrance to High Marnham. This approach to High Marnham is located within the River Trent floodplain and is also constrained by the proposed One Earth solar development and a high voltage overhead transmission line, which reduces the available area for construction of a pipeline alignment, making this a much harder approach when compared to other options in this section.

7.2.39 Option C-3 is located between Option C-1 and Option C-2, the purpose of which is to track to the east of the consented Cottam, West Burton and Tillbridge solar developments. However, in so doing it passes through a greater area of grade 2 BMV agricultural land than Options C-1 and C-2. The benefit of Option C-3 over C-2 is that it is more direct and hence shorter in length which reduces the cost. South of the village of Glentworth, the corridor is largely unconstrained open rural agricultural land. To the east of Saxilby, the corridor passes through some flood risk zone 2 and 3, before turning south westwards and joining Option C-1 to the south of Saxilby or as an alternative at Spalford. It then follows Option C-1 for a short section crossing the A1133 and the River Trent and its floodplain as it approaches High Marnham.

7.2.40 The final corridor option, Option C-4, is a corridor option that branches off Option C-1 to the south of Gainsborough. The purpose of this corridor is to consider a more westerly path that is more direct to the industrial customer demand at Kirton, rather than the hydrogen production at High Marnham. The section of Option C-1 that precedes and leads into Option C-4 comprises largely open agricultural land, with some small areas of flood risk 2 and 3 and passes the consented Tillbridge solar farm. This option would need to find a route between some areas of ancient woodland at its start to the south of Gainsborough and would then need to route through the proposed Steeple solar development. The proposed Steeple solar development would restrict the routing options to a minimum and would probably require routing through a fairly wide proposed environmental mitigation area. This corridor also crosses the proposed 400kV Humber to High Marnham transmission line. Additionally, this corridor option also requires a spur connection to High Marnham, since Option C-4 tracks approximately 7km to the east. This spur would follow the Option D-1 between Kirton and High Marnham, which is described in Section D.

7.2.41 All options will need to approach the High Marnham Hydrogen production plant in the same way owing to the One Earth proposed solar development around the former power station site. Detailed routeing of a pipeline spur here

will need to consider the proposed solar developments alongside other surrounding constraints which includes electricity overhead transmission lines, areas of flood risk, proximity to the River Trent and some areas of grade 2 BMV agricultural land.

Section C HAGI Search Areas

7.2.42 In Section C, two potential HAGIs would be required, comprising:

- HAGI near or at the hydrogen production at High Marnham
- HAGI in corridor Option C-3 to allow a pipeline to continue southwards and split to connect to hydrogen production at High Marnham. This connection could alternatively be made at HAGI Search area D-III

7.2.43 There is limited space for a HAGI around High Marnham due to flood risk zones and planned development at High Marnham. At the present time, it is considered that a HAGI would be developed on the High Marnham site adjacent to the hydrogen production plant since there is room for development and the surrounding area is heavily constrained.

7.2.44 HAGI Search Area C-I is needed to allow a connection from Option C-3 to allow the pipeline to track southwards towards Newark but provide a link to High Marnham. The search area is located in open agricultural land. There are some residential properties that would need to be avoided and some areas of ancient woodland immediately adjacent to the south and east of the search area. There are also some small areas of flood risk zone 2.

Section D: High Marnham to Kirton and Newark

7.2.45 Section D forms the southernmost section of the pipeline corridor, extending from the High Marnham production area towards key industrial demand in Newark and Kirton.

7.2.46 This section will connect the following industrial users:

- Forterra located in Kirton; and
- British Sugar located in Newark.

7.2.47 Three broad corridor options have been considered for this section. **Figure** 12 illustrates the corridor options, HAGI search areas and the key constraints.

Section D Route Corridor Options

7.2.48 Route corridor options extending from the former High Marnham Power Station site towards Kirton and Newark, cross predominantly rural land interspersed with floodplain, mineral extraction zones, and large-scale solar developments. Key constraints include extensive flood risk zones 2 and 3 along the River Trent, proposed solar NSIPs such as One Earth Solar Farm and Great North Road Solar and Biodiversity park, and active quarry sites near Kirton.

7.2.49 Option D-1 takes a fairly direct route to Kirton from High Marnham, followed by a relatively direct route south east towards Newark. There are relatively few constraints between High Marnham and Kirton that restrict a direct approach. However, as highlighted in Section C, the proposed One Earth

solar development surrounding High Marnham will need to be navigated by all options in order to connect to the HyMarnham hydrogen production facility.

7.2.50 South of Tuxford there are several complex crossings to negotiate including two railway lines, the B1164 and a watercourse with a floodplain in a flood risk zone 2, all in close proximity to one another. As this option approaches the industrial customer at Kirton, the corridor passes through grade 2 BMV agricultural land, which could only be avoided by approaching with a more southerly route to the south of Laxton, which is a Conservation Area. This has been discounted on the basis of it being a longer route, would require careful routing to the south of Laxton and involve a crossing of an electricity overhead transmission line. The final approach to Kirton includes some constraints including ancient woodland and the Wellow Park and Kirton Wood SSSIs, some active mineral workings (associated with the industrial customer at Kirton) and areas allocated for mineral working.

7.2.51 Option D-1 continues south-west from Kirton, passing to the south of the Conservation area around Laxton and some areas of ancient woodland, some flood risk zones 2 and 3, and the Great North Road proposed solar development. Other than that, the approach to the west side of Newark is fairly unconstrained and comprises mostly open agricultural land.

7.2.52 Option D-2 considers the shortest and most direct route to Newark, routeing to the west of the River Trent floodplain and passing to the west of a conservation area around Sutton on Trent. It has the same rail and road crossings to negotiate as with Option D-1. However, this route is fairly constrained with areas of Grade 2 BMV agricultural land and extensive areas of the proposed Great North Road Solar and Biodiversity development, where there are limited options for routeing. The approach to Newark, joins the approach taken by Option D-1 to the west of Newark between Norwell and Little Carlton near to the HAGI search area (D-IV) and where D-1 crosses grade 2 BMV land and the River Trent floodplain. Whilst this corridor is the most direct to Newark, it would require a spur to Kirton. The spur pipeline would follow the same route as D-1 to Kirton.

7.2.53 Option D-3 takes a more easterly approach remaining as a continuation of Option C-3. It stays to the east of the River Trent until near Collingham to the north of Newark and then passes through the River Trent floodplain passing a number of scheduled monuments located in this area. A corridor to the east of Collingham, tracking outside the River Trent floodplain was discounted due to increased length, more railway crossings and additional scheduled monuments. The final approach to Newark is challenging from a construction viewpoint, with former flooded mineral workings and a crossing of the River Trent, the A1 and nearby railway line. Option D-3 also joins the Option D-1 corridor, near to Little Carlton and the HAGI search area (D-IV) in order to reach the industrial customer.

7.2.54 The final spur pipeline into the Newark based industrial customer requires another crossing of the River Trent, passing through areas of flood risk zone 2 and 3 and across an area of grade 2 BMV agricultural land, which is common to all corridor options.

7.2.55 As highlighted in **Table 7.1**, there is no Option D-4 in Section D.

Section D HAGI Search Areas

7.2.56 In Section D, the HAGIs required would include the following:

- HAGI to allow connection to customer spurs; and
- HAGIs to be located at each industrial customer.

7.2.57 The HAGI search areas that have been identified based on the above requirements are shown in **Figure 12**.

7.2.58 HAGI Search Area D-I relates to route corridor option D-1 and is needed for a customer spur pipeline at Kirton whilst continuing the main pipeline southwards towards Newark as well as a potential main pipeline to the west towards Mansfield. If route corridor Option C-4 is used this HAGI would also be needed to receive the main pipeline from the north and provide for a spur pipeline to High Marnham. As highlighted in the description of the Option D-1 corridor and spur pipeline, the area near to the industrial customer at Kirton is quite constrained with Grade 2 BMV agricultural land, ancient woodland and two SSSIs along with existing and planned mineral workings.

7.2.59 HAGI Search Area D-II is needed should route corridor Option D-2 be selected. This HAGI would provide for a customer spur pipeline to Kirton and a continuation of the main pipeline into the Option D-2 corridor. This search area largely comprises unconstrained open agricultural land, although it does interact with small sections of planned solar development.

7.2.60 HAGI Search Area D-III relates to route corridor Option D-3, which is a continuation of Option C-3, and a route corridor staying to the east of the River Trent floodplain. As a result, a HAGI would be needed to provide a main pipeline spur connection to High Marnham. The search area for a HAGI here comprises largely open agricultural land with some limited flood risk zone 2 associated with the River Trent. Other than a few isolated buildings, there are no other significant constraints in this search area.

7.2.61 HAGI Search Area D-IV is needed to locate a HAGI to provide a spur connection into the industrial customer at Newark and to enable future onward main pipeline connections southwards towards Nottingham, Derby and Leicester. The search area comprises some areas of open agricultural land, but also some woodland areas.

7.3 Evaluation of Route Corridor Options

7.3.1 This section presents the findings of the overall route corridor appraisal, from the Humber to Nottinghamshire, and the selection of the Preferred Route Corridor. The Preferred Route Corridor will be taken forward into Stage Three: Pipeline Routing (see **Section 4.7**).

7.3.2 As outlined in **Section4.6**, the evaluation criteria used to appraise the route corridor options, including HAGI search areas, is as follows:

- Operational considerations, such as safety and proximity to residential areas;
- Constructability considerations, such as major crossings or terrain challenges;

- Potential environmental, land use and planning constraints; and
- Factors influencing cost, such as length, number of HAGIs, complex crossings.

7.3.3 Four combined corridors have been considered by combining the section options described in **Section 6.2**.

7.3.4 The findings of the evaluation are presented in **Table 7.2**.

Table 7.2: Route Corridor Evaluation

	Corridor Option 1 (Corridors A-1, B-1, C-1, D-1)	Corridor Option 2 (Corridors A-2, B-2, C-2, D-2)	Corridor Option 3 (Corridors A-3, B-3, C-3, D-3)	Corridor Option 4 (Corridors A-1, B-4, C-4, D-1)
Operational considerations	No particular operational concerns. There is sufficient space to locate HAGIs away from sensitive receptors, such as residential areas.	No particular operational concerns. There is sufficient space to locate HAGIs away from sensitive receptors, such as residential areas, although search areas are slightly closer to residential development than other options.	No particular operational concerns. There is sufficient space to locate HAGIs away from sensitive receptors, such as residential areas.	No particular operational concerns. There is sufficient space to locate HAGIs away from sensitive receptors, such as residential areas.
Constructability	The corridor interacts with some areas of flood risk and has several major crossings including motorways, railway lines and the River Trent (see below). Interacts with consented solar developments (Tillbridge, Cottam and West Burton) in Section C-1 and proposed solar development (One Earth and Great North Road) in D-1 which may require some trenchless crossings or narrow working widths, however, likely to be able to avoid locations designated for solar arrays. Avoids constrained corridor along River Trent to north of High Marnham.	As per Option 1 has several major crossings (see below). Limited routeing options and challenging construction in approach to High Marnham in Section C and throughout Section D due to flood risk zones, River Trent crossing, solar array areas of consented (Cottam, West Burton) and proposed (One Earth and Great North Road) solar developments, public open space, buildings and small villages and electricity transmission lines.	As per Option 1 has several major crossings (see below). Manages to largely avoid interaction with the consented solar developments of Cottam, Tillbridge, West Burton, though would interact with the proposed One Earth solar farm at High Marnham. Limited routeing options and challenging construction through D-3 due to former flooded mineral workings, River Trent floodplain, residential buildings and multiple crossings. Avoids constrained corridor along River Trent to north of High Marnham.	As per Option 1 has several major crossings (see below). Route interacts with the solar arrays of the proposed Steeple solar developments in C-4 and to a lesser extent parts of the Great North Road solar farm in D-1. Limited routeing options and would probably require trenchless crossings in a number of places to cross the Steeple solar farm. Avoids constrained corridor along River Trent to north of High Marnham.
Major Crossings	Motorway - 3 Railway - 11	Motorway - 2 Railway - 8	Motorway - 2 Railway - 11	Motorway - 2 Railway - 10

	Corridor Option 1 (Corridors A-1, B-1, C-1, D-1)	Corridor Option 2 (Corridors A-2, B-2, C-2, D-2)	Corridor Option 3 (Corridors A-3, B-3, C-3, D-3)	Corridor Option 4 (Corridors A-1, B-4, C-4, D-1)
	A Roads - 14 Watercourses – 4 **Total - 32**	A Roads - 17 Watercourses – 5 **Total - 32**	A Roads - 16 Watercourses – 6 **Total – 35 (plus challenging crossing of flooded mineral working in Section C-4)**	A Roads - 14 Watercourses – 3 **Total – 29 (plus Steeple Solar Farm arrays and Brocklesby Park Registered Historic Park and Garden)**
Length	Approx. 150 km	Approx. 155 km	Approx. 165 km	Approx 160 km
Number of HAGI (excluding BVIs and HAGIs within industrial customer sites)	8	8	8	7
Environmental constraints	Corridor includes areas of Grade 2 BMV agricultural land, though less than Option 3 and 4. Flood risk zones 2 and 3 crossing River Ancholme (B-1) and River Trent. Woodland and SSSI to south and south-east of Scunthorpe and at Kirton (common to all options).	Corridor includes areas of Grade 2 BMV agricultural land but passes through less areas than other options. Passes through area of deep peat in B-2. Flood risk zones 2 and 3 crossing River Ancholme (B-2) and River Trent. Woodland and SSSI to south and south-east of Scunthorpe and at Kirton (common to all options).	Passes through the most grade 2 BMV agricultural land; Passes through areas of deep peat in B-3. Flood risk zones 2 and 3 crossing River Ancholme (B-3) and River Trent. Woodland and SSSI to south and south-east of Scunthorpe and at Kirton (common to all options).	Passes through a large area of Grade 2 BMV agricultural land. Brocklesby Park Registered Park and Garden in B-4. Flood risk zones 2 and 3 crossing River Ancholme (B-4) and River Trent. Woodland and SSSI to south and south-east of Scunthorpe and at Kirton (common to all options). Areas of ancient woodland south of Gainsborough.
Planning constraints	Interacts with some other developments including consented (Tillbridge, Cottam, West Burton) and proposed	Interacts with the Humber CCP more than Option A-1. Some interaction with consented (Cottam, West Burton) and	Limited interaction with consented (Tillbridge, Cottam and West Burton) solar developments through Section	Interaction with the Steeple proposed solar development through Section C-4, resulting in limited room for pipeline route

	Corridor Option 1 (Corridors A-1, B-1, C-1, D-1)	Corridor Option 2 (Corridors A-2, B-2, C-2, D-2)	Corridor Option 3 (Corridors A-3, B-3, C-3, D-3)	Corridor Option 4 (Corridors A-1, B-4, C-4, D-1)
	(One Earth, Great North Road) solar developments and the Humber CCP which is currently at pre-application stage and therefore the final route, including above ground infrastructure is not yet fully defined.	proposed (One Earth, Great North Road) solar developments in Option C-2.	C-3, though like all other options would interact with the proposed One Earth and Great North Road solar farms.	optionality. Has least interaction with Humber CCP proposals but is the only option to cross the National Grid's Humber to High Marnham proposals for a high voltage 400kV overhead transmission line.

7.4 Preferred Route Corridor

7.4.1 The evaluation of the route corridors shows that no significant construction, environmental or planning constraints currently identified between Humber and Nottinghamshire, cannot be avoided. This is generally considered to be in line with the general view that the topography and countryside along the corridors is largely open rural agricultural land making it generally suitable for pipeline construction. However, four corridors have been investigated to consider alternative ways of connecting industrial customers and hydrogen production to avoid development constraints, as much as practically possible.

7.4.2 However, there are localised constraints which none of the corridors can avoid. Some of the more challenging locations common to all corridors are the approaches to industrial customers where space for spur pipelines tends to be more constrained. Typical constraints include industrial and residential development, woodland, minerals workings, SSSIs and potentially contaminated land. The approach to industrial customers, generally being common to all options, are not a differentiator when determining the preferred corridor.

7.4.3 Option 2 is overall shorter in length than corridor Option 3 and 4 but is marginally longer and, therefore, more costly than Option 1. Option 2 is also routed to avoid more areas of grade 2 BMV agricultural land but does interact with an area of deep peat within the River Ancholme valley. Sections C-2 and D-2 also come with significantly greater construction challenges compared to other options. Therefore, this corridor is not being taken forward for further consideration at this time with other options considered to perform better.

7.4.4 Option 3 avoids the most interaction with consented solar farms but is the longest option. It passes through significantly more grade 2 BMV agricultural land compared to other options and passes through River Ancholme valley deep peat. This is due to the mainline staying east of the River Trent. However, by staying east of the River Trent, the corridor is presented with construction challenges which would be difficult and costly to overcome. Option 3 also has the highest number of major crossings. On this basis, this route corridor option is also discounted from further investigation.

7.4.5 Option 4 is the second longest option considered. Section B-4 also interacts with the Brocklesby Park Registered Park and Garden and Section C-4 interacts with solar developments, where there is little room for alternative pipeline alignments. This option also passes through significant areas of grade 2 BMV agricultural land in Section B-4. Brocklesby Park could probably be avoided by using a long trenchless crossing technique, however, this would be complex and costly. The solar developments to the south of Gainsborough present very few opportunities for pipeline development. From an engineering and construction perspective, it was considered that this option presents significant challenges. Due to the factors identified above, Option 4 is discounted from further investigation at this time.

7.4.6 Option 1 is the shortest route corridor. It also minimises interaction with grade 2 BMV agricultural land and avoids the area of deep peat in the River Ancholme valley. On balance Option 1 minimises interaction with constraints

when compared to other corridors. It does interact with some consented solar development when passing through Section C-1, though there are several potential options for minimising this interaction by avoiding solar panel development and passing through areas earmarked for electric cables, access roads and potentially ecological mitigation, linked to the solar developments. Other options either interact with solar developments or result in marginally longer pipelines. Given Option 1 provides several routing options to minimise interactions with solar developments and interacts with fewer environmental and planning constraints than other options, Option 1 is being taken forward as the Preferred Route Corridor.

7.4.7 The Preferred Route Corridor (Option 1) has now been taken forward for EIA Scoping. In order to provide sufficient flexibility an EIA Scoping boundary has been created based on the Preferred Route Corridor but extended in some places to ensure there is sufficient space to investigate route alignments and avoid potential constraints. **Figure 13** illustrates the EIA Scoping boundary for the Preferred Route Corridor.

8 Next Steps

8.1.1 Feedback received from this first consultation on the Project and the Preferred Route Corridor will be reviewed and fed back into the Project as required.

8.1.2 The next steps in the evolution of the Project design will be pipeline routeing as described in Stage Three of the Project development methodology (see **Section 4.7**). This will begin to investigate pipeline route options within the Preferred Route Corridor in detail. This exercise will also take on board any comments provided during the first consultation.

8.1.3 The route options which will be generated following the consultation on the corridors and the preferred route option to be selected, will be subject to a further public consultation exercise later in the development process (Consultation Two) and prior to the submission of an application for development consent. Feedback from Consultation Two will also be reviewed and fed back into the Project design.

400000
440000
480000
520000

Wakefield
Doncaster
Sheffield
Lincoln
Nottingham
Derby
Lichfield
Leicester
Wolverhampton
Peterborough

400000
360000
320000

N

LEGEND

Study Area

0 10 20

Kilometres

H2East Pipeline
Humber to
Nottinghamshire

Cadent
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DESIGN EVOLUTION REPORT

STUDY AREA

FIGURE 2

Scale 1:500,000 @ A3

Date FEBRUARY 2026

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402.064333.00001.0076.1 Study Area

400000
440000
480000
520000
400000
360000

Wakefield
Doncaster
Sheffield
Lincoln
Nottingham
Derby
Lichfield
Leicester
Wolverhampton
Peterborough

N

0 10 20
Kilometres

LEGEND

Study Area

Hydrogen Producer

Hydrogen Demand Cluster

Potential Industrial Users by H_2 Demand (2035)

Gw/Hour

0 - 50

50 - 100

200 - 250

250 - 500

>500

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INDUSTRIAL USERS BY H_2 DEMAND AND PRODUCERS

FIGURE 3

Scale 1:500,000 @ A3

Date FEBRUARY 2026

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402.064333.00001.0035.1 Producers and Consumers

400000 440000 480000 520000

360000 400000

N

LEGEND

- Study Area
- Hydrogen Producer
- Hydrogen Demand Cluster
- Strategic Route Option

Potential Industrial Users by H_2 Demand (2035)

Gw/Hour

- 0 - 50
- 50 - 100
- 200 - 250
- 250 - 500
- >500

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STRATEGIC OPTION 1: HUMBER TO NORTH LINCOLNSHIRE

FIGURE 4

Scale 1:500,000 @ A3

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0 10 20 Kilometres

402.064333.00001.0048.1 Strat Op 1 Imming to N Linc

400000 440000 480000 520000

400000 360000

N

LEGEND

- Study Area
- Hydrogen Producer
- Hydrogen Demand Cluster
- Strategic Route Option

Potential Industrial Users by H_2 Demand (2035)

Gw/Hour

- 0 - 50
- 50 - 100
- 200 - 250
- 250 - 500
- >500

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STRATEGIC OPTION 2: HUMBER TO SOUTH YORKSHIRE

FIGURE 5

Scale 1:500,000 @ A3

Date FEBRUARY 2026

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0 10 20
Kilometres

402.064333.00001.0050.1 Strat Op 2 Imming to S York

400000 440000 480000 520000

400000 360000

LEGEND

- Study Area
- Hydrogen Producer
- Hydrogen Demand Cluster
- Strategic Route Option

Potential Industrial Users by H_2 Demand (2035)

Gw/Hour

- 0 - 50
- 50 - 100
- 200 - 250
- 250 - 500
- >500

N

0 10 20
Kilometres

H2East Pipeline Humber to Nottinghamshire

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STRATEGIC OPTION 3: HUMBER TO NOTTINGHAMSHIRE

FIGURE 6

Scale 1:500,000 @ A3 | Date FEBRUARY 2026

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402.064333.00001.0051.1 Strat Op 3 Imming to Notts

400000 440000 480000 520000

360000 400000

N

LEGEND

- Study Area
- Hydrogen Producer
- Hydrogen Demand Cluster
- Strategic Route Option

Potential Industrial Users by H_2 Demand (2035)

Gw/Hour

- 0 - 50
- 50 - 100
- 200 - 250
- 250 - 500
- >500

H2East Pipeline Humber to Nottinghamshire

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STRATEGIC OPTION 4: NOTTINGHAMSHIRE, DERBYSHIRE AND NORTH LEICESTERSHIRE

FIGURE 7

Scale 1:500,000 @ A3

Date FEBRUARY 2026

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0 10 20
Kilometres

402.064333.00001.0052.1 Strat Op 4 Notts Derby Leicester

460000 480000 500000 520000

420000 400000 380000

Section A
Section B
Section C
Section D

Option A-1
Option A-2
Option A-3
Option B-1
Option B-2
Option B-3
Option B-4
Option C-1
Option C-2
Option C-3
Option C-4
Option D-1
Option D-2
Option D-3

N

LEGEND

- Hydrogen Producer
- Potential Customer Location
- Option 1
- Option 2
- Option 3
- Option 4
- Section Division
- Urban Area

ENGLAND

0 5 10 Kilometres

H2East Pipeline Humber to Nottinghamshire

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DESIGN EVOLUTION REPORT

CORRIDORS OVERVIEW

FIGURE 8

Scale 1:250,000 @ A3

Date FEBRUARY 2026

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402.064333.00001.0053.1 Alternative Corridors Overview

510000
517500
525000
420000
412500
402.064333.00001.0060.1 Alternative Corridors Sections Only

HAGI Search Area: A-I
HAGI Search Area: A-II
HAGI Search Area: A-III
HAGI Search Area: B-I
Option A-1
Option A-2
Option A-3
Option B-1
Option B-2
Option B-4
Section A
Section B

N

LEGEND

- Hydrogen Producer
- Potential Customer Location
- Corridor Section Division
- HAGI Search Area

Corridor Option

- Option A-1
- Option B-1
- Option A-2
- Option B-2
- Option A-3
- Option B-4

0 2.5 5
Kilometres

H2East Pipeline Humber to Nottinghamshire

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DESIGN EVOLUTION REPORT

SECTION A: CORRIDOR OPTIONS

FIGURE 9

Scale 1:60,000 @ A3
Date FEBRUARY 2026

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487500 495000 502500 510000

412500

405000

LEGEND

- Hydrogen Producer
- Potential Customer Location
- Corridor Section Division
- HAGI Search Area

Corridor Option

- Option A-1
- Option B-1
- Option C-1
- Option B-2
- Option C-2
- Option A-3
- Option B-3
- Option B-4

HAGI Search Area: A-I

HAGI Search Area: A-II

HAGI Search Area: B-I

HAGI Search Area: B-II

HAGI Search Area: B-III

HAGI Search Area: B-IV

HAGI Search Area: B-V

Option A-1

Option B-1

Option C-1

Option B-2

Option C-2

Option A-3

Option B-3

Option B-4

Section A
Section B

Section B
Section C

N

0 2.5 5
Kilometres

H2East Pipeline Humber to Nottinghamshire

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DESIGN EVOLUTION REPORT

SECTION B: CORRIDOR OPTIONS

FIGURE 10

Scale 1:80,000 @ A3

Date FEBRUARY 2026

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402.064333.00001.0060.1 Alternative Corridors Sections Only

465000 472500 480000 487500 495000 502500 510000

405000 397500 390000 382500

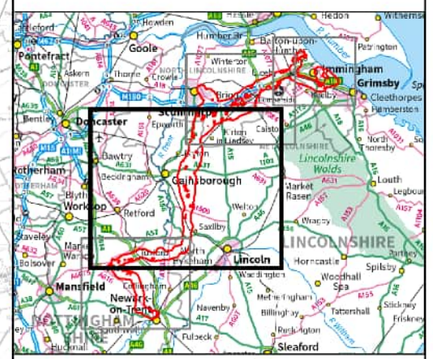
Option B-1
HAGI Search Area: B-II
HAGI Search Area: B-V
Option B-4
HAGI Search Area: B-III
HAGI Search Area: B-II
Option B-2
Option B-3
HAGI Search Area: Area B-IV
Section B
Section C
Option C-3
Option C-1
Option C-2
Option C-4
Option C-2
HAGI Search Area: C-1
Section C
Section D
HAGI Search Area: D-I
Option D-1
HAGI Search Area: D-II
Option D-2
Section C
Section D
HAGI Search Area: D-III
Option D-3

LEGEND

- Hydrogen Producer
- Potential Customer Location
- Corridor Section Division
- HAGI Search Area

Corridor Option

- Option B-1
- Option C-1
- Option D-1
- Option B-2
- Option C-2
- Option D-2
- Option B-3
- Option C-3
- Option D-3
- Option B-4
- Option C-4



0 2.5 5
Kilometres

H2East Pipeline Humber to Nottinghamshire

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DESIGN EVOLUTION REPORT

SECTION C: CORRIDOR OPTIONS

FIGURE 11

Scale 1:140,000 @ A3

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402.064333.00001.0060.1 Alternative Corridors Sections Only

465000 472500 480000 487500

367500

360000

Option C-4
Option D-1
Option C-2
Option C-1
Option C-3
Option D-2
Option D-3
Section C
Section D
HAGI Search Area: D-I
HAGI Search Area: D-II
HAGI Search Area: D-III
HAGI Search Area: D-IV
NEWARK AND SHERWOOD DISTRICT
NEWARK-ON-TRENT
SOUTHWELL

N

LEGEND

- Hydrogen Producer
- Potential Customer Location
- Corridor Section Division
- HAGI Search Area

Corridor Option

- Option C-1
- Option D-1
- Option C-2
- Option D-2
- Option C-3
- Option D-3
- Option C-4

0 2.5 5
Kilometres

H2East Pipeline Humber to Nottinghamshire

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DESIGN EVOLUTION REPORT

SECTION D: CORRIDOR OPTIONS

FIGURE 12

Scale	Date
1:80,000 @ A3	FEBRUARY 2026

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402.064333.00001.0060.1 Alternative Corridors Sections Only

460000 480000 500000 520000

420000 400000 380000

Section A

Section B

Section C

Section D

N

LEGEND

- Hydrogen Producer
- Potential Customer Location
- Preferred Corridor
- Section Division

ENGLAND

0 5 10 Kilometres

H2East Pipeline Humber to Nottinghamshire

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DESIGN EVOLUTION REPORT

EIA SCOPING BOUNDARY

FIGURE 13

Scale 1:250,000 @ A3

Date FEBRUARY 2026

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402.064333.00001.0058.1 Preferred Corridor

Appendix A GIS Constraints Data

GIS Constraints to be used in pipeline routeing

Constraint
A and B Roads
Agricultural Land classification LC Grade 1 and 2
Ancient Woodland
Areas of Mine Shaft Entries
Battlefields
Built development
COMAH
Common Land
Conservation Areas
Country Parks
Drinking Water Safeguard Zones
Electric overhead lines
Flood Defences
Above Ground Gas Sites
Greenspace
Listed Building - All Grades
Local Nature Reserves
Military areas
Motorway
National Cycle Network
National Grid Electrical Infrastructure
National Nature Reserve
National Park
National Trails
National Gas Transmission Pipelines
Peaty Soils Shallow and Deep
Priority Habitats
Quarries
Railway Station
Railway Track
Ramsar
Registered Parks and Gardens
Reservoirs
RSPB Reserves
Scheduled Monuments
Source Protection Zones (inner zone)

Source Protection Zones (outer zone and total catchment)
Special Areas of Conservation
Special Protection Areas
SSSI
Standoff distances from sensitive sites
Statutory Main Rivers
Tidal Water
UK Airfields
Utilities, such as gas and water pipelines, and electric and telcommunications cables
Watercourses
Woodland
World Heritage Site