Grid Supply Point
Connection at Parkgate - Addendum
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1 Summary

1.1.1 This is an addendum to the Grid Supply Point (GSP) Connection at Parkgate report published in February 2019. It provides a comparative appraisal of making the connection by overhead line (OHL), as proposed in Additional Provision 2 (AP2), to making a connection underground (UGC).

1.1.2 The use of an overhead line (OHL) connection between the National Grid Parkgate substation and the National Grid Newlands Lane substation, is accordance with government policy and statutory obligation and reflects National Grid’s route selection guidance for development of UK wide infrastructure development. The approach to this scheme selection by National Grid was accepted by HS2 during the development of the Phase 2a scheme in promoting AP2.

1.1.3 For the purpose of this comparison, illustrative designs of an OHL and an UGC connections are located within the 200m-wide corridor defined in AP2 for the Parkgate GSP connection. Both are illustrations of how the respective schemes could be designed, within the assumptions set out in the Supplementary Environmental Statement 2 and Additional Provisions 2 Environmental Statement (SES2 and AP2 ES). These illustrative designs are not intended to represent detailed design of either option.

1.1.4 The illustrative OHL connection option (representing the baseline scheme):

- would require a temporary corridor of land required for construction of approximately 65m, however disturbance of land will be mostly limited to works to construct the pylon bases;
- connects, via OHL, from the proposed National Grid Parkgate substation to the National Grid Newlands Lane substation; and
- all land would be returned to its existing use, excluding the land required for the footings of pylons.

1.1.5 The illustrative UGC connection option:

- would require an approximately 65m wide temporary corridor of land required, all of which would be disturbed as a result of construction;
- would require three UGC connection trenches to house the UGC connection, areas of land for storing excavated material, haul roads along the full length of the route;
- would introduce four additional satellite construction compounds; and
• would return the land above ground to its existing use, subject to some restrictions, and with the exception of land permanently required for inspection boxes at approximately 600m intervals, which provide a location for monitoring the cables during operation and operational access.

1.1.6 The environmental comparison of the illustrative UGC connection to the illustrative OHL connection identifies for temporary impacts; a moderate worsening due to the greater scale of construction and land clearance, and for permanent effects; a moderate improvement due to the limited extent of above ground equipment.

1.1.7 The overall rating for construction complexity of an illustrative UGC connection is a moderate worsening due to relatively more complex construction and a minor worsening due to added disruption to existing roads and utility connections. In terms of safety there the comparison is neutral.

1.1.8 The capital cost of an illustrative UGC connection option is estimated to be £65 million higher (see Appendix H) than for an illustrative OHL connection option. The operational costs for an illustrative UGC connection option are anticipated to be broadly similar to those for an illustrative OHL connection option.

1.1.9 In summary, the comparison of an illustrative UGC connection against the OHL connection using HS2 appraisal criteria has shown that the illustrative UGC connection would result in a significant cost increase, with no significant engineering or environmental benefit.

1.1.10 This appraisal conclusion is consistent with the initial policy appraisal by National Grid for connection selection between National Grid Parkgate substation and National Grid Newlands Lane substation, applying government policy and their own statutory obligations (on cost efficient delivery of infrastructure and adequate protection of the environment and amenity).
2 **Introduction**

2.1 **Purpose of the Report**

2.1.1 This report is provided as an addendum to the report ‘Grid Supply Point Connection at Parkgate’. This report sets out the outcome of an engineering, environmental and cost comparison between an illustrative overhead line (OHL) connection and an illustrative underground cable (UGC) connection to Parkgate. The OHL connection appraised in this report is an illustrative version of the design in the Additional Provision 2 (AP2) revised scheme, submitted to Parliament in February 2019. Both the illustrative OHL and the illustrative UGC connections are located between the National Grid Parkgate substation and National Grid Newlands Lane substation.

2.1.2 The selection of an OHL connection and the route choice, as provided for in the AP2 scheme, were developed by National Grid in accordance with policy and statutory obligations for new infrastructure of this scale (i.e. infrastructure comprising 132kV electrical circuits or greater and over 2km in connection length).

2.1.3 The report sets out:

- a description of the illustrative OHL connection option and the illustrative UGC connection option;
- an engineering, environmental and cost comparison appraisal of the illustrative OHL connection option (representing the baseline scheme) and the illustrative UGC connection option.

**Limitations of the report**

2.1.4 The illustrative OHL connection option and the illustrative UGC connection option detailed in this report have been developed for the purposes of this comparison appraisal only, and are not intended to represent the design development of any scheme once completed. A final alignment would be determined during detailed design.

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2.1.5 High-level desk-based information has been used to inform these illustrative designs and the appraisal. No additional site visits have been undertaken with respect to the design of the illustrative UGC connection option. Various sources of information have been used as the basis for this appraisal including, in particular, the Supplementary Environmental Statement 2 (SES2) and Additional Provision 2 Environmental Statement (AP2 ES) Volume 2 Community Area report CA1: Fradley to Colton and, National Grid reference material and online mapping tools.

2.1.6 There are certain unknown variables that would affect the design, construction and cost of both the illustrative OHL and UGC connection. These include ground conditions, other service locations and routes, approvals, and environmental constraints. Where data is not available reasonable assumptions have been made, on a precautionary basis, for the purpose of the illustrative design and appraisal.

2.1.7 These are considered to be reasonable limitations and wouldn’t contribute to the outcomes of the comparative analysis at this stage of design development.

2.2 Government policy and statutory obligations supporting the selection of the Parkgate GSP connection

2.2.1 The OHL connection provided for in the AP2 revised scheme was developed by National Grid applying industry standards and the national planning policy for new infrastructure of this scale.

2.2.2 Government planning policy relating to electricity infrastructure can be found in two National Policy Statements (NPS) – the Overarching NPS for Energy (EN-1)³ and, more specifically, the NPS for Electricity Networks Infrastructure (EN-5)⁴. These are the main documents that inform decision making on major energy infrastructure projects, including whether to adopt an OHL or UGC connection. The policy applies to infrastructure comprising 132kV electrical circuits or greater and for connections over 2km in length.


2.2.3 National Grid has a statutory obligation under the Electricity Act 1989 to develop and maintain efficient, coordinated and economical systems of electricity transmission. National Grid also has a statutory obligation to have regard to the preservation of amenity when developing connections.

2.2.4 When deciding whether to implement an OHL or an UGC connection, National Grid must balance the reliability, capability, cost, construction impact and land use advantages of an OHL connection, against the reduction in visual impacts associated with an UGC connection. In general, UGC connections are implemented where:

- there is a densely populated area; or
- where the proposed route alignment is within a protected area, for example an Area of Outstanding Natural Beauty (AONB) or a Site of Special Scientific Interest (SSSI).

2.2.5 The area within which the Parkgate GSP connection is proposed is not a protected area in planning terms, as it does not contain areas of a national interest or other protected features or landscapes, and it is not a densely populated area. Therefore, under the national planning policy approach, the visual impacts of the OHL connection should not outweigh other considerations of this connection selection, such as reliability, capability, cost, construction impacts and land use. Upon this basis, National Grid did not consider there to be a need for an UGC connection as part of the AP2 revised scheme. As such National Grid developed the OHL connection for the AP2 revised scheme guided by the Holford Rules to minimise the effects of the OHL connection.

2.2.6 The approach to scheme selection by National Grid was endorsed by HS2 Ltd during the design development of the AP2 revised scheme. An UGC connection was not considered to be a reasonable alternative by HS2 Ltd to the OHL connection proposed by National Grid, given the policy framework, the disruptive nature of the construction works for the UGC connection and the likely very significant increased cost. The reason for not taking forward an UGC connection as part of the AP2 revised scheme was reported in the SES2 and AP2 ES Volume 2 CA1 report. This report considers the two options in more detail and confirms HS2’s view that the OHL connection is the correct approach.

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3 **Illustrative OHL connection option (baseline scheme)**

### 3.1 Summary of AP2 revised scheme - Parkgate GSP connection

3.1.1 The illustrative overhead line (OHL) connection is based on the Additional Provision (AP) 2 revised scheme, providing for a connection to the grid supply point at a proposed permanent National Grid Parkgate substation located immediately south of the existing 400kV National Grid overhead power line. From the National Grid Parkgate substation, a 7.7km OHL connection will cross predominantly open agricultural land, to a proposed National Grid Newlands Lane substation, located adjacent to the Newlands Lane auto-transformer feeder station.

3.1.2 The OHL connection will consist of two parallel lines of steel lattice pylons, carrying three circuits, one carrying two circuits and the other carrying a single circuit. The proposed power lines will run in a generally south-west direction from the National Grid Parkgate substation towards the National Grid Newlands Lane substation.

3.1.3 The pylon line carrying two circuits will vary in height from 23m to 38m. The pylon line carrying a single circuit will vary in height from 23m to 35m. The height of the pylons will vary to take account of the topography, to maintain the required clearance beneath the 132kV overhead line.

### 3.2 Illustrative detail of the AP2 OHL connection to inform the comparison study

3.2.1 The assumptions used for the illustrative OHL connection represent one way that the AP2 revised scheme could be built, but are not based on any additional design information. The flexibility provided for in the AP2 revised scheme is still required to enable achievement of a final design which minimises the adverse impacts and which will be reviewed and updated through the detailed design process.

3.2.2 For example, in the detailed design, localised constraints such as ground conditions may require the pylons proposed in the AP2 revised scheme to be repositioned. The environmental impact assessment approach used within the AP2 ES reports the effects arising from repositioning of pylons by up to 50m in either direction along the power line route, and/or laterally within the pylon construction corridor. To accommodate this need for flexibility, the AP2 revised scheme provides for an approximately 200m wide corridor of land required to construct an OHL.
connection, and the SES2 and AP2 ES reports likely effects relating to this AP2 revised scheme. In practice, the final corridor of land needed to construct the OHL connection will be narrower, within the 200m width of land identified in the AP2 revised scheme and is likely to be a corridor approximately 65m in width.

Figure 1: An indicative example of two parallel lines of pylons at Shaw Lane, Kings Bromley

**Temporary land requirements**

3.2.3 To be able to undertake a representative comparison between an OHL connection scheme and an UGC connection, for this report only, the AP2 revised scheme design has been refined and the land required to construct the OHL connection reduced to an approximately 65m wide corridor. The illustrative OHL connection option alignment used, is shown in Appendix A. This is indicative only, does not represent the final design and consequently does not fix the land that would not be required. This is referred to as the baseline scheme for the purposes of comparison analysis.

3.2.4 The majority of disturbance during the construction phase will be localised at the pylon locations. An area approximately 0.19ha has been assumed to be required for the construction of each pair of pylons, with additional land required for the pulling platforms and construction access roads.

3.2.5 Where possible, pylons have been placed at the edge of field boundaries, avoiding roads and crossings over watercourses to minimise impacts on agriculture, connectivity and water resources.
3.2.6 Typically, only areas where pylons are constructed will be fenced off during construction reducing the area of land being disrupted (in addition to road crossings and compounds).

3.2.7 The 65m corridor of land identified for the purposes of construction between the pylon locations would only be required temporarily for the pylon stringing and access. Disturbance of land and existing vegetation will limited through the implementation of the Code of Construction Practice.

Permanent land requirements

3.2.8 The size of pylon bases will vary with the height of the pylon ranging from 36m² for a 23m high pylon, to 81m², for a 38m high pylon.

3.2.9 The environmental mitigation design shown in Appendix G, reflects the mitigation required for the illustrative OHL connection. This mitigation design takes into account the assumptions set out in Appendix F relating to avoidance of habitat removal. Mitigation is predominantly required to mitigate the loss of ecological habitats.
4 Alternative UGC connection option

4.1 Overview of the option

4.1.1 The extent of the illustrative UGC connection option is shown in Figure. The assumed route of the alternative UGC connection runs from the proposed National Grid Parkgate substation (connecting to the existing 400kV overhead power line at Parkgate) to the proposed National Grid Newlands Lane substation and Newlands Lane auto-transformer feeder station. The illustrative UGC connection option has been based on using the land required for the OHL connection in the AP2 revised scheme. The UGC connection alignment is illustrated in Appendix B.

4.1.2 The illustrative UGC connection option, like the illustrative OHL connection option, is predominantly located within agricultural land with crossings of watercourses, B roads, minor roads/access tracks and existing utilities. These crossings are detailed in Figure and presented in Appendix C. A number of Public Right of Way diversions would be required with both options during construction. The detail of these diversions will differ with each option but would be able to be accommodated within normal working practices during construction.

4.1.3 As with the illustrative OHL connection option, wherever possible, the illustrative UGC connection option has been designed to avoid existing features, such as ponds or woodland, and avoids residential properties.
Figure 2: Key crossings associated with the Parkgate UGC connection
4.2 Description of the illustrative UGC connection

UGC connection installation methodology

4.2.1 The details provided in this section set out the current working assumptions for a UGC connection for the purposes of comparison and agree these will be subject to potential change in the detailed design.

4.2.2 To maintain a resilient power supply to HS2 there is a requirement for three 132kV circuits between the proposed National Grid Parkgate substation and the proposed National Grid Newlands Lane substation. For each circuit, three cables would need to be laid along the full length of the route as shown in Figure 2. These would need to be laid in a horizontal formation in three separate 1.2m-wide trenches, as shown in Figure 3 (i.e. nine cables in total).

Figure 3: Typical detail of a cable trench for one 132kV circuit (Detail X in Figure 3) (dimensions in mm)

Figure 4: Illustrative cross section showing typical layout of trench provision for all three circuits forming UGC connection (dimensions in mm)
4.2.4 The cables would need to be laid beneath a layer of warning tape and protective tiles. The protective tiles would be buried to a minimum depth of 900mm. The tiles and tape would reduce the risk of accidental damage from unauthorised excavations.

4.2.5 A cross section of a standard 65m-wide UGC connection construction area is provided in Appendix D. This incorporates the three open cut trenches carrying each circuit, in addition to site haul roads and associated topsoil and subsoil spoil storage and temporary drainage.

4.2.6 The proposed site haul roads would run along the full length of the open cut sections and be approximately 7m wide. The site haul roads would be accessed from the public highway in six separate locations. Satellite compounds proposed in the AP2 revised scheme would be located at either end of the UGC connection with four additional satellite construction compounds located at intervals in between. These would provide locations for storing materials, site offices and welfare facilities.

4.2.7 There is a requirement to join the cables at approximately 600m intervals (limited by cable drum delivery length). At these locations an underground joint bay would need to be constructed with an above ground inspection box.

4.2.8 For all road crossings, with the exception of the B5014 Lichfield Road crossing, trenches would be dug across the road, ducts laid within protective material and the road surface reinstated. This would require short term, temporary road closures during the period of construction. Where the site haul road crosses the public highway, traffic management measures would be implemented to segregate construction traffic from local traffic.

4.2.9 This open cut technique would also be adopted for minor watercourse crossings, with temporary dewatering and over-pumping of the watercourse adopted during the excavation activities. The site haul roads, which would be in operation throughout the construction period, would cross the watercourse through the temporary installation of a culvert/pipe.

4.2.10 For a 500m section where the route passes under the River Blithe, the B5014 Lichfield Road and the Little Blithe, it is proposed to lay the ducts using non-dig methodologies, such as horizontal directional drilling (HDD). In this location a launch pit would be constructed at one end of the bore, from which the drilling would commence. A receiving pit would be constructed at the other end. No construction activities would be needed above ground between these points, therefore avoiding any disturbance to the watercourses and their floodplains, and the B5014 Lichfield Road. The site haul road would not be provided at this location,
instead the local road system would be used for construction traffic either side of the HDD site.

4.2.11 A non-dig method would also have to be used for the crossing of Ash Brook to avoid any open excavation in the floodplain. However, in this location it would be necessary to maintain a site haul road crossing of the brook through temporary installation of a culvert/pipe. At this stage of design this is considered feasible due to the size of the watercourse to deal with the impact of vehicle movements on the local road network.

4.2.12 It should be noted that non-dig methods, such as HDD, introduce additional costs and construction complexity when compared to open cut techniques. They are therefore not a generally preferred method, unless required due to site specific constraints.

**Temporary land requirements**

4.2.13 Approximately 206ha of land would be required to construct the illustrative UGC connection. The open cut sections, would be approximately 65m-wide as a construction area along the full length of the route. Within this area, topsoil would be stripped and locally stored for reinstatement. Subsoil would be excavated, stored in segregated spoil heaps and, where in excess, would be removed from site for disposal.

4.2.14 The illustrative UGC connection would require four new construction satellite compounds, located along the line of the UGC connection. Within these areas, topsoil would be stripped and locally stored for reinstatement.

4.2.15 Temporary working areas would be fenced off to restrict unauthorised access. No current land use activity would be available in these areas for the full duration of the construction works (assumed to be two years) and until full land reinstatement has been successfully completed.

**Permanent land requirements**

4.2.16 The permanent land required would be for inspection boxes enclosed within cabinets, located at approximately 600m intervals along the route, above the underground joint bays. These cabinets provide a location for monitoring the cables during operation and would require an area of land to be fenced off. There would be a permanent requirement for operational access to these locations. The inspection boxes would require an area approximately 15m². Figure 4 illustrates a typical inspection box structure.
4.2.17 On completion of construction, reinstatement works would be undertaken to return the land to its existing use. Generally, there are restrictions placed on land use above and adjacent to buried cables in order to reduce the risk of damage and to avoid reducing the capacity of the cable system. These restrictions include avoiding planting trees directly above the cables to avoid root damage. There may also be restrictions on the use of deep cultivating equipment and future development.

Operation, maintenance and refurbishment

4.2.18 Cables have an asset life of around 60 years. During their lifetime regular inspection and testing is carried out to ensure that cable insulation and joints are operating correctly. Over the lifetime of a cable, refurbishment and repairs to ancillary equipment may be required.

4.2.19 Vehicular access to strategic areas of the cable route, such as the inspection boxes, would be required at all times.
5 Comparison analysis

5.1 Introduction

5.1.1 This section outlines a comparative appraisal between the illustrative OHL connection option (baseline scheme) and an illustrative UGC connection option. The full environmental and engineering appraisals (the review matrices) are presented in Appendix E and F, and the cost appraisal is presented in Appendix H.

5.2 Policy appraisal

5.2.1 Referring to NPS EN-1\(^{3}\) Section 5.9 and NPS EN-5\(^{6}\) Section 8.8.8., Government expects that in fulfilling the need of new electricity lines of 132kV and above, the development of overhead lines will often be appropriate. However, it is recognised that there will be cases where OHL is not appropriate due to serious concerns about the potential adverse landscape and visual effects of a proposed overhead line in areas such as in National Parks, AONB and residential areas.

5.2.2 The AP2 Parkgate GSP connection scheme has been reviewed in line with the above and Section 2.8.9 of EN-5. Section 2.8.9 of EN-5 provides the specific policy guidance that “the IPC (Infrastructure Planning Commission) should, however only refuse consent for overhead line proposals in favour of an underground or sub-sea line if it is satisfied that the benefits from the non-overhead line alternative will clearly outweigh any extra economic, social and environmental impacts and the technical difficulties are surmountable.”

5.2.3 In addition, National Grid have published guidance\(^{7}\) in terms of reliability, capability, cost, construction impacts and land use of OHL compared to UGC, informing likely impact. Considering this National Grid guidance, EN-1 and EN5, there is no policy requirement to consider an UGC connection in the Parkgate location. The area in which the proposed AP2 Parkgate connection line is proposed is sparsely populated with no notable residential areas, and it is not within a National Park or an AONB\(^{3}\). Considering the guidance in implementing the Parkgate GSP connection, the benefits from an UGC connection would not be outweighed by economic, social and environmental impacts, including a greater level of land disruption, disturbance to biodiversity and archaeological sites.

\(^{3}\) National Policy Statement for Electricity Networks Infrastructure (EN-5)

\(^{6}\) https://www.nationalgrid.com/sites/default/files/documents/45349-Undergrounding_high_voltage_electricity_transmission_lines_The_technical_issues_INT.pdf
5.2.4 A comprehensive environmental, engineering and cost appraisal with respect to both OHL and UGC connection for the Parkgate GSP connection is set out in the following sections. In summary the appraisal also concludes that the permanent environmental benefits of an UGC connection, do not outweigh the significant additional cost, additional construction complexities, and additional temporary environmental impacts of an UGC connection for the Parkgate GSP connection.

5.3 **Engineering appraisal**

5.3.1 The engineering comparison between the illustrative OHL connection option and the illustrative UGC connection option is summarised below. It sets out the key differences in construction and operation between the two options. The detailed impact appraisal is set out in Appendix E.

### Construction complexity

5.3.2 The relative greater complexity of construction adds both cost and programme risks, due to possible unknown constraints resulting from, amongst other things:

- the interface with requirements for directional drilling under the River Blithe in the central section of the route results in additional construction complexity for the illustrative UGC connection option as compared to the illustrative OHL connection option due to jointing arrangements and potential project risk due to adverse ground conditions;

- the underground cables along the route will have an increased impact on existing buried services, including an existing high pressure gas pipeline, crossing perpendicular to the Parkgate corridor, requiring greater levels of design and supervision;

- the requirement for inspection boxes adds additional design and construction complexity for the illustrative UGC connection compared to the illustrative OHL connection option which does not have such requirements. Underground joint bays require deep excavations and controlled conditions in the working areas during jointing operations; and

- there is additional complexity in the construction of the illustrative UGC connection option, due to the need for cable sealing ends at the proposed National Grid Newlands Lane and Parkgate substations, compared with no such requirement for the illustrative OHL connection option.

5.3.3 The construction complexity rating therefore involves a moderate worsening compared with the illustrative UGC connection option due to the potential for changing ground conditions, the interface with non-dig construction methods, a requirement for additional cable jointing and the need to cross existing services.
Disruption to existing infrastructure

5.3.4 There is the potential for added disruption to existing infrastructure for the UGC connection as compared to the OHL connection baseline scheme due to:

- several road crossing closure requirements and/or associated traffic management;
- the necessary management of the interface between the local traffic network and construction site haul roads; and
- the need for access points from the public highway for the construction of the UGC connection, whereas access for the installation of the OHL connection baseline scheme is more flexible and generally across existing farm accesses.

5.3.5 The disruption to existing infrastructure therefore involves a minor worsening with the illustrative UGC connection option due to increases in heavy goods vehicle (HGV) movements and greater numbers of interactions between construction traffic and local roads.

Safety

Construction

5.3.6 The main differences in safety between the illustrative UGC connection and the illustrative OHL connection option in construction are:

- reduced requirements for working at height or major lifting requirements for the illustrative UGC connection compared to illustrative OHL connection option;
- increased HGV movements would be required for the illustrative UGC connection option due to the increase in excavation and the need for disposal of materials offsite; and
- areas of deeper excavation for the underground joint bays and long sections of open trench are needed for the illustrative UGC connection option.

5.3.7 The safety rating comparison is neutral compared with the illustrative OHL connection option as the reduction in risks from working at height is balanced against the increased risk associated with working within areas of deep excavation and the increase in HGV movements.
Operation

5.3.8 Safety during operation, maintenance and decommissioning, and emergency access is similar for both options. Underground cables pose a similar risk of contact compared to overhead lines.

Maintenance and renewal

5.3.9 Whilst maintenance and operational access is needed to inspection boxes only, in the event of cable failure, cables would need to be exposed and removed. This would be more difficult and poses increased operational risks for underground cables compared with overhead lines.

5.4 Environmental appraisal

Introduction

5.4.1 The appraisal compares the likely impacts from the illustrative OHL connection option (representing the baseline scheme) and the illustrative UGC connection option. The impact appraisal is set out in Appendix F and has been undertaken in line with the Scope and Methodology Report (SMR)\(^8\), SMR addendum\(^9\) and SMR addendum 2\(^10\). Assumptions and limitations which have been used to inform the appraisal are also set out in Appendix F.

5.4.2 The appraisal has concluded that the temporary impacts of the illustrative UGC connection option (impacts during construction) are moderately worse overall than the illustrative OHL connection option. For the permanent impacts (impacts following completion of construction) the appraisal concluded the illustrative UGC connection would represent a moderate improvement compared to the illustrative OHL connection. A summary of the key differences from the appraisal is presented below.

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5.4.3 Where it is considered that impacts could be avoided, as reported in the assumptions in Appendix F, then these have informed the appraisal. Where required, the appraisal identifies mitigation measures which could be applied to mitigate the impacts, and the rating is based on these mitigation measures being applied. This includes the indicative mitigation design measures, shown in Appendix G, such as bird deflectors, and measures detailed in the HS2 Phase 2a draft Code of Construction Practice (CoCP).\(^\text{11}\)

5.4.4 Also provided in Appendix G is an illustrative comparable plan for the mitigation presented in the AP2 revised scheme.

**Temporary impacts**

5.4.5 The construction of the illustrative UGC connection option would require a greater scale of excavation and vegetation clearance across a larger area compared to the illustrative OHL connection option. This would result in a worsening of impacts over the two-year construction period, when compared against the illustrative OHL connection option, on the rural and historical landscape, visual receptors and the setting of built heritage assets. These impacts would mostly be temporary and reversible.

5.4.6 Excavation of trenches would result in a greater level of physical disturbance to agricultural land during construction. This would be temporary and appropriate material handling measures would minimise long term impacts. Excavation would result in increased risks of temporary localised flooding and disruption to land drainage and the groundwater regime.

5.4.7 Construction of the illustrative UGC connection option would also require greater numbers of HGV movements, due to the increase in material to construct the site haul road and the increase in surplus material for disposal. The increase in HGVs would increase the level of traffic on the local road network and result in localised impacts on a limited number of residential properties in terms of increased noise and reduced air quality.

5.4.8 Overall, the illustrative UGC connection option would result in a moderate worsening in construction compared to the illustrative OHL connection option due to the increased scale and disruption during construction.

Permanent impacts

5.4.9 The permanent impacts of the illustrative UGC connection option would be mostly limited to the presence of a number of inspection boxes, which provide maintenance access to the joint bays along the route (located approximately every 600m along the route). The absence of pylons would reduce the permanent impacts on views from the small number of residential properties and PRoW located within the area. It will also reduce the permanent impacts on the rural and historic landscape character and remove impacts on the setting of historic structures.

5.4.10 Less agricultural land would be required permanently in the illustrative UGC connection option, however as the position of pylons in the illustrative OHL connection option has limited impact on the function of farm holdings the difference between the two options would be minimal. There would be farm management and land use restrictions imposed on the land above the cables for the illustrative UGC connection option.

5.4.11 Vegetation clearance and excavation would permanently impact on buried archaeology and local/regional value ecological receptors, including hedgerow, floodplain grazing marsh, terrestrial habitat associated with ponds and woodland. Habitat creation would, however, mitigate the ecological impacts.

5.4.12 The illustrative OHL connection option would introduce a potential national level risk of mortality of individual birds through collision with the OHL, as it is located within the Impact Risk Zone for Blithfield Reservoir SSSI. However, this could be mitigated through the use of measures such as bird diverters if detailed field surveys within the area identify any important bird flight lines and foraging areas. The illustrative UGC connection option would be an improvement on this, as it would remove the collision risk.

5.4.13 Therefore, the balance of greater vegetation clearance and against the removal of the bird mortality risk impact would represent a neutral change for biodiversity.

5.4.14 The permanent presence of the illustrative UGC connection would result in a greater extent of permanent sterilisation of a designated sand and gravel Mineral Safeguarded Area (MSA), however this would be limited to only a small area of the MSA. In addition, the trench and underground cables could permanently disrupt land drainage and the groundwater regime.

5.4.15 Overall, the illustrative UGC connection would result in a moderate improvement compared to the illustrative OHL connection option due to the removal of large permanent structures and their associated permanent impacts.
5.5 **Cost appraisal**

**Overview**

5.5.1 The capital cost of the illustrative UGC connection option is estimated to be significantly higher than for the illustrative OHL connection option.

5.5.2 The operational costs for the illustrative UGC connection option are anticipated to be broadly similar to those for the illustrative OHL connection option\(^7\).

**Estimated construction cost summary**

5.5.3 The estimated construction cost of the illustrative OHL connection option is: £105 million (at 2015 prices). The estimated construction cost of the illustrative UGC connection option is: £170 million (at 2015 prices). Both costs include contingency. The cost differential of £65 million is due to a number of factors including additional site workers required to construct an UGC connection, increased costs of cables and materials, more expensive methods required such as HDD, and additional exposure to unknown ground conditions.

5.5.4 A summary, breakdown of the construction costs for the illustrative OHL and UGC connection options is provided in Appendix H.
Appendix A - Illustrative OHL connection corridor

A.1.1 The following drawing presents an illustrative alignment and area of land for construction of the OHL connection option (within the land required to construct the AP2 Parkgate GSP connection)
Appendix B - Illustrative UGC connection corridor

B.1.1 The following drawing illustrates the alignment of the illustrative UCG connection option considered in the appraisal.