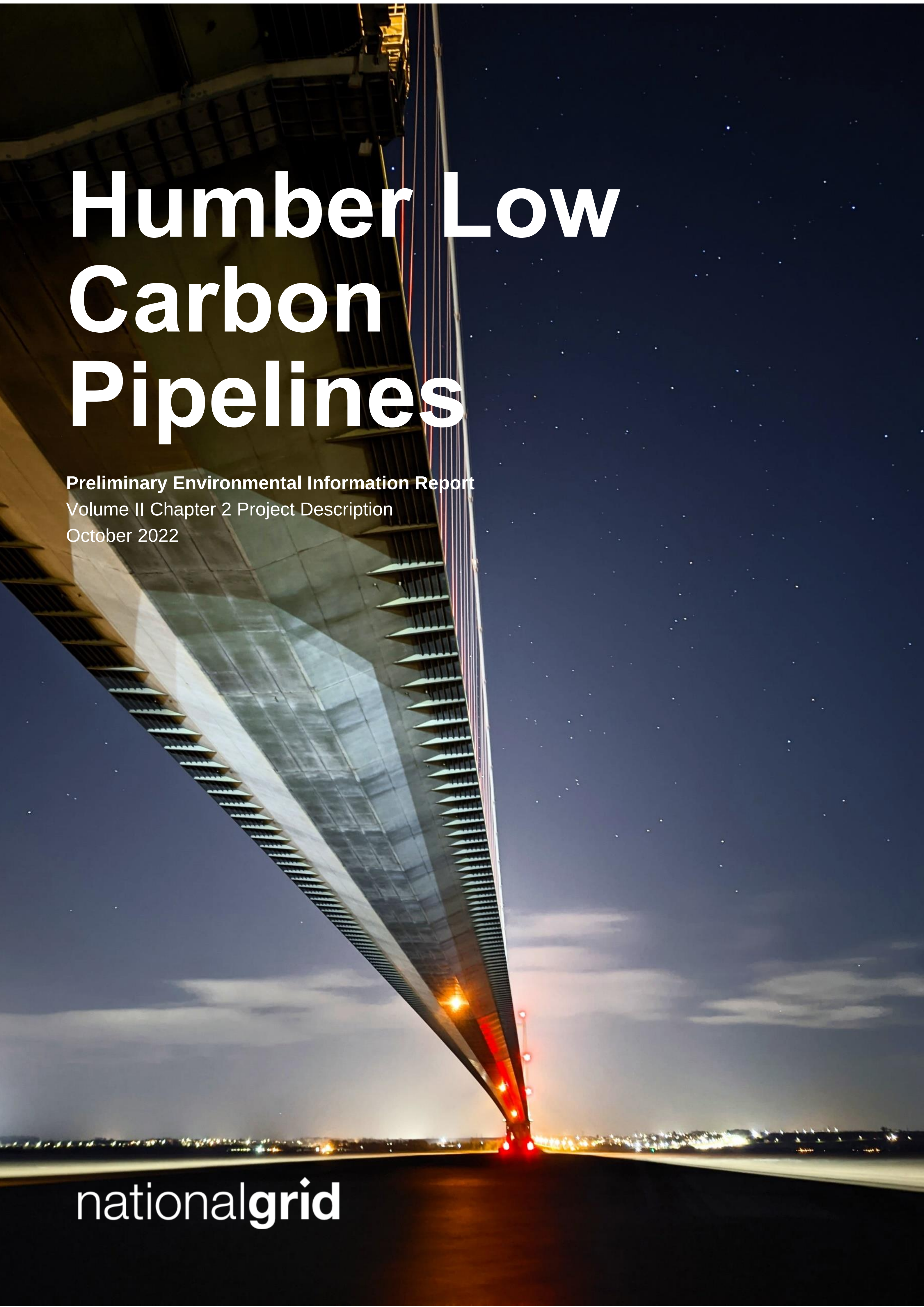


Humber Low Carbon Pipelines

Preliminary Environmental Information Report

Volume II Chapter 2 Project Description

October 2022

nationalgrid

Contents

2. Project Description

2.1 Introduction

2.1.1 This Chapter provides a description of the Humber Low Carbon Pipelines Project (referred to as the Project) for the purposes of identifying and reporting the potential environmental impacts and effects in this Preliminary Environmental Information Report (PEIR).

2.1.2 The description of the Project represents the current design parameters and configuration. However, following Statutory Consultation, a further update to the description of the Project will be included in the Environmental Statement (ES) which will confirm the details for which consent will be sought.

2.1.3 In order to ensure a robust assessment of the likely significance of the environmental effects of the Project, the Environmental Impact Assessment (EIA) is being undertaken adopting the principles of the 'Rochdale Envelope' approach where appropriate. This involves assessing a limit of deviation (in the case of the PEIR the Proposed Order Limits) and the maximum (or where relevant, minimum) parameters for elements of the Project (such as Above Ground Installations (AGI)) where flexibility needs to be retained. Refer to Section 4.7 in Chapter 4: EIA Methodology (Volume II) for further details on the Rochdale Envelope approach.

2.1.4 Justification for the need to retain flexibility in certain parameters is also outlined in this Chapter and in Chapter 3: Consideration of Alternatives (Volume II). As such, this PEIR represents a reasonable worst-case assessment of the potential impacts and effects of the Project at its current stage of design.

2.2 Project Context

2.2.1 The United Kingdom (UK) Government has set legally binding net zero carbon dioxide emissions targets. These include an amendment to the Climate Change Act 2008 to commit the UK to achieving net zero by 2050 (Ref 2.1).

2.2.2 The objective of the Project is to deliver new onshore pipeline infrastructure. This would transport captured anthropogenic carbon dioxide from the region's emitters to safe subsea storage and to enable industries to fuel-switch from fossil fuels to low carbon hydrogen.

2.2.3 The Project forms part of Zero Carbon Humber (ZCH), a consortium of leading energy and industrial companies and academic institutions with a shared vision to transform the Humber region into a net-zero carbon cluster by 2040.

2.2.4 ZCH initially includes the Connected Projects set out in Table 2.1. Each of the Connected Projects are subject to their own separate application for consent. A more detailed description of the Connected Projects will be included within the ES.

2.2.5 The Project has been designed around the Connected Projects within the ZCH consortium. However, the Project has also been designed to facilitate other developments to connect to it at a later date. Currently there is opportunity for future connectees to seek connections to a relevant carbon dioxide pipeline pursuant to The

Storage of Carbon Dioxide (Access to Infrastructure) Regulations 2011. However, the Government is also in the process of developing transport and storage network business models for both carbon and hydrogen pipeline infrastructure. Alongside adoption by Government of these business models, it is expected a general obligation to provide pipeline connections (subject to appropriate parameters) will be provided in future legislation and/or economic licence conditions to be adopted in relation to carbon and hydrogen networks, in line with the approach taken for gas and electricity networks. A single Carbon Capture and Storage (CCS) Network Code is also expected to stipulate minimum standards for connections and provide regulatory recourse should bilateral negotiations between users and network providers fail.

2.2.6 On the 12 August 2022 the Department for Business, Energy & Industrial Strategy (BEIS) announced the phase 2 short list of developments to receive CCUS cluster funding that could also connect to the Project. Three of these developments are not a Connected Project or part of ZCH. The developments on the short list include Keadby 3 Carbon Capture Power Station, Hydrogen to Humber Saltend, Humber Zero – Phillips 66 Humber Refinery, Prax Lindsey Oil Refinery Carbon Capture Project and ZerCaL250. Table 2.1 provides further details of the short list developments that are not Connected Projects. They are referred to as ‘Other Phase 2 Short List Projects’ within the table. An environmental assessment of the connections to the Other Phase 2 Short List Projects will be made at the time they are brought forward, consequent on any subsequent decision by BEIS to award funding following its due diligence exercise in relation to the short-listed projects (or any other projects that are considered viable for connection).

2.2.7 The Northern Endurance Partnership is made up of bp, Equinor, National Grid Ventures, Shell and Total and was formed to develop the carbon dioxide transportation and storage infrastructure to serve a diverse range of businesses in the Teesside and Humber regions. This includes an offshore pipeline approximately 100 km long to transport carbon dioxide from ZCH projects to a carbon dioxide storage facility in the Southern North Sea, known as Endurance.

2.2.8 The Northern Endurance Partnership will also serve Net Zero Teesside via a separate offshore pipeline of approximately 145 km length connecting to the Endurance storage facility. Net Zero Teesside is a cluster of projects in Teesside that is currently going through the Development Consent Order (DCO) process and is in the examination phase. All projects within Net Zero Teesside will be subject to separate consents.

2.2.9 Together ZCH, Net Zero Teesside and the Northern Endurance Partnership comprise the East Coast Cluster.

2.2.10 The East Coast Cluster has the potential to transport and securely store nearly 50% of all UK industrial cluster carbon dioxide emissions – up to 27 million tonnes of carbon dioxide emissions a year – by 2030. On 19 October 2021, the Minister of State for Energy, Clean Growth and Climate Change, the Rt Hon Greg Hands MP, confirmed that the East Coast Cluster had been identified as a ‘Track 1’ Cluster, meaning that it will be taken forward into Track 1 negotiations and will receive support under the Government’s Carbon Capture Usage and Storage (CCUS) Programme if they are deemed value for money for the consumer and taxpayer (Ref 2.2).

Table 2.1: Details of the Connected Projects

Connected Project	Applicant	Project description	Consenting regime
East Coast Cluster – Connected Projects			
Drax's bioenergy with carbon capture and storage (BECCS) project	Drax Limited	The proposal is to install carbon capture technology on up to two of the Drax Power Station's existing biomass generating units to remove up to 95% of the carbon dioxide from the flue gas emitted from those units. Drax Power Station is located 5 km southeast of Selby.	DCO Application – currently in pre-examination.
SSE Thermal's and Equinor's Keadby Clean Power Hub	SSE and Equinor	The Clean Power Hub comprises Keady 3 and Keadby Hydrogen. Keadby 3 is a low carbon Combined Cycle Gas Turbine (CCGT). The low carbon CCGT generating station will be fuelled by natural gas. It will be designed to operate with a post-combustion carbon capture plant and will generally be operated as a dispatchable low carbon generating station. Keadby Hydrogen would be a hydrogen fuelled power station. The Clean Power Hub is set to be located within Keadby in the vicinity of the other Keadby Power Stations (the existing Keadby 1 Power Station and Keadby 2 Power Station, which is under construction).	Keadby 3 – DCO Application currently in examination. Keadby Hydrogen – to be confirmed.
British Steel's Zero Carbon Humber scheme	British Steel	British Steel has developed an internal Low Carbon Roadmap discussion document for achieving a phased reduction of carbon dioxide emissions by 2030, 2035 and 2050. Within this roadmap, British Steel identified low carbon hydrogen as playing a major role in reducing emissions in the steel sector going forward. Subsequently, British Steel has held exploratory discussions with key partners on the potential supply and use of hydrogen from the ZCH dual carbon dioxide and hydrogen pipeline.	To be confirmed.
Uniper's blue and green hydrogen hub	Uniper	Uniper's hydrogen hub at Killingholme is set to be a large-scale hydrogen production hub with up to 700 megawatt (MW) blue hydrogen production and up to 100 MW green hydrogen production.	Town and Country Planning Application.

		Uniper's Killingholme Hydrogen Hub is expected to be located 1.3 km east of East Halton.	
Equinor's Hydrogen to Humber Saltend or H2H project	Equinor	A proposed hydrogen production facility that will convert natural gas to hydrogen whilst capturing the associated carbon dioxide emissions. This is known as blue hydrogen technology. The facility will be a 600 MW auto thermal reformer with carbon capture. It will be located at Saltend Chemicals Park just east of Hull on the north bank of the Humber estuary.	Town and Country Planning Application.
Northern Endurance Partnership – Connected Projects			
Northern Endurance Partnership	bp	This includes an offshore pipeline approximately 85 km long to transport carbon dioxide from Zero Carbon Humber projects offshore, and a carbon dioxide storage facility in the Southern North Sea, known as Endurance.	Oil and Gas Authority Storage permit.
Other Phase 2 Short-List Projects			
VPI Humber Zero (Philips 66 and VPI Immingham)	VPI Immingham B Ltd	The Humber Zero project aims to decarbonise the Immingham industrial hub via the use of post-combustion carbon capture. The Humber Zero project participants, VPI Immingham and Phillips 66, operate facilities at Immingham. VPI Immingham's Combined Heat and Power Plant supplies electricity and steam to the Phillips 66 Humber Refinery and nearby industry, as well as electricity to the grid. The Humber Refinery manufactures fuels and other associated products. It is anticipated that Humber Zero project will create a carbon dioxide stream for compression and transportation via a pipeline for storage in the North Sea. It is this Pipeline that the Humber Zero project will be undertaking the DCO Application for.	Carbon Dioxide Pipeline – DCO Application.
Prax Lindsey Oil Refinery Carbon Capture Project	Prax	The Prax Lindsey Oil Refinery is located in North Lincolnshire and extends across more than 500 acres. It manufactures crude oil and petroleum products – more specifically, petrol and diesel for road vehicles, alongside specialty products like fuel oil, bitumen, kerosene and aviation fuel.	Unknown

		The Prax Lindsey Oil Refinery announced in September 2021 that they will be joining the V Net Zero Humber Cluster. It is anticipated that the Prax Lindsey Oil Refinery Carbon Capture Project will utilise CCUS technologies to accelerate the Prax Group's decarbonisation ambitions, this will be facilitated by connection to CO_2 pipelines and storage under the North Sea.	
Singleton Birch (ZerCal 250)	Origen and Singleton Birch	ZerCal 250 was short-listed as part of the BEIS Phase 2 process. Origen are in the final stages of developing a new zero-carbon lime kiln as part of a joint project with Singleton Birch — the UK's leading independent supplier of lime — at its quarry near Melton Ross in North Lincolnshire.	Unknown

2.3 Overview of the Project

2.3.1 The Project to be applied for in the proposed DCO application shall comprise the simultaneous construction of a dual pipeline system (one for carbon dioxide and one for hydrogen), as well as the associated AGIs. The majority of the carbon dioxide pipeline would be up to 600 mm (24”) nominal diameter and the hydrogen pipeline would be up to 900 mm (36”) nominal diameter. This is referred to as the Base Case in this PEIR. Further details regarding the diameter and capacity of the pipelines are provided in Section 2.4.

2.3.2 Also considered within this PEIR is the possibility of deploying a larger carbon dioxide pipeline, with a nominal diameter up to 750 mm (30”) (with the hydrogen pipeline remaining the same diameter as within the Base Case). This is referred to in this PEIR as Sensitivity 1.

2.3.3 For the purposes of the PEIR, an assessment has been carried out of the infrastructure to be constructed for the Base Case. Permanent and temporary land take for both the Base Case and Sensitivity 1 will be within the Proposed Order Limits. Sensitivity 1 could require an increase in temporary land take, with the construction working width increasing from approximately 80 m to 100 m, and a larger permanent easement could be required. The number of AGI locations required would remain the same.

2.3.4 It is anticipated that there will be no difference in the type of environmental impacts associated with the Base Case or Sensitivity 1. However, the overall magnitude of the impacts may vary. A full assessment of Sensitivity 1 will be undertaken and recorded within the ES if the larger carbon dioxide pipeline diameter is taken forward into the DCO application.

2.3.5 The DCO application will seek consent for the following key elements (applicable to the Base Case and Sensitivity 1) which form the Project:

- An onshore pipeline system to transport carbon dioxide from industrial and power sector Connected Projects, including power generators and hydrogen production plants in the Humber area. This includes interconnecting carbon dioxide pipelines between the main pipeline system and Drax, British Steel and the Hydrogen to Humber Saltend (H2H Saltend) project.
- An onshore pipeline system to transport hydrogen from production plant Connected Projects to end users (aligned with the carbon dioxide pipeline). This includes interconnecting hydrogen pipelines between the main pipeline system and Drax, British Steel and the Hydrogen to Humber Saltend (H2H Saltend) project.
- A tunnel beneath the Humber Estuary including launch and receiving arrangements.
- AGIs comprising:
    - A carbon dioxide and a hydrogen pipeline inspection gauge (PIG) trap arrangement at or in the vicinity of Drax Power Station (Drax AGI Options A to D);
    - A carbon dioxide and a hydrogen block valve between Drax and Keadby (Block Valve KP 19.3[1]);

[1] Note, KP refers to kilometre point and is an approximate location along the route.

- A carbon dioxide and a hydrogen connection arrangement at Keadby Power Station (Keadby AGI Options A, B and C);
- Connecting arrangements onto the main carbon dioxide and a hydrogen pipeline incorporating a block valve with PIG trap arrangements for the interconnecting pipelines to British Steel (Block Valve KP 46.3);
- A PIG trap facility at British Steel (British Steel AGI Options A and B);
- Two carbon dioxide and a hydrogen block valves between British Steel and Killingholme (Block Valve KP 57.4 Option A and Block Valve KP 57 Option B, and Block Valve KP75.1 Option A and Block Valve KP 75.2 Option B);
- A multi-junction at Killingholme (Killingholme AGI);
- A multi-junction at Hedon (Hedon AGI Options A and B);
- A carbon dioxide and a hydrogen PIG trap at Saltend (Saltend AGI Options A to D);
- A carbon dioxide and a hydrogen block valve between Saltend and Easington (Block Valve KP 109.6); and
- A Pump Facility (including PIG trap) at Easington, to increase the pressure of the carbon dioxide for transportation offshore to the storage facility.

  Note, for some AGIs various options are presented.

- A landfall at Easington which is the 'landing' point for the offshore carbon dioxide pipeline transportation system so it can connect into the Pump Facility and is where the carbon dioxide transportation pipeline infrastructure transitions from the onshore to the marine environment.

Project Design

2.3.6 The design of the Project that this PEIR is assessing and that will be applied for within the proposed DCO application is shared by different members of the East Coast Cluster as follows:

- National Grid Ventures are responsible for the design of:
  - The carbon dioxide and hydrogen pipeline infrastructure from Drax to the Pump Facility;
  - The AGIs (except for the PIG trap co-located with the Pump Facility); and
  - Any interconnections to the Connected Projects that have been agreed.
- bp are responsible for the design of the PIG trap on the downstream pipeline which is located at the Pump Facility and the carbon dioxide pipeline section from this location to mean low water spring (MLWS). A separate consent for the offshore carbon dioxide pipeline and offshore carbon dioxide store is also being progressed by bp.

2.4 Carbon dioxide and hydrogen pipeline route

2.4.1 This section describes the boundary within which the carbon dioxide and hydrogen pipelines would be developed ('Proposed Order Limits'). The information in this section remains indicative and subject to further design refinement. The Applicant continues to liaise with local stakeholders, including individuals, landowners and occupiers and local authorities to understand the impact of the Project, as well as working with engineering and environmental experts, to refine the route of the proposed pipelines and the Proposed Order Limits. The route of the proposed pipelines and the extent of the order limits will additionally be reviewed with regards to consultation feedback received during the statutory consultation phase.

2.4.2 The carbon dioxide and hydrogen pipelines are expected to run from Drax Power Station to the Pump Facility located near Easington on the Holderness Coast. There would be a section of carbon dioxide pipeline from the Pump Facility to MLWS that would connect to the separate offshore application.

2.4.3 In the Base Case, the carbon dioxide pipeline between Drax and the Pump Facility would be up to 600 mm (24") nominal diameter with a capacity up to 17.8 million tonnes of carbon dioxide per annum (MTPA) and a Maximum Allowable Operating Pressure (MAOP) of 136 barg. The carbon dioxide pipeline from the Pump Facility to MLWS would be designed to a MAOP of 235 barg with the operating pressure of the pipeline typically increasing with time as the offshore storage reservoir fills. It would be up to 711 mm (28") nominal diameter. The hydrogen pipeline would be up to 900 mm (36") nominal diameter, with a capacity up to 10 Giga Watts (GW) and a Maximum Operating Pressure (MOP) between 50 to 75 barg. As discussed in Section 2.3 above, it is possible that a larger carbon dioxide pipeline between Drax and the Pump Facility may be promoted (Sensitivity 1). This would be a 750 mm (30") diameter pipeline.

2.4.4 Other key features include:

- A design life of 40 years for the infrastructure from Drax to the Pump Facility and 25 years from the PIG trap at the Pump Facility to and the carbon dioxide pipeline from the Pump Facility to MLWS;
- Protection against corrosion such as cathodic protection and pipeline coating;
- Protection against loss of containment;
- Pressure sensors to allow continual remote monitoring;
- Telemetry to allow remote monitoring and operations of valves; and
- Pipeline marker posts.

2.4.5 The Proposed Order Limits have been split into five sections for the purposes of describing the route, namely:

- Section – 1 - Drax to Keadby;
- Section – 2 - Keadby to Scunthorpe;
- Section 3 – Scunthorpe to Killingholme;
- Section – 4 - Killingholme to Hedon (Humber Crossing); and
- Section – 5 - Hedon to Easington.

2.4.6 A description of the Proposed Order Limits is provided below and can be seen in Figure 2.1 (Volume IV). Compass directions in the text below are approximate.

Section 1 – Drax to Keadby

2.4.7 From the existing Drax Power Station, the route heads south-east of Drax through arable fields before crossing the River Aire. Here, the route is split into two possible options due to the potential for a Spherical Tokamak for Energy Production (STEP) Fusion plant at this location. Five siting options are currently being considered for the STEP Fusion, including at this location. The UK Atomic Energy Authority is undertaking a siting study to establish the best location. A decision on the location of the STEP Fusion plant is expected to be announced in 2022 and the route of the Proposed Order Limits are contingent upon this decision.

2.4.8 Route option 1 (as shown on Figure 2.1 (Volume IV)), continues south (through the potential STEP Fusion site) before crossing the A614 Rawcliffe Road and then shortly after (approximately 750 m) it crosses the M62 between Junctions 35 and 36.

2.4.9 Route option 2 (as shown on Figure 2.1 (Volume IV)), accounts for the possibility of the STEP Fusion plant location that is currently under consideration. It turns west and crosses the A645 before continuing south for approximately 1.91 km and then crosses the M62 between Junctions 35 and 36.

2.4.10 The route then continues south before crossing the Wakefield and Goole Railway Line, the Aire and Calder Navigation Canal and the Dutch River (all within approximately 200 m). The route then begins heading in a south-easterly direction crossing the Sheffield to Hull Railway Line and subsequently, continuing through arable fields towards Eastoft.

2.4.11 Before reaching Eastoft, the route begins heading south, crossing the A161 Crowle Road between Eastoft and Crowle. The route continues south through arable fields towards Keadby.

Section 2 – Keadby to Scunthorpe

2.4.12 From Keadby, the route travels south through arable fields before crossing the South Humberside Main Railway Line and shortly after, the Stainforth and Keadby Canal. The route then continues south through arable fields until crossing the Three Rivers and shortly after (approximately 150 m), the A18. The route then takes a short south-east trajectory before continuing south again.

2.4.13 The route crosses the M180 and continues south before turning east and crossing the River Trent to the south of West Butterwick. The route continues east before crossing the A159 Northfield Road and then continues east through arable fields, running in parallel with the M180 until it reaches an AGI to the south of British Steel's plant at Scunthorpe.

Section 3 –Scunthorpe to Killingholme

2.4.14 From the British Steel Plant at Scunthorpe, the route travels south initially crossing the M180 for a second time before continuing through areas of arable fields and deciduous woodland. It then turns east through further arable fields before crossing the A15 Ermine Street, continuing north-east. The route continues north-east direction crossing the Sheffield to Grimsby Railway Line. Prior to crossing the New River Ancholme, the route begins to head east.

2.4.15 Shortly after crossing the New River Ancholme (approximately 2 km), the route returns to a north-east trajectory through arable fields before crossing the A1084 Bigby High

Road. After continuing north-east through arable fields for approximately 700 m, the route crosses the Sheffield to Grimsby Railway Line again. The route then continues north-east through arable fields, briefly heading east before returning to a north-east trajectory.

2.4.16 The route carries on through arable fields before crossing the A18 High Street and subsequently progresses north through predominantly arable fields. The route continues north as it crosses the Manchester and Cleethorpes Railway Line and shortly after, the A180. As the route adjusts to a north-east trajectory, it crosses the A1077 Wootton Road. The route then turns east continuing through arable fields crossing the Barton Railway Line and approximately 1.54 km after, East Halton Beck.

2.4.17 The route progresses through predominantly arable fields before it curves south to reach Killingholme.

Section 4 – Killingholme to Hedon (Humber Crossing)

2.4.18 From Killingholme, the route heads north through arable fields. It then makes a sharp turn east as the route approaches the River Humber.

2.4.19 The route would cross the River Humber via tunnel to the north of Killingholme.

2.4.20 Once it has crossed the River Humber, the route heads north-east arable fields as it reaches Saltend.

Section 5 – Hedon to Easington

2.4.21 From Hedon, the route heads north-east across a mixture of arable fields and coastal/floodplain grazing marsh before crossing the A1033 Main Road. The route continues north-east through arable fields. It then turns to the east and progresses through arable fields, crossing an unmarked road. The route subsequently curves round and progresses south before weaving through arable fields crossing the A1033 Hollym Road.

2.4.22 The route heads to the south-east, continuing across arable fields eventually reaching the Pump Facility at Easington. The route then continues towards the coast where it connects to a separate consent at MLWS.

2.5 Above Ground Installations (AGI)

2.5.1 The AGIs are securely fenced compounds of varying size which form an essential part of the buried pipeline system for operation, inspection, maintenance and connection. The AGI would have an anticipated operational life of 40 years.

2.5.2 The AGI would be located within a secure compound surrounded by approximately 3 m high fencing. They would include low level lighting, but would not be permanently lit.

2.5.3 The types of AGI required for the Project include:

- PIG traps;
- Multi-junctions;
- Block valves; and
- A Pump Facility.

2.5.4 A description of the purpose of each AGI type is given below.

Pipeline Internal Gauge (PIG) trap installation

2.5.5 A PIG trap installation is an above ground site with horizontally mounted pipework vessel installed at either end of a section of buried pipeline to allow a pipeline internal gauge (PIG) to be inserted into the pipeline for the purpose of cleaning, gauging and inspection. A PIG would be launched from a PIG trap installation at one end of the pipeline and retrieved from a PIG trap at the other end of the pipeline.

Multi-junction installation

2.5.6 A multi-junction installation is an AGI at the connection point of a number of buried pipelines which accommodates PIG traps for each pipeline (to allow for the inspection and maintenance of the pipelines) and connecting pipework with isolation valves.

Block valve installation

2.5.7 Block valve installation are required for isolation and monitoring of the pipelines. These would include buried pipework, valves and an instrument building.

Pump Facility

2.5.8 A Pump Facility is proposed near to the landfall location at Easington to pressurise the carbon dioxide for onward transportation to the offshore subsea storage site.

2.5.9 The Pump Facility would be designed for:

- Unmanned operation under remote supervisory control of the control room managing the carbon dioxide pipeline transportation system; and
- To have suitable facilities for local operation in the event of telemetry failure, maintenance, upset conditions or other events.

2.5.10 The Pump Facility would be located within up to two security fences with a fence overall height of up to 3 m and would have a vehicle access point from the local road network for the site main entrance. A secondary access point may also be required to allow for emergency vehicles or egress. An internal access roadway would be provided around the Pump Facility to facilitate access to the various parts of the installation for ongoing maintenance and inspection activities.

2.5.11 The carbon dioxide and hydrogen pipeline infrastructure would terminate at the Pump Facility with PIG trap arrangements to facilitate pipeline cleaning, gauging and inspection. The PIG trap arrangement on the pipeline system downstream of the Pump Facility to the offshore storage site would also be located on the Pump Facility.

2.5.12 Provision would be made for up to eight pump units driven by electric motors to raise the pressure of the carbon dioxide which would be housed either in a single building or a series of buildings up to around 9 m high. If a series of buildings is utilised, the buildings would be arranged in a way so they can be constructed as and when they are required.

2.5.13 There would be a series of ancillary buildings (up to approximately 9 m high) located on the installation for administration (including office space, control room for maintenance personnel, toilet and welfare facilities for staff and visitors), site workshop and store, electrical switch room, analyser building, an instrument air package, nitrogen package, emergency generator etc. The buildings would be accessed either via the vehicle internal access roadway or via pedestrian access routes.

2.5.14 The Pump Facility would include equipment and process areas (i.e. for filtration, metering, cooling etc.) with pipework (both above and below ground) used to interconnect the equipment and process areas and pipework would be buried wherever practicable.

2.5.15 Under normal operation, minimum venting of the Pump Facility would be required. Venting would either take place locally to particular items of equipment/process areas or via vertical vent stacks with the tallest being up to 50 m above ground level. Carbon dioxide emissions from equipment and process areas would be minimised to the lowest practicable level.

2.5.16 Utilities including electricity, water, drainage and telecommunications would be required to the Pump Facility.

2.5.17 The Pump Facility would have its own fire protection system based upon a Fire Risk Analysis.

AGI locations

2.5.18 Table 2.2 below describes the AGI locations currently being considered and, in some cases, these include options for the location of that AGI. Consideration will be given to technical considerations and consultation feedback received before selecting the final locations that will be included within the DCO application. A confirmed list of AGI locations, along with relevant design parameters, their footprint and maximum heights will be provided within the ES.

Table 2.2: Description of the AGI options

AGI Name	AGI Type	Approximate location	Maximum parameters	Figure number	Description of location
Drax AGI (Option A)	PIG trap	X: 467158.4649 Y: 427909.6288	Approximately 120 m x 165 m (operational area). Surrounded by security fencing of up to 3 m high and, if required, surrounded by a 25 m wide natural planting strip to reduce any visual effect. Maximum building height approximately 8 m (temporary vent stack maximum height approximately 5 m).	Figure 2.1 (Volume IV) (Page 1 of 15)	• Located within the Parish of Long Drax. • The site is situated on arable land which is encompassed by industrial land to the south. Drax Power Station is located to the east through to the south-west of the site (approximately 230 m). • The nearest settlement is the village of Drax located approximately 1.04 km south. • There is a Scheduled Monument - more specifically, Drax Augustinian Priory – approximately 310 m north-west of the Site. • The site is located within Flood Zone 3. • There is a public right of way (PRoW) that runs in

AGI Name	AGI Type	Approximate location	Maximum parameters	Figure number	Description of location
					parallel with the eastern and southern edges of the AGI before continuing in a north-westerly direction.
Drax AGI (Option B)	PIG trap	X: 467021.6864 Y: 428024.1654		Figure 2.1 (Volume IV) (Page 1 of 15)	• Located within the Parish of Long Drax. • The site is situated on arable land which is encompassed by industrial land to the south. Drax Power Station is located to the east through to the south-west of the site (approximately 220 m). • The nearest settlement is the village of Drax located approximately 1.23 km south. • There is a Scheduled Monument - more specifically, Drax Augustinian Priory – approximately 180 m north-west of the AGI option. • The AGI option is located within Flood Zone 3.

AGI Name	AGI Type	Approximate location	Maximum parameters	Figure number	Description of location
					• There is a PRoW running through the site from the north-western corner to the southern edge.
Drax AGI (Option C)	PIG trap	X: 466702.3933 Y: 428129.2673		Figure 2.1 (Volume IV) (Page 1 of 15)	• Located within the Parish of Long Drax. • The AGI option is situated on arable land which is encompassed by industrial land to the south. Drax Power Station is located to the east through to the south of the AGI option (approximately 200 m). • The nearest settlement is the village of Drax located approximately 1.46 km south. • There is a Scheduled Monument - more specifically, Drax Augustinian Priory – approximately 100 m north of the AGI option. • The site is located within Flood Zone 3.

AGI Name	AGI Type	Approximate location	Maximum parameters	Figure number	Description of location
					• There is a PRoW running from the east to the west of the AGI option.
Drax AGI (Option D)	PIG trap	X: 466520.0102 Y: 428237.7998		Figure 2.1 (Volume IV) (Page 1 of 15)	• Located within the Parish of Long Drax. • The AGI option is situated on arable land which is encompassed by industrial land to the south. Drax Power Station is located to the east through to the south-west of the AGI option (approximately 180 m). • The nearest settlement is the village of Drax located approximately 1.69 km south. • There is a Scheduled Monument - more specifically, Drax Augustinian Priory – approximately 130 m north-east of the AGI option. • The AGI option is located within Flood Zone 3.

AGI Name	AGI Type	Approximate location	Maximum parameters	Figure number	Description of location
					• There is a PRoW running from the east to the west of the AGI option.
Block Valve KP 19.3	Block valve	X: 477946.3862 Y: 417933.884	Carbon dioxide installation - Approximately 90 m x 90 m (operational area). Hydrogen installation - Approximately 90 m x 90 m (operational area). Surrounded by security fencing of up to 3 m high and, if required, surrounded by a 25 m wide natural planting strip to reduce any visual effect. Maximum building height approximately 8 m (temporary vent stack maximum height approximately 5 m).	Figure 2.1 (Volume IV) (Page 3 of 15)	• Located within the Parish of Reedness. • Located within a rural location. • The nearest settlement is the village of Eastoft located approximately 2.85 km south-east. • There are two Grade II listed buildings within 1 km, the closest of which is Moorend Farmhouse located approximately 580 m north. The other, the Stable/Granary Range approximately 30 m west of Moorend Farmhouse, is located approximately 600 m north. • The AGI is located within Flood Zone 3. • There is a mineral safeguarding zone located

AGI Name	AGI Type	Approximate location	Maximum parameters	Figure number	Description of location
					approximately 750 m south-east.
Keadby AGI (Option A)	Block Valve	X 481652.4598 Y 412009.0886	Approximately 175 m x 100 m (operational area). Surrounded by security fencing of up to 3 m high and, if required, surrounded by a 25 m wide natural planting strip to reduce any visual effect. Maximum building height approximately 8 m (temporary vent stack maximum height approximately 5 m).	Figure 2.1 (Volume IV) (Page 4 of 15)	• Located within the Parish of Keadby with Althorpe. • Located within a rural location. • Located adjacent to an industrial area. Keadby Power Station is located directly east of the AGI option (approximately 2 m). • The nearest settlement is the village of Keadby, located approximately 1.56 km east. • The site is located within a historic landfill site, more specifically: Keadby Power Station. • The AGI option is located within a mineral safeguarding area.

AGI Name	AGI Type	Approximate location	Maximum parameters	Figure number	Description of location
Keadby AGI (Option B)	Block Valve	X 481580.7723 Y 411927.6549		Figure 2.1 (Volume IV) (Page 4 of 15)	• Located within the Parish of Keadby with Althorpe. • Located within a rural location. • Located adjacent to an industrial area. Keadby Power Station is located directly east of the AGI option (approximately 2 m). • The nearest settlement is the village of Keadby, located approximately 1.76 km east. • The site is located within a historic landfill site, more specifically: Keadby Power Station. • The AGI option is located within a mineral safeguarding area.
Keadby AGI (Option C)	Block Valve	X: 480481.946 Y: 412357.8276		Figure 2.1 (Volume IV) (Page 4 of 15)	• Located within the Parish of Crowle and Ealand. • Located within a rural location. • The nearest settlement is the village of Ealand,

AGI Name	AGI Type	Approximate location	Maximum parameters	Figure number	Description of location
					located approximately 1.46 km west. • There are seven historic landfill sites located within 1 km, the closest of which is: Keadby Power Station located 330 m east. • The AGI option is located within Flood Zone 3. • The AGI option is located within a mineral safeguarding area. • There are seven PRoWs located within 1 km of the site, the closest runs through the centre of the AGI option.
Block Valve KP 46.3	Block Valve	X: 491512.7195 Y: 406015.3281	Carbon dioxide installation - Approximately 90 m x 90 m (operational area). Hydrogen installation - Approximately 90 m x 90 m (operational area). Surrounded by security fencing of up to 3 m high and, if required,	Figure 2.1 (Volume IV) (Page 6 of 15)	• Located within the Parish of Messingham. • Located within a rural location. • The M180 runs to the north of the AGI. • The nearest settlement is the village of Holme,

AGI Name	AGI Type	Approximate location	Maximum parameters	Figure number	Description of location
			surrounded by a 25 m wide natural planting strip to reduce any visual effect. Maximum building height approximately 8m (temporary vent stack maximum height approximately 5m). (Note: if there is no connection to British Steel the dimensions of the installation will be as set out above. If a connection is required to British Steel the size of the installation could increase to accommodate the additional equipment required).		located approximately 950 m north-east. • There is one listed building within 1 km, Grade II Listed 'Holme Hall' located approximately 980 m north-west. • The AGI is located within a mineral safeguarding area. • There is one PRoW running perpendicular to the eastern section of the site, located approximately 170 m east.
British Steel AGI (Option A)	PIG trap	X: 493495.7135 Y: 409084.7069	Approximately 120 m x 165 m (operational area). Surrounded by security fencing of up to 3 m high and, if required, surrounded by a 25 m	Figure 2.1 (Volume IV) (Page 6 of 15)	• Located within the Parish of Messingham. • The site is situated on arable land which is encompassed by industrial land and the south-east portion of the

AGI Name	AGI Type	Approximate location	Maximum parameters	Figure number	Description of location
			wide natural planting strip to reduce any visual effect. Maximum building height approximately 8 m (temporary vent stack maximum height approximately 5 m).		site contains industrial equipment. British Steel is located directly east of the site (approximately 40 m) and there is a solar farm approximately 420 m southeast. • The nearest settlement is the Scunthorpe suburb of Ashby, located approximately 1.3 km south-west. • The AGI is located within a mineral safeguarding area. • There are two PRoWs located within 1 km of the site, the closest is located approximately 170 m to the south-east.
British Steel AGI (Option B)	PIG trap	X: 493520.7703 Y: 408607.2381		Figure 2.1 (Volume IV) (Page 6 of 15)	• Located within the Parish of Messingham. • The AGI option is situated on arable land which is encompassed by industrial land. British Steel is located directly east of the site (approximately 20 m) and

AGI Name	AGI Type	Approximate location	Maximum parameters	Figure number	Description of location
					there is a solar farm located approximately 330 m east. • The nearest settlement is the Scunthorpe suburb of Ashby, located approximately 1.3 km south-west. • The AGI option is located within a mineral safeguarding area. • There are two PRoWs located within 1 km of the site, the closest is located approximately 400 m to the south-east.
Block Valve KP 57.4 (Option A)	Block Valve	X: 498655.0605 Y: 405613.4497	Carbon dioxide installation - Approximately 90 m x 90 m (operational area). Hydrogen installation - Approximately 90 m x 90 m (operational area). Surrounded by security fencing of up to 3 m high and, if required, surrounded by a 25 m wide natural planting	Figure 2.1 (Volume IV) (Page 7 of 15)	• Located within the Parish of Scawby. • Located within a rural location. • The nearest settlement is Scawby, located approximately 990 m west. • The AGI option is located within a mineral safeguarding area.

AGI Name	AGI Type	Approximate location	Maximum parameters	Figure number	Description of location
			strip to reduce any visual effect. Maximum building height approximately 8 m (temporary vent stack maximum height approximately 5 m).		• The site is located within Flood Zone 3. • There are four PRoWs located within 1 km, the closest of which is located approximately 800 m east.
Block Valve KP 57 (Option B)	Block Valve	X: 498318.828 Y: 405391.985		Figure 2.1 (Volume IV) (Page 7 of 15)	• Located within the Parish of Scawby. • Located within a rural location. • The nearest settlement is Brigg, located approximately 930 m north-west. • The AGI option is located within a mineral safeguarding area. • There is a Flood Zone 3 area approximately 240 m east.
Block Valve KP 75.1 (Option A)		X: 511408.6936 Y: 412922.2493		Figure 2.1 (Volume IV) (Page 9 of 15)	• Located within the Parish of Ulceby. • Located in a rural location. • The nearest settlement is Croxton, located

AGI Name	AGI Type	Approximate location	Maximum parameters	Figure number	Description of location
					approximately 1.45 km south-west. • There is one Grade I Listed Park and Garden within 1 km, 'Brocklesby Park, located approximately 760 m south-east. • . • The AGI option is located within a mineral safeguarding area. • There is a Flood Zone 3 area approximately 20 m south-east. • There are three PRoW located within 1 km, the closest of which runs parallel to both the northern and eastern edge of the site.
Block Valve KP 75.2 (Option B)		X: 511374.1787 Y: 413005.3943		Figure 2.1 (Volume IV) (Page 9 of 15)	• Located within the Parish of Ulceby. • Located in a rural location. • The nearest settlement is Croxton, located

AGI Name	AGI Type	Approximate location	Maximum parameters	Figure number	Description of location
					approximately 1.57 km south-west. • There is one Grade I Listed Park and Garden within 1 km, 'Brocklesby Park, located approximately 810 m south-east. • The AGI option is located within a mineral safeguarding area. • There is a Flood Zone 3 area approximately 40 m north. • There are three PRoW located within 1 km, the closest of which runs parallel to both the southern edge of the site.
Killingholme AGI	Multi-junction	X: 515240.5727 Y: 419668.1697	Approximately 125 m x 185 m (operational area). Surrounded by security fencing of up to 3 m high and, if required, surrounded by a 25 m wide natural planting	Figure 2.1 (Volume IV) (Page 11 of 15)	• Located within the Parish of North Killingholme. • The site is situated on arable land and enclosed by an industrial area on both the eastern and southern sides.

AGI Name	AGI Type	Approximate location	Maximum parameters	Figure number	Description of location
			strip to reduce any visual effect. Maximum construction height approximately 8 m (temporary vent stack maximum height approximately 5 m).		• The nearest settlement is the village of East Halton, located approximately 900 m to the west. • The North Haven Pits SSSI is located approximately 940 m east. • There are six PRoWs located within 1 km, the closest is located within the site. • There is a Flood Zone 3 area approximately 290 m south-east.
Saltend AGI (Option A)	PIG Trap	X: 517689.1651 Y: 427941.991	Approximately 120 m x 165 m (operational area) Surrounded by security fencing of up to 3 m high and, if required, surrounded by a 25 m wide natural planting strip to reduce any visual effect. Maximum building height approximately 8 m (temporary vent stack	Figure 2.1 (Volume IV) (Page 12 of 15)	• Located within the Parish of Preston. • Located within a rural location. • The A1033 runs near to the northern fringes of the site (approximately 110 m). The nearest settlement is the town of Hedon, located approximately 500 m north-west.

AGI Name	AGI Type	Approximate location	Maximum parameters	Figure number	Description of location
			maximum height approximately 5 m)		• There is one Scheduled Monument within 1 km – more specifically, 'Hedon Medieval Town' located approximately 670 m north-west. • There are three historic landfill sites located within 1 km, the closest of which is 'Haven' located approximately 80 m west. • The site is located within Flood Zone 3. • There are eight PRoWs located within 1 km, the closest is located approximately 60 m south of the site.
Saltend AGI (Option B)	PIG Trap	X: 517103.5575 Y: 427699.8713		Figure 2.1 (Volume IV) (Page 12 of 15)	• Located within the Parish of Paull. • The site is situated on arable land and enclosed by an industrial area on the northern side. • The Humber Estuary SSSI, Special Area of Conservation (SAC), Special Protection Area

AGI Name	AGI Type	Approximate location	Maximum parameters	Figure number	Description of location
					(SPA) and Ramsar is located approximately 30 m south-west. • There is one historic landfill site located within 1 km, more specifically 'Haven' located approximately 630 m east. • The site is located within Flood Zone 3. • There are two PRoWs located within 1 km, the closest of which runs parallel with the northern edge approximately 80 m away.
Saltend AGI (Option C)	PIG Trap	X: 517373.8314 Y: 426987.5281		Figure 2.1 (Volume IV) (Page 12 of 15)	• Located within the Parish of Paull. • Located in a rural location. • The nearest settlement is the village of Paull located approximately 770 m south-west. • The Humber Estuary SSSI, SAC, SPA and Ramsar is located

AGI Name	AGI Type	Approximate location	Maximum parameters	Figure number	Description of location
					approximately 850 m west. • There is one historic landfill site – 'Haven' – located approximately 940 m north-east. • The site is located within Flood Zone 3. • There is one PRoW located approximately 800 m east.
Saltend AGI (Option D)	PIG Trap	X: 516646.8858 Y: 426996.1331		Figure 2.1 (Volume IV) (Page 12 of 15)	• Located within the Parish of Paull. • Located in a rural location. • The site is in close proximity (approximately 260 m north) to an industrial area – more specifically, Saltend Chemical Park and Saltend Power Station. • The nearest settlement is the village of Paull located approximately 300 m south. • There is one Grade II Listed building, The Old

AGI Name	AGI Type	Approximate location	Maximum parameters	Figure number	Description of location
					Lighthouse and Adjoining Keeps House, located approximately 760 m south. • The Humber Estuary SSSI, SAC, SPA and Ramsar is located approximately 90 m west. • The site is located within Flood Zone 3. • There is one ProW that begins by running in parallel with the northern portion of the AGI option, working its way around to run alongside the western border of the AGI before continuing south and away from the AGI option (approximately 60 m at its closest point).
Hedon AGI (Option A)	Multi-junction	X: 518346.0787 Y: 426386.7754	Approximately 180 m x 180 m (operational area) Surrounded by security fencing of up to 3 m high and, if required,	Figure 2.1 (Volume IV) (Page 12 of 15)	• Located within the Parish of Paull. • Located in a rural location. • The nearest settlement is the village of Paull located

AGI Name	AGI Type	Approximate location	Maximum parameters	Figure number	Description of location
			surrounded by a 25 m wide natural planting strip to reduce any visual effect. Maximum building height approximately 8 m (temporary vent stack maximum height approximately 5 m)		approximately 1.3 km west. • The site is located within Flood Zone 3. • There is one PRoW located approximately 520 m north-east.
Hedon AGI (Option B)	Multi-junction	X: 518347.977 Y: 426925.6563		Figure 2.1 (Volume IV) (Page 12 of 15)	• Located within the Parish of Paull. • Located in a rural location. • The nearest settlement is the village of Hedon located approximately 1.07 km north. • There is one Scheduled Monument within 1 km – more specifically, ‘Hedon Medieval Town’ located approximately 970 m north. • The site is located within Flood Zone 3. • There are two historic landfill sites located within 1 km, the closest of which is ‘Haven’ located

AGI Name	AGI Type	Approximate location	Maximum parameters	Figure number	Description of location
					approximately 940 m north.
Block Valve KP 109.6	Block Valve	X: 525524.9354 Y: 428255.3482	Carbon dioxide installation - Approximately 90 m x 90 m (operational area) Hydrogen installation - Approximately 90 m x 90 m (operational area) Surrounded by security fencing of up to 3 m high and, if required, surrounded by a 25 m wide natural planting strip to reduce any visual effect. Maximum building height approximately 8 m (temporary vent stack maximum height approximately 5 m)	Figure 2.1 (Volume IV) (Page 13 of 15)	• Located within the Parish of Burton Pidsea. • Located within a rural location. • The nearest settlement is Halsham located approximately 1.33 km south-east. • The site is located within Flood Zone 3. • There is a PRoW located within 1 km, it runs in parallel to the southern edge of the AGI.
Easington Pump Facility (Option A)	Pump Facility (including PIG trap)	X: 539036.3146 Y: 420869.6085	Approximately 500 m x 350 m (operational area) Surrounded by security fencing of up to 3 m high and, if required, surrounded by a 25 m	Figure 2.1 (Volume IV) (Page 15 of 15)	• Located within the Parish of Easington. • Located within a rural location. • An industrial area – namely, Perenco

AGI Name	AGI Type	Approximate location	Maximum parameters	Figure number	Description of location
			wide natural planting strip to reduce any visual effect. Max height of the vent stack 50 m		Easington Gas Terminal - is located directly south of the site (approximately 80 m away). • The nearest settlement is the village of Easington, located approximately 1.2 km south. • The Site is located close to the Dimlington Cliff SSSI. • There is a Flood Zone 3 area approximately 280 m east. • There are four PRoWs located within 1 km, the closest is located on the eastern side.
Easington Pump Facility (Option B)	Pump Facility (including PIG trap)	X: 538869.0351 Y: 420286.4134		Figure 2.1 (Volume IV) (Page 15 of 15)	• Located within the Parish of Easington. • Located within a rural location. • An industrial area – namely, Perenco Easington Gas Terminal – borders the east of the site.

AGI Name	AGI Type	Approximate location	Maximum parameters	Figure number	Description of location
					• The nearest settlement is the village of Easington, located approximately 650 m southeast. • The Site is located close to the Dimlington Cliff SSSI. • There is a Flood Zone 3 area approximately 160 m west. • There are two PRoWs located within 1 km, the closest of which is located approximately 70 m northeast.

2.6 Other above ground infrastructure

Cathodic protection system

2.6.1 A cathodic protection system would be installed along the pipelines to protect them from corrosion.

2.6.2 The cathodic protection system, including cabling and ground beds, would be buried below ground and would be installed as part of the pipelines construction. Cabinets for the cathodic protection transformer rectifiers would be above ground and are required along the length of each pipeline. The transformer rectifier cabinets would be approximately 1 m high x 0.5 m wide x 0.5 m deep and are installed on a concrete plinth. The number and location of the cathodic protection cabinets is not yet known and is unlikely to be known at the ES stage, however, the preferred location for the transformer rectifier cabinets would depend on:

- Proximity to the pipelines;
- Ground resistivity;
- Ease of access for maintenance and inspection;
- Proximity to other buried metallic services and infrastructure;
- Proximity to power supplies;
- Any existing ground beds for other pipelines;
- Local environmental sensitivities; and
- Minimising interference with agricultural operations in the locality.

2.6.3 The transformer rectifier cabinets would require an electrical power supply and the supplies required would be progressed with the respective Distribution Network Operator (DNO) responsible for the local electricity network and is therefore not included as part of this Project.

2.6.4 The cathodic protection system would also include small above ground test posts (i.e. up to around 1.2 m high) strategically located along the pipelines to allow the cathodic protection to be monitored.

Marker posts

2.6.5 The Project would include the installation of small above pipeline marker posts (i.e. up to around 1.2 m high) strategically located along the pipelines, i.e. at field boundaries, at road, rail and watercourse crossings, at changes in pipeline direction etc, to highlight the presence of the pipelines. The exact design, number and location of marker posts are not known at this stage and will not be known for the ES.

2.6.6 The route of both pipelines would also be marked with aerial marker posts to facilitate the regular aerial surveillance operations to check for activities taking place close to the pipelines to prevent damage occurring.

2.7 Other

Communication system

2.7.1 At present, the communication system options are being considered. One option that is being considered is the use of a Fibre Optic Cable (FOC). The system would be installed along the entire length of the pipelines, connecting into communication equipment installed at each AGI.

2.7.2 It is assumed that underground FOCs would be within the trench for the pipelines.

Electrical connection

2.7.3 A connection into the local electricity network would be required for each AGI at the nearest practicable connection points. These connections would be undertaken via the respective statutory undertakers (i.e. DNOs) and are therefore not included as part of the Project. The potential for cumulative impacts from these electrical connections would be considered as part of the EIA, based on the information that is available at the time.

2.8 Construction

2.8.1 This section summarises the key construction activities of the Project.

Pipeline construction

2.8.2 The pipelines would be predominantly buried underground. The minimum depth from the top of the pipe to the ground surface would be in accordance with relevant standards but is typically 1.2 m in open cut trenched sections and deeper for trenchless crossings to avoid existing services and physical obstructions.

2.8.3 Open-cut trenching methods would be used for a majority of the pipeline route. For crossings of railway lines, specified roads, major watercourses and other major infrastructure, specialist trenchless techniques are anticipated to be used.

2.8.4 Construction of the pipelines would be undertaken by a specialist construction company(s) who would work under the management of the Applicant.

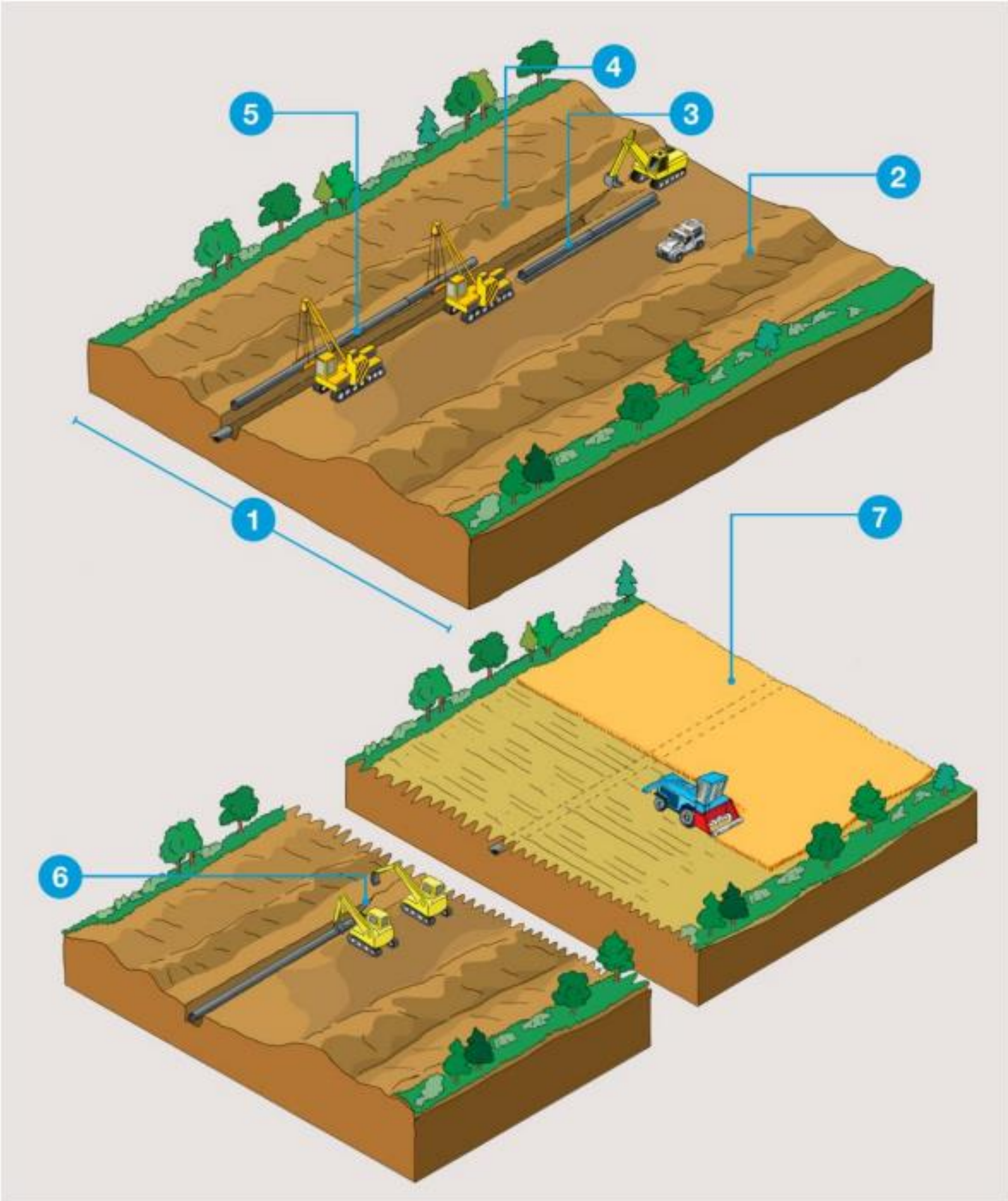
2.8.5 Construction of the pipelines would likely follow the following key steps:

1. Temporary construction working width is set out, i.e. the total area within which construction work would take place, is marked out.
2. The topsoil is carefully stripped and stored on one side of the construction working width.
3. The pipelines are delivered in short lengths and placed on supports. These short lengths of pipeline are welded together into longer sections called ‘strings’.
4. The pipeline trenches are excavated, with the excavated material being stored separately from the topsoil on the opposite side of the construction working width.
5. The pipeline ‘strings’ are then lowered into the trenches using specialist pipe laying equipment called ‘side booms’ and welded to the pipeline already installed.

6. The trench is backfilled using the previously excavated material and the topsoil reinstated.

7. Following reinstatement, the land is returned to its previous use.

2.8.6 Insert 2.1 below shows this process in diagrammatic form.



Insert 2.1: A diagrammatic representation of the open cut construction techniques likely to be employed along the majority of the route (Ref. 2.3).

2.8.7 More detail on the construction methodologies likely to be used are as follows:

Pre-construction activities

2.8.8 Ahead of construction, the route would be surveyed and marked/'pegged' out in consultation with the landowner/occupier. This would establish the precise alignment, particularly in relation to field boundaries and environmentally sensitive sites. Wherever practical, full use would be made of existing gaps in hedgerows and between mature trees, springs, seepage lines and rocky outcrops would be avoided.

2.8.9 The location and detail of existing land drainage schemes would be established based on information from landowner liaison, drainage surveys and intrusive investigation. Where necessary, and subject to agreement with the landowner/occupier, new field drains would be installed to:

- Enable the landowner/occupier's current drainage system outside of the construction working area to continue working throughout the period of pipeline construction;
- Replace existing drains damaged within the construction working area;
- Help prevent damage to the soil structure;
- Aid/accelerate soil structural recovery following completion of the construction activity; and
- Ensure the site work areas are kept as dry as practically possible.

2.8.10 The design of these drainage schemes would be agreed between the Applicant, the contractor and the landowners/occupiers. A specialist drainage contractor in most instances would carry out the work. Permanent records of the land drainage locations, including records existing drains connected, would be produced.

2.8.11 In addition, a number of engineering surveys would be carried out including surveys to locate existing services and geotechnical surveys to establish ground conditions using trial pits, boreholes and cone penetration tests.

2.8.12 If appropriate, bio-security measures would be implemented through liaison with Department for Environment, Food and Rural Affairs (DEFRA's) Animal Health and Veterinary Laboratories Agency.

Preparation of the construction working width

2.8.13 All construction activities would normally be undertaken within a demarcated strip of land, fenced in places, known as the construction working width. The working width would then be cleared of vegetation. Where possible, established trees would be worked around.

2.8.14 The topsoil would be stripped across the working width, using appropriate earth moving equipment. The width of topsoil to be stripped should generally be that required to contain the pipe trench, the pipe sections, the excavation plant, the temporary running track and the width required for stacking the subsoil. The full depth of the topsoil would be stripped and stored carefully to one side of the working width in such a way that it is not mixed with subsoil or trafficked over by vehicles or construction plant.

2.8.15 In general, access would be restricted to the fenced working width and vehicles would use the temporary running track. Access would be gained to and from the public highway at road crossings and at other agreed points of access.

Pipe stringing and welding

2.8.16 Lengths of pipe (typically around 12-18 m long) would be delivered to the working width, unloaded and located along the pipeline route (referred to as 'stringing'). Sections of pipe may then be bent on site using a bending machine to accommodate horizontal and vertical changes in direction and to mimic the contours of the ground.

2.8.17 The ends of the pipe are prepared, inspected, positioned together and then clamped in place for welding using a suitable welding technique. All welds are then inspected using suitable non-destructive techniques.

2.8.18 Uncoated parts of the pipe are then coated to prevent corrosion.

Trench excavation and pipe installation

2.8.19 The pipe trenches would be dug either with trenching machines or mechanical excavators. The material excavated from the pipe trenches would generally be stored on the opposite side of the working width from the topsoil to prevent the mixing of subsoil and topsoil, which might hinder reinstatement. The depth would be variable but would normally be installed to the contour of the land with a minimum reinstated cover level of 1.2 m over the top of the pipelines in agricultural land. The pipe trenches would be left open for the minimum length of time as is practicable. In areas where angular rocks or sharp stones are encountered, the pipe would need to be bedded on and surrounded by sand or similar material to prevent damage to the pipe and external coating.

2.8.20 Dewatering of the pipeline trenches may be required in some areas to stabilise the ground during construction.

2.8.21 Following trench excavation, the welded pipe sections would be carefully lowered into the trench in a continuous operation using specialist pipe laying equipment (i.e. 'sideboom' tractors) or equivalent plant. The pipe trenches would then be backfilled, where possible with the material taken from the trenches in the reverse order in which it was excavated preserving the original soil sequence. Sand (or similar material) padding may be used to protect the pipes if the backfill material is particularly unsuitable and in areas of rock.

2.8.22 The backfilled materials would be consolidated in layers by tamping or rolling to ensure consolidation comparable with the adjacent subsoil. Any excess material may be spread within the working width to 'crown' the trenches to allow for settlement and to aid consolidation.

2.8.23 Where necessary, outfall drains would be re-connected across the trench as part of the backfill operation.

2.8.24 Where necessary, additional post construction drainage would be installed within the construction working width to ensure that the integrity of the drainage infrastructure affected by construction is adequately restored. Detailed drainage designs would have regard to soil type, existing drainage systems and land levels.

Reinstatement

2.8.25 The ground would be reinstated with the stored topsoil. All surplus construction materials would be removed upon completion of the work.

2.8.26 The landowner/occupier would also be consulted before any off-site disposal is planned. In such instances, disposal would be undertaken in accordance with waste management regulations. Further detail is provided in Chapter 16: Waste and Materials (Volume II).

2.8.27 Following reinstatement, the restoration of the pipelines' construction working width would commence. Restoration activities would include reseeding of pastureland and reinstatement of field boundaries.

2.8.28 The route of the pipelines would be marked with marker posts at field boundaries. These would be visible from the ground and would be located to minimise interference with agricultural activities.

Pre-commissioning and commissioning (terrestrial pipelines)

2.8.29 The pipelines would be internally cleaned in sections to ensure removal of all debris. It would then be hydrostatically tested to prove its integrity in accordance with the relevant specifications. Water required for testing would be sourced and discharged from the same catchment location or sourced from groundwater and discharged with the agreement of the Environment Agency and the quality of the water being discharged would be monitored.

Pre-commissioning and commissioning (carbon dioxide/offshore pipeline)

2.8.30 Due to the linkage of the onshore section of the carbon dioxide pipeline and the offshore carbon dioxide pipeline (subject to a separate consent), it is highly likely that the carbon dioxide pipeline between the and the Endurance Store would be pre-commissioned as a single pipeline system.

2.8.31 The pre-commissioning activities for the carbon dioxide pipeline would include:

- Hydrotesting of the pipeline;
- Internal cleaning of the pipeline; and
- Dewatering and drying of the pipeline.

2.8.32 The carbon dioxide pipeline would be installed dry. The offshore sections would then be flooded with filtered and conditioned seawater (treated with oxygen scavenger and biocide) and the onshore section to the Pump Facility would be flooded with potable water sourced from a suitable local water supply. Details of chemical treatment would be determined at the detailed design stage.

2.8.33 Flooding PIGs would travel in front of the seawater to either landfall or the PIG trap at the Pump Facility. The Flooding PIGs would then run with dry air from onshore back offshore.

2.8.34 On reaching PIG trap at the Pump Facility, the pre-commissioning water would be stored either in a surface lagoon or using bladder tanks. Two options are currently being considered for disposal of the pre-commissioning water as follows:

- Water would be disposed to an offsite approved location; or
- Water would be injected back into the pipeline prior to de-watering operations and it would be discharged offshore.

2.8.35 There would be a requirement for additional equipment to support the offshore pipeline pre-commissioning works within the compound for the crossing of the cliffs and inter-tidal zone (discussed further below). This equipment may include compressors, air dryers, nitrogen production equipment etc.

2.8.36 The offshore pipeline and its pre-commissioning and commissioning activities offshore will be subject to a separate consent and will be considered as part of the cumulative assessment. The pre-commissioning and commissioning activities that involve equipment onshore and the disposal of treated seawater onshore will be assessed as part of this Project.

Terrestrial crossings

2.8.37 Tracks, minor roads and B-roads are anticipated to be crossed using open cut techniques unless otherwise specified. For tracks and minor roads, road closures and traffic diversions would likely be required. For B-roads, depending on size, works may be undertaken using either full or partial road closures with traffic controls.

2.8.38 For minor rivers, watercourses, ditched and streams open cut techniques are anticipated to be used. Regulating authorities, would be engaged as required depending on the nature of the waterbody throughout the crossing design and construction phases.

2.8.39 The crossing of trunk roads, motorways, railways and major watercourses (e.g. the River Trent) would be crossed using trenchless techniques. Trenchless techniques can install a pipeline underneath major obstructions without disturbance or interruption to the feature being crossed.

2.8.40 As part of the design development process, individual crossing locations would be assessed as being appropriate for open cut or trenchless techniques. The ES will identify the locations where trenchless techniques are expected to be used.

2.8.41 A description of the potential trenchless techniques that could be utilised are set out below.

Unguided Auger Boring (UAB)

2.8.42 UAB is a common economical method for construction of short trenchless crossings on pipeline projects.

2.8.43 UAB is mostly used on high pressure gas pipelines where line and level is not critical. UAB is usually driven from a long-thrust pit to the reception pit. This technique involves creating a base in a pit to an accurate line and level and setting up the rig inside that base. On completion of the works, these pits would be backfilled and the surface re-instated.

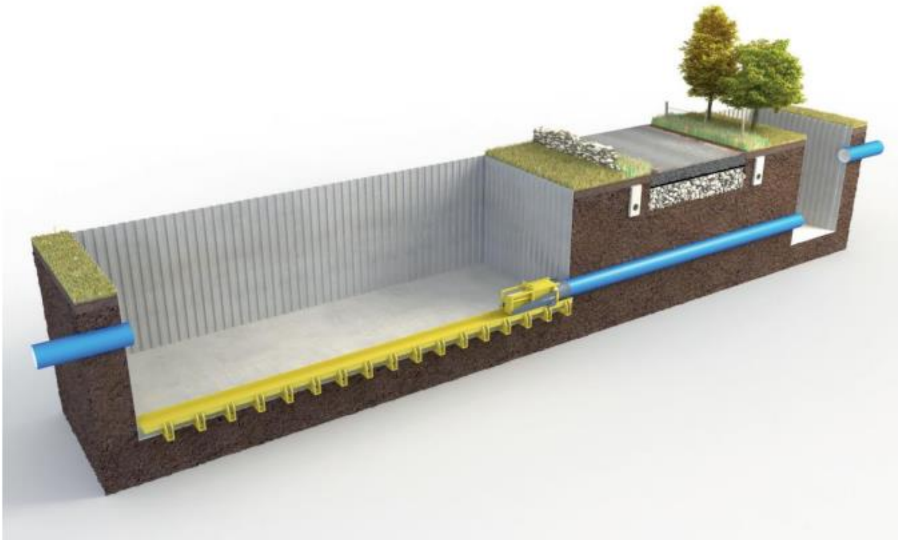
Guided Auger Bore (GAB)

2.8.44 GAB is a common alternative to UAB where stricter controls on the crossing alignment are required and where ground conditions allow. In highly congested areas and when accuracy in the route is important, GAB would be utilised.

2.8.45 Shallow launch and reception shafts would be dug on either side of an obstacle. These may need supporting with concrete rings or sheet piles. An auger would bore horizontally to install a sleeve pipe beneath the obstacle and connect each pit. Where necessary, as the sections of sleeve pipe are pushed through, they would be welded together. GAB is required under operational railway lines and areas where close proximity to other underground utilities and cabling is expected.

2.8.46 Pits would be constructed at the entrance and exit of the crossing to where the pipe would be pushed through. The equipment used to push the pipe through the crossing would push against the entrance pit walls applying both a thrust and torque reaction to the pit. These pits would be removed on completion of the works with the surface being returned to the original condition.

2.8.47 Insert 2.2 provides an illustration of the GAB technique.



Insert 2.2: Illustration of GAB Technique (Ref 2.3).

Horizontal Directional Drilling (HDD)

2.8.48 Sites for HDD equipment are established at either side of the obstacle to be crossed. A series of flexible rods would be driven through the earth from a launch pit to form a small 'pilot' hole. As the rods progress through the earth, extra rods would be added until the drill head emerges at a reception pit. At the reception pit, the drill head would be removed, a larger one attached and it is pulled back. This would continue to enlarge the hole until it is a size greater than the pipe.

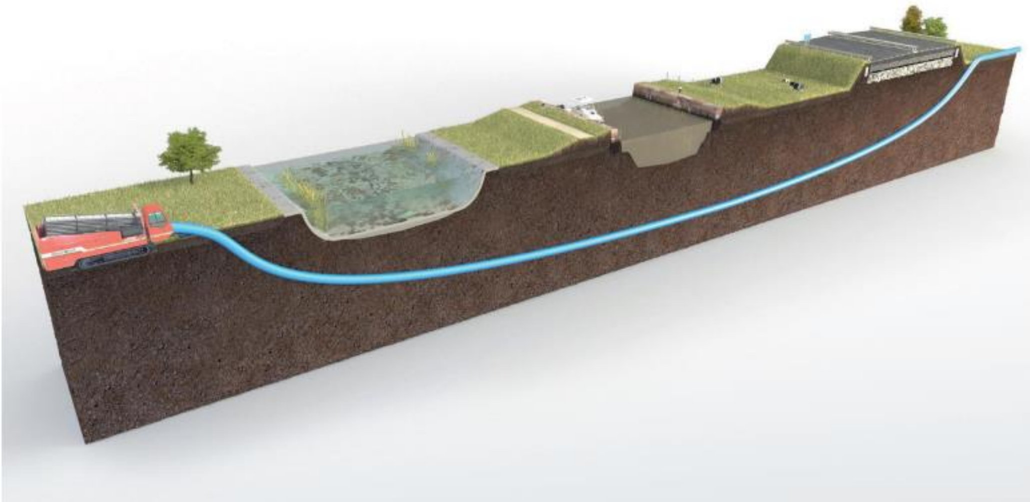
2.8.49 Drilling fluid, such as bentonite, is utilised to stabilise the drilled hole during all stages of the drilling operation.

2.8.50 A length of pipeline would be laid out and welded (pipe stringing) beyond the crossing. The welded pipe would then be pulled back through the hole completing the drilling operation.

2.8.51 With the pipelines successfully pulled through the crossing, the ends would be connected to the rest of the pipeline and the area would be re-instated to its original condition.

2.8.52 A temporary compound of a minimum of 50 m x 50 m would be required with level and stable terrain. The compound is required for welfare, offices, storage, mud mixing, mud recycling units, HDD rig and workshops.

2.8.53 Insert 2.3 provides an illustration of the HDD technique.



Insert 2.3: Illustration of HDD Technique (Ref 2.3).

Micro-tunnelling

2.8.54 Micro-tunnelling is a trenchless installation technique used over short distances and usually at shallow depths.

2.8.55 Shallow entry and exit shafts would be dug on either side of an obstacle. A rotating cutting head is inserted into one shaft and progresses forward to dig the tunnel. This is lined with concrete segments as it is dug. The pipe is then inserted into the tunnel in sections which are subsequently welded together as they are pushed through the tunnel.

2.8.56 The pits dug for the entry and exit shafts would be removed on completion of the works and the surface returned to its' original condition.

2.8.57 Insert 2.4 provides an illustration of the micro-tunnelling technique.

Insert 2.4: Illustration of Micro-tunnelling technique (Ref 2.3).

Direct pipe

2.8.58 Direct pipe is another method for the construction of short and long trenchless crossings on pipeline projects, where ground conditions may not be suitable for HDD or auger bore.

2.8.59 The method, working area requirements, accuracy and applicable ground conditions are generally similar to microtunnelling (a tunnel boring machine is driven from one side of the crossing to the other), but the pipeline is installed directly into the ground behind the tunnel boring machine, rather than being installed inside a completed tunnel.

River Humber special crossing

2.8.60 The River Humber would be crossed using a trenchless technique. The crossing would be a concrete lined tunnel, under the River Humber with a minimum diameter of 3 m and a maximum diameter of 6 m (to be confirmed through the design process).

2.8.61 The pipelines would be installed at a minimum depth of 7 m below the true bed of the river within a tunnel of 3 m diameter minimum and 6 m diameter maximum.

2.8.62 The tunnel would be constructed using a Tunnel Boring Machine (TBM) which would be launched from a drive shaft located on the Goxhill (south) side of the River Humber. The selection of the TBM would depend upon the findings of ground investigation work, detailed design and be confirmed by the appointed contractor. The TBM could be a Slurry TBM or an Earth Pressure Balance TBM. For the purposes of this PEIR, it is assumed that a Slurry TBM would be used as this would result in a greater requirement for processing and, therefore, more infrastructure. The TBM would be powered by onsite generators. Ventilation and intrinsically safe lighting for the machine and workforce would be provided. The TBM would travel forward, boring the diameter required.

2.8.63 Tunnel arisings would be removed from the tunnel by locomotive, slurry pipes or little vehicles dependent upon the type of TBM used and removed for storage, re-use and disposal as appropriate. A treatment facility is likely to be required and this is likely to be up to 15 m in height and potentially consist of a small number of silo structures. This treatment facility would only remain on site for the duration of the tunnelling works – approximately 18 to 24 months. The number of silos required would not be confirmed until the geotechnical surveys have been completed and the soil type has been classified. The tunnel lining would consist of a series of interlinked segments which would be transported to the rear of the tunnelling machine which would install the segments. The tunnel arisings would be evaluated to determine suitability for possible inclusion within the backfill material. The tunnel segments would be grouted into position as the construction progresses.

2.8.64 Following the completion of the tunnel construction, the carbon dioxide and hydrogen pipelines would be installed in the tunnel annulus. The tunnel would be backfilled using either cementitious grout, blown glass or be flooded with consideration also currently being given to leaving the tunnel open and sealing off the tunnel onshore.

2.8.65 The feasibility of alternative crossing techniques are also being explored for the crossing of the River Humber.

Construction of the landfall location

2.8.66 Only the carbon dioxide pipeline would continue offshore from the Pump Facility. As previously described, the Project covers the section from the Pump Facility to MLWS only.

2.8.67 From the Pump Facility to the landfall, the construction of the carbon dioxide pipeline would likely follow the construction techniques set out above. Then four options have been identified for the construction of the carbon dioxide pipeline installation at the landfall as follows: HDD, direct pipe, micro-tunnel, or micro-tunnel and cofferdam. These construction techniques as they relate to the landfall location have been detailed further below.

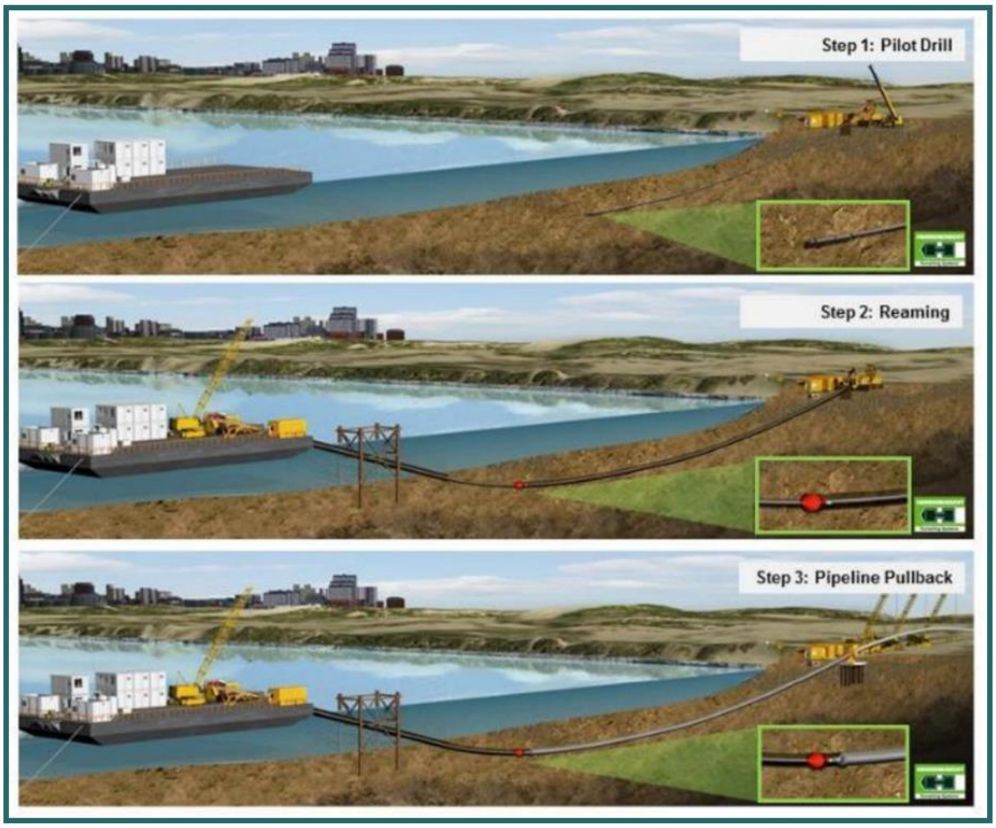
2.8.68 To provide suitable protection to the carbon dioxide pipeline at this location it would be designed to be below the predicted cliff line and seabed profile throughout its design life.

Horizontal directional drilling

2.8.69 HDD at the landfall location would entail drilling of a pilot hole along the proposed route. The pilot hole is subsequently enlarged to the target diameter via the use of a tool termed a reamer. Reaming is followed by “pullback” whereby the reamer is withdrawn to the entry point and the pipeline simultaneously installed. The process requires:

- A drilling rig where up to two rigs may be utilised, located at both the entry point (onshore) and the punch out location (offshore). The rigs drill simultaneously with gyroscopic and magnetic guidance systems are used to ensure the two pilot holes align (termed ‘intersect drill’). Onshore the HDD drill rig would be secured, typically using sheet piles to ensure it is securely anchored;
- A jack-up barge which supports the HDD drilling spread and counteracts the HDD rigs forces for the diameter and length of pipe required. The jack-up barge is likely to be in the order of 12 m above sea level to take account of deck thickness, maximum tides and maximum waves;
- Trestles to support the casing pipe emergence from the seabed and the jack-up barge; and
- Onshore for a typical HDD application, a compound of a minimum 50 m x 50 m would be required with level and stable terrain. The compound is required for welfare, offices, storage, mud labs, mud mixing, mud recycling units, HDD rig and workshops.

2.8.70 Insert 2.5 shows a typical HDD operation at a landfall location.



Insert 2.5: Shows a typical HDD drill operation at a landfall location. HDD schematic showing the phases of pilot drill, remaining and pipeline pullback (images courtesy of Herrenknecht and SDL)

Direct Pipe

2.8.71 Direct pipe is a combination of HDD and pipe jack tunnelling with simultaneous excavation of the tunnel and installation of a conduit pipeline through which the carbon dioxide pipeline can subsequently be installed. The process requires:

- A launch pit made of sheet piles, sufficiently shallow to accommodate a pipe casing string of a minimum of 50 m. The micro-tunnel boring machine (mTBM) is typically launched from this pit onshore;
- Launch pit: a temporary excavation which may require temporary works/sheet piles or similar, dependent upon depth and geology. Usually the floor of the excavation is graded to provide the correct entry angle for a mTBM, and to allow for insertion of pipe string, which can be of varying length, dependent upon site space constraints. The mTBM is typically launched from this pit onshore;
- Pipe thruster to be located within the launch pit, consists of hydraulically operated pipe clamp. The clamp grips the pipe and hydraulic rams push the pipe forward at the same time that the mTBM is excavating at the head of the casing pipe string. The casing forms the permanent ducting through which the pipeline is installed at a later date, with the annulus between the casing and product pipe grouted up;
- A jackup barge is used for the retrieval of the mTBM offshore after it is detached from the pipeline; and

- An onshore compound, typically of size 100 m by 100 m, is required to site a variety of units and containers which contains welfare, offices, storage, mud labs, mud mixing, mud recycling units, control unit and workshops. The drilling fluids and cuttings are pumped back along the casing through pipework with clean water pumped to the cutting head and the cuttings removed in the return flow and then processed through shakers and screeners located at the shaft head.

Micro-tunnel

2.8.72 The mTBM is launched from the base of a vertical shaft to drill a tunnel beneath the cliffs. As the mTBM cuts the ground, the whole assembly is jacked forwards by hydraulic rams located within the shaft with pre-cast segmental concrete pipe attached and jacked in behind as the tunnel progresses. The arisings generated by the mTBM are then passed through a crushing cone and removed to the surface through a closed slurry circuit within the tunnel. Clean water is pumped to the face and the arisings pumped back to the surface and processed through shakers and screeners located at the surface prior to the cleaned water being pumped back to the cutting head. The casing forms the permanent ducting through which the pipeline would be installed.

2.8.73 The offshore exit point would be into a pre-cut trench that is maintained to keep it free of silt and sand accumulations. The offshore pit would allow recovery of the mTBM, which would be by crane from a barge and assisted by divers/Remotely Operated Vehicle (ROV).

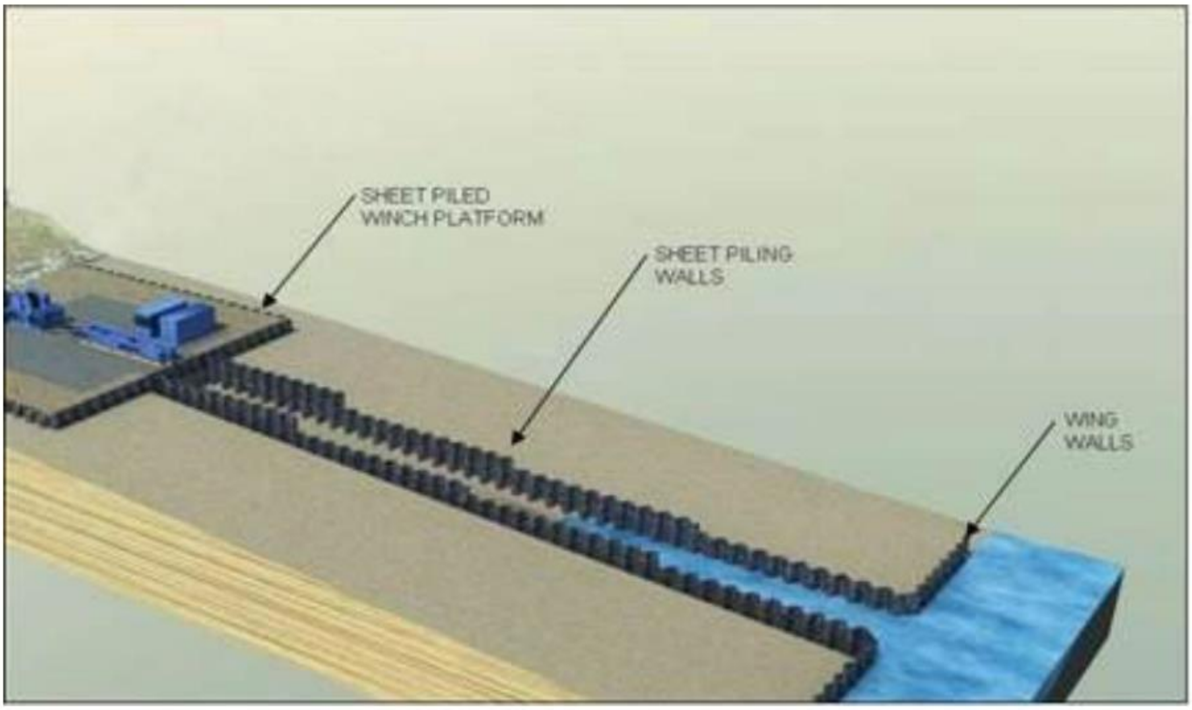
2.8.74 Onshore, the compound is required to site a variety of units and containers which contain welfare, offices, storage, mud recycling units, control unit and workshops as well as a suitable area for a concrete pipe laydown. To launch the mTBM, a vertical precast caisson shaft would need to be excavated through very stiff to hard clay behind the cliff-line by combination of excavation and jacking. The shaft would house the mTBM jacking frame and its final diameter would depend on the design diameter of the tunnel to allow the running of slurry and water pipes as well as allow the installation of a suitably sized MTM and jacking frame.

Micro-tunnel with cofferdam

2.8.75 This method, which has been adopted by other pipeline projects that have made landfall along the Dimlington/Easington coast.

2.8.76 A vertical shaft and tunnel is required, as described for the micro-tunnel option. The pipeline is routed across the beach in a trench, construction of which would require vehicle access to the foreshore and necessitating works to create a temporary roadway from the existing public road network to the foreshore.

2.8.77 The exit point of the mTBM would be a cofferdam sheet pile reception pit located on the foreshore above the MHWS boundary. This would allow for recovery of the mTBM from the foreshore. A combination of cofferdam trenching across the intertidal beach area, and winched plough, mounted on a working platform on the beach, with a subsequent pre-cut trench would be used to form a trenched installation out to -8 m Lowest Astronomical Tide (LAT). Insert 2.6 shows an illustration of a beach crossing cofferdam and working platform.



Insert 2.6: Example of a beach crossing cofferdam and working platform (images courtesy of Herrenknecht and SDL).

2.8.78 The cofferdam comprises two rows of sheet piles, approximately 7 m apart, from the low water mark to the seaward end of the work platform, a distance of approximately 100 m. The steel sheet piles of the cofferdams would be driven using one or more conventional pile driving rigs (a hydraulic vibratory hammer mounted on a tracked crawler vehicle) as tides permit. It is anticipated that due to the high undrained shear strength of the clay present, pre-augering to loosen the ground over the full pile depth may be required prior to main pile driving operations. Pre-augering can be undertaken using a continuous flight auger rig. Following on from pre-augering at each location, the main pile driving operations would be undertaken with hydraulic vibratory piling hammers.

2.8.79 Upon completion of the piling works, the area inside of the working platform would be built up to approximately +4.0 m ordnance datum (OD) by re-using the sands and gravels excavated during cofferdam construction. After the pipeline has been installed, it would be buried using the excavated material and the beach would be reinstated to pre-construction condition, as far as reasonably practicable.

2.8.80 Onshore, the infrastructure above the cliff would be as per the micro-tunnel, described above. Infrastructure on the beach would include a number of cabins and stores containers to support personnel working on the beach, plus storage of piles and plant. The beach works site would be cordoned off from the general public for health and safety grounds. A passage would be maintained to allow members of public access along the length of the beach during construction works. Access would be maintained for as much of the construction period as possible.

2.8.81 A temporary access road from the top of the cliffs down to the beach would be required for this option to allow equipment to be transported to the beach area. The cliffs would be reinstated on completion.

General

2.8.82 At the landfall location, in each of the trenchless crossing methods proposed, drilling is undertaken with the help of a viscous drilling fluid (typically bentonite mud), which is usually a mixture of water and bentonite (a non-toxic clay commonly used in farming practices). The bentonite mud is continuously pumped to the cutting head or drill bit to facilitate the removal of cuttings, stabilise the tunnel, cool the cutting head and lubricate the passage of the pipeline/lining. Drilling fluid would be recycled as far as practicable by separating the drill cuttings which the drilling fluid recovers from the cutting head, allowing the cleaned drilling fluid to be reused in a closed drilling fluid cycle. This reduces the use of raw materials (in particular water and bentonite) and reduces the time taken for the drilling process to be completed. Care is taken to ensure the risk of bentonite release onshore and offshore is at the lowest practicable level.

2.8.83 Installation of the pipeline through the tunnel or into the HDD, may be from sea to land or land to sea. If from sea to land, this would involve a ‘pulled’ installation technique in which the length of pipeline to be installed would be floated out to sea in full or installed in sections from the pipelay vessel or jack-up barge. If from land to sea, this would involve a ‘pushed’ installation technique in which the length of pipeline to be installed would be pushed from land until it reaches the ‘punch-out’ location. The final option would be selected following detailed engineering.

List of anticipated trenchless crossings

2.8.84 Further detail on construction methods in provided in Section 2.8. A list of anticipated trenchless crossings is given below and shown on Figure 2.1 (Volume IV):

Section 1 – Drax to Keadby

- River Aire;
- A645;
- Two crossings of the M62;
- A614 Rawcliffe Road;
- Wakefield and Goole Railway Line;
- Aire and Calder Navigation;
- Dutch River;
- Sheffield to Hull Railway Line;
- A161 Crowe Road;

Section 2 – Keadby to Scunthorpe

- South Humberside Main Railway Line;
- Sheffield and South Yorkshire Canal;
- Three Rivers;
- A18 Anthorpe Bypass;
- M180;

- River Trent;
- A159 Northfield Road;

Section 3 –Scunthorpe to Killingholme

- A15 Ermine Street;
- Sheffield to Grimsby Railway Line;
- New River Ancholme;
- A1084 Bigby High Road;
- Sheffield to Grimsby Railway Line;
- A18 High Street;
- Sheffield to Manchester and Cleethorpes Railway Line;
- A180;
- A1077 Wootton Road;
- Barton Railway Line;

Section 4 – Killingholme to Hedon (Humber Crossing)

- River Humber;

Section 5 – Hedon to Easington

- A1033 Main Road;
- A1033 Hollym Road; and
- The Landfall location.

2.8.85 The location and number of trenchless crossings proposed may change between the PEIR and the ES based on ongoing design work and feedback received at Statutory Consultation.

AGI construction

2.8.86 Construction of the AGIs is anticipated to involve the following sequence of activities:

- Mobilisation, site preparation, establishment of temporary working areas, temporary access and laydown areas;
- Construction of an access road if required or upgrading of an existing access way;
- Installation of below ground works, such as concrete foundations, bases and plinths, below ground pipework and equipment, drainage, ducting, earthing system etc;
- Installation of above ground structures, including above ground pipework and equipment, electrical, instrumentation and telecommunication cabling, buildings and kiosks, corrosion protection arrangements utility apparatus etc;
- Installation of pipeline, mechanical instrumentation and electrical equipment;
- Connection to utilities/services (e.g. electrical, telecommunications etc);

- Provision of site finishes, vehicular access and turning areas, pedestrian access surfacing, installation of fencing, placement of site finishes such as gravel, provision of landscaping and planting as required etc;
- Testing, conducting pre-commissioning activities and commissioning; and
- Demobilisation and reinstatement of temporary works areas.

Temporary working areas

2.8.87 Temporary working areas would be required to facilitate the construction of the Project. The likely types of temporary working areas are outlined below:

- Construction working width (including temporary accesses);
- Trenchless crossing compounds;
- AGI laydown areas;
- Site offices;
- Welfare, yard and workshop facilities;
- Pipe delivery areas; and
- Compound for crossing of the cliffs and inter-tidal zone (including beach access road and working platform for microtunnel and cofferdam option).

2.8.88 Site offices, welfare, yard and workshop facilities, pipe delivery areas and workforce accommodation can be situated on individual or combined sites and are not required to be situated on the route itself. Therefore, it is impracticable to extend the Proposed Order Limits to capture all potential locations for these facilities.

2.8.89 Further work will be undertaken between the PEIR and the ES to refine the land that is likely to be required for temporary working areas. Locations of the temporary working areas will be detailed within the ES.

2.8.90 Further details on the current understanding of the temporary working area required are provided below.

Construction working width and trenchless crossing compounds

2.8.91 The construction working width is the primary construction area for the construction of the pipelines. For the terrestrial elements of the pipelines, an 80 m wide temporary working area is required that extends along the majority of the route as shown on Figure 2.1 (Volume IV).

2.8.92 For the carbon dioxide pipeline only, from the Pump Facility to MLWS, the pipeline construction working area would be 45 m wide (split 20 m of subsoil side and 25 m on topsoil side). However, it should be noted that additional working areas would be required at service and road crossings.

2.8.93 The construction working width may not be required at trenchless crossings where access along the pipelines route is not possible (e.g. a river, rail or motorway crossings). At these locations there would likely be trenchless crossing compounds as shown on Figure 2.1 (Volume IV).

2.8.94 The specific trenchless crossing technique to be utilised at each crossing location would not be confirmed until the detailed design stage.

2.8.95 In general, access to and from the construction working width would be gained at road crossings and restricted to the working width, vehicles would use the running track where possible. Temporary access would be created where pipeline routes cross public roads, where it is safe to do so.

AGI laydown areas

2.8.96 AGI laydown areas are temporary extensions of the permanent AGI compounds. As a minimum, each AGI laydown area would comprise:

- Storage areas for stripped topsoil, excavated material and civil engineering materials;
- Office and welfare facilities (e.g. temporary portable office facilities or similar);
- Secure equipment storage (steel containers);
- Safe off-road vehicle parking areas for operatives and visitors; and
- Plant working areas; including an area for delivery and offloading of major equipment, such as crane bases.

2.8.97 The land required for AGI laydown areas is covered within the AGI operational areas shown in Figure 2.1 (Volume IV).

Site offices

2.8.98 Site offices are required to house client, project management, contractor management and supervisory staff. The location of site offices would not be known until detailed design stage. They would either be within existing office space, rented on a commercial basis, or in temporary office type complexes erected on existing vacant brownfield sites or included within the temporary working areas already identified within the Proposed Order Limits as shown on Figure 2.1 (Volume IV).

Welfare, yard and workshop facilities

2.8.99 Central yards for use by the workforce and construction supervisory staff would be required and are proposed on either side of the Humber crossing, with small satellite yards within the Proposed Order Limits as shown on Figure 2.1 (Volume IV).

Pipe delivery areas

2.8.100 Pipe delivery areas are proposed for the receipt and inspection of line pipe and materials from suppliers, storage and loading for onward transportation to the construction working width for use.

2.8.101 The pipe delivery areas are either side of the Humber crossing as identified in Figure 2.1 (Volume IV).

2.8.102 Alternatively, separate yards may be established, one for each pipe size located on each leg of the system.

Compound for crossing of the cliffs and inter-tidal zone

2.8.103 There would be a requirement for significant temporary working area for the carbon dioxide pipeline only around the start of the trenchless crossing at the cliff top. The exact location and size of this compound will not be confirmed until the preferred crossing technique has been identified. For direct pipe, the land use for temporary construction compounds is likely to be a maximum 100 m by 100 m and required for drilling activities onshore and temporary spoil storage.

2.8.104 If the microtunnel and cofferdam construction option is selected, a beach access road and beach working platform would be required. The approximate dimensions for this would be:

- Beach access road approximately 400 m x 6 m wide. Where the road crosses the cliff face there would be additional construction area required for both benching of the road into the cliff face and of storage of excavated materials; and
- Beach working platform approximately 40 m x 25 m required for parking of vehicles in a safe area above high water.

Construction workers

2.8.105 Total construction worker numbers for the terrestrial elements of the Project are set out in Table 2.3 below.

Table 2.3: Approximate total construction worker numbers for the terrestrial elements of the Project.

Activity	Total personnel
Yard/TCC Operation	20
Survey	10
Cleaning	13
Access works	27
Trenching	29
Fabrication	94
Inspection and field pipe joint coating	22
Installation	32
Backfilling	22
Re-instatement	33
Pre-commissioning	46
HDD	7
Tunnelling	25
Trenchless crossing reinstatement	16
AGI construction	52

Compound reinstatement	16
Other activities	10
Total	**474**

2.8.106 The peak construction workforce for the element of the Project from the Pump Facility to MLWS would be 60 persons.

2.8.107 Standard construction working hours would be Monday-Saturday 07:00 to 19:00 hrs and travel to and from site is likely to happen an hour either side of these hours. The requirement to work on Sunday or bank holidays cannot be excluded, although it would not be usual, on these days the working hours would be 07.00 to 17.00 hrs.

2.8.108 Twenty-four-hour working would be required to align with critical work activities such as tunnelling, testing or works associated with offshore interfaces. For the purposes of the PEIR to provide a worst-case for assessment, it is assumed that 24-hour working could be required at all trenchless crossing locations.

Equipment and materials

Types of Plant and Equipment

2.8.109 A range of construction plant and equipment would be required for the construction phase of the Project.

2.8.110 Pipeline construction would typically require welding systems, specialist pipe laying vehicles, air compressors, excavators, Heavy Goods vehicles (HGVs) such as tipper lorries and flatbed haulage lorries, tractors, pump systems, vibratory rollers, percussion/vibratory piling rigs, pipe coating systems, auger bore rigs, HDD rigs etc.

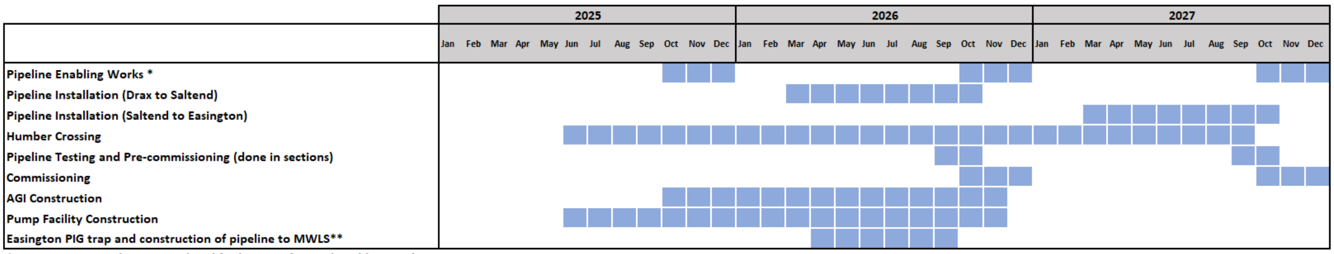
2.8.111 The earthworks associated with the installation of the pipeline would require use of plant and equipment including excavators, pump systems, bulldozers/dozers, vehicles to move excavated material (wheeled and tracked), vibratory rollers and various HGVs.

Construction programme

2.8.112 A detailed construction programme would be developed during the detailed design stage. An indicative construction programme is set out in Insert 2.7 below.

2.8.113 Subject to the granting of a DCO, construction is anticipated to commence in 2025 and is envisaged to be completed by the end of 2027. The construction programme is expected to last approximately 31 months. Not all locations would be subject to construction works for the entire length of the Project construction phase. The exact construction programme at each specific location along the route is still being determined.

2.8.114 The Applicant has been considering what preliminary works could be undertaken to facilitate the construction works programme. These works will be discussed with stakeholders at the appropriate time where practicable.



* opportunities are being considered for bringing forward enabling works
** the timing of this six month window is not yet confirmed

Insert 2.7: Indicative construction programme

2.9 Operation and maintenance

2.9.1 The pipelines will be designed, constructed, operated and maintained in accordance with relevant industry codes of practice, standards and recommended practice.

- Carbon dioxide pipeline: British Standards Institution (BSI) code of practice for onshore steel pipelines, PD 8010-1:2015 (Ref 2.4); and
- Hydrogen pipeline: The Institution of Gas Engineers and Managers (IGEM) standard IGEM/TD/1 Edition 6 plus Supplement 2 (Ref 2.5).

2.9.2 The proposed pipelines would be externally coated and have a cathodic protection system to provide protection from corrosion.

2.9.3 Once the pipelines are in operation, they would be monitored around the clock, every day of the year, by a remote fully staffed central control room. The central control room does not form part of this Project.

2.9.4 The pipelines would be monitored by flying or walking the route to check for activities taking place close to the pipelines to prevent pipeline damage (i.e. third party interference). The pipelines and associated AGIs would also be regularly maintained to ensure their continued reliability using trained and competent personnel and all work would be strictly controlled. Where issues are found, these would be corrected by appropriate remedial works. Periodically the pipelines would be internally inspected to check for corrosion and any damage present.

Operational staffing requirements

2.9.5 There would be no permanent operational onsite staff associated with the Project. It is intended for all the Project's AGIs to be unmanned and be remotely operated. However, the installations would have suitable facilities for local operation in the event of a telemetry failure, maintenance, operational upset or other events requiring site attendance.

Venting

2.9.6 Permanent vent stacks would be required at the Pump Facility, whilst all other AGI locations would use temporary vent stacks which would be installed when required.

2.9.7 Some maintenance activities will require the venting of carbon dioxide or hydrogen from the AGI locations and vent operations would be conducted whilst staff are on site to monitor conditions. Venting of carbon dioxide and hydrogen could take place in the following circumstances:

- Depressurisation of a pipeline section to allow for maintenance activities, such as the repair of pipeline damage or replacement of a section of pipeline. This is an infrequent event; and
- As part of routine planned maintenance or inspection activities to facilitate safe working and enable functional checks on equipment, pipeline internal inspection, isolation arrangements for invasive work etc.

2.9.8 Planned maintenance of the AGIs would be undertaken up to twice a year in compliance with all relevant safety requirements. In order to undertake maintenance, the AGI, or part of the AGI, would first be isolated from the upstream and downstream pipelines or pipework. Any carbon dioxide or hydrogen within the AGI internal inventory would then be vented to atmosphere through the vent stack prior to any maintenance activities taking place. The carbon dioxide and hydrogen vented would be small in volume, short term and an infrequent event. The venting of the carbon dioxide and hydrogen inventory at PIG Traps within the AGIs for the purpose of the internal inspection of the pipelines would be set at once every five years. Over time the frequency would be adjusted following examination of the previous inspection data, i.e. the inspection intervals could be extended or reduced to meet the needs of maintaining safe operating pipelines.

2.9.9 The duration of the vent activity would depend on the level of inventory being vented, weather conditions and would typically only take place between the hours of 07:00 and 19:00 hrs Monday to Friday. For large levels of inventory, venting may be repeated on multiple days until it is complete. The carbon dioxide and hydrogen would be vented at a rate whereby noise emissions are limited through the appropriate design of the vent or venting procedure.

2.9.10 The offshore carbon dioxide pipeline, that does not form part of this Project or this consent, may also require venting. With the exception of the carbon dioxide inventory at the PIG Trap for the offshore pipeline, there is no planned venting of carbon dioxide from the offshore pipeline and associated infrastructure and any venting of carbon dioxide would only occur in response to an unplanned event.

2.9.11 There is ongoing engineering work on the onshore and offshore pipeline infrastructure to confirm possible venting scenarios and operational response requirements in the unlikely event of an incident occurring.

Operational lighting

2.9.12 Permanent low-level lighting would be provided on the AGIs but it would only be used when people are on site working in low light conditions.

Operational restrictions

2.9.13 The pipelines would be buried to a minimum cover depth of 1.2 m. Above the pipelines the planting of deep-rooted vegetation and trees would be restricted. However, standard agricultural use of the land crossed by the pipelines would not be restricted.

2.10 Decommissioning

2.10.1 The pipelines from Drax to the Pump Facility as well as the AGIs would have an operational design life of at least 40 years. The carbon dioxide pipeline from the Pump Facility to MLWS and the PIG trap at the Pump Facility would have an operational design life of at least 25 years. In reality, the pipelines would likely be operational for longer than their design lives.

2.10.2 When the pipelines reach the end of their life, they would be decommissioned safely under a separate consent. Decommissioning would consider all the relevant environmental legislation and technology available at the time. Any necessary licences and permits would be acquired.

2.10.3 There are options currently available for the decommissioning of the pipelines from Drax to the Pump Facility. These are as follows:

- The pipelines would be filled with nitrogen and left in situ at a positive pressure. The cathodic protection system would be kept in would be monitoring to provide ongoing protection against corrosion; or
- The pipelines would be split into sections, filled with grout and left in situ.

2.10.4 For the carbon dioxide pipeline from the Pump Facility to MLWS, the pipeline would be filled with grout and left in situ, unless there is a risk identified that the pipeline may become exposed, in which case the pipeline would be removed.

2.10.5 The AGIs would be dismantled, all equipment would be removed and the land returned to agricultural or other appropriate uses.

2.11 References

- Ref 2.1 Dray (2021) *Climate change targets: the road to net zero?* Available at: https://lordslibrary.parliament.uk/climate-change-targets-the-road-to-net-zero/ (Accessed: 24 January 2022).
- Ref 2.2 Department for Business, Energy and Industrial Strategy (2021) *Climate Change Update.* Available at: https://questions-statements.parliament.uk/written-statements/detail/2021-10-19/hcws325 (Accessed: 24 January 2022).
- Ref 2.3: National Grid website. https://www.nationalgrid.com/our-businesses/national-grid-ventures/humber-low-carbon-pipelines/the-project (Access: 23 September 2022).
- Ref 2.4 British Standards Institute (2015) *Pipeline Systems. Steel pipelines on land – code of practice (+A1:2016).* Available at: https://www.thenbs.com/PublicationIndex/documents/details?Pub=BSI&DocID=315849 (Accessed: 26 January 2022).
- Ref 2.5 Institution of Gas Engineers (2021) *IGEM/TD/1 Edition 6 Supplement 2.* Available at: https://www.igem.org.uk/technical-services/technical-gas-standards/transmission-and-distribution/igem-td-1-edition-6-steel-pipelines-for-high-pressure-gas-transmission/ (Accessed: 25 January 2022).

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