

CHAPTER 4 – CONSIDERATION OF ALTERNATIVES

Padeswood Carbon Dioxide Spur Pipeline Proposed Development

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4. CONSIDERATION OF ALTERNATIVES

4.1. INTRODUCTION

- 4.1.1. This chapter of the Environmental Statement (ES) sets out the assessment of reasonable alternatives that have been considered during the evolution of the Padeswood Spur Pipeline Proposed Development and design process as presented in **Chapter 3 - Description of the Padeswood Spur Pipeline Proposed Development (Document Reference: PW.3.2.3)**. This chapter outlines the main alternatives to the Padeswood Spur Pipeline Proposed Development that have been considered by the Applicant, including the 'do-nothing' scenario in which the Padeswood Spur Pipeline Proposed Development is not taken forward.
- 4.1.2. In this context, the consideration of alternatives and design evolution has been undertaken with the aim of avoiding and/or reducing adverse environmental effects, maintaining operational efficiency and cost-effective design solutions, and with consideration of other relevant matters such as available land and planning policy.

4.2. REQUIREMENT FOR CONSIDERATION OF ALTERNATIVES

- 4.2.1. Schedule 4(2) of the Town and Country Planning (Environmental Impact Assessment) (Wales) Regulations 2017 ('EIA Regulations') (HM Government, 2017) states that an ES should include:
- 'A description of the reasonable alternatives (for example in terms of development design, technology, location, size and scale) studied by the applicant or appellant which are relevant to the proposed development and its specific characteristics and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects'.
- 4.2.2. To accord with the EIA Regulations, the following alternatives have been considered for the Padeswood Spur Pipeline Proposed Development to minimise environmental effects:
- Do nothing Scenario;
 - Alternate route options; and
 - Mitigation by Design.

4.3. DO NOTHING SCENARIO

- 4.3.1. The Do-Nothing Scenario would mean that the Padeswood Spur Pipeline Proposed Development would not be progressed. As a part of the HyNet Project, this would mean that carbon emissions from the

Padeswood Carbon Capture and Storage (CCS) Project will remain unabated.

- 4.3.2. The Do-Nothing scenario would be contrary to the UK's goal to achieve net zero carbon emissions by 2050. The role that CCS plays in wider government policy is discussed in **Chapter 2 - The Project (Document Reference: PW.3.2.2)**. The Do-Nothing scenario represents the current and future baseline which is considered in each of the technical chapters (**Technical Chapters 6 – 18 (Document References PW.3.2.6 to PW.3.2.18)**), and as such will not be investigated further as part of this chapter.

4.4. PIPELINE DESIGN AND ROUTEING

PIPELINE SIZE AND MATERIALS

- 4.4.1. To determine the most appropriate size for the pipeline, it was necessary to consider the maximum capacity that will be required during operation and the overall operating pressure requirements of the wider transportation system. The smallest size was selected to effectively and safely transport CO₂ through the system, minimising the potential cost, constructability, future expansion, and environmental impacts associated with the pipeline. This has resulted in the proposal for a 16" pipeline along the entire length of the Padeswood Spur Pipeline Proposed Development.
- 4.4.2. Engineering and safety requirements dictated the material selection of the pipeline, taking into consideration corrosion risk, pressure, and temperature of the CO₂.

DEVELOPMENT OF ROUTE OPTIONS

- 4.4.3. In developing the Padeswood Spur Pipeline route options, the following guiding principles were developed:
- To avoid, minimise and manage impacts upon the environment and local amenity;
 - To ensure the transportation of the CO₂ is undertaken safely and securely;
 - To optimise the potential socio-economic benefits within the region;
 - To be technically viable and constructible with minimum disruption; and
 - To be cost-effective.
- 4.4.4. To align with these guiding principles, a process was developed which will allow for the identification and assessment of route options at varying geographical scales, permit the rejection of unfeasible alternative options and culminate in the selection of a Preferred Route.

- 4.4.5. This process consisted of four stages as follows:
- Stage 1: Identification of the Study Area;
 - Stage 2: Identification of Potential Route Options;
 - Stage 3: Route Section Identification;
 - Stage 4: Appraisal of Route Sections.
- 4.4.6. These stages have been developed based on best practice methodologies used in the industry, including guidance from the National Grid in developing new gas and electricity infrastructure (National Grid, 2012), intended primarily for major infrastructure projects under the Planning Act (PA) 2008. The National Grid guidance sets out the importance of a robust and transparent process as well as balancing the technical, socio-economic, environmental, and cost considerations when selecting a project option.
- 4.4.7. Having a process in place that enables a coherent and consistent appraisal of potential options to be undertaken allows for the later 'back-checking' of any options. The back-checking of options will be triggered if new material information or a material change in circumstances comes to light which warrants a reconsideration of previously discontinued options.
- 4.4.8. Details of each stage of this process are provided under the below headings.

STAGE 1: IDENTIFICATION OF THE STUDY AREA

- 4.4.9. An outline Study Area was identified by considering several indicative corridor options between the Padeswood Above Ground Installation (AGI) and the Northop Hall AGI.
- 4.4.10. Four baseline corridors were identified:
- Central Corridor (Option 1), measuring approximately 11km, and passed between Mynydd Isa and Mold;
 - Western Option (Option 2), measuring approximately 16km, and passed to the west of Mold. This option was discounted as it was significantly longer than the other options;
 - Eastern Option (Option 3), measuring approximately 10km, and passed to the east of Buckley. This option was discounted due to engineering constraints; and
 - Sandycroft Option (Option 4), measuring approximately 9 km, passing north of Penyffordd and Broughton to connect with the Hynet Main Onshore Pipeline south of Sandyford. This option was discounted as it will require an additional AGI to be constructed.

- 4.4.11. Additional corridor options, comprising variations to the baseline corridors above, were also considered. The baseline and additional corridors are shown in **Figure 4.1**.
- 4.4.12. Baseline information was gathered for the baseline corridors and additional corridors to identify potential constraints and opportunities to routing. This baseline information was captured through desk-based studies, site visits and consultations.
- 4.4.13. A Screening Study was then undertaken on each of the baseline and additional corridor options to identify which corridor should be taken forward for further design development. The Screening Study was underpinned by several foundations (linked to the guiding principles listed in **paragraph 4.4.3**) which included, but were not limited to:
- Pipeline length and intersection points should be minimised;
 - Corridors with existing pipelines should be shared where possible, however, adequate separation distances between pipelines shall be maintained;
 - Environmentally sensitive areas, e.g. wetlands areas, archaeological sites, nature reserves, RAMSAR sites and Sites of Special Scientific Interest (SSSIs) should be avoided as far as practicable;
 - The number of crossings of other pipelines, cables and existing infrastructure should be minimised as far as practicable;
 - Difficult terrain, unstable soil conditions and geohazards should be avoided as far as practicable; and
 - General population habitats, buildings with high concentration of people and planned development areas should be avoided as far as practicable.
- 4.4.14. A high-level scoring assessment of each corridor option was undertaken against a series of tailored engineering, environmental and safety-based criteria. These criteria were based on the key foundations outlined above and were as follows:
- Engineering:
 - Overall length (km);
 - Presence of AGI at connection point (designated / New Proposed);
 - Total number of major road / watercourse / rail crossings;
 - Total length (m) of major road / watercourse / rail crossings;
 - Environmental – possible risk due to the pipeline route:
 - Total number of ancient woodland / national forest crossings;
 - Total length of ancient woodland / national forest crossings;

- Total length of Sites of Special Scientific Interest (SSSI) crossings (m).
- Safety – possible risk due to pipeline construction and or operation:
 - Route proximity / crossings from residential / industrial areas;
 - Route proximity / crossing critical features such as mining features, historical landfills; and
 - Congested areas (multiple route constrained features in a confined area).

4.4.15. Each corridor option was scored on a scale of 1-10 for each criterion listed above, with one being the lowest score. For example, the shortest possible route will receive a score of 10 for 'overall route length'.

4.4.16. Once the corridors were scored against each criterion, scores were totalled and compared to determine the preferred route corridor (the corridor which, at this stage, was anticipated to best align with the key principals).

4.4.17. Overall, the **Central Corridor** (Option 1) was the preferred option for several reasons, including:

- The least likely option to result in direct impacts to environmentally sensitive areas;
- The option likely to be the least complex and safest to construct, on account of having fewer complex crossings; and
- The option likely to offer the most cost-effective solution.

4.4.18. The Central Corridor defined the Study Area to be taken forward to Stage 2 of the routeing and design process. The Western Option, Eastern Option and Sandyford Option were therefore discounted.

STAGE 2: IDENTIFICATION OF POTENTIAL ROUTE OPTIONS

4.4.19. Several potential route options were then identified within the Central Corridor Study Area. This process involved a 'weighting exercise' whereby environmental, technical and socio-economic features within the Study Area were identified and assigned a weighting depending on their sensitivity to impacts from pipeline development. The weighting categories applied to the features were as follows:

- No-go areas;
- High-level constraint;
- Moderate-level constraint; and
- Low-level constraint.

4.4.20. It is recognised that impacts to features may occur due to pipeline development that is located some distance away from the feature itself. To account for this, buffer areas were applied to each

environmental, technical and socio-economic feature within the Study Area. The sizes of the applied buffer areas were chosen based on specialist judgement and industry best practice methodology. In general, the more sensitive the feature, the larger the buffer area applied. Weightings were also given to the buffer areas.

4.4.21. **Table 4.1** details the weighting categories applied to example environmental, technical and socio-economic features identified within the Study Area and their buffer areas.

Table 4.1 - Strategic feature weighting categorisation

Sensitivity	Justification	Strategic Feature	Route identification response
No Go (NG)	Features considered to have extreme sensitivity to infrastructure.	<ul style="list-style-type: none"> • Special Areas of Conservation (SAC); • Ramsar; • Special Protection Areas (SPA); • National Nature Reserves (NNR); • Listed buildings; • Historic parks and gardens; • Battlefields; • World heritage sites; • Military crash sites; • Residential dwellings; • Areas of Outstanding Natural Beauty (AONBs); • National Parks; • Airports; and • Wind turbines 	Pipeline route to avoid
High	Features considered sensitive to infrastructure.	<ul style="list-style-type: none"> • Land within 200 m of SPA; • Land within 200 m of Ramsar; • SSSIs; • Royal Society for the Protection of Birds (RSPB) reserves; • Ancient Semi Natural Woodland (ASNW) and 15 m buffer; • Plantations of Ancient woodland sites (PAWS) and 15 m buffer; • Ancient woodland of unknown category and 15 m buffer; • Scheduled monuments and 50 m buffer; • Land within 300 m of a military crash site; • Land within 1 km of AONB; • National Recreational Routes; 	Areas that should be avoided where possible and prioritise for mitigation

Sensitivity	Justification	Strategic Feature	Route identification response
		<ul style="list-style-type: none"> • Land within 1 km of national parks; • Inland Waterways; • Slopes steeper than 20% over 100 m; • Railway stations and 75 m buffer; • Historic Landfill sites; and • Coal Mining and 15 m buffer; 	
Moderate	Features considered less sensitive to infrastructure	<ul style="list-style-type: none"> • Land within 100 m of SAC; • Land within 500 m of SPA; • Land within 500 m of Ramsar; • Land within 100 m of NNR; • Land within 100 m of SSSI; • Local Nature reserves; • Land within 100 m of RSPB; • Important bird areas; • Land within 30 m of ASNW; • Land within 30 m of PAWS; • Land within 30 m of ancient woodland of unknown category; • Land within 250 m of Grade I listed building; • Land within 250 m of Battlefields; • Conservation areas; • Land within 20 m of residential buildings; • Land within 2 km of AONB; • Land within 500 m of recreational route; • Land within 2 km of National Parks; • Flood zone 2 & 3; • Flood storage areas; • Slopes steeper than 10% over 100 m; • Roads; and • Gas utilities – feature and 5 m. 	Proceed with caution, taking potential mitigation measures into account during design and planning.

Sensitivity	Justification	Strategic Feature	Route identification response
Low	Features considered not to be sensitive to infrastructure	<ul style="list-style-type: none"> • Land within 100 m of LNR; • Land within 250 m of Grade II and II* listed building; • Land within 100 m of historic parks and gardens; • Historic Landscapes; • Land within 40 m of residential buildings; and • All utilities excluding gas – feature and 5 m; 	Some constraints of lesser sensitivity – not expected to be an issue for route identification.

- 4.4.22. Following determination of the sensitivity weighting, a digital tool, Goldset, was utilised to analyse potential routes within the Study Area. Goldset was chosen as it allows for the interrogation of geospatial information using a multi-criteria analysis approach, thereby offering a systematic process for the evaluation of route options.
- 4.4.23. The datasets from the weighting exercise were run through the Goldset tool. The features, buffers and weightings were evaluated to determine paths which avoided environmental features. Simultaneously a 'heatmap' was produced, which illustrates the density of these features within the Study Area. For example, light green areas are less constrained, red areas are more highly constrained, and clear areas are strictly no-go areas such as statutory designated sites or residential properties (this heatmap can be seen in **Figure 4.2**).
- 4.4.24. The Goldset results were then reviewed to ensure no features had been missed, and options were given a high-level review to see if the number of potential routes can be reduced, or other factors needed to be considered.
- 4.4.25. The Goldset exercise resulted in the identification of several potential route options within the Study Area. These route options are shown on **Figure 4.3**.

STAGE 3: ROUTE SECTION IDENTIFICATION

- 4.4.26. Following the identification of route options by Goldset, the route options were divided into several sections for further detailed appraisal.
- 4.4.27. The route sections were designed so that the potential to reduce impacts to designated areas of high environmental value, minimal access requirements and irreplaceable habitat could be assessed. In some cases, professional judgement was used to add additional sections where necessary. For example, Section 1B was not preferred in terms of landowner sentiment, so an additional section (1Y) was added.
- 4.4.28. Given the distance between the two AGIs, the 11 route sections were then subdivided into 20 colour-coded segments (to aid in identification). This was to ensure environmental appraisal was proportionate and that the appraisal will be reflective of the constraints in specific areas. The identified route sections and segments are listed in **Table 4.2** below and shown in **Figure 4.4**.

Table 4.2 - Identified Route Sections and Segments

Section	Segment
S1	1B (Blue)
	1Y (Yellow)
S2	2Y (Yellow)
S3	3B (Blue)
	3Y (Yellow)
S4	4Y (Yellow)
S5	5B (Blue)
	5Y (Yellow)
S6	6B (Blue)
	6Y (Yellow)
S7	7Y (Yellow)
S8	8B (Blue)
	8Y (Yellow)
S9	9Y (Yellow)
	9B (Brown)
S10	10B (Blue)
	10G (Green)
	10B (Brown)
	10Y (Yellow)
S11	11Y (Yellow)

STAGE 4: APPRAISAL OF ROUTE SECTIONS AND SEGMENTS

4.4.29.

Each Route Segment was then appraised by key disciplines to determine which has the greatest or least capacity to accommodate the Padeswood Spur Pipeline Proposed Development. This appraisal allows for the assessment of the positive and negative effects of routing in a robust, defensible and transparent manner, and permits the comparison of these effects across multiple sections and segments.

4.4.30. The broad methodology used for each segment appraisal was as follows:

- Through a desk-based assessment of relevant datasets, identify features within and in proximity to the segment which may present constraints or opportunities to routing;
- Determine the sensitivity of identified features and the potential impacts to each feature which may result from pipeline development in the segment;
- Apply a Red/Amber/Green (RAG) rating to each segment based on its capacity to accommodate the Padeswood Spur Pipeline Proposed Development. This RAG rating allows for a quantification of each segment appraisal.

4.4.31. The sections and segments were appraised by the key disciplines listed below. Details of the features examined for each discipline are included in **Table 4.3**.

- Planning Discipline, to determine the potential impact of the route sections on planning applications and Local Development Plan allocations within the area surrounding the route;
- Lands Discipline, to determine the potential of the route sections to cause disruption to landowners and, where relevant, their business activities;
- Engineering / Technical Discipline, to determine the safety, constructability and cost-effectiveness of each route section; and
- Environment Discipline, to determine the potential impacts relating to the following topics:
 - Landscape and Visual amenity;
 - Biodiversity;
 - Cultural Heritage including archaeology;
 - Land and Soils;
 - Noise and Vibration;
 - Population and Human Health;
 - Traffic and Transport; and
 - Water Resources and Flood Risk.

Table 4.3 - Features Examined by each key discipline as part of the segment appraisals

Discipline	Features Examined
Planning	Planning Application Consents for the following types of projects: Nationally Significant Infrastructure Projects (NSIPs); Transport and Works Act Order (TWAO) projects; Developments of National Significance (DNS); and Local Planning permissions. Planning Application appeals. Planning Allocations.
Landowners	Landowner sentiment towards the Padeswood Spur Pipeline Proposed Development.
Engineering/Technical	Pipeline Route Length; Existing land uses; Number of required crossings; Complexity of crossings; Ease of construction access; Terrain and subterranean conditions; Health and Safety.
Environment – Landscape and Visual Amenity	Landscape features including: Local Landscape Areas; Regional Scenic Areas; Regional Parks; National Parks; Areas of Outstanding Natural Beauty; World Heritage Sites; Landscape Character Assessment. Visual receptors, including: Residents; Users of footpaths; Cyclists; Road users; Users of public open space.
Environment – Biodiversity	Internationally designated wildlife sites within a 10 km radius of the Route Corridor Study Area;

Discipline	Features Examined
	<p>Statutory and non-statutory designated wildlife sites within 2 km of the Route Corridor Study Area;</p> <p>Records of any woodlands listed on the Ancient Woodland Inventory (AWI) and Priority Habitats (PH) within 1 km of the Route Corridor Study Area; and</p> <p>Protected and/or notable species records and European Protected Species (EPS) licences within 2 km and extended to 5 km for bats of the Route Corridor Study Area.</p>
<p>Environment – Cultural Heritage</p>	<p>Designated heritage assets including:</p> <ul style="list-style-type: none"> Scheduled Monuments; Listed Buildings; World Heritage Sites; Registered Parks and Gardens; Registered Battlefields; and Conservation Areas. <p>Non-designated heritage assets.</p>
<p>Environment – Land and Soils</p>	<p>Best and Most Versatile (BMV - Grades 1, 2 and 3a) agricultural land;</p> <p>Contaminated land constraints including waste sites and permitted sites; and</p> <p>Coal mining impacted sites.</p>
<p>Environment – Noise and Vibration</p>	<p>Density of populated areas;</p> <p>Priority and Proximity Areas;</p> <p>Locations of major roads.</p>
<p>Environment – Population and Human Health</p>	<p>Community Land and Assets;</p> <p>Private Property and Housing;</p> <p>Development Land and Businesses;</p> <p>Agricultural Land Holdings;</p> <p>Walkers, Cyclists and Horse Riders.</p>
<p>Environment – Traffic and Transport</p>	<p>Suitability of routes for HGVs;</p> <p>Sensitive receptors or vulnerable user groups such as schools and housing; and</p> <p>Major roads or railways and any associated restrictions.</p>

Discipline	Features Examined
Environment – Water Resources and Flood Risk	Watercourses and waterbodies; Watercourse and waterbody Water Framework Directive (WFD) status; Flood Risk; Aquifers; Peat; Geology.

4.4.32. As outlined in **paragraph 4.4.30**, to quantify the appraisals and to permit comparison of segments, a RAG rating was applied to the route segments for each discipline. The RAG ratings were applied using the Impact Rating Bands shown in **Table 4.14** below.

4.4.33. It is important to note that the colour coding in **Table 4.14** represent relative weightings. The coding enables a qualitative analysis to be undertaken, applying professional judgement and experience on an aspect-by-aspect basis for each topic. A green colour code does not indicate that no issues have been identified, and whilst the red colour code is the least preferred, this does not indicate an insurmountable constraint.

Table 4.4 - Pipeline Route Impact Rating Bands

Option	Details
Most potential	Greatest potential to accommodate the Pipeline infrastructure required within the context of the identified environmental, engineering, planning and landowner constraints.
Some potential	Some potential to accommodate the Pipeline infrastructure required within the context of the identified environmental, engineering, planning and landowner constraints.
Least potential	Least potential to accommodate the Pipeline infrastructure required within the context of the identified environmental, engineering, planning and landowner constraints.

4.4.34. Where a segment was appraised and both/all sections had the same Impact Rating, a preference was applied by each specialist, based on professional judgement or connection to subsequent or previous segment.

4.4.35. Where a segment was identified as having “some potential” but contained manageable constraints either by further design work or

considerate construction, these were also highlighted, to ensure they were not dismissed without careful consideration.

- 4.4.36. The results of each appraisal were then compiled in an appraisal summary, shown in **Table 4.25** to identify the emerging preferred route (the option anticipated to have the least significant effects on identified receptors).

Table 4.5 - Summary of Route Options Appraisal

Topic	Route Options																						
	S1		S2		S3		S4		S5		S6		S7		S8		S9		S10				S11
	1B	1Y	2Y	3B	3Y	4Y	5B	5Y	6B	6Y	7Y	8B	8Y	9Y	9Br	10B	10G	10Br	10Y	11Y			
Planning	*												*										
Technical / Engineering	*						*		*				*							*			
Cultural Heritage		*	#			#				#	#	*#		*#					*				
Biodiversity	*			*			*					*		*									
Land and Soils			#	#	#						#		#								#		
Landscape and Visual	*				#	#					#	*			*						#		
Noise and Vibration																							
Population and Human Health	*				*		*		*				*		*			*					
Traffic and Transport																							
Water Resources and Flood Risk	*			*					*						*			*					

Key

- Most potential
- Some potential
- Least potential

* Preferred route option where the same Impact Rating has been applied
 # Pipeline siting required to avoid impacts

SELECTION OF THE PREFERRED ROUTE

- 4.4.37. The Route Options Appraisal concluded with the selection of a Preferred Route for the Padeswood Spur Pipeline Proposed Development.
- 4.4.38. The Preferred Route is the option which is considered technically feasible and economically viable whilst causing the least disturbance to the environment and to people.
- 4.4.39. To select the Preferred Route, cross-discipline discussions were held with representatives from the different topics. Subsequently, parcels of land with potential to be used for environmental mitigation and construction access were incorporated into the Red Line Boundary of the Preferred Route.
- 4.4.40. The outcome of the discussions was that the Preferred Route was to be formed of segments 1Y, 2Y, 3B, 4Y, 5B, 6B, 7Y, 8Y, 9Y, 10Y and 11Y. The Preferred Route is shown on **Figure 4.5**.
- 4.4.41. The Preferred Route was taken forward for the EIA Scoping Opinion Request (see **Appendix 1.2, Document Reference PW.3.3.1.2**). The EIA Scoping Opinion provided an opportunity for the Local Planning Authority (LPA), Flintshire County Council, to consult with statutory consultees, comment on the Preferred Route and indicate the topics to be included within the Environmental Statement.
- 4.4.42. The Preferred Route was then reviewed in light of the EIA Scoping Opinion and subjected to further consideration and modified in response to public and landowner consultation, engineering constraints and ongoing Environmental Surveys.

REFINEMENT OF THE PREFERRED ROUTE

- 4.4.43. As indicated in **paragraph 4.4.42**, the Preferred Route has been further refined following stakeholder, landowner and public consultation, as well as being subjected to environmental survey, design development and subsequent appraisal, resulting in modifications required to avoid and/or minimise effects on the environment.
- 4.4.44. These modifications have resulted in several refinements of the Preferred Route. These modifications have occurred at a series of Design Freezes (DFs) as part of the design process.

DF1 – SCOPING BOUNDARY

- 4.4.45. This is the boundary discussed above, representing the Preferred Route along with potential environmental mitigation land and construction accesses. This was the boundary used for EIA Scoping.

DF1a - Refinement 1

- 4.4.46. A first stage of refinement occurred at DF1a. Discussions were held with landowners potentially impacted by the Preferred Route. This resulted in the addition of one section to the Preferred Route north of New Brighton, general reductions elsewhere in the Red Line Boundary and the removal of one of the Centralised Compound options. The DF1a Red Line Boundary is shown in **Figure 4.7**.

DF2 - Refinement 2

- 4.4.47. A second stage of refinement was undertaken to reduce the width of the Preferred Route down to a typical 50 m corridor, where possible. This was done to minimise land take and potential interaction with environmental features, but still maintain a corridor wide enough for further technical considerations at Detailed Design to be incorporated.
- 4.4.48. Following analysis of preliminary environmental survey data, areas with few environmental features were identified, and optionality in these areas was removed.
- 4.4.49. A detailed technical assessment of the Preferred Route was also undertaken, to further identify key challenges and opportunities for the development of the Padeswood Spur Pipeline within the typical 50m corridor. Emphasis was placed on achieving the straightest-possible route, to limit disruption as much as possible and to enhance cost-effectiveness.
- 4.4.50. Optionality was reduced in the area to the north of New Brighton, where the central alignment was selected. This alignment was selected primarily following landowner discussions. This alignment is also the shortest in length, thereby providing the most cost-effective solution.
- 4.4.51. Optionality was reduced in the vicinity of the Wylfa Roundabout. An alignment to the east was chosen in this area following landowner discussions and consideration of technical features and constructability. This refinement was driven by the avoidance of pylons and overhead line infrastructure adjacent to the A494. The DF2 Red Line Boundary is shown on **Figure 4.8**.

Further Refinement and Environmental Mitigation

- 4.4.52. Following the results from initial environmental surveys and further discussions with landowners, the Red Line Boundary was altered at Design Freeze 2a to take into account the reduction and expansion of 3 separate areas to be used for ecological and riparian mitigation measures.

- 4.4.53. It was also determined that the unnamed road off Alltami Road, previously crossed using trenchless methods, could now be an open trench crossing.
- 4.4.54. Additionally, the results of initial assessments and surveys conducted by the Applicant have influenced changes in design. For example, it was determined that Foundry Drain was fast-flowing, and part of a wide and deep valley that will prohibit open trench methods. A trenchless crossing was therefore incorporated into the Red Line Boundary at Foundry Drain, with a slight extension towards Padeswood Road South to accommodate the required Compounds. . Additionally, in December 2024, crossing TRX-08 was moved 80 meters further north to avoid ecological constraints that were identified during ongoing surveys. A sliver assessment to refine the Red Line Boundary against land parcels was also completed. The final Red Line Boundary included in the individual topic assessments is from Design Freeze 2b, which is shown in **Figure 3.1 (Document Reference: PW.3.4.3.1)**.

PIPELINE CROSSINGS

- 4.4.55. Most of the Padeswood Spur Pipeline Proposed Development route will be constructed using an open cut methodology. As detailed in **Chapter 3 – Description of the Padeswood Spur Pipeline Proposed Development (Document Reference: PW.3.2.3)**, this methodology involves the excavation of a trench, lowering of the pipeline, and reinstatement of the land to its original condition.
- 4.4.56. In specific locations where open cut construction is anticipated to lead to disruption and / or adverse environmental impacts (e.g. at major roads or sensitive environmental features such as Ancient Woodland) Trenchless Crossing techniques will be used. The locations where trenchless techniques are proposed are provided in **Chapter 3 – Description of the Padeswood Spur Pipeline Proposed Development (Document Reference: PW.3.2.3)**.
- 4.4.57. Trenchless Crossing techniques avoid the need for road closures and minimise impacts to certain environmental features. These techniques are therefore utilised in specific locations for reducing the impacts of pipeline construction, but considered in line with other factors, such as safety, cost and programme.
- 4.4.58. Trenchless Crossing technique options include Horizontal Directional Drilling, Guided and Unguided Auger Bore, Pipe-jacking and Micro tunnelling. The preferred technique at each location will be determined during detailed design and will depend on factors including the type of feature to be crossed, length of crossing and ground conditions. Further details of these construction methods are

provided in **Chapter 3 – Description of the Padeswood Spur Pipeline Proposed Development (PW.3.2.3)**. As discussed in **paragraphs 4.4.53 – 4.4.57**, the trenchless crossings have been revised throughout the design process as environmental, stakeholder and technical requirements have been identified.

SUMMARY OF THE ROUTEING EXERCISE

- 4.4.59. A Preferred Route for the Padeswood Spur Pipeline Proposed Development was selected following a four-stage process which has systematically identified options, at a variety of geographical scales, and considered the positives and benefits of each option to refine the route and discount the alternatives.
- 4.4.60. Four initial corridors, plus additional options, were initially identified and subjected to a Screening Study to determine the option which best aligned with the guiding principles of routeing. The Central Corridor (Option 1) performed the best in the Screening Study and was selected, with Options 2, 3 and 4 discounted.
- 4.4.61. Route options were then identified within the Central Corridor using the Goldset Tool. These route options were then split into sections and corresponding segments for the detailed appraisal of the positives and negatives of each option. The appraisal comprised the assessment of features within each segment by key disciplines.
- 4.4.62. Each segment was subsequently RAG rated to quantify the appraisal and allow the comparison of options. This RAG rating provided the basis for the selection of preferred segments for each section and rejection of alternative segments. The preferred segments were then taken forward to form the Preferred Route, discounting the alternative segments. The pipeline route then evolved, taking into account stakeholder consultations, for example with landowners, and further environmental information (e.g. survey results) and requirements.

4.5. CONSTRUCTION COMPOUND ALTERNATIVE SITES

- 4.5.1. Temporary infrastructure required to facilitate the construction of the Padeswood Spur Pipeline Proposed Development is described in **Chapter 3: Description of the Padeswood Spur Pipeline Proposed Development (Document Reference: PW.3.2.3)** and includes:
- Construction Compounds (Centralised, Trenchless Crossing and Localised);
 - Additional working areas, including equipment yards and laydown areas; and

- Temporary access tracks to the Construction Compounds and working areas.
- 4.5.2. The Construction Compounds and working areas need to be adjacent to the work front and will be distributed along the pipeline route. The Central Compound will be larger and house workshops and offices, with Trenchless Crossing Compounds and Localised Compounds being located near the major crossings and AGIs respectively.
- 4.5.3. Where possible, areas of high environmental sensitivity have been avoided and compounds located to minimise effects on environmental features where practicable.
- 4.5.4. The siting of the trenchless crossing and localised compounds has been refined during development of design and through the consideration of construction methods. Options for trenchless crossing and Localised Compounds are restricted as they need to be in close proximity to the working front that they service (i.e. trenchless crossings and AGIs respectively). They will be smaller and will not be in place for the entire construction period, as such the alternatives considered in this section focus on the main Central Compound.
- 4.5.5. Two Central Compound location options were identified during the initial design stages. The key consideration in this process was to identify options that have sufficient space to accommodate the construction offices and plant, that have good connectivity from the Strategic Road Network and that are in a central location relative to the route. This limits the distances to be travelled by construction plant between the work fronts and the Central Compound. Further technical, environmental, socio-economic and landowner constraints were also considered. The locations identified were as follows:
- Option 1: Land to the north-west of the New Brighton roundabout, adjacent to the A549 services; and
 - Option 2: Land south-east of the Wylfa roundabout, adjacent to the A541.
- 4.5.6. Option 1 was selected at DF2, as it was considered that the road network around this option will be more capable of supporting the safe and efficient operation of the Central Compound. The access benefits provided by Option 1 will likely lead to lower disruption to the road network, promote a more efficient construction workflow, and facilitate improved emergency response procedures when compared to Option 2. In addition, the topography and local infrastructure around Option 1 was considered more favourable.

4.6. AGI ALTERNATIVE LOCATIONS

4.6.1. No alternative locations for the Padeswood AGI or Northop Hall AGI have been considered. The AGI locations have been determined by the requirements of the emitter at Padeswood CCS Project and the connection point at Northop Hall AGI which has been consented as part of the HyNet Carbon Dioxide Pipeline Development Consent Order (DCO) 2024. Accordingly, there are no reasonable alternatives in either case.

4.7. MITIGATION BY DESIGN

4.7.1. This section summarises the embedded and good practice mitigation intended to reduce potential environmental impacts that are included within the design and documentation for the Padeswood Spur Pipeline Proposed Development application.

EMBEDDED MITIGATION

4.7.2. Consideration has been given to the potential environmental effects for which embedded mitigation is required. This includes route-wide design measures and more specific design measures associated with the development of the pipeline route and associated infrastructure.

4.7.3. A summary of embedded mitigation is provided in **Table 4.6**

Table 4.6 - Embedded Mitigation

Embedded Mitigation	Purpose
Ancient Woodland areas will be protected with a minimum 15m works exclusion zone. Where environmental mitigation works, drainage works or construction works in areas restricted by existing infrastructure occur within the Root Protection Areas (RPAs) of the ancient woodland, tree protection measures will be detailed within a site-specific Arboricultural Method Statement (AMS) and shown on a Tree Root Protection Plan (TRPP). Where necessary, working methods will be monitored by a suitable Arboricultural Clerk of Works (ACoW). The Construction Contractor will prepare the AMS approved as part of the CEMP	To minimise landscape and visual impacts

Embedded Mitigation	Purpose
<p>A pre-commencement walkover survey will be completed by the ECoW (or appointed ecologist). The walkover survey shall include a ground level assessment of land in search of presence or activity of protected and or notable species. The walkover survey results will determine the need for additional survey, mitigation and/or licensing beyond that included within the ES; to be considered in advance of construction commencement. Results of surveys and any needs for mitigation and licensing will be discussed with relevant stakeholders (e.g. Natural Resources Wales) where required, with amendments captured within the detailed CEMPs.</p>	<p>To update baseline survey results and protect species and habitats</p>
<p>Reinstatement of HPI habitats will take place post construction, however, recognising the need to reinstate with alternative habitats should former habitats potentially interfere with the buried pipeline (e.g. where trees are removed and cannot be reinstated, scrub will be planted as an alternative). Species will comprise native species of local provenance and will comprise a mixture of species. Planting should be undertaken in the appropriate planting season but as soon as possible following completion of the works to reduce the likelihood of undesired colonisation by flora or INNS.</p> <p>Non-HPI/BAP habitats impacted by construction will be reinstated on a like-for-like basis at the locations of loss/impact. Where adjudged appropriate, certain habitats may be left to naturally recover or otherwise be left to be managed by landowners, rather than be subject to dedicated mitigation</p>	<p>To compensate for the loss of habitats.</p>

Embedded Mitigation	Purpose
<p>planting/sowing (e.g. arable fields, pasture grassland). Habitats requiring mitigation planting/sowing will be determined during the detailed design of the Padeswood Spur Pipeline Proposed Development.</p> <p>Reinstated habitats will be monitored and managed for a minimum 5-year period post reinstatement. Any dead or dying plants will be removed and replaced during the monitoring period.</p>	
<p>Construction works will utilise existing accesses wherever practicable. Where new temporary construction accesses are required in existing hedgerows, the width to be lost will be kept to the minimum practicable and will not exceed 17m. Hedgerows, trees and woodland outside of this 17m will be protected and retained. Protective measures will be detailed within a site-specific Arboricultural Method Statement (AMS) and shown on a Tree Protection Plan (TPP) and where necessary, working methods will be monitored by a suitable Arboricultural Clerk of Works (ACoW).</p>	<p>To minimise landscape, visual and ecology impacts</p>
<p>For complex crossings, to avoid disruption to utilities, major highways, watercourses and/or particular environmental sensitivities (e.g. Ancient Woodland), specialist trenchless installation techniques will be used.</p>	<p>To reduce the impacts on environmental features.</p>
<p>The principles of inherent safe design have been incorporated into the design of the pipeline as per relevant industry codes of practice and standards and the requirements of the Pipeline Safety Regulations 1996.</p>	<p>To avoid potential effects on sensitive environmental receptors</p>

Embedded Mitigation	Purpose
24-hour remote monitoring of pipeline operation to detect leaks and enable remote shut down of the pipeline if required.	To avoid potential effects on sensitive environmental receptors

MITIGATION LAND

- 4.7.4. As mentioned in **paragraph 4.4.39**, land with potential for essential mitigation measures has been identified and refined as part of the design process.
- 4.7.5. Draft options for mitigation land were initially identified at DF1a through the consideration of ecological enhancement and landowner engagement. Further ecological survey and assessment work and landowner discussions have occurred at later stages of the design process to inform selection of preferred mitigation land options. At DF2a, these additional mitigation land parcels have been incorporated into the Red Line Boundary, as discussed in **paragraph 4.4.52**.

REFERENCES

HM Government. (2017). *Town and Country Planning (Environmental Impact Assessment) (Wales) Regulations 2017*. Retrieved from <https://www.legislation.gov.uk/wsi/2017/567/schedule/4/made>

National Grid. (2012). Our Approach to Options Appraisal. Retrieved from <https://www.nationalgrid.com/uk/electricitytransmission/document/96531/download>.