HyNet North West

ALLTAMI BROOK CROSSING – OPTIONS APPRAISAL

HyNet Carbon Dioxide Pipeline DCO

Planning Act 2008

The Infrastructure Planning (Examination Procedure) Rules 2010 Rule 8(1)(c)

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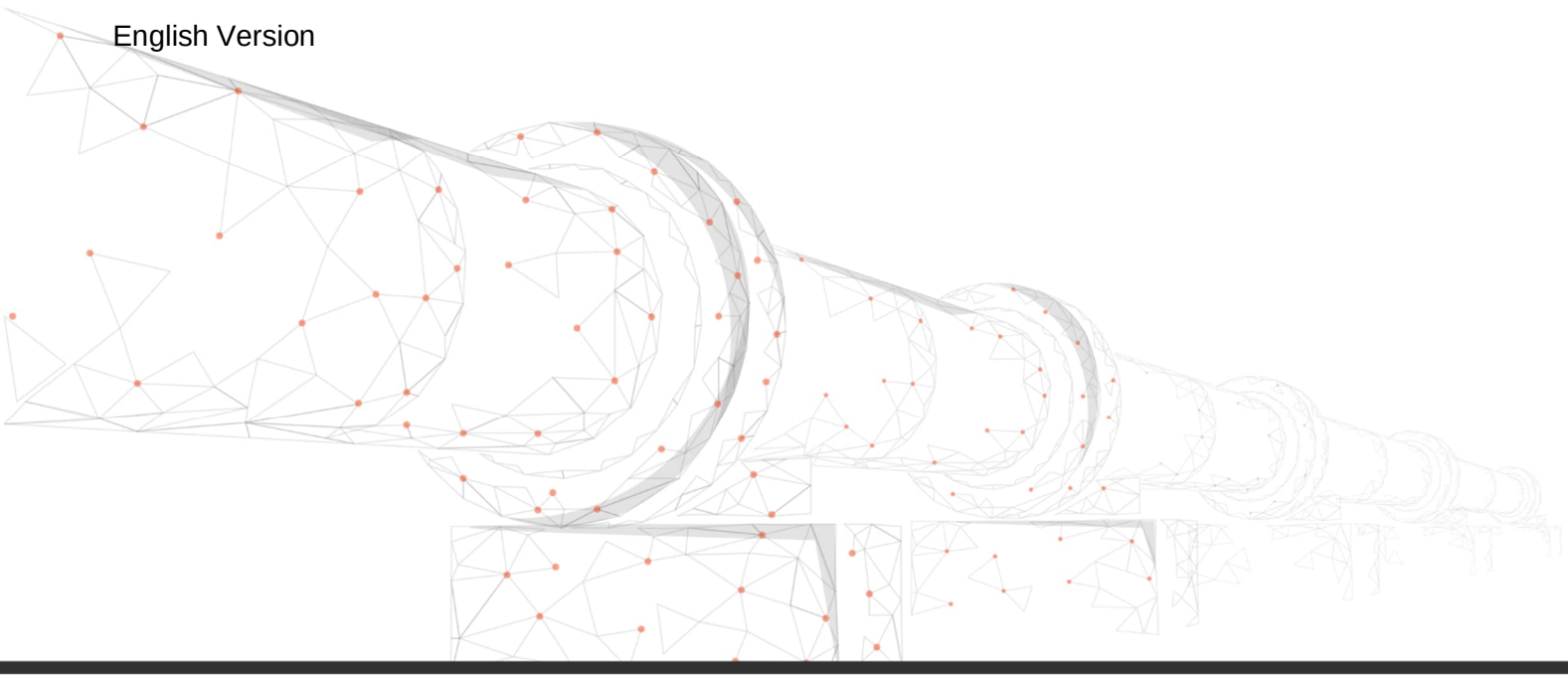

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1. INTRODUCTION

1.1. PURPOSE OF THE DOCUMENT

1.1.1. This document has been prepared on behalf of Liverpool Bay CCS Limited ('the Applicant') and relates to an application ('the Application') for a Development Consent Order (DCO) that has been submitted to the Secretary of State (SoS) for Energy Security and Net Zero under Section 37 of the Planning Act 2008 ('the PA 2008'). The Application relates to the Carbon Dioxide (CO_2) pipeline which constitutes the DCO Proposed Development.

1.1.2. Further details of each element of the DCO Proposed Development are set out in **Chapter 3 – Description of the DCO Proposed Development** of the Environmental Statement (ES) **[APP-055]** and **[CR1-124]**.

1.1.3. This document presents an options appraisal for the pipeline crossing of the Alltami Brook, which forms part of the DCO Proposed Development. Alltami Brook is a gorge located along the pipeline route, and which presents technical challenges that require a detailed study to determine the most suitable crossing method. This document presents the different options available to design and execute the Newbuild Carbon Dioxide Pipeline crossing and evaluates them by considering the following factors: construction feasibility, safety and integrity during the operational life, eventual decommissioning, land requirements and environmental impacts.

2. BACKGROUND

PIPELINE DESIGN

2.1.1. The Newbuild Carbon Dioxide Pipeline will be built out of steel and designed to BS PD8010-1 Pipeline Systems.

2.1.2. In line with PD8010-1, the project design philosophy is to bury the pipeline and to avoid the use of above-ground crossings. As per clause 6.9.4 of PD8010-1, *"the preferred design for pipeline crossings is for the buried installation of pipe"*.

2.1.3. The preferred method to bury the Newbuild Carbon Dioxide Pipeline is through open-trenched installation. Where this cannot be achieved, the use of trenchless crossing techniques is typically utilised instead.

2.1.4. The Applicant has consulted with a major developer and operator of UK onshore cross-country pipeline systems and notes that the industry's current practice is to utilise trenched or trenchless crossings and install pipe bridge solutions only where unavoidable and where any hazard and safety risks associated can be managed to an acceptable level.

2.2. ALLTAMI BROOK LOCATION

2.2.1. Alltami Brook is located southwest of the village of Northop Hall in Flintshire, Wales.

2.2.2. The UK (OSGB 1936) grid reference for the section of the brook in discussion is SJ 27659 67150, which is in Section 5 of the Newbuild Carbon Dioxide Pipeline.

2.2.3. The nearest road access is off Pinfold Lane, CH7 6LE.

2.2.4. The crossing is located approximately 26km along the length of the proposed 36" pipeline from Stanlow AGI (Above-Ground Installation) to Flint AGI and is between Aston Hill BVS (Block Valve Station) and Northop Hall AGI.

2.2.5. **Figure 2-1** highlights the location of the proposed Alltami Brook crossing area.

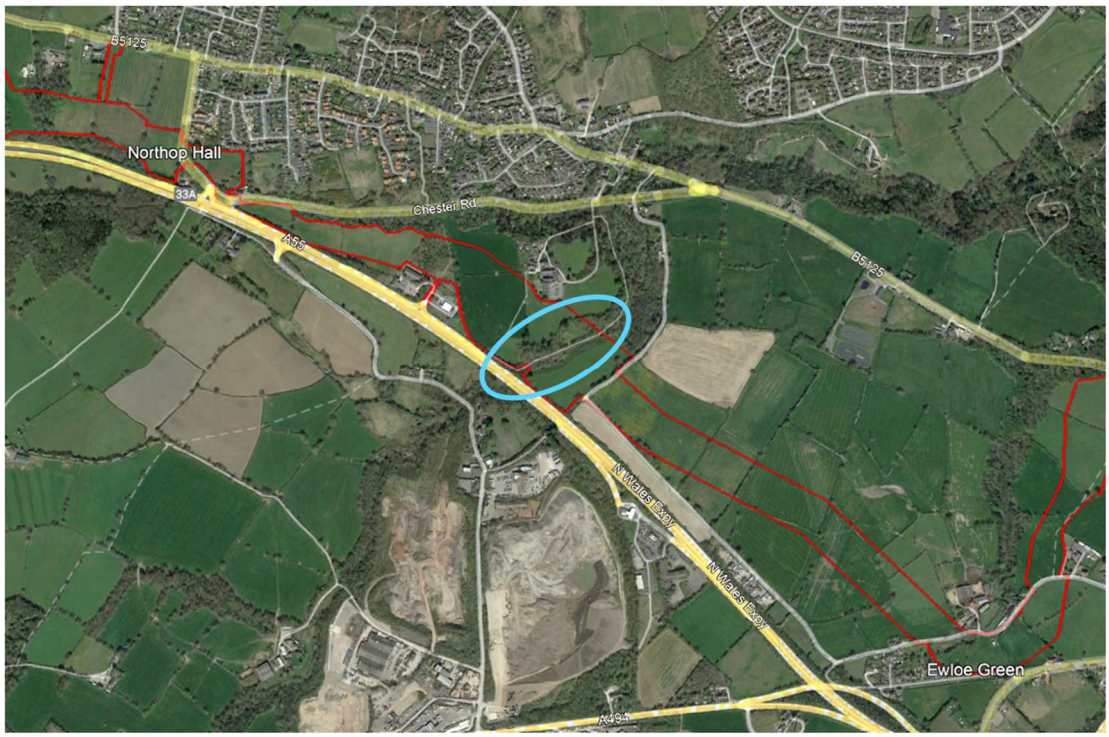

Figure 2-1 – Alltami Brook Crossing Location

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2.3. ALLTAMI BROOK DESCRIPTION

2.3.1. Alltami Brook is a narrow stream with an exposed bedrock bed. It runs in an approximate west-east orientation.

2.3.2. The brook is located in a gorge. Topographic surveys of the site show an approximate elevation difference of 15m between the crest of the slope and the bed of the brook.

2.3.3. The northern slope leading down to the brook is lined with mature trees and dense vegetation. The southern slope from its crest to the brook is terraced with evidence of shallow slope failures along the length. The route of the brook is understood to have been altered as a result of previous infrastructure developments.

2.3.4. Photographs of the crossing area are included in **Annex A** to this document.

2.3.5. The key constraints to pipeline construction are as follows:

- The Alltami Brook and gorge comprises a mixture of habitats including established mature woodland, scrub, and grassland, as well as riparian and aquatic habitats. The area is also encompassed by the Brook Park Farm Wood Wildlife Site, a local nature reserve. The Deeside and Buckley Newt Special Area of Conservation (SAC) is located to the north. Woodland present within the Order Limits has been considered Annex I habitat given its contiguous nature and likely historic connection to the SAC designated woodland.
- To the south of the crossing area, the gorge is steep sided, with areas of local shallow land slippage. This steep profile is made of artificial fill displaced during the construction of the A55. There are areas of historic coal mining located in the field directly adjacent to the brook, including adits and shafts. Historic mine records can be seen in **Annex B**.
- To the west of the crossing area (upstream), the brook is routed through a culvert under the A55 dual carriageway. The A55 is elevated on a steep embankment. There is a 33kV overhead powerline that crosses the brook adjacent to the A55 culvert.
- To the north of the crossing area, the gorge side is less steep, but is predominantly wooded. An old mine track is known to have passed alongside the brook and is now a public footpath.

2.3.6. **Figure 2-2** is annotated with the key local features.

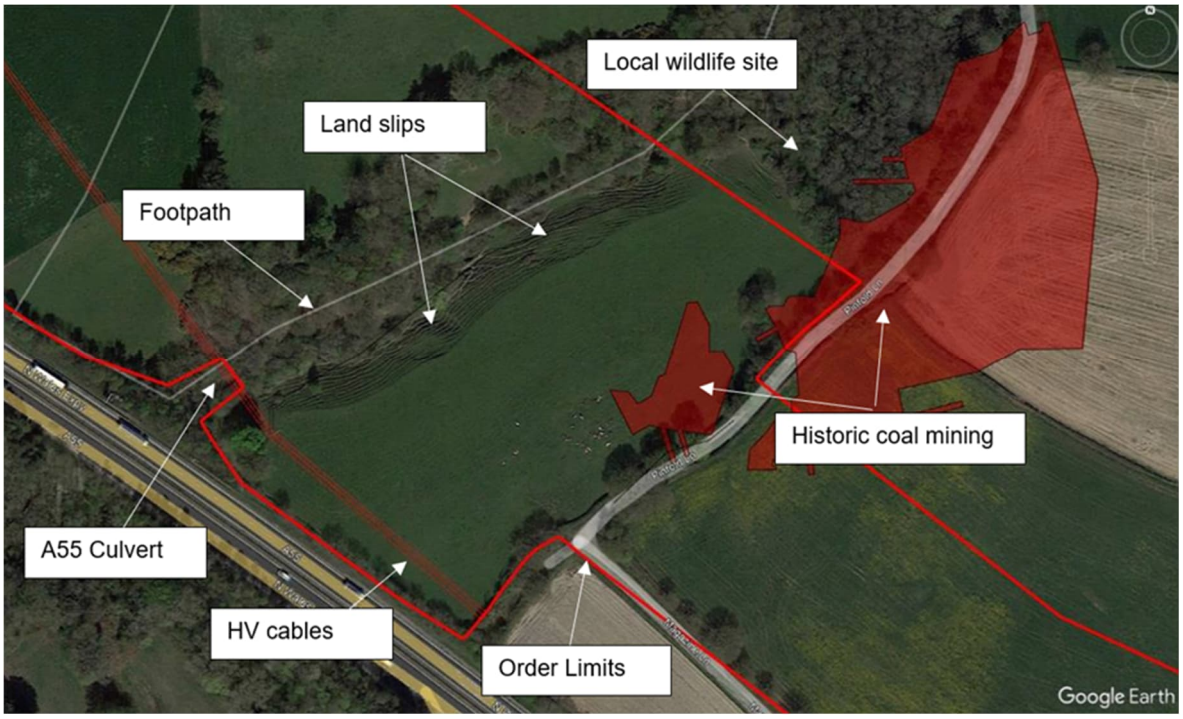

Figure 2-2 – Alltami Brook Crossing Constraints Map

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3. CROSSING METHOD OPTIONS APPRAISAL

3.1.1. The following methods have been considered for the pipeline crossing of the Alltami Brook:

- Open-Trenched Crossing;
- Trenchless Crossing – Horizontal Directional Drilling (HDD);
- Trenchless Crossing – Micro-Tunnelling;
- Over Crossing – Steel Truss Bridge; and
- Over Crossing – Embedded Pipeline Bridge[1].

3.1.2. Each of the above methods is discussed in the following sub-sections.

3.2. OPEN-TRENCHED CROSSING

INSTALLATION

3.2.1. **Annex C**, Wepre Brook Crossing Sketch 11042022 shows an indicative pipeline profile for an open-trenched crossing of Alltami Brook.

3.2.2. For the majority of typical cross-country pipeline routes, open-trenched installation is the norm. Minor watercourse crossings are generally executed by open cutting. For Alltami Brook, the presence of weak sandstone in the area makes this installation technique possible.

3.2.3. Ground works would be required on the south bank to create a temporary working area closer to the brook, and would include cutting a haul road or working platform out of the bank's artificial fill layer. When reinstating the banks of the slope, long term stabilisation measures, such as a reduced bank angle or geotextile reinforcement would be required to mitigate the possibility of landslip along the pipeline.

3.2.4. It is not thought that the north bank would require similar ground stabilisation, although a working corridor would be required through the trees as for any other open cut installation area. Temporary land take would be required to create a secure working area and provide appropriate access. Current uses which are understood to include grazing cattle would be prevented within the temporary land take area during construction. The Public Right of Way (PRoW) 39A would require to be temporarily diverted onto adjacent land.

3.2.5. During construction, the stream would be maintained by either installing a flume pipe across the gap to be excavated or else dammed up and over-pumped. A combination of these is most likely.

[1] The term Embedded Pipeline Bridge is a development of the 'pipeline over culvert' option presented previously.

3.2.6. After the pipeline is installed, the stream bed would be reinstated with a cementitious material (i.e. concrete). There should be no loss of stream flow as the design will include measures to prevent this, i.e., pipe is positioned well below the reinstated riverbed, concrete and other materials used to embed pipe are specified taking into consideration hydraulic conditions in river channel (e.g. flood rates) and re-instatement of bedrock. There is a low risk of potential loss of water to ground during operation, however the channel bed would be reinstated with impermeable materials to prevent loss of water to bedrock. Elements of the removed bedrock could potentially be embedded as part of the reinstatement to mimic the original conditions of the watercourse bed.

OPERATIONAL PERIOD

3.2.7. Once installed, it is expected that the Newbuild Carbon Dioxide Pipeline installation would essentially be “invisible”. Land take would be limited to subsurface acquisition with restrictions on the surface use to protect the pipeline. The landowners’ current use would not be prevented by those restrictions. Public use of the existing right of way would resume on the current alignment post-construction.

3.2.8. During the operational period the Newbuild Carbon Dioxide Pipeline at this location would require no additional maintenance activities compared to the typical open-trenched sections of the Newbuild Carbon Dioxide Pipeline in general.

3.2.9. Recognising that the bedrock had been disturbed the Applicant would undertake regular monitoring of the reinstated bed of the brook. This monitoring would form part of an adaptive management approach which would allow for reactive works to be designed and brought forward where any adverse impact, such as loss of water to ground in the reinstated area, was identified as occurring. These measures would be secured through the operational and maintenance environment management plan required by the draft DCO **[REP1-004]**.

END-OF-LIFE DECOMMISSIONING

3.2.10. It is expected that the operational life of the pipeline for the service of transporting CO_2 to storage in Liverpool Bay will be of the order of 25 to 30 years, albeit the pipeline has a longer design life. Decommissioning options for the Newbuild Carbon Dioxide Pipeline will depend upon the regulatory regime in place at the time, but one possible option could be to leave the pipeline preserved in place potentially filled with grout at the crossing point to ensure stability. This would avoid disruption to the re-established riparian environment and minimise interference with the landowners’ use.

DISCUSSION

3.2.11. To minimise impacts to the watercourse and the bedrock, the width required for the works for the Alltami Brook crossing would be reduced as far as possible. It is assumed that the works can be contained within a corridor of 16 metres within the riparian zone. The maximum width of the bedrock channel permanently impacted from removal of bedrock can be maintained to a maximum of 4 metres width.

3.2.12. As set out in the Water Framework Directive (WFD) Assessment **[APP-165]** the trenched crossing of Alltami Brook will not cause a deterioration in the status of quality elements or overall status at the Wepre Brook water body scale. Assessments show that the impact to the waterbody is local and minor and therefore it is understood that this meets the requirements of the Water Framework Directive 2017.

ENVIRONMENT

3.2.13. An appraisal of the environmental impacts of the Open-Trenched Crossing at Alltami Brook has been undertaken in **Table G1** in **Annex G**.

3.2.14. The appraisal determined that potential construction impacts relating to air quality, climate resilience, cultural heritage, biodiversity, materials and waste, noise and vibration, population and human health, traffic and transport and water environment would be adequately mitigated via measures set out in the range of documents submitted in support of the DCO application, including the Outline Construction Environmental Management Plan (OCEMP) **[REP2-021],** Outline Construction Traffic Management Plan (OCTMP) **[REP2-019]** and Outline Archaeological Written Scheme of Investigation (OAWSI) **[APP-223]**. All effects relating to greenhouse gas, land and soils and landscape and visual would either be localised or temporary in nature given the duration and nature of the construction phase. Finally, with regards to major accidents and disasters, this option may result in a potential increase in the risk of landslips which may indirectly result in flood risk potential. There may also be potential ground stability risks associated with the presence of historical mine workings.

3.2.15. During the operational phase and following the implementation of mitigation measures, no adverse effects are anticipated for air quality, climate resilience, cultural heritage, biodiversity, land and soils, material assets and waste, noise and vibration, population and human health, traffic and transport and major accidents and disasters. The permanent loss of mature vegetation would introduce notable but localised change and it would likely take approximately 30 years for replacement planting to reach comparable stature. Greenhouse gas emissions are expected to arise from land use, land use change and forestry (LULUCF) due to the removal of trees on the north side of the gorge.

3.2.16. With regards to the water environment, there would be a permanent localised loss of bedrock bed of watercourse (4m length) and potential initiation of geomorphic change and loss of aquatic habitat. However, potential re-use of excavated material could potentially be embedded as part of the reinstatement to mimic the original conditions of the watercourse bed and therefore mitigate potential impacts to geomorphological processes and aquatic habitat. A bespoke geomorphological assessment will be carried out to inform micro-siting and the detailed design of the permanent works in line with D-WR-064 of the Register of Environmental Actions and Commitments (REAC) **[REP2-017].**

3.3. TRENCHLESS CROSSING – HORIZONTAL DIRECTIONAL DRILLING (HDD)

INSTALLATION

3.3.1. **Annex D**, HDD Crossing Sketch 30032023 shows an indicative pipeline profile for an HDD crossing.

3.3.2. HDD is limited by the elastic bend radius of the Newbuild Carbon Dioxide Pipeline to be installed. For the proposed 36” Newbuild Carbon Dioxide Pipeline this is nominally a 1100m radius of curvature. Although the gorge is narrow, it is relatively deep, which means to reach the crossing depth required would result in an HDD crossing profile of at least 450m. It should be noted that this is indicative, and the length will be impacted by factors such as geological profile of the proposed crossing location which may result in a significantly longer crossing.

3.3.3. Temporary land take would be required to create a secure working area, create entry and exit pits for the HDD and provide appropriate access. Land take may be increased in area and/or duration over that required for open trenching to allow for the creation and reinstatement of entry and exit pits. Current uses which are understood to include grazing cattle would be prevented within the temporary land take area during construction. The PRoW would require to be temporarily diverted onto adjacent land.

3.3.4. The installation of pipelines in rock via HDD increases the risk of damage to the pipeline’s protective external coating during installation. In addition, the presence of coal at shallow depths may decrease the efficiency of the cathodic protection system due to its high carbon content and highly conductive nature. This combination results in a significant risk of installing a long section of pipeline, with damaged coating, that is not adequately protected by cathodic protection, at depths that are not practical to maintain and repair. This may significantly reduce the operational life of the Newbuild Carbon Dioxide Pipeline through increased rates of external corrosion.

3.3.5. The uncertainty of coal mining extents and lack of geotechnical investigation (due to the landowner's refusal to grant access for intrusive surveys) in the area increases the risk of encountering unmapped mine workings at depth. Loss of drill fluid into mine workings may result in failure of the crossing installation and poses secondary contamination risks should this create a new pathway for mine water to enter watercourses. These are considered to be major risks. It should be noted that even with borehole results these risks would not be fully removed in this location.

OPERATIONAL PERIOD

3.3.6. Once installed, it is expected that the Newbuild Carbon Dioxide Pipeline installation would essentially be "invisible". Land take would be limited to subsurface acquisition with restrictions on the surface use to protect the pipeline. The landowners' current use would not be prevented by those restrictions. Public use of the existing right of way would resume on the current alignment post-construction.

3.3.7. The comments above regarding the risk of coating damage during installation by HDD and impaired cathodic protection effectiveness raise significant concerns over pipeline integrity. It would be potentially necessary to increase the frequency of in-line-inspection (or "pigging" using a Pipeline Inspection Gauge) to monitor pipeline integrity. During such inspections the pipeline CO_2 throughput may have to be reduced, potentially causing either shut-down, restricted operations or emission of CO_2 to atmosphere at emitter facilities using the pipeline.

END-OF-LIFE DECOMMISSIONING

3.3.8. Refer to 3.2.14 above.

3.3.9. It would not be practical to remove a pipeline installed using this technique.

Discussion

3.3.10. As indicated in the sections above, consistent with previous options assessments presented in Chapter 4 of the 2022 ES **[APP-056]** and 2023 ES Addendum **[CR1-124]**, there are significant installation and operational risks associated with this type of crossing design.

3.3.11. The above assessments, and those in 3.4 below for Micro-Tunnelling have been informed by engineering feasibility and design work commissioned by the Applicant and delivered by OTB Engineering, a specialist trenchless crossing engineering consultant and designer. OTB Engineering is based in the region and has local experience.

Environment

3.3.12. An appraisal of the environmental impacts of the HDD crossing on Alltami Brook has been undertaken in **Table G2** in **Annex G**.

3.3.13. The appraisal determined that potential construction impacts relating to air quality, climate resilience, cultural heritage, biodiversity, materials and waste, noise and vibration, population and human health, traffic and transport would be adequately mitigated via measures set out in the range of documents submitted in support of the DCO application, including the OCEMP **[REP2-021]**, OCTMP **[REP2-019]** and OAWSI **[APP-223]**. With regards to water environment, there is potential for the breakout of drilling fluid from aperture into surrounding fractured bedrock aquifer and rising through bedrock into watercourse or passing through fractures into mine workings and into watercourse. Potential impact on surface water quality assumes upwards hydraulic gradient from aquifer to watercourse.

3.3.14. All effects relating to greenhouse gas, land and soils and landscape and visual would either be localised or temporary in nature given the duration and nature of the construction phase. Finally, with regards to major accidents and disasters, this option may result in a potential increase in the risk of landslips which may indirectly result in flood risk potential. There may also be potential ground stability risks associated with the presence of historical mine workings.

3.3.15. During the operational phase and following the implementation of mitigation measures, no adverse effects are anticipated for air quality, climate resilience, cultural heritage, biodiversity, greenhouse gas, land and soils, landscape and visual, material assets and waste, noise and vibration, population and human health, traffic and transport and water environment and major accidents and disasters.

3.4. TRENCHLESS CROSSING – MICRO-TUNNELLING

INSTALLATION

3.4.1. **Annex E**, drawing OTB-P23-0020DRG-4501 shows an indicative installation method for a micro-tunnel crossing.

3.4.2. Micro-tunnel installation would be a significant undertaking because of the depth of the gorge. Vertical entrance and exit shafts would need to be excavated through bedrock to a minimum depth of at least 25 meters.

3.4.3. **Annex E** shows that with an 8.2m diameter, 25m deep shaft on each side, the jacked tunnel lining is installed at a 1:11 slope. To reduce the slope (and reduce certain handling risks around inserting product pipe) this may increase as far as 35m deep on the north side of the brook. This is to achieve sufficient depth to safely clear the bed of the watercourse without impacting it. Drilling a shaft of such diameter into rock has been achieved before but is a highly specialised activity and is likely to take a number of months.

3.4.4. There is significant uncertainty in the indicative profile due to the lack of site-specific geotechnical investigation information. Fault locations, rock strength, depth of coal measures and presence of ground gas and groundwater would need to be confirmed. These features may also drive the diameter of the launch and reception shafts, as excavation of rock to a vertical depth of 35m may require an increase in working room for larger plant to be used.

3.4.5. The shaft on the south side would need to be sited sufficiently far to avoid encountering variable material from the A55 construction landfill and avoid the risks of unstable ground conditions. The location of the shaft would also need to consider the risks of encountering historical mineworks.

3.4.6. Micro-tunnelling would face similar risks of encountering mining works to those associated with an HDD crossing, albeit on a smaller scale as micro-tunnelling is a ‘closed face’ technique where there is no reliance on mud pressure to stabilise the anulus.

3.4.7. Temporary land take would be required to create a secure working area, create the shafts and provide appropriate access. Land take would be increased in area and/or duration over that required for open trenching to allow for the creation and reinstatement of the shafts which will require drilling works and the movement and storage of a considerable volume of excavated material. Current uses which are understood to include grazing cattle would be prevented within the temporary land take area during construction. The PRoW would require to be temporarily diverted onto adjacent land.

OPERATIONAL PERIOD

3.4.8. Once installed, it is expected that the pipeline installation would essentially be “invisible”. Land take would be limited to subsurface acquisition with restrictions on the surface use to protect the pipeline. The landowners’ current use would not be prevented by those restrictions. Public use of the existing right of way would resume on the current alignment post-construction.

3.4.9. The concerns described for HDD technique do not apply in this case.

END-OF-LIFE DECOMMISSIONING

3.4.10. Refer to 3.2.14 above.

3.4.11. Again, it would not be practical to remove a pipeline installed using this technique.

DISCUSSION

3.4.12. As indicated in the sections above, there are significant installation and operational risks associated with this type of crossing design.

3.4.13. The above assessments have been informed by engineering feasibility and design work commissioned by the Applicant and delivered by OTB Engineering, a specialist trenchless crossing engineering consultant and designer. OTB is based in the region and has local experience.

3.4.14. As indicated in the sections above and consistent with the previous options assessments presented in Chapter 4 of the 2022 ES **[APP-056]** and 2023 ES Addendum **[CR1-124]**, the use of auger boring as an alternative to micro-tunnelling is not considered feasible in this location because of the crossing length, which would require significantly more excavation for the pipeline stringing length.

ENVIRONMENT

3.4.15. An appraisal of the environmental impacts of the Trenchless (Micro-Tunnelling) Crossing on Alltami Brook has been undertaken in **Table G3** in **Annex G**.

3.4.16. The appraisal determined that potential construction impacts relating to air quality, climate resilience, cultural heritage, biodiversity, materials and waste, noise and vibration, population and human health, traffic and transport would be adequately mitigated via measures set out in the range of documents submitted in support of the DCO application, including the OCEMP **[REP2-021]**, OCTMP **[REP2-019]** and OAWSI **[APP-223]**. With regards to water environment, there is potential for the breakout of drilling fluid from aperture into surrounding fractured bedrock aquifer and rising through bedrock into watercourse or passing through fractures into mine workings and into watercourse. Potential impact on surface water quality assumes upwards hydraulic gradient from aquifer to watercourse.

3.4.17. All effects relating to greenhouse gas, land and soils and landscape and visual and water environment would either be localised or temporary in nature given the duration and nature of the construction phase. Finally, with regards to major accidents and disasters, this option may result in potential ground stability risks associated with the presence of historical mine workings.

3.4.18. During the operational phase and following the implementation of mitigation measures, no adverse effects are anticipated for air quality, climate resilience, cultural heritage, biodiversity, greenhouse gas, land and soils, landscape and visual, major accidents and disasters, material assets and waste, noise and vibration, population and human health, traffic and transport and water environment.

3.5. OVER CROSSING – STEEL TRUSS BRIDGE

3.5.1. Installation of a steel truss or exposed pipeline over bridge was not considered appropriate for this crossing in the previous options assessments presented in Chapter 4 of the 2022 ES **[APP-056]** and 2023 ES Addendum **[CR1-124]**.

3.5.2. The steel truss bridge would be supported by large concrete piers on either side of the brook and would span the watercourse so as to avoid impacting it.

3.5.3. Temporary land take would be required to create a secure working area and provide appropriate access. Current uses which are understood to include grazing cattle would be prevented within the temporary land take area during construction. The PRoW would require to be temporarily diverted onto adjacent land.

3.5.4. Permanent land take at the surface would be required for the bridge supports and any ancillary elements required (such as fencing to prevent trespass). The current use of this area would be extinguished. The PRoW would require to be diverted onto a new alignment around the supports. A suitable gradient for the PRoW would be required and ground works may be necessary to achieve that.

OPERATIONAL PERIOD - INSPECTION AND MAINTENANCE

3.5.5. If a steel truss bridge was selected as the method to cross Alltami Brook, it would be the only exposed section of pipeline within the DCO Proposed Development. The only other above-ground sections are located within fenced AGIs with safety monitoring systems.

3.5.6. An exposed pipeline is more susceptible to external corrosion mechanisms and would require dedicated maintenance checks to verify the integrity of the anti-corrosion coatings of both the pipeline and the support structure. Deterioration of the coatings could require the need to repaint over the design life of the project, requiring work at height and over water, both of which are clearly avoidable by using alternative solutions.

3.5.7. As the crossing is over a watercourse, there is a requirement to make the crossing safe for maintenance and inspection works to occur, increasing the steelwork requirement significantly. The Alltami Brook is located at the bottom of a gorge with no established means of access for maintenance and/or repair equipment. Therefore, it is preferred that the design solution in this location is suitable for the full design life of the project without planned maintenance activities.

3.5.8. In addition, an exposed pipeline would be more susceptible to accidental and/or targeted damage.

Operational Period - Public safety

3.5.9. Further to 3.5.8 above, the presence of a nearby PRoW is noted. Industry experience shows that people do trespass onto exposed pipelines at considerable risk to their own safety. While measures to prevent access by unauthorised persons would be included in the design, there would remain a risk both to the safety of persons accessing the pipeline and to the pipeline itself from such access (for example due to damage caused by people climbing onto and along the pipeline).

3.5.10. The 2015 prosecution of a UK pipeline operator for the death of a child after falling off a pipeline into a canal lead to a review of all pipeline overcrossings on their gas distribution network.

3.5.11. It is understood that guidance for the design of new gas pipeline crossings specifies that the construction of such over crossings is *"to be avoided if possible"* for new assets. Even if best practice measures are applied to the design of a new over crossing of the Alltami Brook, the relative risk of this crossing would be classified as 'High', due to it's ease of access from PRoW and evidence of public congregation.

END-OF-LIFE DECOMMISSIONING

3.5.12. At the end of the operating period, it would not be acceptable to leave such a structure in place.

3.5.13. The end-of-life decommissioning of the bridge would have similar environmental impact to its installation and would disturb a re-established riparian environment. There would be no automatic mechanism in place to return the diverted PRoW to its original route which would remain on the diverted route.

DISCUSSION

3.5.14. The use of exposed pipeline crossings, or pipelines supported on steel truss structures was common practice in the UK in the 1960s and 1970s. Their use as a crossing method has decreased as trenchless crossing methods became more accessible, and safety and maintenance issues associated with exposed over crossings have become better understood.

ENVIRONMENT

3.5.15. An appraisal of the environmental impacts of the Over Crossing – Steel Truss Bridge on Alltami Brook has been undertaken in **Table G4** in **Annex G**.

3.5.16. The appraisal determined that potential construction impacts relating to air quality, climate resilience, cultural heritage, biodiversity, materials and waste, noise and vibration, population and human health, traffic and transport would be adequately mitigated via measures set out in the range of documents submitted in support of the DCO application, including the OCEMP **[REP2-021]**, OCTMP **[REP2-019]** and OAWSI **[APP-223]**.

3.5.17. All effects relating to greenhouse gas, land and soils, landscape and visual and water environment would either be localised or temporary in nature given the duration and nature of the construction phase. Finally, with regards to major accidents and disasters, this option may result in a potential increase in the risk of landslips which may indirectly result in flood risk potential. There may also be potential ground stability risks associated with the presence of historical mine workings.

3.5.18. During the operational phase and following the implementation of mitigation measures, no adverse effects are anticipated for air quality, climate resilience, cultural heritage, biodiversity, land and soils, material assets and waste, noise and vibration, population and human health, traffic and transport, water environment and major accidents and disasters. Greenhouse gas emissions are expected to arise from LULUCF due to the removal of trees on the north side of the gorge. With regards to landscape and visual there would be a permanent loss of mature vegetation that would introduce notable but localised change that would likely take approximately 30 years for replacement planting to reach comparable stature and visual impacts on the PRoW from the bridge crossing.

3.6. OVER CROSSING – EMBEDDED PIPE BRIDGE

3.6.1. **Annex F**, drawing 1025HXBLRV80634 – ATT.01 shows an indicative pipeline profile for an embedded pipe bridge crossing of the Alltami Brook.

3.6.2. This method proposes to construct a concrete bridge across the brook and install the Newbuild Carbon Dioxide Pipeline within it. The Newbuild Carbon Dioxide Pipeline approaches either side of the brook would be buried by open-trenched installation. This is similar to the “Buried Pipeline over Culvert” option considered in previous options assessments presented in Chapter 4 of the 2022 ES **[APP-056]** and 2023 ES Addendum **[CR1-124]**, but avoids interference with the stream bedrock by using a bridge design.

3.6.3. The concrete bridge would be supported by large concrete piers on either side of the brook and would span the watercourse so as to avoid impacting it. The clearance over the brook would be designed to avoid any increase in local flood risks. The bridge would be primarily constructed out of pre-cast bridge beams and retaining walls. The Newbuild Carbon Dioxide Pipeline would be installed within and buried with bedding sand or soil.

3.6.4. Dependent on the detailed design of the bridge and the height off the ground, the sides of the bridge would have steel handrails or fencing for fall protection and security. Either end of the bridge would likely be gated and fenced off from the public to avoid trespassing.

3.6.5. Temporary land take would be required to create a secure working area and provide appropriate access. Current uses which are understood to include grazing cattle would be prevented within the temporary land take area during construction. Cranes would be required to lift bridge elements into place from above the gorge slopes Significant ground works, to be optimised during detailed design, would be required on both sides of the brook to enable temporary crane pads to be installed for lifting bridge sections. Piling mats may also be required should the abutments need piling.

3.6.6. The PRoW would require to be temporarily diverted onto adjacent land.

3.6.7. Permanent land take at the surface would be required for the bridge piers and the ancillary elements required (such as fencing to prevent trespass). The current use of this area would be extinguished. The permanent surface land take is likely to be highest for this option. The PRoW would require to be diverted onto a new alignment around the bridge supports. A suitable gradient for the PRoW would be required and ground works may be necessary to achieve that.

OPERATING PERIOD

3.6.8. This crossing enables cathodic protection continuity and would require less frequent inspection of the coating and structural supports. The structure could include guard rails to make safe any unauthorised access.

3.6.9. The section of Newbuild Carbon Dioxide Pipeline embedded in the bridge structure is protected physically and from corrosion in the same manner as the remainder of the pipeline. No additional inspection efforts would be required for the pipeline.

END-OF-LIFE DECOMMISSIONING

3.6.10. Removal of the bridge, if required, would require a significant effort, similar to that of construction.

3.6.11. Any proposal to leave in place would require approval from the applicable regulator at the time.

3.6.12. There would be no automatic mechanism in place to return the diverted PRoW to its original route which would remain on the diverted route.

DISCUSSION

3.6.13. This option presents a departure from the buried pipeline norms by introducing an above-ground structure for the purpose of installing a pipeline. The purpose of the embedded pipeline bridge solution is to avoid impacting the watercourse bedrock during construction, while protecting the Newbuild Carbon Dioxide Pipeline throughout its operating design life and minimising the safety risks involved with an above-ground Newbuild Carbon Dioxide Pipeline crossing solution. With this design, the Newbuild Carbon Dioxide Pipeline is physically protected by burying it within backfill material (sand or soil) and encasing it in concrete. This protects the Newbuild Carbon Dioxide Pipeline from external corrosion mechanisms, and third-party damage and vandalism. This solution also avoids any transitions between a buried and an exposed pipeline, where additional protection measures may be required to protect the pipeline from damage.

3.6.14. A structural form has been shown in **Annex F**. Shorter spans are likely to be achievable following detailed site selection and surveys including geotechnical investigation. The indicative structure in **Annex F** is considered a reasonable worst-case design in terms of the required span and depth of structural members. If a shorter span can be identified, a smaller structure with lower visual impact may be possible.

3.6.15. Permanent re-profiling of the ground on the south bank may be required to reduce the approach angle down onto the bridge itself. This structure is designed to not interfere with the stream bed in the same way that a traditional culvert would (i.e. the same type of culvert that is seen upstream under the A55).

ENVIRONMENT

3.6.16. An appraisal of the environmental impacts of the Over Crossing – Embedded Pipe Bridge on Alltami Brook has been undertaken in **Table G5** in **Annex G**.

3.6.17. The appraisal determined that potential construction impacts relating to air quality, climate resilience, cultural heritage, biodiversity, materials and waste, noise and vibration, population and human health, traffic and transport would be adequately mitigated via measures set out in the range of documents submitted in support of the DCO application, including the OCEMP **[REP2-021]**, OCTMP **[REP2-019]** and OAWSI **[APP-223]**.

3.6.18. All effects relating to greenhouse gas, land and soils, landscape and visual and water environment would either be localised or temporary in nature given the duration and nature of the construction phase. Finally, with regards to major accidents and disasters, this option may result in a potential increase in the risk of landslips which may indirectly result in flood risk potential. There may also be potential ground stability risks associated with the presence of historical mine workings.

3.6.19. During the operational phase and following the implementation of mitigation measures, no adverse effects are anticipated for air quality, climate resilience, cultural heritage, biodiversity, land and soils, material assets and waste, noise and vibration, population and human health, traffic and transport and water environment and major accidents and disasters. Greenhouse gas emissions are expected to arise from LULUCF due to the removal of trees on the north side of the gorge. With regards to landscape and visual there would be a permanent loss of mature vegetation would introduce notable but localised change and it would likely take approximately 30 years for replacement planting to reach comparable stature and visual impacts on the PRoW from the bridge crossing.

3.7. SUMMARY

3.7.1. A summary of the five design solutions considered is shown in **Table 3-1** a comparative RAG assessment has been used to identify critical aspects which rule out several methods (in red).

Table 3-1 – Summary of Crossing Methods

Crossing Method	Construction Feasibility	Operations & Maintenance Phase	Safety / Integrity Considerations	Environmental Considerations	Land Take	End of Life Decommissioning
Open-Trenched	*Technically feasible. Need for stabilisation works along the banks (outside of the watercourse).*	*Low risk – monitoring and adaptive management*	*Low risk once installed and buried.*	*Trees, vegetation and riparian habitat removed (impact reduced following mitigation planting). Temporary PRoW diversion needed. Permanent impact to watercourse bedrock (mitigated through reinstatement to near baseline conditions). Risk of water loss through bedrock considered low.*	*Subsurface only land take (permanent)*	*Low impact– pipe would be left buried in the ground and grouted for stability.*
HDD	*Very long HDD required to achieve crossing depth. Coal mining risk remains despite records review.* *Difficult with many known and unknown risks that at any time could result in a stop of works.*	*Risk of compromising pipeline coating during installation. Potential limited effectiveness of cathodic protection system at this location. Possible need for higher inspection frequency.*	*Refer to comments on pipeline coating and CP.*	*Unlikely to require trees, vegetation and riparian habitat to be removed. Potential for pollution events, discharges of sediment, frac-out and release of drill fluid to ground and / or watercourses during construction.*	*Subsurface only land take (permanent)*	*Low impact– pipe would be left buried in the ground and grouted for stability.*

Crossing Method	Construction Feasibility	Operations & Maintenance Phase	Safety / Integrity Considerations	Environmental Considerations	Land Take	End of Life Decommissioning
Micro-tunnel or Auger bore	*Impractical depth of launch and reception shafts. Coal mining risk remains despite records review.*	*Low risk of pipeline damage on installation*	*Low risk once installed and buried.*	*Unlikely to require trees, vegetation and riparian habitat to be removed. Potential for pollution events, discharges of sediment, frac-out and release of drill fluid to ground and / or watercourses during construction. Potential dewatering required of entry and exit shafts.*	*Subsurface only land take (permanent)*	*Low impact– pipe would be left buried in the ground and grouted for stability.*
Pipeline Bridge Steel Truss	*Technically feasible. Excavation for piers and foundations and stabilisation works along the banks (outside watercourse), and installation of large steel structure challenging.*	*Periodic inspection and maintenance for corrosion protection of pipeline and truss structure required*	*Significant safety risk, related to 1. Trespass and risk of injury or death due to fall from height and 2. Accidental or deliberate damage to the exposed pipeline at this location. Can be mitigated to medium with*	*Trees, vegetation and riparian habitat removed (Impact reduced following mitigation planting but would be greater footprint compared to opencut option). Permanent PRoW diversion required.* *Visual impact of bridge structure.*	*Medium – will be permanent land take/interference with PRoW*	*Steel truss bridge would need to be removed. Access track works required.*

Crossing Method	Construction Feasibility	Operations & Maintenance Phase	Safety / Integrity Considerations	Environmental Considerations	Land Take	End of Life Decommissioning
			appropriate measures (fencing, routine inspections, etc.)			
Embedded pipeline bridge	*Technically feasible. Excavation for piers and foundations and stabilisation works along the banks (outside watercourse), and installation of concrete structures challenging.*	*Inspection and maintenance requirements for structure expected to be lower than for steel truss. Pipeline requires no special attention.*	*No particular concern for pipeline. Risk of unauthorised access to structure is medium if mitigated with appropriate measures*	*Trees, vegetation and riparian habitat removed. Permanent PRoW diversion required.* *Visual impact of bridge structure.*	*Medium – will be permanent land take/interference with PRoW*	*Embedded pipeline bridge would need to be removed. Access track works required.*

3.7.2. The assessment shows that an open-trenched crossing is technically feasible, albeit challenging. This is the preferred option and is aligned with the construction approach adopted across the project.

3.7.3. The second alternative considered feasible is the use of an embedded pipeline bridge. However, this alternative is more impactful in environmental terms. It would also require increased land take at the surface over a trenched option with consequential increase in impact on the landowner and would require the permanent diversion of the PRoW. The diversion of the PRoW may also require some works to ensure that the diverted route has a suitable gradient.

3.7.4. Trenchless crossing techniques are not considered viable construction alternatives.

3.7.5. A steel truss bridge has similar environmental characteristics to the embedded pipeline bridge solution but introduces a number of operational and safety concerns that can be better mitigated by the embedded pipeline bridge solution.

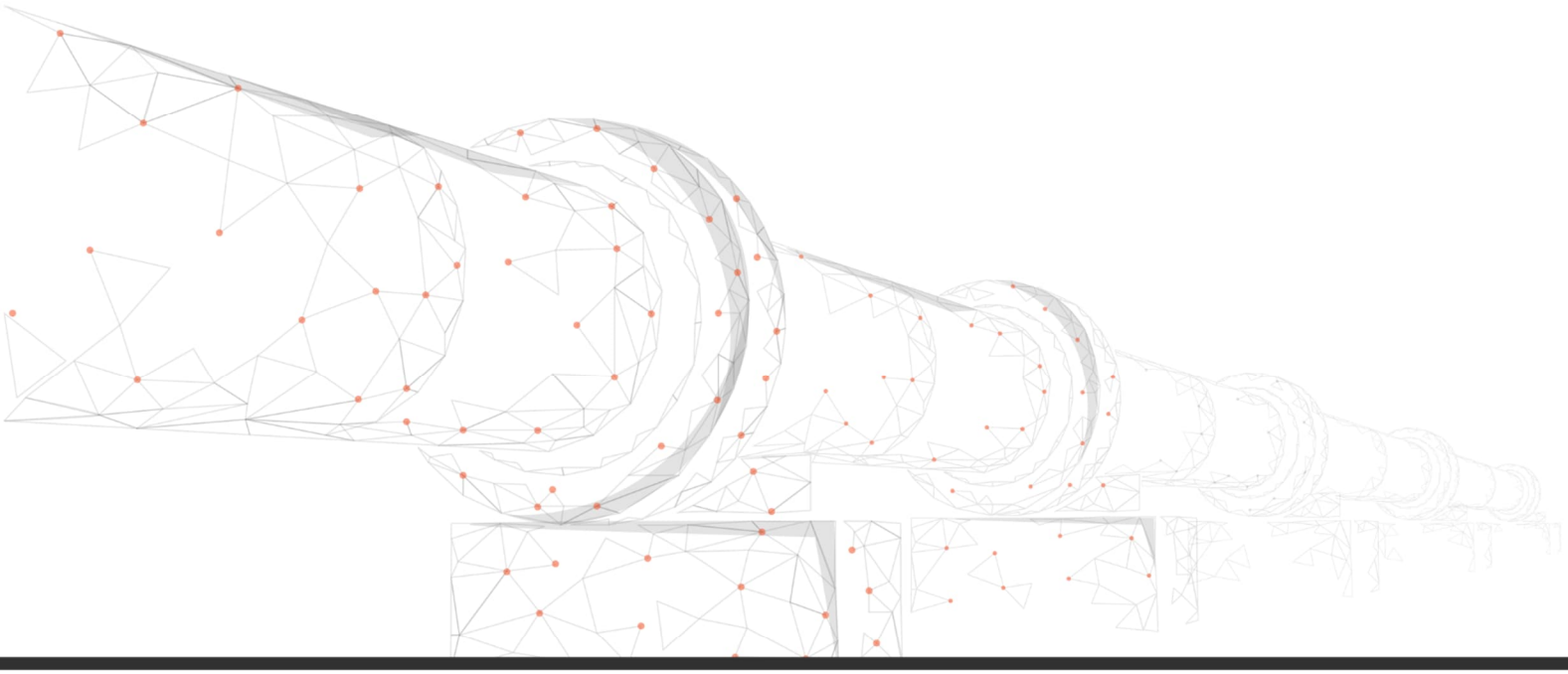
4. CONCLUSION

4.1.1. The Applicant's base case design is an open-trenched crossing of the Alltami Brook. This has been included within the DCO submitted in October 2022.

5. REFERENCES

Ref 1 – BS PD 8010-1 - Pipeline Systems. Steel Pipelines on Land. Code Of Practice.

Annexures



Annex A

PHOTOS

PHOTOS

Photograph A1 : Alltami Brook South Side (Landfill), Looking Upstream Towards A55

Photograph A2: Alltami Brook Looking Downstream

Photograph A3: Culvert Under A55

Annex B

COAL AUTHORITY MAP

The following image shows a hand-drawn map of the mine shafts acquired from the Coal Authority for the field to the south of Alltami Brook.

Figure B1: Alltami Brook South Side (Landfill), Looking Upstream Towards A55

Annex C

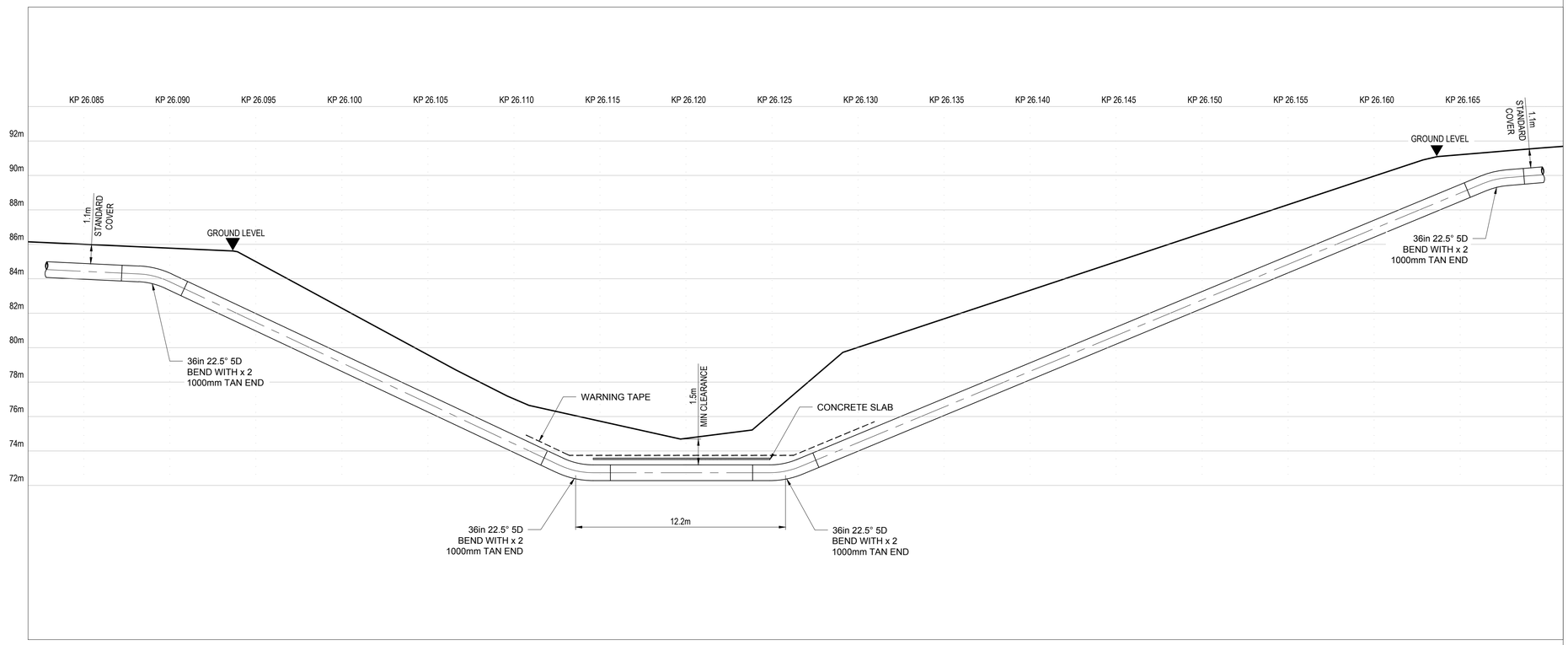
OPEN CUT BROOK CROSSING PROFILE

See attached drawing:

SKETCH – 001,

NEW ONSHORE PIPELINES 36IN WEPRE BROOK CROSSING SKETCH

See Drawing insert:



ELEVATION VIEW ON WEPRE BROOK CROSSING

SCALE 1:150

DRAFT

REFERENCE DOCUMENTS

NUMBER	TITLE

Validity Status	Rev. Number	Date	Description	Prepared	Checked	Approved	Approved Eni UK
CD-FE	00	11.04.2022	ISSUED FOR INFORMATION	R.D.	K.K.	S.G	

Revision index

Company logo and business name: eni uk / eni progetti

Company Document ID: SKETCH - 001

Job. N. JA0614

Facility and Sub Facility Name: LBA CCS

Project Name: LBA CCS Transport and Storage

Scale: 1:150 @A1

Sheet of Sheets: 1 / 1

Document Title

NEW ONSHORE PIPELINES
36in WEPRE BROOK CROSSING SKETCH

Supersedes N.

Superseded by N.

Plant Area: N/A

Plant Unit: N/A

Software:AutoCad

Filename.Crossing Sketch 11042022.DWG

A1 (841 x 594)

Annex D

HDD CROSSING PROFILE

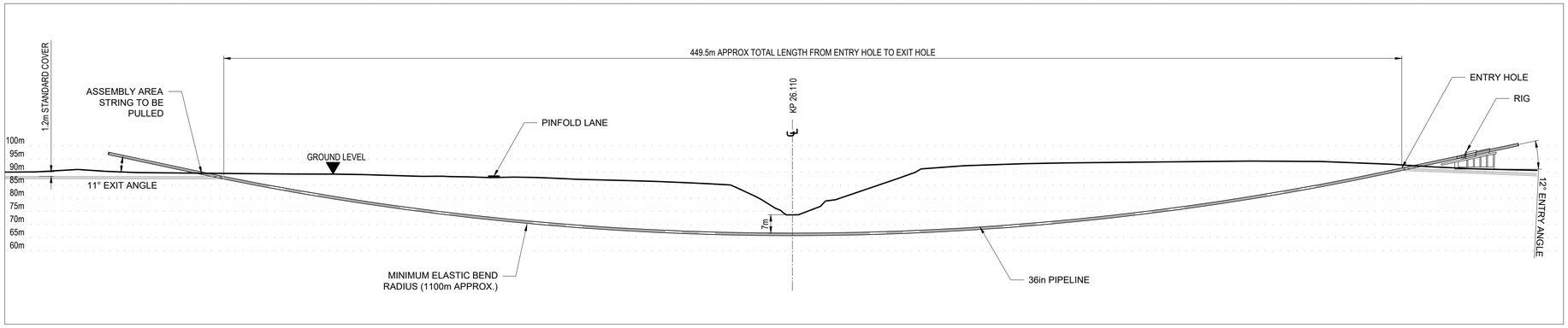
See attached drawing:

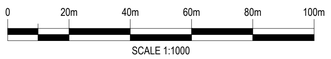
SKETCH – 002,

NEW ONSHORE PIPELINES 36IN HDD CROSSING SKETCH

REFERENCE DOCUMENTS	
NUMBER	TITLE

KP 25.825 · KP 25.850 · KP 25.875 · KP 25.900 · KP 25.925 · KP 25.950 · KP 25.975 · KP 26.000 · KP 26.025 · KP 26.050 · KP 26.075 · KP 26.100 · KP 26.125 · KP 26.150 · KP 26.175 · KP 26.200 · KP 26.225 · KP 26.250 · KP 26.275 · KP 26.300 · KP 26.325 · KP 26.350 · KP 26.375 · KP 26.400





ELEVATION VIEW ON ALTAMI BROOK HDD CROSSING

SCALE 1:1000

DRAFT

Validity Status	Rev. Number	Date	Description	Prepared	Checked	Approved	Approved Eni UK
CD-FE	00	30.03.2023	ISSUED FOR INFORMATION	R.D.	K.K.	S.G.	

Revision index

Company logo and business name

Company Document ID: SKETCH - 002

Job. N. JA0614

Facility and Sub Facility Name	Project Name	Scale	Sheet of Sheets
LBA CCS	LBA CCS Transport and Storage	1:1000 @A1	1 / 1

Document Title

NEW ONSHORE PIPELINES
36in ALTAMI BROOK HDD CROSSING SKETCH

Superseded N.

Superseded by N.

Plant Area	Plant Unit
N/A	N/A

Software:AutoCad

Filename.HDD Crossing Sketch 15072022.DWG

A1 (841 x 594)

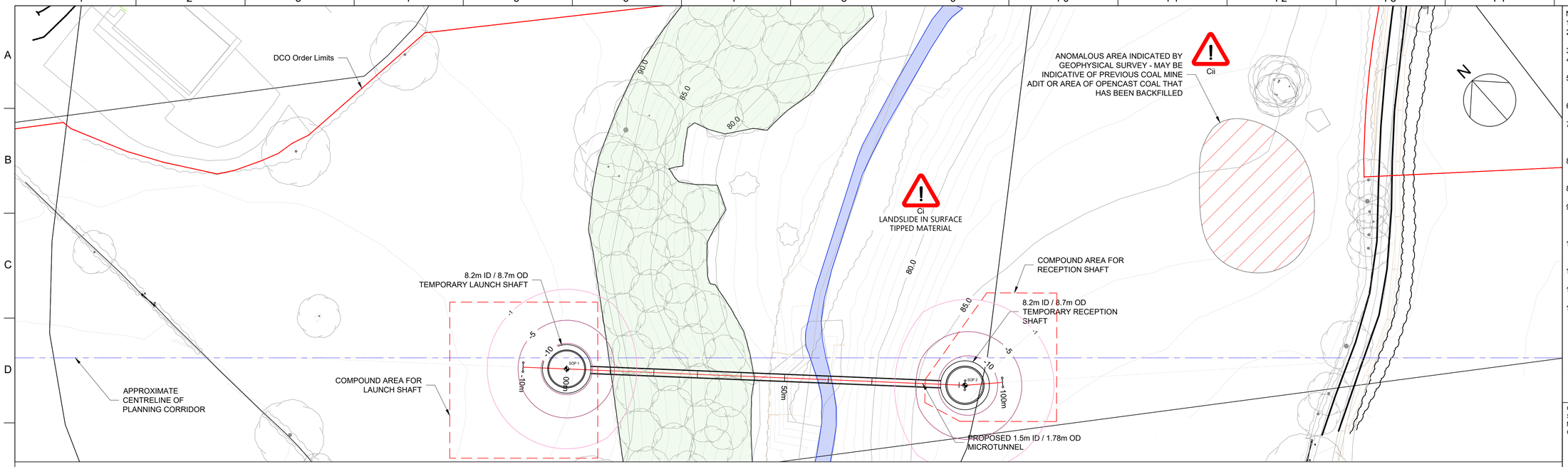
Annex E

MICRO-TUNNEL CROSSING PROFILE

See attached drawing:

OTB-P23-002-DRG-4501 REV 1

TRS 45 CROSSING TUNNELING WORKS GENERAL ARRANGEMENT



PLAN VIEW
SCALE 1:500 — 01 / -

SOP CO-ORDINATES		
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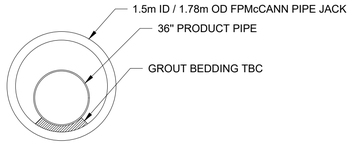
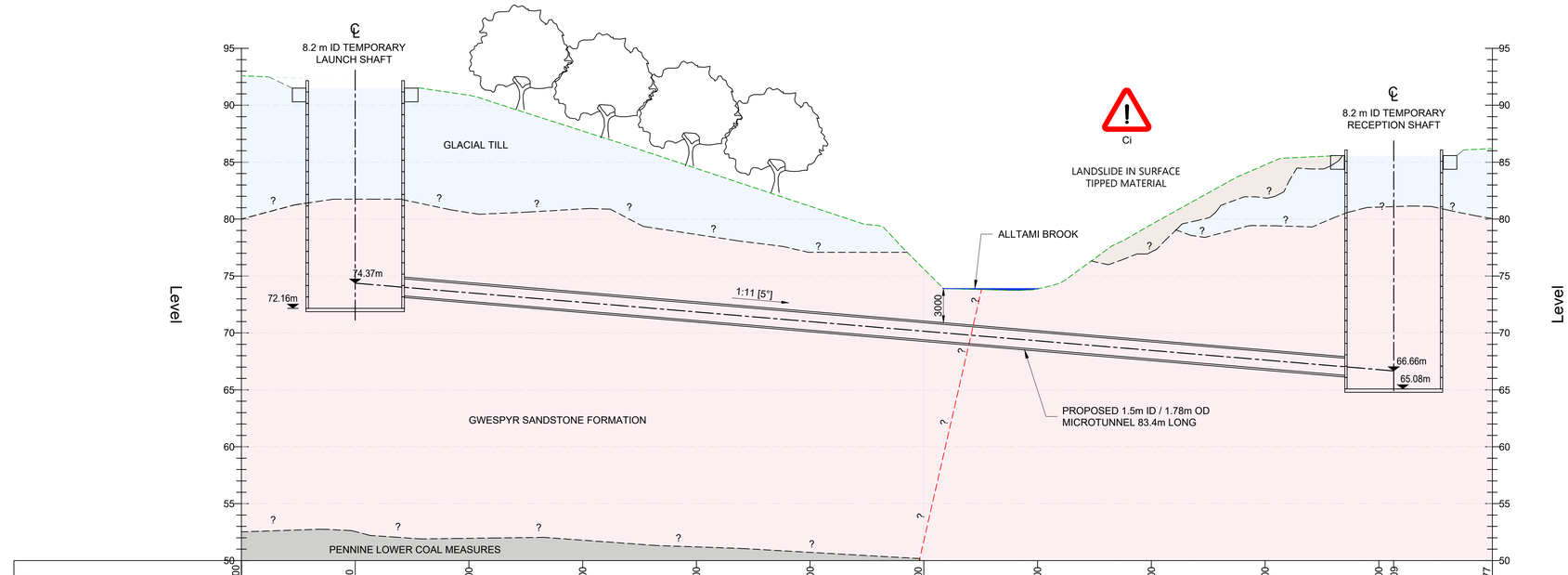
SOP2	327673.661	367117.429



TYPICAL PIPE SECTION
SCALE 1:50 — B / -



Chainage [m]	-10.000	0.000	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000	91.309	99.977
Existing Ground Levels [mOD]	92.591	92.088	90.879	87.734	84.448	81.124	75.613	73.866	79.522	84.763	85.749	85.749	86.195

LONG SECTION
SCALE H 1:250, V 1:250 — A / -

GEOLOGICAL CONSIDERATIONS:

DUE TO THE LACK OF INTRUSIVE GEOLOGICAL EXPLORATION WITHIN CLOSE PROXIMITY OF THE SITE THE GEOLOGICAL BOUNDARIES HAVE BEEN INFERRED FROM A RANGE OF SOURCES INCLUDING:

- BGS GEOINDEX ONLINE VIEWER
- BGS 10:10,000 GEOLOGICAL MAPPING
- BGS 1:50,000 GEOLOGICAL MAPPING
- COAL AUTHORITY REPORTING
- GEOPHYSICAL INVESTIGATIONS

MAPPING OF THE AREA SHOWS EXTENSIVE FAULTING IN THE REGION. IT IS ANTICIPATED FROM THE MAPPING THAT THE LAUNCH AND RECEPTION SHAFTS IN THESE LOCATIONS WILL BE FOUNDED WITHIN THE GWESPYR SANDSTONE FORMATION.

THE PENNINE LOWER COAL MEASURES HAVE BEEN MAPPED USING THE COAL AUTHORITY REPORT AND THE BGS 1:10,000 GEOLOGICAL MAP AND THE SHAFT LOCATIONS HAVE BEEN CHOSEN TO REDUCE THE RISK OF ENCOUNTERING COAL SEAMS OR PREVIOUS WORKINGS.

THE RISK OF ENCOUNTERING UNKNOWN OR UNRECORDED COAL MINING STILL REMAINS A RISK FOR THE WORKS AND INTRUSIVE GROUND INVESTIGATION ON SITE IS RECOMMENDED BEFORE SITE WORKS COMMENCE.

GROUNDWATER LEVEL DATA NOT AVAILABLE. ASSUMED SUPERFICIAL GROUNDWATER IS PRESENT WITHIN POCKETS OF GRANULAR GLACIAL TILL AS PERCHED GROUNDWATER.

KEY:

- TIPPED WASTE MATERIAL
- GLACIAL TILL
- PENNINE MIDDLE COAL MEASURES
- GWESPYR SANDSTONE FORMATION
- PENNINE LOWER COAL MEASURES
- GROUND LEVEL FROM TOPOGRAPHICAL SURVEY
- -5.0 / -1.0 SETTLEMENTS CONTOURS

NOTES:
1. DIMENSIONS NOT TO BE SCALED OFF DRAWING.
2. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE SHOWN.
3. ALL LEVELS ARE IN METRES AT ORDINANCE DATUM.
4. GROUND CONDITIONS ARE BASED ON HISTORICAL DATA THAT IS PUBLICLY AVAILABLE.
5. GROUND LEVELS HAVE BEEN DEVELOPED BASED ON TOPOGRAPHIC SURVEY INFORMATION SUPPLIED BY THE CLIENT.
6. LAUNCH AND RECEPTION SHAFTS DIAMETER BASED ON THE USE OF ISEKI UCLEMOLE 1500 mTBM.
7. TOP OF BASE SLAB CLEARANCE ASSUMED 1000mm BELOW PIPE INVERT LEVEL INSIDE SHAFTS TO BE FINALIZED WITH THE JACKING RIG TO BE USED AND PIPE INSTALLATION REQUIREMENTS.
8. JACKING PIPES LENGTH ASSUMED TO BE 2.5m LONG IN ACCORDANCE WITH FP MCCANN'S JACKING PIPE RANGE.
8. JACKING PIPES TO BE GROUTED AFTER THE COMPLETION OF THE TUNNELING WORKS.
9. GROUNDWATER LEVEL DATA NOT AVAILABLE. ASSUMED SUPERFICIAL GROUNDWATER IS PRESENT WITHIN POCKETS OF GRANULAR GLACIAL TILL AS PERCHED GROUNDWATER.
10. GROUND MOVEMENT SETTLEMENT CONTOURS SHOWN FOR SHAFTS AND TUNNELS AT SURFACE LEVEL.
11. FOR SHAFTS REFER TO DRAWING OTB-P23-002-DRG-4502 AND 4503.
12. FOR COMPOUND LAYOUT REFER TO DRAWING OTB-P23-002-DRG-4504.
13. DRAWING TO BE READ IN CONJUNCTION WITH DESIGNER RISK ASSESSMENT OTB-P23-002-DRA-001.

Ci. LANDSLIDE IN SURFACE TIPPED MATERIAL. Cii. COAL MINE.	N/A	N/A
CONSTRUCTION RISKS	MAINTENANCE / CLEANING RISKS	DEMOLITION / ADAPTATION RISKS

In addition to the hazard/risks normally associated with the type of works detailed on this drawing take note of the above It is assumed that all works on this drawing will be carried out by a competent contractor working where appropriate, to an appropriate method statement

SAFETY HEALTH AND ENVIRONMENTAL INFORMATION BOX

Rev.	By	Revision	Desn	Chkd	Appd	Date
P01	BB	FOR ACCEPTANCE	AM	HN	DM	31/03/23

Owner
OTB Engineering Ltd
12 Rushworth Street,
London SE1 0RB
TEL 020 7099 2608
www.otbeng.com

extraordinary ingenuity

Client

Purpose of Issue: FOR ACCEPTANCE — Suitability: S2

Location: NORTHOP HALL, FLINTSHIRE, WALES, UK

Project: HYNET CO2 PRIORITY CROSSINGS

Title: TRS 45 CROSSING TUNNELING WORKS GENERAL ARRANGEMENT

Drawn	BB	31/03/23
Checked	HN	-
Approved	DM	-
Scale	AS SHOWN @ A1	Sheet: -
Drawing Number	OTB-P23-002-DRG-4501	Rev. P01

1:250
5m 0 5m 10m 15m 20m 25m

1:500
10m 0 10m 20m 30m 40m 50m

A1 MICROFILM REF. 0 1 2 3 4 5 6 7 8 9 10

A 1

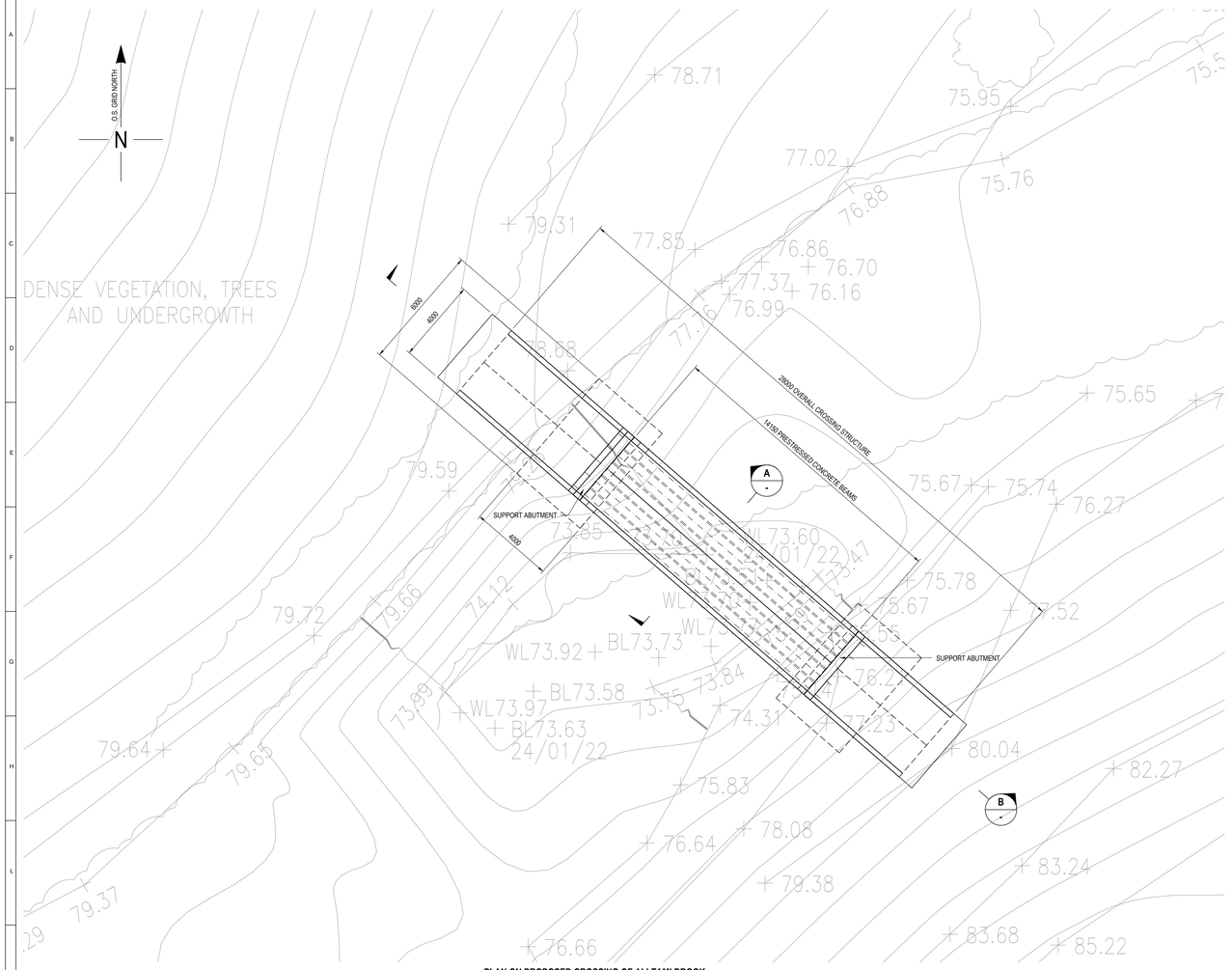
Annex F

EMBEDDED PIPELINE BRIDGE

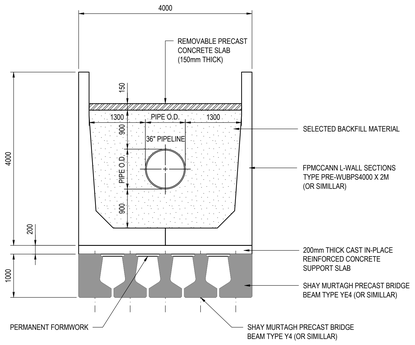
See attached drawing:

TECHNICAL NOTE – ALLTAMI BROOK

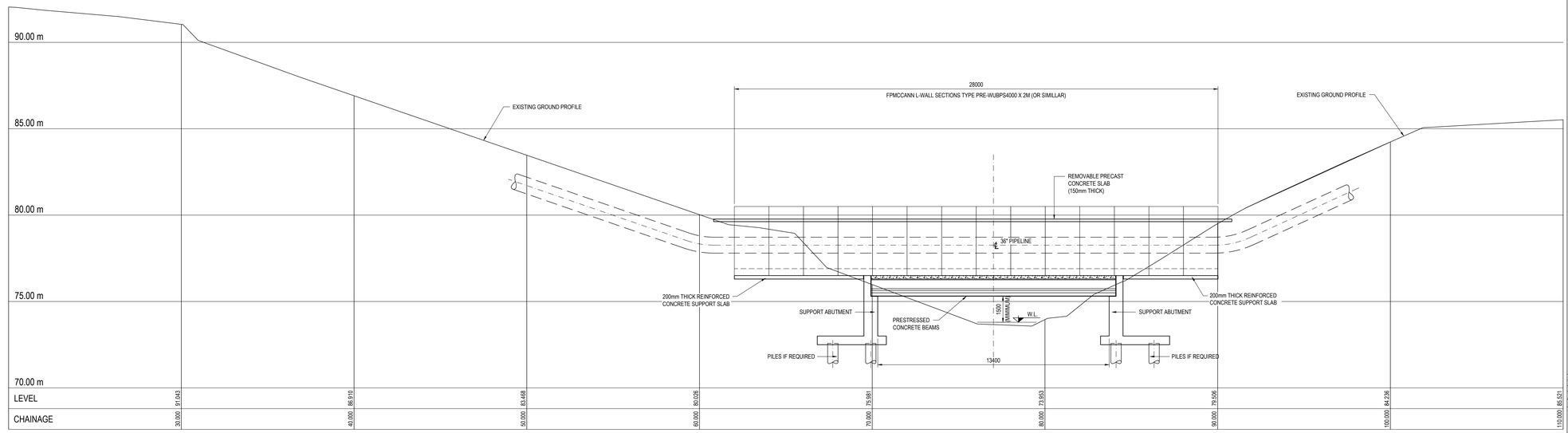
BURIED PIPELINE BRIDGE - ATTACHMENT 1



PLAN ON PROPOSED CROSSING OF ALLTAMI BROOK
SCALE 1:100



SECTION A - TYPICAL CROSS-SECTION OVER ALLTAMI BROOK
SCALE 1:50



SCALE : VERTICAL 1:100, HORIZONTAL 1:100

SECTION B

0 1 2 3 4 5 m
1:50

0 1 2 3 4 5 10 m
1:100

REFERENCE DOCUMENTS

NUMBER	TITLE

NOTES:

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH CIVIL WORK STANDARD GENERAL NOTES 28816.ENG.CIV.DWG.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
3. ALL COORDINATES AND ELEVATIONS ARE IN METRES UNLESS NOTED OTHERWISE.
4. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH THE FUGRO TOPOGRAPHICAL SURVEY DOCUMENT No. 57611 - 3D TOPOGRAPHICAL SURVEY REV A (20-12-22). ALL ELEVATIONS AND EXISTING FEATURES HAVE BEEN TAKEN FROM THE TOPOGRAPHICAL SURVEY.
5. THE FOUNDATION SHOWN IS INDICATIVE. DESIGN TO BE COMPLETED AFTER RECEIVING GEOTECHNICAL DATA.
6. FENCING AND FALL PROTECTION ARE TO BE ADDED

Validity Status	Rev. Number	Date	Description	Prepared	Checked	Approved	Approved Eni UK
CD-FE	00	23/03/2023	ISSUED FOR COMMENT	S. NORRISH	M.SHOEB	MBRENNAN	

Revision Index

Company logo and business name: eni uk / eni progetti

Company Document ID: **1025HXBLRV80634 - ATT. 01**

Job. N. JP6614

Facility and Sub Facility Name

Project Name: LBA CCS Transport and Storage

Scale: 1:100

Sheet of Sheets: 1 OF 1

Document Title

TECHNICAL NOTE – ALLTAMI BROOK BURIED PIPELINE BRIDGE - ATTACHMENT 1

Superseded N.

Superseded by N.

Plant Area: 00

Plant Unit: 000

Software:AutoCad

Filename.1025HXBLRV80634 - ATT. 01.DWG

A0 (1189 x 841)

Annex G

ENVIRONMENTAL ASSESSMENTS

Table G1 – Open-Trenched Crossing: Environmental Appraisal

Topic	Construction	Operation
Air Quality	Construction dust impacts could occur on the adjacent woodland and the residential receptor approximately 140m away from the works. However, all impacts will be managed, and significant effects removed with the application of mitigation set out in the Dust Management Plan **[REP2-043]** (part of the OCEMP, secured under Requirement 5 of the dDCO **[REP1-004]**). Any additional construction traffic as a result of the option will be temporary and not anticipated to be significant.	No air quality impacts anticipated during operation.
Climate Resilience	Measures expected to protect materials and site from climate hazards are expected to be covered in the CEMP secured under Requirement 5 of the dDCO **[REP1-004]**.	No climate resilience impacts anticipated during operation.
Cultural Heritage	The construction is not expected to impact any known heritage assets either through physical impact or impacts to the setting. There is potential for impacts to unknown later medieval and post-medieval agricultural remains which would not be anticipated to result in significant effects. Any impacts to unknown archaeological remains would be mitigated by measures detailed in the OAWSI **[APP-223]**.	Once operational, effects on cultural heritage assets are considered negligible as there are no designated assets with intervisibility with the brook crossing. No adverse effects are anticipated.
Biodiversity	Given the 16m working width requirement, trees and vegetation would need to be removed on both sides of the gorge. As the area was not made available for surveying, the potential impacts here have not been able to be fully quantified and therefore subject to a precautionary assessment. However, the area of removals is likely to be less than the	Once operational, following implementation of mitigation, effects on biodiversity are considered negligible. No adverse effects are anticipated.

Topic	Construction	Operation
	32m corridor of removals assumed in the worst-case scenario approach used in the AIA and shown on the Preliminary Constraints and impacts Plan. Direct loss (permanent and temporary) of habitats (including woodland assessed as Annex I woodland; riparian habitat, and in-channel). Potential loss and / or disturbance of protected and / or notable species, such as bats, riparian mammals, and fish within the Alltami Brook and adjacent woodland and riparian habitat. Impacts to aquatic habitats and potential loss of sensitive life stage dependant habitat types, flow refugia and cover, and disruption in sedimentation processes with consequential loss and/or access to sensitive habitat upstream and downstream of the crossing point. Temporary short-term disturbance and/or dispersal of fish populations and aquatic macroinvertebrates from works areas due to increased noise, light, and vibration impacts associated with construction (for example, excavation activities and vehicle/plant movements), leading to disturbances to fish migration, spawning, and/or embryo mortality. Impacts would be mitigated for by measures detailed within the OCEMP **[REP2-021]**.	
GHG	Greenhouse gas (GHG) emissions are expected to arise from embodied carbon, transport of materials to Site, transport of waste from Site, disposal of waste, construction plant use and land use, land use change and forestry (LULUCF) during the construction phase.	During the operational phase, GHG emissions are expected to arise from LULUCF due to the removal of trees on the north side of the gorge.

Topic	Construction	Operation
Land and Soils	Temporary loss of agricultural land during trench excavation works. Temporary works for access etc may require excavation of fill material of unknown composition.	No adverse impacts are expected during the operational phase.
Landscape and Visual	Landscape • Removal of mature vegetation would introduce notable but localised change. • Excavation resulting in temporary landform change and loss of surface vegetation. • Temporary loss of relative tranquillity resulting from presence of construction activity in a rural landscape. Visual • Visibility of construction activity for a limited number of visual receptors including users of Pinfold Lane and PRoW 39A.	Landscape • Permanent loss of mature vegetation would introduce notable but localised change. Likely take 30+ years for replacement planting to reach comparable stature. • Upon reinstatement of surface vegetation to access routes / compounds landscape effects beyond the immediate site area will be limited because of the containment provided by the valley landform. Visual • At operation visual change will be limited to that resulting from tree loss and would mainly be perceived by users of PRoW 39A.
MA&D	Potential increase in the risk of landslips associated with construction work on the south bank. Potential change to flood risk in the event of a landslip. Potential ground stability risks associated with the presence of historical mine workings.	During operation, the vulnerability of the DCO Proposed Development to a MA&D event is no different to other locations along the DCO Proposed Development.
Material Assets and Waste	Material resources will be required during construction and some waste may be generated. However, given the construction phase mitigation measures (as detailed in Chapter 14: Material Assets and Waste **[APP-066]** of the 2022 ES), adverse impacts are not anticipated to be significant.	During operation, negligible quantities of materials and waste will be required and generated for occasional maintenance and repair work. As such, no adverse impacts are anticipated.

Topic	Construction	Operation
Noise and Vibration	Construction noise impacts could occur at the residential receptor approximately 140m away from the works. However, all impacts will be managed, and significant effects removed with the application of mitigation set out in the Noise and Vibration Management Plan (part of the OCEMP, secured under Requirement 5 of the dDCO **[REP1-004]**). Construction traffic as a result of the option will be temporary and not anticipated to be significant.	No noise or vibration impacts anticipated during operation.
Population and Health	The local population may be temporarily affected by construction traffic, noise and reductions in air quality during the installation of pipeline. The PRoW diversion / shortening may also affect people's ability to undertake recreational activities. Mitigation measures are covered in the OCTMP **[REP2-019]** of the 2022 ES, secured under Requirement 6 of the dDCO **[REP1-004]**. All population and human health effects associated during the Construction Stage will be temporary and adverse impact are not anticipated to be significant.	Once operational, effects on population and human health are considered negligible. No adverse effects are anticipated.
Traffic and Transport	Construction traffic will be generated during the installation of pipeline. Mitigation measures are covered in the OCTMP **[REP2-019]** of the 2022 ES, secured under Requirement 6 of the dDCO **[REP1-004]**. All the traffic and transport effects associated during the Construction Stage will be temporary and adverse impacts are not anticipated to be significant.	Traffic generated during operational phase will be negligible for occasional staff travel and maintenance work. No adverse impacts are anticipated.

Topic	Construction	Operation
Water	Entrainment of sediments within the watercourse from works in the channel would be mitigated by the measures in the OCEMP **[REP2-021]** secured under Requirement 6 of the dDCO **[REP1-004]**. Risk of spillage impacting the watercourse from works in the channel would be mitigated by the measures in the OCEMP **[REP2-021]**. Loss of riparian vegetation would be required as part of the enabling works. There may be a potential inflow of groundwater from likely saturated fractured bedrock into excavation, which will require temporary dewatering during construction. The excavation will be isolated from the [redirected] Alltami Brook during construction, preventing any inflow or direct loss of flow.	Permanent localised loss of bedrock bed of watercourse (4m length) and potential initiation of geomorphic change and loss of aquatic habitat. However, potential re-use of excavated material could potentially be embedded as part of the reinstatement to mimic the original conditions of the watercourse bed and therefore mitigate potential impacts to geomorphological processes and aquatic habitat. A bespoke geomorphological assessment would be carried out to inform micro-siting and the detailed design of the permanent works (D-WR-064 of the REAC **[REP2-017]**). Loss of riparian vegetation local to the crossing. This impact is considered negligible at the water body scale. There should be no loss of stream flow to ground as the design will include measures to prevent this, i.e., pipe is positioned well below the reinstated riverbed, concrete and other materials used to embed pipe are specified taking into consideration hydraulic conditions in river channel (e.g., flood rates) and re-instatement of bedrock. There is a low risk of potential loss of water to ground during operation, however the channel bed would be reinstated with impermeable materials to prevent loss of water to bedrock. Routine monitoring would inspect the integrity of the reinstated bed.

Table G2 – Trenchless Crossing – Horizontal Directional Drilling (HDD): Environmental Appraisal

Topic	Construction	Operation
Air Quality	Earthworks associated with entry/exit pits of the HDD could result in dust impacts on nearby receptors. However, all impacts will be managed, and significant effects removed with the application of mitigation set out in the Dust Management Plan **[REP2-043]** (part of the OCEMP, secured under Requirement 5 of the dDCO **[REP1-004]**). Any additional construction traffic as a result of the option will be temporary and not anticipated to be significant.	No air quality impacts anticipated during operation.
Climate Resilience	Measures expected to protect materials and site from climate hazards are expected to be covered in the CEMP. Secured under Requirement 5 of the dDCO **[REP-004]**.	No climate resilience impacts anticipated during operation.
Cultural Heritage	The construction is not expected to impact any known heritage assets either through physical impact or impacts to the setting. There is potential for impacts to unknown later medieval and post-medieval agricultural remains which would not be anticipated to result in significant effects. Any impacts to unknown archaeological remains would be mitigated by measures detailed in the OAWSI **[APP-223]**.	Once operational, effects on cultural heritage assets are considered negligible as there are no designated assets with intervisibility with the brook crossing. No adverse effects are anticipated.
Biodiversity	Assuming the entry/exit pits of the HDD drill are located outside of tree root protection zones, this option is unlikely to have any significant effect on trees. Potential exists for pollution events, discharges of sediment, frac-out and	No adverse impacts are expected during the operational phase.

Topic	Construction	Operation
	release of drill fluid to ground and / or watercourses during construction. There is potential for dispersal of sediments/pollution downstream in the event of discharge to watercourse, with potential for effects to be spread over a larger distance than the point of origin. Discharge of sediment or drill fluid may impact fauna and flora, both aquatic and terrestrial (e.g. through smothering). Potential for noise and vibration impacts caused by trenchless installation activities impacting on migratory fish / fish passage and other protected species, although likely to be localised and short term. Impacts would be mitigated for by measures detailed within the OCEMP [**REP2-021**].	
GHG	Greenhouse gas (GHG) emissions are expected to arise from embodied carbon, transport of materials to Site, transport of waste from Site, disposal of waste and construction plant use during the construction phase.	No GHG emissions are expected to arise during the operational phase.
Land and Soils	Temporary loss of agricultural land during trench excavation works.	No adverse impacts are expected during the operational phase.
Landscape and Visual	Landscape • Anticipated that there would be limited removal of mature vegetation. • Temporary loss of relative tranquillity resulting from presence of construction activity in a rural landscape. Visual • Anticipated visibility of construction activity for a limited number of visual receptors including users of Pinfold Lane and potentially some residential	Limited permanent landscape and visual influence. Assumed that there will be minimal loss of mature vegetation or presence of above ground infrastructure.

Topic	Construction	Operation
	receptors to the northwest of the brook.	
MA&D	Potential ground stability risks associated with the presence of historical mine workings.	A loss of containment event due to corrosion is unlikely due to the implementation of an asset integrity inspection regime as part of the management arrangements (as detailed in Chapter 13: Major Accidents and Disasters **[APP-065]** of the 2022 ES) but the full design life of the pipeline crossing would be reduced. Therefore, during operation, the vulnerability of the DCO Proposed Development to a MA&D event is no different to other locations along the DCO Proposed Development.
Material Assets and Waste	Material resources will be required during construction and some waste may be generated. However, given the construction phase mitigation measures (as detailed in Chapter 14: Material Assets and Waste (APP-066) of the 2022 ES), adverse impacts are not anticipated to be significant.	During operation, negligible quantities of materials and waste will be required and generated for occasional maintenance and repair work. As such, no adverse impacts are anticipated.
Noise and Vibration	Earthworks associated with entry/exit pits of the HDD could result in noise impacts on nearby receptors. However, all impacts will be managed, and significant effects removed with the application of mitigation set out in the Noise and Vibration Management Plan (part of the OCEMP, secured under Requirement 5 of the dDCO **[REP1-004]**). Construction traffic as a result of the option will be temporary and not anticipated to be significant.	No noise or vibration impacts anticipated during the operational phase.

Topic	Construction	Operation
Population and Health	The local population may be affected by construction traffic, noise and reductions in air quality during the installation of pipeline. The PRoW is unlikely to require diversion / shortening however and is not anticipated to affect people's ability to undertake recreational activities. Mitigation measures are covered in the OCTMP **[REP2-019]** of the 2022 ES, secured under Requirement 6 of the dDCO **[REP1-004]**. All population and human health effects associated during the Construction Stage will be temporary and adverse impact are not anticipated to be significant.	Once operational, effects on population and human health are considered negligible. No adverse effects are anticipated.
Traffic and Transport	Construction traffic will be generated during the installation of pipeline. Mitigation measures are covered in the OCTMP **[REP2-019]** of the 2022 ES, secured under Requirement 6 of the dDCO **[REP1-004]**. All the traffic and transport effects associated during the Construction Stage will be temporary and adverse impacts are not anticipated to be significant.	Traffic generated during operational phase will be negligible for occasional staff travel and maintenance work. No adverse impacts are anticipated.
Water	Potential breakout of drilling fluid from aperture into surrounding fractured bedrock aquifer and rising through bedrock into watercourse or passing through fractures into mine workings and into watercourse. Impact on surface water quality (i.e. increased turbidity and pollutants that are potentially harmful to the aquatic environment) assumes upwards hydraulic gradient from aquifer to watercourse.	No water impacts are anticipated during the operation phase.

Table G3 – Trenchless Crossing – Micro-Tunnelling: Environmental Appraisal

Topic	Construction	Operation
Air Quality	Earthworks associated with entry/exit pits of the micro-tunnelling could result in dust impacts on nearby receptors. However, all impacts will be managed, and significant effects removed with the application of mitigation set out in the Dust Management Plan (part of the OCEMP). Any additional construction traffic as a result of the option will be temporary and not anticipated to be significant.	No air quality impacts anticipated during operational phase.
Climate Resilience	Measures expected to protect materials and site from climate hazards are expected to be covered in the CEMP	No climate resilience impacts anticipated during operation.
Cultural Heritage	The construction is not expected to impact any known heritage assets either through physical impact or impacts to the setting. There is potential for impacts to unknown later medieval and post-medieval agricultural remains which would not be anticipated to result in significant effects. Any impacts to unknown archaeological remains would be mitigated by measures detailed in the OAWSI [**APP-223**].	Once operational, effects on cultural heritage assets are considered negligible as there are no designated assets with intervisibility with the brook crossing. No adverse effects are anticipated.
Biodiversity	Assuming the entry/exit shafts of the micro-tunnel are located outside of tree root protection zones, this option is unlikely to have any significant effect on trees. Potential exists for pollution events, discharges of sediment, frac-out and release of drill fluid to ground or watercourses/waterbodies during construction. There is potential for dispersal of sediments/pollution downstream in the event of discharge	No adverse impacts are expected during the operational phase.

Topic	Construction	Operation
	to watercourse, with potential for effects to be spread over a larger distance than the point of origin. Discharge of sediment or drill fluid may impact fauna and flora, both aquatic and terrestrial. Potential noise and vibration impacts caused by trenchless installation activities impacting on migratory fish / fish passage and other protected species, although likely to be localised and short term. All impacts would be mitigated for by measures detailed within the OCEMP [**REP1-017**].	
GHG	Greenhouse gas (GHG) emissions are expected to arise from embodied carbon, transport of materials to Site, transport of waste from Site, disposal of waste and construction plant use during the construction phase.	No GHG emissions are expected to arise during the operational phase.
Land and Soils	Temporary loss of agricultural land during trench excavation works.	No adverse impacts are expected during the operational phase.
Landscape and Visual	Landscape • Anticipated that there would be limited removal of mature vegetation. Assumed that mature tree loss within the valley and to field boundaries can largely be avoided. • Temporary loss of relative tranquillity resulting from presence of construction activity in a rural landscape. Visual • Anticipated visibility of construction activity for a limited number of visual receptors including users of Pinfold Lane and potentially some residential	Limited permanent landscape and visual influence. Assumed that there will be minimal loss of mature vegetation or presence of above ground infrastructure.

Topic	Construction	Operation
	receptors to the northwest of the brook.	
MAD	Potential ground stability risks associated with the presence of historical mine workings. Assuming the shaft on the southside is located away from the A55 construction landfill, there should be no risks associated with landslips and subsequent potential flood risk.	During operation, the vulnerability of the DCO Proposed Development to a MA&D event is no different to other locations along the DCO Proposed Development.
Material Assets and Waste	Material resources will be required during construction and some waste may be generated. However, given the construction phase mitigation measures (as detailed in Chapter 14: Material Assets and Waste (APP-066) of the 2022 ES), adverse impacts are not anticipated to be significant.	During operation, negligible quantities of materials and waste will be required and generated for occasional maintenance and repair work. As such, no adverse impacts are anticipated.
Noise and Vibration	Earthworks associated with entry/exit pits of the micro-tunnelling could result in noise impacts on nearby receptors. However, all impacts will be managed, and significant effects removed with the application of mitigation set out in the Noise and Vibration Management Plan (part of the OCEMP [**REP1-017**]). Construction traffic as a result of the option will be temporary and not anticipated to be significant.	No noise or vibration impacts anticipated during operation.
Population and Health	The local population may be affected by construction traffic, noise and reductions in air quality during the installation of pipeline. The PRoW is unlikely to required diversion/ shortening however and is not anticipated to affect people's ability to undertake recreational activities. Mitigation measures are covered in the OCTMP (APP-224) of the 2022 ES. All population and human health effects associated during the	Once operational, effects on population and human health are considered negligible. No adverse effects are anticipated.

Topic	Construction	Operation
	Construction Stage will be temporary and adverse impact are not anticipated to be significant.	
Traffic and Transport	Construction traffic will be generated during the installation of pipeline. Mitigation measures are covered in the OCTMP (APP-224) of the 2022 ES. All the traffic and transport effects associated during the Construction Stage will be temporary and adverse impacts are not anticipated to be significant.	Traffic generated during operational phase will be negligible for occasional staff travel and maintenance work. No adverse impacts are anticipated.
Water	Potential breakout of drilling fluid from aperture into surrounding fractured bedrock aquifer and rising through bedrock into watercourse or passing through fractures into mine workings and into watercourse. Impact on surface water quality (i.e. increased turbidity and pollutants that are potentially harmful to the aquatic environment) assumes upwards hydraulic gradient from aquifer to watercourse. Potential dewatering required of entry and exit shafts due to groundwater inflow, resulting in a temporary quantitative impact to the surrounding aquifer. Potential to extend to nearby groundwater receptors. This may result in a hydraulic gradient from Alltami Brook to entry and exit shafts drawing in water. Water is likely to be recirculated back to the brook during dewatering (following treatment), meaning ultimately a temporary, neutral effect.	None.

Table G4 – Over Crossing – Steel Truss Bridge: Environmental Appraisal

Topic	Construction	Operation
Air Quality	Construction dust impacts could occur on the adjacent woodland and the residential receptor approximately 140m away from the works. However, all impacts will be managed, and significant effects removed with the application of mitigation set out in the Dust Management Plan **[REP2-043]** (part of the OCEMP, secured under Requirement 5 of the dDCO **[REP1-004]**). Any additional construction traffic as a result of the option will be temporary and not anticipated to be significant.	No air quality impacts anticipated during operation.
Climate Resilience	Measures expected to protect materials and site from climate hazards are expected to be covered in the CEMP, secured under Requirement 5 of the dDCO **[REP1-004]**	Extreme weather events including heatwaves and heavy rainfall will occur which without appropriate mitigation / management measures may damage the pipe if the ground conditions experience droughts or heavy flooding.
Cultural Heritage	The construction is not expected to impact any known heritage assets either through physical impact or impacts to the setting. There is potential for impacts to unknown later medieval and post-medieval agricultural remains which would not be anticipated to result in significant effects. Any impacts to unknown archaeological remains would be mitigated by measures detailed in the OAWSI [**APP-223**].	Once operational, effects on cultural heritage assets are considered negligible as there are no designated assets with intervisibility with the brook crossing. No adverse effects are anticipated.
Biodiversity	Even though the impacts here cannot be quantified as the area was not made available for surveying, a reasonable worst-case scenario is assumed in terms of arboriculture for this option. This assumes all trees on both sides of the gorge within the 32m corridor of vegetation removal,	The shading effects associated with the pipeline bridge are not anticipated to result in the restriction of fish passage, due to the set-back design of the bridge abutments, or a change in macrophyte community, due to the absence of this receptor at Alltami

Topic	Construction	Operation
	used in the AIA and shown on the Preliminary Constraints and Impacts Plan, would be removed. Permanent direct and indirect loss and/or damage to riparian and non-riparian habitats associated with the construction and installation of a steel truss bridge. Habitat severance and barriers to fish migration may occur where there is a requirement for the creation of dry-works areas and/or installation of a steel truss bridge and temporary culverts. Temporary short-term disturbance and/or dispersal of fish populations and aquatic macroinvertebrates from works areas due to increased noise, light, and vibration impacts associated with construction and installation of a steel truss bridge (for example, drilling activities, pile driving, and vehicle/plant movements), leading to disturbances to fish migration, spawning and/or embryo mortality. Impacts would be mitigated for by measures detailed within the OCEMP **[REP2-021]**, secured under Requirement 5 of the dDCO **[REP1-004]**.	Brook within the baseline assessment. No adverse impacts are expected during the operational phase.
GHG	Greenhouse gas (GHG) emissions are expected to arise from embodied carbon, transport of materials to Site, transport of waste from Site, disposal of waste, construction plant use and land use, land use change and forestry (LULUCF) during the construction phase.	During the operational phase, GHG emissions are expected to arise from LULUCF due to the removal of trees on the north side of the gorge.
Land and Soils	Temporary loss of agricultural land during trench excavation works. Temporary works for access etc may	No adverse impacts are expected during the operational phase.

Topic	Construction	Operation
	require excavation of fill material of unknown composition.	
Landscape and Visual	Landscape • Removal of mature vegetation would introduce notable but localised change. • Excavation resulting in temporary landform change and loss of surface vegetation. • Temporary loss of relative tranquillity resulting from presence of construction activity in a rural landscape. Visual • Visibility of construction activity for a limited number of visual receptors including users of Pinfold Lane and PRoW 39A.	Landscape • Permanent loss of mature vegetation would introduce notable but localised change. Likely take 30+ years for replacement planting to reach comparable stature. • Upon reinstatement of surface vegetation to access routes/compounds landscape effects beyond the immediate site area will be limited because of the containment provided by the valley landform. Visual • At operation visual change would mainly be perceived by users of PRoW 39A as a result of tree loss and the presence of the steel bridge and any associated fencing or hard surfacing in views of walkers for a short section of the route.
MA&D	Potential increase in the risk of landslips associated with construction work on the south bank. Potential change to flood risk in the event of a landslip. Potential ground stability risks associated with the presence of historical mine workings.	Potential for loss of containment of CO_2 due to 3rd party damage to the pipeline. A loss of containment event due to corrosion is unlikely due to the implementation of an asset integrity inspection regime as part of the management arrangements (as detailed in Chapter 13: Major Accidents and Disasters (**APP-065**) of the 2022 ES) but the full design life of the pipeline crossing would be reduced.
Material Assets and Waste	Material resources will be required during construction and some waste may be generated. However, given the construction phase mitigation measures (as detailed in Chapter 14:	During operation, negligible quantities of materials and waste will be required and generated for occasional maintenance and repair

Topic	Construction	Operation
	Material Assets and Waste **[APP-066]** of the 2022 ES), adverse impacts are not anticipated to be significant.	work. As such, no adverse impacts are anticipated.
Noise and Vibration	Construction noise impacts could occur at the residential receptor approximately 140m away from the works. However, all impacts will be managed, and significant effects removed with the application of mitigation set out in the Noise and Vibration Management Plan (part of the OCEMP, secured under Requirement 5 of the dDCO **[REP1-004]**). Construction traffic as a result of the option will be temporary and not anticipated to be significant.	No noise or vibration impacts anticipated during operation.
Population and Health	The local population may be affected by construction traffic, noise and reductions in air quality during the installation of pipeline. The PRoW diversion/ shortening may also affect people's ability to undertake recreational activities. Mitigation measures are covered in the OCTMP **[REP2-019]** of the 2022 ES, secured under Requirement 6 of the dDCO **[REP1-004]**. All population and human health effects associated during the Construction Stage will be temporary and adverse impact are not anticipated to be significant.	Once operational, effects on population and human health are considered negligible. Whilst it is likely that a permanent diversion of the PRoW would be required, this is unlikely to adversely affect people's ability to undertake recreational activities. As such, no adverse effects are anticipated.
Traffic and Transport	Construction traffic will be generated during the installation of pipeline. Mitigation measures are covered in the OCTMP **[REP2-019]** of the 2022 ES, secured under Requirement 6 of the dDCO **[REP1-004]**. This crossing method will likely require the use of larger vehicles, with pre-cast beams transported on tractor and trailer and potentially the use of cranes. All the	Traffic generated during operational phase will be negligible for occasional staff travel and maintenance work. No adverse impacts are anticipated.

Topic	Construction	Operation
	traffic and transport effects associated during the Construction Stage will be temporary and adverse impacts are not anticipated to be significant.	
Water	Entrainment of sediments within the watercourse from works adjacent to and over the channel would be mitigated by the measures in the OCEMP **[REP2-021],** secured under Requirement 5 of the dDCO **[REP1-004]**. Risk of spillage impacting the watercourse from works adjacent to the channel would be mitigated by the measures in the OCEMP **[REP2-021]**. Loss of riparian vegetation would be required as part of the enabling works. Potential dewatering required of foundation excavations, due to groundwater inflow, resulting in a temporary quantitative impact to the surrounding aquifer. This may have the potential to extend to nearby groundwater receptors. This may result in a hydraulic gradient from Alltami Brook to foundation excavations drawing in water. Water is likely to be recirculated back to the brook during dewatering (allowing treatment), meaning ultimately a temporary, neutral effect.	Installation of permanent structure on valley sides and riparian zone of the Alltami Brook introducing a new physical modification along the banks of watercourse. Impact will be less than the embedded pipeline bridge. The impact is considered negligible at the WFD water body scale. Although there is potential for this option to cause obstruction to flow, it can be mitigated by appropriate design to ensure there is adequate freeboard in the design to prevent flood risk impacts to the structure or elsewhere.

Table G5 – Over Crossing – Embedded Pipe Bridge: Environmental Appraisal

Topic	Construction	Operation
Air Quality	Construction dust impacts could occur on the adjacent woodland and the residential receptor approximately 140m away from the works. However, all impacts will be managed, and significant effects removed with the application of mitigation set out in the Dust Management Plan **[REP2-043]** (part of the OCEMP, secured under Requirement 5 of the dDCO **[REP1-004]**). Any additional construction traffic as a result of the option will be temporary and not anticipated to be significant.	No air quality impacts anticipated during operation.
Climate Resilience	Measures expected to protect materials and site from climate hazards are expected to be covered in the CEMP (secured under Requirement 5 of the dDCO **[REP1-004]**).	Extreme weather events including heatwaves and heavy rainfall will occur which without appropriate mitigation / management measures may damage the pipe if the ground conditions experience droughts or heavy flooding.
Cultural Heritage	The construction is not expected to impact any known heritage assets either through physical impact or impacts to the setting. There is potential for impacts to unknown later medieval and post-medieval agricultural remains which would not be anticipated to result in significant effects. Any impacts to unknown archaeological remains would be mitigated by measures detailed in the OAWSI **[APP-223]**.	Once operational, effects on cultural heritage assets are considered negligible as there are no designated assets with intervisibility with the brook crossing. No adverse effects are anticipated.
Biodiversity	Even though the impacts here cannot be quantified as the area was not made available for surveying, a reasonable worst-case scenario is assumed in terms of arboriculture for this option. This assumes all trees on	The shading effects associated with the pipeline bridge are not anticipated to result in the restriction of fish passage, due to the set-back design of the bridge abutments, or a change in macrophyte community, due to the absence of this

Topic	Construction	Operation
	both sides of the gorge within the 32m corridor of vegetation removal, used in the AIA and shown on the Preliminary Constraints and Impacts Plan, would be removed. Permanent direct and indirect loss and/or damage to riparian and non-riparian habitats associated with the construction and installation of a buried pipeline bridge. Habitat severance and barriers to fish migration may occur where there is a requirement for the creation of dry-works areas and/or installation of a buried pipeline bridge and temporary culverts. Temporary short-term disturbance and/or dispersal of fish populations and aquatic macroinvertebrates from works areas due to increased noise, light, and vibration impacts associated with construction and installation of a buried pipeline bridge (for example, drilling activities, pile driving, and vehicle/plant movements), leading to disturbances to fish migration, spawning, and/or embryo mortality. Impacts would be mitigated for by measures detailed within the OCEMP [**REP2-021**], secured under Requirement 5 of the dDCO **[REP1-004]**.	receptor at Alltami Brook within the baseline assessment. No adverse impacts are expected during the operational phase.
GHG	Greenhouse gas (GHG) emissions are expected to arise from embodied carbon, transport of materials to Site, transport of waste from Site, disposal of waste, construction plant use and land use, land use change and	During the operational phase, GHG emissions are expected to arise from LULUCF due to the removal of trees on the north side of the gorge.

Topic	Construction	Operation
	forestry (LULUCF) during the construction phase.	
Land and Soils	Temporary loss of agricultural land during trench excavation works for pipeline approaches. Temporary works for access, foundation excavation etc may require excavation of fill material of unknown composition.	No adverse impacts are expected during the operational phase.
Landscape and Visual	Landscape • Removal of mature vegetation would introduce notable but localised change. • Excavation resulting in temporary landform change and loss of surface vegetation. • Temporary loss of relative tranquillity resulting from presence of construction activity in a rural landscape. Visual • Visibility of construction activity for a limited number of visual receptors including users of Pinfold Lane and PRoW 39A.	Landscape • Permanent loss of mature vegetation would introduce notable but localised change. Likely take 30+ years for replacement planting to reach comparable stature. • Upon reinstatement of surface vegetation to access routes/compounds landscape effects beyond the immediate site area will be limited because of the containment provided by the valley landform. Visual • At operation visual change would mainly be perceived by users of PRoW 39A as a result of tree loss and the presence of the pipe bridge and any associated fencing or hard surfacing in views of walkers for a short section of the route.
MA&D	Potential increase in the risk of landslips associated with construction work on the south bank. Potential change to flood risk in the event of a landslip. Potential ground stability risks associated with the presence of historical mine workings.	During operation, the vulnerability of the DCO Proposed Development to a MA&D event is no different to other locations along the DCO Proposed Development.
Material Assets and Waste	Material resources will be required during construction and some waste may be generated. However, given the construction phase mitigation measures (as	During operation, negligible quantities of materials and waste will be required and generated for occasional maintenance and repair work. As such, no adverse impacts are anticipated.

Topic	Construction	Operation
	detailed in Chapter 14: Material Assets and Waste **[APP-066]** of the 2022 ES), adverse impacts are not anticipated to be significant.	
Noise and Vibration	Construction noise impacts could occur at the residential receptor approximately 140m away from the works. However, all impacts will be managed, and significant effects removed with the application of mitigation set out in the Noise and Vibration Management Plan (part of the OCEMP **[REP2-021]**, secured under Requirement 5 of the dDCO **[REP1-004]**). Construction traffic as a result of the option will be temporary and not anticipated to be significant.	No noise or vibration impacts anticipated during operation.
Population and Health	The local population may be affected by construction traffic, noise and reductions in air quality during the installation of pipeline. The PRoW diversion/ shortening may also affect people's ability to undertake recreational activities. Mitigation measures are covered in the OCTMP **[REP2-019]** of the 2022 ES, secured under Requirement 6 of the dDCO **[REP1-004]**. All population and human health effects associated during the Construction Stage will be temporary and adverse impact are not anticipated to be significant.	Once operational, effects on population and human health are considered negligible. Whilst it is likely that a permanent diversion of the PRoW would be required, this is unlikely to adversely affect people's ability to undertake recreational activities. As such, no adverse effects are anticipated.
Traffic and Transport	Construction traffic will be generated during the installation of pipeline. Mitigation measures are covered in the OCTMP **[REP2-019]** of the 2022 ES, secured under Requirement 6 of the dDCO **[REP1-004]**. This	Traffic generated during operational phase will be negligible for occasional staff travel and maintenance work. No adverse impacts are anticipated.

Topic	Construction	Operation
	crossing method will likely require the use of larger vehicles, with pre-cast beams transported on tractor and trailer and potentially the use of cranes. All the traffic and transport effects associated during the Construction Stage will be temporary and adverse impacts are not anticipated to be significant.	
Water	Entrainment of sediments within the watercourse from works adjacent and over the channel would be mitigated by the measures in the OCEMP **[REP2-021]**, secured under Requirement 5 of the dDCO **[REP1-004]**. Risk of spillage impacting the watercourse from works adjacent to the channel would be mitigated by the measures in the OCEMP **[REP2-021]**, secured under Requirement 5 of the dDCO **[REP1-004]**. Loss of riparian vegetation as part of the enabling works. Potential dewatering required of foundation excavations, due to groundwater inflow, resulting in a temporary quantitative impact to the surrounding aquifer. This impact has the potential to extend to nearby groundwater receptors. This may result in a hydraulic gradient from Alltami Brook to foundation excavations drawing in water. This water is likely to be recirculated back to the brook during dewatering (following treatment), meaning ultimately a temporary, neutral effect.	Installation of permanent structure on the valley sides and riparian zone introducing a new physical modification of approximately 4m in width along the banks of watercourse. This impact is considered negligible at the water body scale. Potential increase in fluvial flood risk upstream of the structure, however, the structure would be designed to mitigate any increase in flood risk at the site or elsewhere.