

## Overhead Line Tie-in; Cambushinnie 400kV OHL Tie-In

Geo-environmental Desk Study

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## Quality information

Prepared by	Checked by	Verified by	Approved by
Oceane Mbaguta	George Baggott	Judit Gal	Oli Nofal
Graduate Environmental	Principal Geo- environmental Consultant	Associate Director	Senior EIA Consultant

## **Revision History**

Revision	<b>Revision date</b>	Details	Authorized	Name	Position
Issue 1	24 May2024	Issue 1		Judit Gal	Associate Director
Revision 1	02 July 2024	Revised boundary considering Option 1 for OHL layout.		George Baggott	Principal Consultant
Revision 2	30 July 2024	Internal team comments		George Baggott	Principal Consultant
Revision 3	16 October 2024	Revision following clients' comments		George Baggott	Principal Consultant

### Prepared for:

Scottish Hydro Electric Transmission known as Scottish & Southern Electricity Networks ('SSEN Transmission')

Prepared by:

AECOM 177 Bothwell Street GLASGOW G2 7ER, United Kingdom United Kingdom

T: +44 (0)20 8639 3500 aecom.com

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The methodology adopted and the sources of information used by AECOM in providing its services are outlined in this Report. The work described in this Report was undertaken between 16 February and 27 June2024 and is based on the conditions encountered and the information available during the said time period. The scope of this Report and the services are accordingly factually limited by these circumstances. AECOM disclaim any undertaking or obligation to advise any person of change in any matter affecting the Report, which may come or be brought to AECOM's attention after the date of the Report.

The Site walkover conducted of areas accessible to public on 15 January 2024 consisted of a general inspection of the Study Area aimed at identifying any obvious signs and potential sources of ground contamination affecting the Proposed Development areas. An environmental compliance audit and/ or detailed structural inspection of existing buildings were out with the scope of this report. Similarly, the Site visit excluded detailed consideration of the ecological or archaeological aspects of the Site, and if such are believed to be of potential significance then it is recommended that specialist advice is sought.

Any risks identified in this Report are perceived risks, based on the information reviewed during the desk study and therefore partially based on conjecture from available information. The study is limited by the non-intrusive nature of the work and actual risks can only be assessed following a physical investigation of the Site. The opinions expressed in this report and the comments and recommendations given are based on a desk-based assessment of readily available information and an initial site reconnaissance by an AECOM Engineer.

Reference to historical Ordnance Survey (OS) maps and/or data provides invaluable information regarding the land use history of a site. However, it should be noted that historical evidence will be incomplete for the period predating the first edition and between the release of successive maps and/or data.

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## **1. Introduction**

## 1.1 Commission

AECOM Limited has been commissioned by Scottish Hydro Electric Transmission operating and known as Scottish & Southern Electricity Networks ('SSEN Transmission') (the Client) to undertake a Geo-environmental Desk Study for the construction of a new electricity substation at Braco West in proximity to the existing substation and an overhead line tie in to the existing Beauly – Denny overhead line, with a section of Underground Cable (UGC) to connect the two sites, an access and bypass tracks.

This report is specifically for the Overhead line (OHL) link, referred hereafter as the 'Proposed Development' or 'Site', as summarised below in **Section 1.2**. The desk study findings for the proposed Cambushinnie substation, underground cable route (UGC) and access tracks are discussed in a separate AECOM report titled *Cambushnnie 400Kv Substation* (AECOM 60721943-R-001 June 2024).

The Geo-environmental Desk Study is required to characterise potential land quality constraints / opportunities, to provide input as baseline data to the Environmental Appraisal and support for a Section 37 Application<sup>1</sup>.

## **1.2 Proposed Development and Planning Status**

The Proposed Development consists of a 400kV steel lattice tower design, and a planning application for the permission for the Proposed Development has not been submitted at time of writing. It is understood from the Client that the Proposed Development will comprise the following:

- Implementation of two temporary towers 380T and 379T to allow for short term OHL diversions during the construction of the new terminal tower 380R;
- One new permanent terminal tower 380R;
- Dismantling of redundant tower T380; and
- Temporary access routes to permanent and temporary towers except at T378.

The Applicant is also seeking deemed planning permission under section 57(2) of the Town and Country Planning (Scotland) Act 1997 for certain elements of the Proposed Development, or ancillary development required to facilitate its construction and operation. The ancillary development will include the installation of temporary access tracks, vegetation clearance, temporary working areas and upgrades to existing access tracks and existing access points.

The Site location plan and Final OHL Arrangement plan are included for the Proposed Development in **Appendix A**, with an extract of the Final OHL Arrangement provided in **Figure 1**, below.

<sup>&</sup>lt;sup>1</sup> Energy Consents Unit - Good Practice Guidance for Applications under Section 36 and 37 of the Electricity Act 1989, Scottish Government 2022



#### Figure 1. Final OHL Arrangement Plan

## 1.3 Scope and Objective of Report

The objective of the Geo-environmental Desk Study is to characterise the environmental setting and sensitivity across the Site, along with the potential for contamination to exist and the pathways through which contamination may come into contact with sensitive receptors. This assessment assumes the Proposed Development as an overhead line link tie-in to the existing power line and pylon structure, requiring construction of a new permanent tower and two temporary towers, with the removal of an existing tower and the two temporary towers. The Geo-environmental Desk Study includes the following key activities:

- Review of aerial imagery for site layout and terrain evaluation to provide a current description of the Site's layout and setting within the local area;
- Review of historical land uses for the Site and surrounds with a particular emphasis on identifying potential on-site and off-site contamination sources, and potential for made ground;
- A review of the Site's geological (including available BGS borehole records), hydrological and hydrogeological setting, publicly available non-coal and coal mining records and geo-environmental information to build up an understanding of the Site setting and surrounding environmental sensitivity;
- Request and review relevant records held by the Local Authority Contaminated Land Officer, the Scottish Environment Protection Agency along with public regulatory records provided within Groundsure Report (Enviro + Geo Insight) purchased for the Site;
- Review of available records provided by the Client;
- Review of publicly available records including (but not limited to) Historic Environment Scotland website, the Zetica bomb risk maps, UK Radon website, flooding information and the National Library of Scotland to further inform the study;
- Develop a preliminary Conceptual Site Model (CSM) for the Site to identify the potential contamination sources, pathways, and receptors for consideration in the context of the potential development followed by a preliminary qualitative risk assessment for the Site;

- Summarise identified geo-environmental and land quality risks; and
- Recommendations for further geo-environmental assessments, if required.

### 1.4 Sources of Information

The following bodies were consulted during the assessment:

- Groundsure Enviro+Geo Insight (ref. GS-BMC-5AI-LLZ-3UB, 6 February 2024)
- Groundsure Enviro+Geo Insight (ref GSIP-2024-14502-17022, 29 January 2024)
- Geo-Environmental Desk Study LT520-Braco West Substation (SSEN, October 2023)
- Igne, Report on Ground Investigation (2024)
- The Coal Authority (CA) (Interactive Map Viewer | Coal Authority (bgs.ac.uk))
- British Geological Survey (BGS) (GeoIndex British Geological Survey (bgs.ac.uk))
- Scottish Environment Agency (SEPA) (Water Environment Hub (sepa.org.uk))
- SEPA Flood Risk (https://map.sepa.org.uk/floodmaps/FloodRisk/Search)
- NatureScot (Map | Scotland's environment web)
- Historic Environment Scotland (HES) (Designations Map Search (arcgis.com))
- Zetica UXO Map (<u>Risk Maps | Zetica UXO</u>)
- UK Radon Map (<u>UKradon UK maps of radon</u>)
- Topography map (United Kingdom topographic map, elevation, terrain (topographic-map.com))
- Scottish Government Energy Infrastructure (<u>Energy Consents Scottish Government</u>)
- Google Earth satellite imagery (Google Earth)

Specific information sources are referenced throughout the document.

## **2. Site Description**

## 2.1 Site Location

The Site is located approximately 4.5 km west of the village of Braco, 170 m south of Bullie Burn, 4.27 km northwest of the A9 dual carriageway and 7.5 km northeast of Dunblane village. The national grid reference of the centre of the Site is NN 79176 09097 and the nearest postcode is FK15 9LP.

The Site location is shown in Figure 2 below with the larger figure included in Appendix A.

#### Figure 2 Site Location Plan



### 2.2 Site Walkover and Description

A site reconnaissance survey was undertaken by AECOM staff on 15 January 2024. During the reconnaissance observations were made on the topography, land use, drainage and potential sources of contamination identified on site.

The Site comprises an area of vacant land for the Proposed Development to tie into the proposed Cambushinnie substation and is also in proximity to the existing Braco West Substation. The Site is predominantly located in an area of agricultural and forestry land and includes three pylon towers. No evidence of contamination was noticed during the Site walkover.

The Proposed Development will connect to the proposed Cambushinnie substation to the southeast. The existing Braco West electricity substation and the four pylon towers are the only structures within 500 m of the Site. No residential dwellings are present within 500 m of the Site.

Details of the Site reconnaissance are incorporated within **Section 2.3** and photos from the survey are included as **Appendix B**.

## 2.3 Current Site Use, Topography and Geography

### 2.3.1 On-site

The Site comprises coniferous forestry land with both mature and young growth trees present, with forestry access tracks, and open moorland also found across the Site. According to the UK topographic map<sup>2</sup>, the Site is situated at approximate elevations varying between 250-253 m above ordnance datum (AOD) on a hillside with the ground sloping down towards the south and south-east. There are four existing pylon towers and associated overhead lines within the west, center and east of the Site. The overhead lines run approximately northeast to southwest. The existing Braco West substation and associated car park are located within the northeast of the Site and surrounded by palisade fencing. Additionally, the existing Braco West substation comprises an approximately rectangular area of approximately 150 m by 90 m, and is surfaced with a mix of hardstanding, asphalt and gravel. The northern sections of the proposed Cambushinnie substation and UGC development overlaps to the south and east of the Site, respectively.

### 2.3.2 Off-site

The off-site area described below extends to a boundary of 1 km to the north, east, south, and west of the Site.

- North An area of plantation forestry comprising predominantly coniferous woodland is present approximately 130 m north of the Site. The forested land slopes downward until it reaches the Bullie Burn approximately 170 m north of the Site, at an elevation of 224 m AOD. To the north of the burn the land remains under use as plantation forestry, however, slopes upward to the north.
- **East –** Plantation forestry comprising predominantly coniferous woodland is present to the east of the Site. Land to the east of the Site slopes downward to the east and southeast. Three culverts are located at approximately 500 m southeast of the Site, and which drain into the Bullie Burn. An access track is to the immediate southeast of the existing substation.
- South Plantation forestry comprising predominantly coniferous woodland is present to the south of the Site
  and the land slopes downward to the southwest, southeast and south. Feddal Hill is located to the immediate
  southeast of the Site. Adjacent to the south of the Site is the area of the proposed Cambushinnie substation.
- West Plantation forestry comprising predominantly coniferous woodland is present to the west of the Site. The land slopes gently upward to the northwest towards Cambushinnie Hill, approximately 1.10 km west of the Site at an elevation of 270 m AOD.

<sup>&</sup>lt;sup>2</sup> https://en-gb.topographic-map.com/map-cgt/United-Kingdom/

## 3. Site History

## 3.1 Introduction

The following account of the historical development of the Site and its immediate surroundings are based on a review of historical Ordnance Survey (OS) maps and aerial photography both obtained as part of a Groundsure Report (attached as **Appendix C**), and a review of publicly available web-based mapping services.

AECOM also notes that only indicative map scales are provided. Where dates are stated, these refer to the dates of maps on which the features are present, have changed use or are no longer annotated, and do not necessarily refer to the exact dates of existence of a particular feature. Development that may have occurred between map editions is recorded as occurring on the latter published map, hence there are some limitations to the accuracy to the date of development unless supplementary evidence is available.

## 3.2 Historical Ordnance Survey Mapping & Aerial Photographs

A review of historical land uses within the Study Area has been undertaken using the Groundsure maps and aerial photography and is summarised in **Table 1** below. It should be noted that the search has been limited to within 250 m of the site, with only notable land uses beyond this distance included.

Where map dates are not included in table below, there was no significant information present on those maps, or there were no apparent land use changes shown for these dates.

Dates	Features within the Site	Features within 250 m of the Site
1862-1954 (1:10,560)	<ul> <li>The Site was undeveloped with mainly agricultural land and forestry. across the Site.</li> <li>Three access tracks within the south of the Site. Two of the tracks are divided into two as they cross the Site.</li> </ul>	<ul> <li>An access track enters the Site from the southeast, running parallel to Bullie Burn located 170m north of the Site.</li> <li>Another access track is shown at approximately 160m northeast.</li> <li>Bullie Burn is shown flowing west to east.</li> <li>The immediate surrounding comprises agricultural land and forestry.</li> </ul>
1977- 1978(1:10,560)	The three access tracks are no longer shown on site.	The access tracks are no longer shown.
2001-2010 (1:10,000)	<ul> <li>New access tracks across the Site, within the east, centre and west.</li> <li>The Site is agricultural land and shown to be divided into sections of plantation forestry. No other significant changes.</li> </ul>	<ul> <li>New access tracks/roads are shown within 250 m of the north, east, south and west of the Site.</li> <li>The immediate surrounding comprises agricultural land and forestry land divided into sections.</li> <li>The access track located to the immediate east of the Site is shown in its full length. No other significant changes</li> </ul>
2003 (1:1,250)	No significant changes	No significant changes
2005 (aerial imagery)	No significant changes	No significant changes
2015 (aerial imagery)	<ul> <li>Four new pylons within the west, centre and east of the Site. Pylons are associated with the existing Braco West 275kV substation located in the northeast of the Site.</li> <li>Car Park associated with the existing substation</li> </ul>	No significant changes
2024 (10,000)	<ul> <li>An access track is shown running along the south boundary of the Site, following the line of the pylons. The track runs southwest to the southeast of the Site.</li> <li>The existing Braco West 275Kv substation is shown within the northeast of the Site.</li> </ul>	No significant changes

#### Table 1 Summary of Historical Mapping & Aerial Photography

## 3.3 Summary of Potential Historical Contamination Sources

This section summarises potential contamination associated with historical features identified in **Section 3.2**. These include:

- Made Ground associated with the construction of the existing Braco West substation (on-site), the construction of access roads and tracks (on-site and off-site) and of the pylon towers and existing substation (on-site). These could have the potential for contaminants<sup>3</sup> such as metals and inorganic compounds, pH, Polycyclic aromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPH) including benzene, toluene, ethylbenzene, xylene (BTEX) and methyl-tert-butyl-ether (MTBE), semi volatile organic compounds (SVOCs), volatile organic compounds (VOCs), sulphates, sulphides and phenols;
- Electricity Substation (on-site), with potential for contaminants<sup>4</sup> such as hydrocarbons, heavy metals and sulphates; and
- Car park (on-site) associated with the existing substation, with potential for contaminants such as mineral Oils, PAHs, TPH including BTEX and MTBE.

<sup>&</sup>lt;sup>3</sup> Asbestos has been discounted as the existing substation was constructed post-1999 after asbestos has been banned in the UK.

<sup>&</sup>lt;sup>4</sup> Polychlorinated biphenyls (PCBs) discounted as substation constructed post-2010 after use of PCBs had been banned.

## 4. Existing Information Review

## 4.1 Introduction

Information provided to AECOM related to the subject site from previous planning developments, and planning applications including one internal report and information issued by Consultees (i.e. Perth and Kinross Council Contaminated Land Officer) have been reviewed as part of this study. Relevant information relating to the Proposed Development geological or land quality status, has been subject to a review and summary as part of this report.

## 4.2 Previous SSEN Desk Study Report

## 4.2.1 Geo-Environmental Desk Study LT520 – Braco West Substation (2023)

AECOM has received a previous Phase 1 Desk Study report for the Site undertaken by SSEN for the purpose of identifying geotechnical and geo-environmental implications of the construction of a new 400kV substation adjacent to the existing 275kV substation at Braco West, and provides an appraisal of two options (designated as Option 2 and Option 3) for construction and site layout [report ref. LT520-BRCW-GDS\_CIV-001, dated 31 October 2023]. A copy of this report is available in **Appendix D**.

The site options for the location of the Proposed Development, the proposed Cambushinnie substation and UGC considered for assessment within the desk study report were Options 2 ('site 2') approximately encompassing the Site, and Option 3 ('site 3'), located approximately 300 m west of the existing Braco West 275kV substation<sup>5</sup>. The area considered for site 2 better represents the Site of the Proposed Development as discussed in this AECOM report.

The report reviewed details for the new substation development and surrounding area including historical mapping and environmental setting and formed conclusions and made recommendations for further assessment of the site. The report identified the following key findings:

- The history of the Site and surrounding area was found to be open moorland / rough pastureland from 1866 with some access tracks marked in the east of the Site. The Site remained unchanged until 2001 by which time the Site and surrounding area comprised coniferous forestry with a network of access tracks throughout. By 2022 the Beauly-Denny OHL crossed the Site with a more established access track network running along the route of the Beauly-Denny OHL. No Made Ground or contamination is anticipated within the Site based on historical use of the site was found.
- The underlying geology of the Site, the proposed Cambushinnie substation and UGC was found to comprise of superficial deposits of peat underlying the site areas, with Glacial Till expected to underly the southern area of the site 2 area. Glacial meltwater channels were identified running approximately northwest to southeast across both site 2 and site 3 areas. Solid geology underlying the site was found to comprise Teith Sandstone Formation and Cromlix Mudstone Formation. A bedrock fault was identified running east to west located to the south of both site 2 and site 3 areas. The Envirocheck report referenced found both site 2 and site 3 to be at high-risk potential for compressible ground stability hazards, associated with the peat deposits. However, both site 2 and site 3 areas are classified as low risk for all other ground stability hazards such as for collapsible ground stability, landslide, dissolution stability, running sand, shrinkage, and swelling clay hazards.
- Nearby surface water features were identified as the Bullie Burn approximately 300 m north of the site 3 area, and Muckle Burn approximately 600 m south of the site 2 area. The hydrological regime of the site area was recorded as draining into the surrounding tributary river network before joining Allan Water to the south. The bedrock, which is part of the Strathmore Group, is classified as a moderately productive aquifer.
- Neither of the site 2 or site 3 were identified to be at risk of flooding. However, it was noted that a high likelihood
  of localised surface water flooding existed in proximity to the perimeter of the site 2 area though not expected
  to impact site itself.
- Conclusions of the report were as follows:
  - A peat management plan would be required for the construction of a new substation at either site option to reduce the amount of peat disturbed and manage the peat being excavated.

<sup>&</sup>lt;sup>5</sup> The substation is located within the northeast (section 2.3.2) of the Proposed Development discussed in this report.

- A water source for the duration of construction works would be required to be established, as no such water source or connection was present on or near the site.
- Further detailed flood risk assessment for both site options was considered necessary.
- Contamination at the sites was considered unlikely based on the history of the site and surrounding area.
- Shallow bedrock was anticipated meaning a potential constraint for development as the competency of the rock is unknown.
- The report made the following recommendations based on the findings:
  - A detailed Ground Investigation comprising peat probing, hand dug inspection pits, boreholes advanced to 5 m into the rockhead, trial pits to 4.5 m or to bedrock, soil and water sampling for geotechnical and geo-environmental testing, monitoring well installation and ground gas / groundwater monitoring.
  - Recommendations for the production of reports were made including a Ground Investigation (Phase 2) Report (GIR), an Interpretative Ground Investigation Report, and a summary of presentation of factual / interpretative report findings.
  - Additional recommendations included a peat management plan to be put in place prior to commencement of the main construction works.

## 4.3 Igne, Report on Ground Investigation (2024)

SSEN commissioned Raeburn Drilling & Geotechnical Limited (RDG) to undertake a ground investigation including peat probing within the Site, to the immediate north of the site, and within the proposed Cambushinnie substation and UGC. A factual ground investigation report<sup>6</sup> was provided to AECOM for review. The objective of the works was to provide information on the ground conditions for design and construction of the Proposed Development and to determine any geochemical contamination of the Site. The sitework was carried out between 15 November and 8 December 2023, in accordance with EN1997-2:2007, BS5930, BS10175 and in house - procedures. Additionally, one round of ground gas was undertaken on 11 December 2023.

The report on ground investigation comprised borehole and trial pits records, testing records, laboratory results, photographs, and a site plan. A copy of this report is available in **Appendix D**.

The ground investigation works included fourteen boreholes drilled by sonic and rotary core drilling, with three boreholes drilled by continuous percussion using a dynamic sampler and rotary core drilling up to 15.75m below ground level (bgl)<sup>7</sup>. Twenty trial pits were undertaken within the Site, the proposed Cambushinnie substation and UGC, and excavated by mechanical means up to 3.00 m bgl<sup>8</sup>. Approximately 4,600 peat probes were also undertaken across the Site and to the immediate north of the Site, and at the proposed Cambushinnie substation and UGC.

Monitoring wells were installed in nine boreholes between 0.50 m bgl and 10.00 m bgl to monitor ground gas concentrations for methane, carbon monoxide, carbon dioxide, hydrogen sulphide, and oxygen. In addition, groundwater levels were recorded during ground gas monitoring.

The report identified the following key findings:

- The Site, the proposed Cambushinnie substation and UGC are located within an area of forestry land comprising of mature and semi mature trees on the eastern slopes of Feddal Hill located approximately 5.0 km west of Braco Village, Perth and Kinross.
- The laboratory geotechnical testing was carried out by Terra Tek Limited (Trading as Igne) and included the following: Moisture content, Liquid and plastic limit tests, Bulk Density, Particle Size Distribution, Moisture Condition Value, California Bearing Ratio, Small Shearbox, Los Angeles, Point Load, Unconfined Compressive Strength.
- The laboratory geo-environmental testing was carried out by Terra Tek Limited (Trading as Igne) and included the following testing: Metals, Inorganic Suite, Total Petroleum Hydrocarbon Criteria Working Group / Volatile Petroleum Hydrocarbon Criteria Working Group (TPHCWG / VPHCWG), Total Organic

<sup>&</sup>lt;sup>6</sup> Igne-Report on Ground Investigation, LT307 Braco West Sites 2 &3, 26 January 2024

<sup>&</sup>lt;sup>7</sup> Based on BH05

<sup>&</sup>lt;sup>8</sup> Based on TP21

Carbon, Phenol, Organic Matter, pH, Sulfate, Polyaromatic Hydrocarbons (PAH), Asbestos, WAC analysis.

- Chemical contamination testing was carried out on 19 samples of made ground and soil.
- Chemical results were generally close to or below the method detection limit, except for generally higher total chromium, arsenic, zinc, lead, nickel, copper, organic matter and sulphate. Whilst AECOM have not undertaken a formal quantitative risk assessment of the data provided for review, the concentrations do not appear to indicate contamination impacts for a proposed commercial land use.
- No asbestos containing materials were identified within the soil samples analysed.
- The WAC testing (only one completed) did not show any exceedances of inert landfill, stable non-reactive hazardous landfill and hazardous landfill acceptance criteria.
- Groundwater strikes were encountered in three of the trial pits -TP07 at 1.20m bgl, TP09 at 2.00 m bgl and TP13 New at 1.50m bgl, within bedrock and superficial deposits.
- A summary of the geological strata encountered during the ground investigation is presented below:
  - Peat from surface up to 1.90 m bgl and described as soft brown to dark brown spongy amorphous<sup>9</sup>. Peat was encountered in all locations with the exception of TP10 New and TP21.
  - Made ground was encountered from surface up to maximum depth of 0.70m bgl<sup>10</sup> in two trial pits (TP21 and TP23) and described as of dark brown/grey to brown slightly gravelly silty fine to coarse sand with occasional roots, or reddish brown gravely clayey fine to coarse sand with medium to high cobble content and occasional pieces of wood.
  - Superficial deposits of sand, gravel and clay were encountered between 0.20 m bgl<sup>11</sup> to 5.50 m bgl<sup>12</sup>, and described as brown to reddish brown very gravelly silty fine to coarse SAND, and red brown sandy CLAY with sandstone boulders, respectively. Gravel was encountered between 0.45 m bgl to a maximum depth of 2.70 m bgl<sup>13</sup>, and described as brown very sandy silty with medium cobble content<sup>14</sup> or reddish brown very sandy silty<sup>15</sup>. Deposits of silt were encountered in BH04 between 0.55 m bgl and 1.20 m bgl and described as reddish brown slightly gravelly sandy.
  - Bedrock was encountered in all boreholes. However, it was not positively encountered in trial pits-TP04, TP05, TP09, TP11, TP12 New, TP13 New and TP21, though pits were terminated due to hard digging on 'possible bedrock'.
  - Bedrock of sandstone was encountered between 0.90 m bgl<sup>16</sup> and 5.50 m bgl<sup>17</sup> (depths of top of the bedrock) and described as medium strong brown grey, slightly moderately weathered and recovered as gravelly silty fine to medium sand with high cobble and medium boulder content; and weak to medium strong thinly to thickly laminated reddish brown fine to coarse medium grained SANDSTONE recovered as very sandy very gravelly cobbles, respectively.
  - Very weak to weak greyish brown MUDSTONE with reddish brown siltstone laminae was encountered between 3.80 m bgl<sup>18</sup> to 10.55 m bgl<sup>19</sup> (depths of top of the bedrock).
  - The maximum bottom depths of bedrock were 15.75 m bgl<sup>20</sup> and 15.45 m bgl<sup>21</sup> for sandstone and mudstone, respectively.
- Assumed Zone of Core Loss were encountered in BH01, BH02, BH05, BH08 as follows:

<sup>&</sup>lt;sup>9</sup> Based on BH18

<sup>&</sup>lt;sup>10</sup> Based on TP21

<sup>&</sup>lt;sup>11</sup> Based on TP13 New

<sup>&</sup>lt;sup>12</sup> Based on BH01

<sup>&</sup>lt;sup>13</sup> Based on BH01, BH02, BH05, BH07, BH08

<sup>&</sup>lt;sup>14</sup> Based on BH07

<sup>&</sup>lt;sup>15</sup> Based on BH05

<sup>&</sup>lt;sup>16</sup> Based on TP01

<sup>&</sup>lt;sup>17</sup> Based on BH01

<sup>&</sup>lt;sup>18</sup> Based on BH02

<sup>&</sup>lt;sup>19</sup> Based on BH05

<sup>&</sup>lt;sup>20</sup> Based on BH05

<sup>&</sup>lt;sup>21</sup> Same as above

- BH01 between 4.00-4.40 m bgl, between natural deposits
- BH02 1.80m bgl-2.30 m bgl, and 9.10-9.30 m bgl between natural deposits and bedrock.
- BH05 between 3.90-4.30 m bgl, and 5.40 m bgl -5.95 m bgl, between bedrock
- BH08 between 2.70 m bgl -3.10 m bgl, between natural deposits and bedrock.
- One round of ground gas monitoring data was undertaken at atmospheric pressure ranging between 962mbar and 971mbar. The following ground gas results were recorded:
  - Methane (CH4) at 0%v/v;
  - Carbon dioxide (CO2) between 0 %v/v and 0.10%v/v (steady levels), with higher peaks at 0.20% v/v in BH04 and BH13;
  - Oxygen (O2) between 19.10 %v/v and 19.40%v/v (steady levels);
  - Hydrogen sulphide (H2S) between 0ppm and 1ppm; and
  - Carbon monoxide (CO) at 0 ppm and 2ppm (steady levels).

Groundwater levels were recorded between 2.44 m bgl (BH01) and 8.74 m bgl (BH19). Locations BH04, BH10, BH13 and BH14 New were recorded as dry.

## 4.3 Local Authority Consultation

#### 4.3.1 Contaminated Land Officer - Consultation

AECOM has requested information from the Perth and Kinross Council (PKC) Contaminated Land Officer relating to potentially contaminated land within the Site within a radius of no greater than 500 m from the Site. The following information has been issued to AECOM on 23 February 2024 (ref. PKCIR:1864), a copy of the correspondence is available in **Appendix E**:

- PKC Contaminated Land Team does not hold records of any current or historical environmental problems at the Site or surrounding area.
- There are no known private water supplies within 500 m of the Site. However, it is known that PKC's records are incomplete so there may be supplies that PKC is unaware of.
- There are no known historical landfills within 500 m of the Site.
- There are no known areas of sensitivity in the vicinity of the Site.
- PKC is not aware of any further environmental information for the Site.

## 5. Environmental Setting

## 5.1 Published Geology

The following summary of the geology beneath the Site is based on a review of geological mapping available from the BGS Geoindex, published BGS 1:50,000 scale map Sheets 39W Stirling (dated 1974 and 1976), and the Groundsure Report (**Appendix C**). Extracts of the geological maps indicated above are presented below as **Figures 3** and **4**.

### 5.1.1 Artificial Ground

There are no BGS designated areas of made ground or artificial ground recorded within the Site or within the surrounding area.

Although no Made Ground is shown on published BGS mapping on the Site and within 1 km, localised Made Ground from the construction of the existing Braco West 275kV substation, associated pylon towers and buildings, and access roads and tracks may be present.

### 5.1.2 Natural Superficial Deposits

The Site is set within Strathallan, in the northern extant of the Scottish Central Lowlands / Midland Valley, approximately 11 km south of the Highland Boundary Fault. Regionally, the superficial geology is influenced by glaciation and a subsequent late (and rapid) deglaciation. As the ice retreated westwards from nearby Dunblane and Doune up the River Teith and River Forth valleys, a series of other glacial meltwater channels were formed, laying down significant deposits of outwash gravels<sup>22</sup>. The most significant deposits are to the south along the approximate route of the A9, though localised meltwater channels around the Site are shown on **Figure 3** below. Locally, more recent Quaternary Period superficial geology sits on top of the older glacial deposits forming peat across the Site and surrounding area. BGS Geoindex mapping indicates the presence of Peat across much of the Site, with a small area of Till within the southwest of the Site.

The southwest of the Site is indicated by BGS mapping to be underlain by natural superficial deposits of Peat, and a small area of Till. The immediate surrounding area of the Site comprises Alluvium (of Clay, Silt, Sand and Gravel) to the northwest and northeast, and Glacial Till (Till Devensian-Diamicton) to the north, east, south and west of the Site. This is also confirmed by the Groundsure Report (**Appendix C**).

The paper map in **Figure 3** below shows '*Peat*' across the Site. This is in general agreement with the Groundsure Report and BGS Geoindex.



#### Figure 3 Drift Geology

C6/02-CSL British Geological Survey © UKRI. All rights reserved.

<sup>&</sup>lt;sup>22</sup> Sourced from: '*The Geology of the Stirling District – Explanation of One-Inch Geological Sheet 39*'. The National Environment Research Council, published 1970.

#### 5.1.3 Solid Geology

Regionally, the Site is located at the northern extent of the Midland Valley of Scotland<sup>23</sup> and on the Strathmore syncline<sup>24</sup>. The mapped bedrock within the area is associated with the Strathmore Group.

Locally, published mapping shows the bedrock beneath the Site is recorded as the Teith Sandstone Formation (sandstone), and Cromlix Mudstone Formation (mudstone and siltstone) at approximately 160 m east and 650 m south of the Site, both are part of the Strathmore Group<sup>25</sup>.

The bedrock is disrupted by faults within 1 km of the Site. The faults are inferred and present at approximately 270 m southwest and 980 m south of the Site.

#### Figure 4 Solid Geology



C6/02-CSL British Geological Survey © UKRI. All rights reserved.

## 5.2 Historical Borehole Records

Historical borehole records available on the BGS Onshore Geoindex<sup>26</sup> have been reviewed on 24 June 2024 to provide an indication of the ground conditions on site. No borehole records were recorded on site. The nearest borehole record was present in the area of the existing substation (BGS Geoindex reference NN70NE9), to the immediate southeast of the Site; however, the borehole details of this record were not provided. Nine other borehole records were available for the wider surrounding area including; two boreholes located approximately 2.5 and 2.6 km south-west of the Site (BGS Geoindex ref. NNN70E8 - NN70NE2), four boreholes located at approximately 1.98 km northeast of the Site (NN81SW18, NN81SW19, NN81SW17, NN81SW16), one borehole located approximately 2.44 km south-east of the Site (BGS Geoindex ref. NN80NW19), and two borehole records located approximately 2.44 km south-east of the Site (BGS Geoindex ref. NN80NW1 and NN80NW21). Records of these are included in Appendix F.

The BGS historical borehole records encountered the following general sequence:

**Topsoil** - encountered between 0.0 m – 0.60 m<sup>27</sup> below ground level-(bgl):

Comprising black, and black and dark brown topsoil and subsoil (in NN80NW19, NN70NE8 and NN80NW21).

Peat – encountered between ground level and 0.30 m<sup>28</sup> bgl:

Comprising dark brown pseudo-fibrous peat with abundant small rootlets (in NN81SW16, NN81SW17, NN81SW18, NN81SW19).

Glaciofluvial Ice Contact Deposits (not present on-site) encountered between 0.60-5.00 m<sup>29</sup> bgl:

<sup>&</sup>lt;sup>23</sup> A specific geological area between the Highland Boundary Fault and the Southern Upland Fault which constitutes southern portion of Scotland between Glasgow and Edinburgh as well as surrounding areas. <sup>24</sup> Syncline with an axis roughly parallel to the Highland Boundary Fault (running approx. southwest to northeast) of Devonian

strata.

<sup>&</sup>lt;sup>25</sup> Geology names used are the current most up to date as supplied by the British Geological Survey, GeoIndex dataset.

<sup>&</sup>lt;sup>26</sup> GeoIndex – British Geological Survey (bgs.ac.uk)

<sup>&</sup>lt;sup>27</sup> Based on NN80NW21

<sup>&</sup>lt;sup>28</sup> Based on NN81SW19

<sup>&</sup>lt;sup>29</sup> Both based on NN70NE2

 Dense to very dense reddish brown silty clayey fine to coarse sand and gravel with frequent large cobbles and fragments of weak brown sandstone" (in NN80NW21)<sup>30</sup>.

**Devensian Till** (*potentially present on-site – underlying peat*) – encountered between 0.00m<sup>31</sup> – 8.53.30<sup>32</sup>m bgl:

- Clay, gravelly, sandy containing numerous fragments of weathered sandstone, firm, reddish brown (in NN80NW19)<sup>33</sup>;
- Clay, silty and sandy clasts of sandstone, mudstone and siltstone, reddish brown (in NN70NE8 and NN70NE2)<sup>34</sup>;
- Reddish brown slightly clayey gravelly very silty fine sand or dense reddish brown slightly clayey silty gravelly fine sand, with gravel of various natural lithologies (in NN81SW16, NN81SW17)<sup>35</sup>;
- Reddish brown slightly clayey gravelly very silty fine to medium sand with occasional cobbles of sandstone, gravel of various lithologies (in NN81SW18)<sup>19</sup>;
- Dense reddish brown slightly clayey slightly silty gravelly fine to medium sand with gravel of predominantly sandstone in (NN81SW19)<sup>19</sup>. and
- Red sandy clay and boulders and red sand and coarse gravel (in NN80NW1)<sup>19</sup>.

**Bedrock** – encountered between 2.20m<sup>36</sup> - 8.60m bgl<sup>37</sup>:

- Red sandstone (in NN80NW1);
- Siltstone, red, micaceous, fissile (in NN70NE2);
- Weathered red sandstone with very soft areas encountered (in NN81SW16, NN81SW17, NN81SW18 NN81SW19); and
- Weak thinly laminated to thinly bedded reddish brown sandstone with some thin laminations of siltstone.
   Fractures sub-horizontal (5 10 degrees) closely to very closely spaced, planar smooth and undulating smooth, tight to moderately open with some soft clay infill (in NN81SW16).

Made Ground was not encountered within historical borehole records which is consistent with historical land uses from the surrounding area.

Groundwater was encountered during the drilling of boreholes NN70NE2, NN70NE8, and NN80NW1, located approximately 2.60 km, 2.50 km and 2.46 km southeast of the Site respectively. Water strikes are recorded in NN70NE2 and NN70NE8 logs at 130.0 m bgl and 128.2 m bgl respectively. Additionally, borehole log NN80NW1 records the initial water strike depth to be 30ft (9.14m) below the well top, and the standing level of water inside the borehole to be 3ft (0.91m) below the well top, it is not recorded if the well top is flush with the ground or raised.

## 5.3 Mining and Quarrying

The Coal Authority website<sup>38</sup> reviewed on 25 June 2024, determined that the Site does not lie within a Coal Mining Reporting Area, also confirmed by the Groundsure Report (**Appendix C**).

The Groundsure report indicates three non-coal mining areas of vein mineral commodity-one on site, and at distances of 681 m north and 773 m east of the Site. The last two are well distanced from the Site and considered unlikely represent potential impacts to the Site from a contamination perspective.

The closest quarry 'The Carsemeg Wood' is located at approximately 1.51 km southeast of the Site. This quarry is for the commodity of sandstone and of 'ceased' status<sup>39</sup>.

<sup>&</sup>lt;sup>30</sup> The borehole log is shown on BGS to be underlain by Glaciofluvial Ice Contact Deposits

<sup>&</sup>lt;sup>31</sup> Based on NN80NW1

<sup>&</sup>lt;sup>32</sup> Based on NN70NE2

<sup>&</sup>lt;sup>33</sup> Classified by BGS log as Till

<sup>&</sup>lt;sup>34</sup> Classified by BGS log as Till

<sup>&</sup>lt;sup>35</sup> The borehole log is shown on BGS to be underlain by Till, however, this description is not typical of Glacial Till and could potentially comprise Glaciofluvial Ice Contact Deposits.

<sup>&</sup>lt;sup>36</sup> Based on NN81SW17

<sup>&</sup>lt;sup>37</sup> Based on NN70NE2

<sup>&</sup>lt;sup>38</sup> Interactive Map Viewer | Coal Authority (bgs.ac.uk)

<sup>&</sup>lt;sup>39</sup> AECOM Cambushinie 400Kv Substation Phase 1 Desk Study Report, February 2024

## 5.4 Hydrology

The SEPA Water Environment Hub<sup>40</sup>, the Groundsure report (**Appendix C**) and other publicly available sources have been reviewed to identify relevant hydrological features on-site and in the surrounding area. The hydrology of the area is summarised in **Table 2** below.

#### Table 2 Summary of On-site and Surrounding Area Hydrology

Feature	Distance & Direction*	Flow Direction	Description
Bullie Burn and associated tributaries	170m north	East	SEPA classify the Bullie Burn (SEPA ID: 4605) as having a water quality of 'High' in 2014, predicted to be 'High' in 2027, and having an overall condition of 'High'. No pressures affecting the overall condition were identified. It is sourced from around NN 76328 11041 and splits at NN 81122 10301 into the Kier Burn and Mill Burn (which are both 2 km downstream of the Proposed Development). These burns then enter Allan Water at NN 83471 07902 and NN 82746 07735 respectively.
Crocket Burn	760m southwest	Southeast	This is a tributary of the Muckle Burn, in which it flows at NN 79942 07950.
Froskin Burn	1km northwest	Southeast	This is a tributary of Bullie Burn, flowing into this one to the south.
Kier Burn	530mnortheast	Unknown	This burn enters Allan Water, southeast of the Site at NN 83471 07902.
Muckle Burn and associated tributaries	1km southwest	Southeast	SEPA classify the Muckle Burn (SEPA ID: 4604) as having a water quality of 'High' in 2014, predicted to be 'Good' in 2027, and having an overall condition of 'High'. No pressures affecting the overall condition were identified.
Feddal Burn	2.58km southeast	East	The Feddal Burn is identified as a ground surface water course, a lake, loch or reservoir, and as a manmade watercourse for water transfer <sup>41</sup> . Sourced around NN80000888, Feddal Burn flow roughly south through approximately four small lochans (largest 7,000 m2 in area). Feddal Burn eventually flows into Allan Water at NN82740773.
Mill Burn and associated tributaries	2.71km southeast	Northeast to southwest	The Mill Burn is identified as a ground surface water course and as a lake, loch or reservoir <sup>42</sup> . Flows from Bullie Burn at NN 81122 10300, flows south easterly to join Feddal Burn at NN 82309 08986 which then joins Allan Water at NN 82744 07730 south of site. Flows through three lochans (NN82451034, NN 82308 09236 and NN82020985) before joining Feddal Burn.
Allan Water	3.6km south	Southeast	Allan Water (SEPA ID: 6833) is the principal river in the Allan Water catchment area. SEPA classified it in 2014 as being in overall 'Poor' condition, predicted to be 'Poor' in 2021 and 'Good' in 2027.

\*All distance measured at closest point to site area.

## 5.5 Hydrogeology

Information from the Groundsure Report (**Appendix C**), BGS Onshore Geoindex<sup>43</sup>, Aquifer Productivity (Scotland) GIS datasets Version 2 Revised Report<sup>44</sup> and the Scotland's Aquifers and Groundwater Bodies Report<sup>45</sup> have been reviewed in relation to the aquifer classifications for superficial deposits and bedrock underlying the Site. These conclude that:

- The superficial deposits are not classified as a groundwater aquifer. This is also confirmed by the Groundsure report. However, the Groundsure report defines the superficial permeability on site as very low to high.
- According to BGS Geoindex, the bedrock deposits of the Strathmore Group is characterised as a Moderately Productive aquifer and described as sandstones, in places flaggy, with siltstones, mudstones, conglomerates

<sup>40</sup> https://www.sepa.org.uk/data-visualisation/water-environment-hub/

<sup>&</sup>lt;sup>41</sup> Definition From Groundsure Report ref GSIP-2024-14502-17022

<sup>&</sup>lt;sup>42</sup> Definition From Groundsure Report ref GSIP-2024-14502-17022

<sup>&</sup>lt;sup>43</sup> <u>GeoIndex – British Geological Survey (bgs.ac.uk)</u>

<sup>44</sup> BGS Report, single column layout (nerc.ac.uk)

<sup>&</sup>lt;sup>45</sup> OR15028.pdf (nerc.ac.uk)

and interbedded lavas, locally yielding moderate amounts of groundwater. The Groundsure report describes the flow as virtually all through fractures and other discontinuities with high permeability due to fractures in the bedrock.

Groundwater bodies are classified by SEPA under the Water Framework Directive, whereby water bodies in Scotland are classed as High, Good, Moderate, Poor, or Bad. A search of SEPA Water Environment Hub's<sup>46</sup> online database was conducted regarding the groundwater quality beneath the Site. Groundwater within the bedrock beneath the Site falls within the 'Dunblane' river basin district (SEPA ID: 150628) which classified the water quality as 'Good' and overall condition as 'Poor' in 2022.

Groundwater flow direction within the aquifer units will be influenced by the local topography, hence, groundwater is thought to flow either in a general southerly and south-easterly direction towards the Allan Water or flow north towards the Bullie Burn. However, the nature and extent of groundwater bodies within the area is unknown, as such no certainty can be placed on the existence or movement of possible groundwaters.

## 5.6 Flood Risks

The SEPA Flood Maps for planning website<sup>47</sup> was reviewed on 25 June 2024 to assess potential flood risks at the Site, which are summarised below:

- **River Flooding** the Site is not in an area of designated flood risk from river flooding, suggesting that the flood risk is <0.1% chance. This is also confirmed by the Groundsure Report (**Appendix C**).
- **Coastal Flooding** The Site is not at risk of coastal flooding. This is also confirmed by the Groundsure Report.
- Surface Water Flooding SEPA flood mapping indicates the Site is mainly at no specific risk from surface water flooding. This is also confirmed by the Groundsure Report (ref GS-BMC-5AI-LLZ-3UB). Additionally, some sporadic areas within the southeast and to the immediate southeast of the Site are at low to medium risk of surface water flooding. An area located at approximately 100 m southeast of the Site is shown as low to high risk from surface water flooding. However, the Groundsure report (ref GSIP-2024-14502-17022), indicates the Site to be at a low risk of flooding with a 1 in 1000-year flooding event having the potential to cause greater than 1.0 m of flooding.
- Groundwater Flooding The Groundsure Report indicates that the Site lies predominantly within an area of
  negligible risk of flooding from groundwater. A small section within the southwest of the Site lies in an area of
  low risk from groundwater flooding. SEPA does not provide information on groundwater flooding risk.

The above does not constitute a formal flood risk assessment, which is out with the scope of this study.

## 5.7 Radon

The UK Health Security Agency's UK Radon website<sup>48</sup> was reviewed on 24 June2024 to determine potential radon risks for the Site.

According to the website the Site is located within an area where the potential for radon is less than 1%. This is also confirmed by the Groundsure Report (**Appendix C**). It is therefore anticipated that radon protective measures will not be necessary should the construction of any new occupied buildings within the Site be undertaken (none are proposed currently).

## 5.8 Environmental Designated Sites and Listed Buildings

The NatureScot Viewer<sup>49</sup> "Sitelink", was used on 16 February 2024 to identify environmental designated sites.

The database indicated that there are no recorded sensitive sites including Sites of Special Scientific Interest (SSSIs), Conserved Wetland Sites (Ramsar Sites), Special Areas of Conservation (SAC), Special Protection Areas (SPAs), National Nature Reserves (NNR), Local Nature Reserves (LNR), or Forest Parks within the development boundary or within 1km, which was confirmed as part of a review of the Groundsure Report (**Appendix C**).

<sup>&</sup>lt;sup>46</sup> https://www.sepa.org.uk/data-visualisation/water-environment-hub/

<sup>47</sup> https://map.sepa.org.uk/floodmaps/FloodRisk/Search

<sup>48</sup> https://www.ukradon.org/information/ukmaps

<sup>49</sup> SiteLink (nature.scot)

PASTMAP interactive mapping service<sup>50</sup>, which provides access to the databases of Historic Environment Scotland (HES), and the Groundsure report were consulted regarding sites of potential historical and/or archaeological significance, and none were recorded within 1km of the Site.

## 5.9 Unexploded Ordnance

To assess the potential risks from Unexploded Ordnance (UXO) at the Site, the Zetica Unexploded Bomb Risk Map<sup>51</sup> was used on 20 February 2024. The Map indicated a Low risk for the Site and surrounding area, which is defined by Zetica as an '*area indicated as having 15 bombs per 1000 acres or less*'.

A Zetica Pre-Desk Study Assessment (PDSA) has identified WWII military activities on or affecting the Site, which are presented in **Table 3** below. It is recommended that a detailed desk study is commissioned to assess, and potentially zone, the Unexploded Ordnance (UXO) hazard level on the Site. Risks appear to relate to the use of the nearby areas for live fire training during and post-World War 2. The extended assessment is in **Appendix G**.

Table 3 Summary of WWII Military Activities On or Affecting the Si	ies On or Affecting the Site
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Date	On or Affecting the Site
Pre-WWI Military Activity	
WWI Military Activity	None Identified
WWI Bombing	-
WWII Military Activity on or Affecting the Site	During WWII, military training is known to have taken place throughout rural areas of Scotland. By 1940, the Corry Our Range had been established in a wide area surrounding Glen Artney, approximately 0.8 km north of the Site. Records indicate it was used for artillery training, with armoured vehicles and field guns in Glen Artney directing fire over the Site towards Sheriffmuir, approximately 6.5km southeast of the Site. By 1945, the range was disused and the land de-requisitioned.
WWII Bombing	During WWII the Site was located in the Landward Area (LA) of Perth, which officially recorded 171No. High Explosive (HE) bombs with a bombing density of 1.1 bombs per 405 hectares (ha). No readily available records have been found to indicate that the Site was bombed.
Post-WWII Military Activity on or Affecting the Site	Readily available records have been found to indicate that post-WWII training took place in the vicinity of Glen Artney, in the vicinity of the Site.

## 5.10 Soil Classification

The National Soil Map of Scotland<sup>52</sup> was reviewed on 25 June 2024 to determine the soil type on site and within the surrounding area. The soil association on site is 'Organic Soils' with the soil group classed as 'Blanket peats' and the major soil subgroup classed as 'Dystrophic blanket peat', located within the east, south and west and to the immediate north of the Site. Additionally, 'Balwornie' soil association with the soil group classed as 'Podzols' and the major subgroup as 'Peaty gleyed podzols' is present within the centre, north, southwest and to the immediate south and northeast of the Site. Localised areas, of soil association 'Balwornie' with the soil group 'gleys' and subgroup 'Noncalcareous gleys' are located at approximately 510 m southeast, and 740 m-780 m southwest of the Site. The soil association 'Alluvial Soils' with the soil group classed as 'Alluvial soils and undifferentiated alluvial soils' is localised at approximately 120 m northeast and 700 m southwest of the Site. The soil association 'Balwornie' with the soil group classed as 'Brown Soils' and subgroup 'Brown Earths' is located within 1 km south of the Site.

Areas of carbon-rich soil, deep peat and peatland habitats are mapped by NatureScot<sup>53</sup>. The top two classes, 1 and 2, taken together identify the nationally important resource. The classes are defined as follows:

Class 1: Nationally important carbon-rich soils, deep peat and priority peatland habitat, areas likely to be of high conservation value.

<sup>&</sup>lt;sup>50</sup> Historic Environment Scotland Pastmap (2023)

<sup>&</sup>lt;sup>51</sup> Risk Maps | Zetica UXO

<sup>&</sup>lt;sup>52</sup> UK Soil Observatory (bgs.ac.uk)

<sup>53</sup> Map | Scotland's environment web

• **Class 2:** Nationally important carbon-rich soils, deep peat and priority peatland habitat, areas of potentially high conservation value and restoration potential.

No areas of Class 1 or Class 2 soils are present on-site or in the immediate surrounding area. Soils across the Site and surrounding area are classed as Class 4 & 5. Areas of class 0 are shown at approximately 120 m northeast and 410 m southeast of the Site.

## 5.11 Regulatory Database Review

This section presents a summary of current and historical regulatory database entries included within the Groundsure Report (**Appendix C**) pertaining to the Site and surrounding land within 250 m which could result in soil and groundwater contamination.

Generally, sites with regulated processes, registered radioactive substances, licensed waste management facilities and landfills, hazardous substances, fuel station entries and selected contemporary trade directory entries within 250 m of the Site, could, depending upon the nature of their activities, represent potential sources of contamination.

#### Table 4 Summary of Regulatory Database and Records Review

Data Type	Onsite	Within 250m
Historical Industrial Land Uses	None Recorded	None Recorded
Recent Industrial Land Uses	The four pylon towers and the existing Braco West substation are listed as Electrical Features under the category Infrastructure and Facilities.	
Gas Pipelines	None Recorded	None Recorded
Electricity Cables	None Recorded	None Recorded
British Pits	None Recorded	None Recorded
Surface Ground Workings	None Recorded	None Recorded
Pollution Inventory Substances, Inventory Waste Transfers and Inventory Radioactive Waste	None Recorded	None Recorded
Control of Major Accidents Hazards Sites (COMAH)	None Recorded	None Recorded
Regulated Explosive Sites	None Recorded	None Recorded
Hazardous Substance Storage/Usage	None Recorded	None Recorded
Part A (1) IPPC and Historic IPC Authorisations	None Recorded	None Recorded
Part B Authorisations	None Recorded	None Recorded
Historical Tanks	None Recorded	None Recorded
Historical energy features	None Recorded	None Recorded
Historical/Current petrol stations and garages	None Recorded	None Recorded
Registered Landfill or Historical BGS Recorded Landfill Sites	None Recorded	None Recorded
Licensed Waste Management Facilities	None Recorded	None Recorded

Data Type	Onsite	Within 250m
Historical Waste Sites	None Recorded	None Recorded
Contaminated Land	None Recorded	None Recorded
Current or Recent Petrol Stations	None Recorded	None Recorded

## 6. Preliminary Conceptual Site Model

## 6.1 General

The approach adopted by AECOM in order to assess risk associated with land contamination is in line with the Scottish Government's approach outlined in Planning Advice Note (PAN) 33 Development of Contaminated Land. The Government considers that the most appropriate approach is a 'suitable for use' one in which risks to human health and the wider environment are assessed within the context of the current or proposed use of the land in question.

The risk assessment described below follows the methodology set out in the Environment Agency's Land Contamination Risk Management (LCRM) guidance which was published in October 2020 and updated in 2023. The LCRM guidance has now replaced the earlier Model Procedures for the Management of Land Contamination (CLR11), which has been withdrawn. AECOM understands that at the time of writing, SEPA has not yet formally made its position clear on the published LCRM guidance. However, given that the methodology in the LCRM guidance is essentially the same as that in CLR11, the key difference being some of the terminology used, AECOM has adopted the more recent guidance in this assessment.

The basic approach to risk assessment, as followed in this report, involves four steps:

- Hazard Identification establishing contaminant sources, pathways and receptors (the conceptual site model);
- **Hazard Assessment** analysing the potential for unacceptable risks (what contaminant linkages could be present, what the effects could be);
- **Risk Estimation** aiming to establish the magnitude and probability of the possible consequences (what degree of harm might result and to what receptors, and how likely is it); and
- **Risk Evaluation** evaluating whether the predicted risk is unacceptable.

The LCRM guidance provides the following staged approach to aid the management of land contamination:

- Stage 1: Risk Assessment;
- Stage 2: Options Appraisal; and
- Stage 3: Remediation.

This assessment undertakes only the Stage 1 Risk Assessment, which LCRM guidance presents as three tiers:

- Preliminary Risk Assessment (Tier 1);
- Generic Quantitative Risk Assessment (GQRA) (Tier 2); and
- Detailed Quantitative Risk Assessment (DQRA) (Tier 3).

This report has been provided to meet the requirements for a Preliminary Risk Assessment (Tier 1).

The methodology adopted is described in detail in LCRM and relies on the development of a site-specific conceptual site model (CSM) consisting of contaminant linkages. A contaminant linkage requires three components:

- A source of contamination, for example due to historical site operations;
- A pathway, a route by which receptors can become exposed to contaminants. Examples include vapour inhalation, soil ingestion and groundwater migration; and
- A receptor, a target that may be exposed to contaminants via the identified pathways. Examples include human occupiers / users of the Site, the water environment, property or ecosystems.

For a potential risk to either environmental and / or human receptors to exist, a plausible contaminant linkage involving each of these components must exist. If one of the components is absent then a contaminant linkage, and thereby potentially unacceptable risk, is also unlikely to exist. Where all three components are present, a potentially complete contaminant linkage can be considered to exist. This does not automatically imply the presence of unacceptable risk, but that further investigation of the potential contaminant linkage is required.

## 6.2 **Preliminary Conceptual Site Model**

The preliminary CSM has been developed to identify potentially complete contaminant linkages that may require further investigation to assess their existence and/ or potential significance. The potential sources of contamination on or in the vicinity of the Site, receptors on or near the Site, and pathways on or near the Site are discussed within the following sub-sections.

The preliminary CSM assesses the potential risks/ liabilities and constraints associated with the Site in its current condition, prior to any proposed redevelopment. Risks associated with the proposed re-development have also been assessed based on expected environmental and ecological sensitivity in line with the planning application and development description.

#### 6.2.1 Potential Sources of Contamination

This section uses the information described in earlier sections of this report to identify potential sources of contamination on and within 250 m of the Site.

It should be noted that the historical use of the Site and surrounding area has presented limited potential for significant contamination to be present, soil and groundwater contamination within the Site or close proximity is considered unlikely, and should any minor contamination exist it is unlikely to represent an impact due to the absence of receptors.

#### Table 5. Potential Sources of On-site Contamination

Potential On-site Source	Potential Contaminants	Area On-site Affected	Current/ Historical
Potential Made Ground associated with construction of the of the existing pylon towers, the existing Braco West 275kV substation, and access tracks.	Metals and inorganic compounds, pH, Polycyclic aromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPH) including benzene, toluene, ethylbenzene, xylene (BTEX) and methyl-tert-butyl-ether (MTBE), SVOCs, VOCs, sulphates, sulphides, phenols, explosive residues.	Pylon towers and existing OHL within the west, centre and east of the Site. Access tracks passing through the Site.	Current and Historical
Existing electricity Braco West 275kV Substation	Contaminants may include, chlorinated aromatic hydrocarbons and heavy metals, sulphates.	Substation within the northeast of the Site	Current and Historical
Car Park associated with the existing substation	Mineral Oils, PAHs, TPH including BTEX and MTBE	Associated with the substation located within the northeast of the Site	Current and Historical
Road and access forestry tracks (hard standing within the substation's car park)	РАН, ТРН	Access forestry gravel tracks passing through the Site. Car park within the northeast of the Site.	Current and Historical

#### Table 6. Potential Sources of Off-site Contamination (within 250m of proposed re-development area)

Potential Off-site Source	Potential Contaminants	Area Off-site Affected	Current/ Historical
Potential Made Ground associated with access roads and tracks.	Metals and inorganic compounds, pH, PAHs, TPH including BTEX and MTBE, SVOCs, VOCs, sulphates, sulphides, phenols.	Access roads and tracks across the Site.	Current and Historical
Road and Access tracks	РАН, ТРН	To the north, east, south and west of the Site.	Current and Historical

#### 6.2.2 Potential Receptors

The following potential receptors for contamination have been identified:

#### Table 7. Potential Receptors

Receptor	Description
Human Health	<ul><li>Current and future site users, i.e. visitors to site and substation engineers.</li><li>Future on-site construction and maintenance workers.</li></ul>
The Water Environment	<ul> <li>Bullie, Crocket, Froskin, Keir and Muckle Burns draining into the Allan Water.</li> <li>Groundwater within the underlying bedrock aquifer (Strathmore Group moderate-high permeability strata, moderately productive aquifer).</li> </ul>
The Built Environment	<ul> <li>In future developments including concrete foundations of any Proposed Development.</li> </ul>

#### 6.2.3 Potential Pathways

Potential pathways have been identified, which could link the potential sources with the potential receptors. These pathways are discussed by receptor type below in consideration of the Proposed Development of the Site.

#### **Table 8. Potential Pathways**

Pathway	Description				
Human Health	<ul> <li>Industrial land users (current site users) and future on-site workers by direct contact and ingestion of contaminated soil, dust and / or groundwater, inhalation of windblown dust.</li> <li>presence of airborne dust may be exacerbated by demolition of existing structures and construction work.</li> </ul>				
The Water Environment	<ul> <li>Groundwater within the superficial deposits by leaching and migration of contaminants via shallow Made Ground (if any) and natural superficial deposits;</li> </ul>				
	<ul> <li>Groundwater within the bedrock aquifer by leaching and migration of contaminants via shallow Made Ground (if any) and natural superficial deposits;</li> </ul>				
	<ul> <li>Surface water via surface water run-off, and lateral migration of contaminants via shallow deposits and service runs; and</li> </ul>				
	Surface water by migration of contaminants via groundwater.				
The Built Environment	<ul> <li>Concrete construction materials by direct contact with contaminated soil and groundwater (e.g. hydrocarbons) and aggressive ground conditions (pH and sulphate);</li> </ul>				
	Direct contact of contaminated groundwater.				

## 6.2.4 Discounted Sources / Pathways / Receptors

The following sources, pathways and receptors are discounted from the conceptual site model with the justification presented:

Sources (on-site/off-site):

- Polychlorinated biphenyls (PCBs) discounted as Braco West 275kV substation constructed post-2010 after use of PCBs had been banned.
- Nearby forestry use is generally not considered as a likely source of contamination, given the periodic machinery use only.
- The Site is predominantly greenfield (with the exception of the small area within the existing substation) with no past historical construction, no asbestos is anticipated<sup>54</sup>. Moreover, any buildings built after 2000 (such as the existing substation) are not expected to have asbestos<sup>55</sup>.

Receptors:

- Groundwater within the Peat (onsite) -There is no recorded aquifer within the natural deposits, according to SEPA WAT-PS-10-Annex 2<sup>56</sup>, peat is therefore not considered as a groundwater aquifer.
- Off-site third-party land users There are no occupied buildings within 1km of the Site (with the exception of the existing Braco West Substation, only periodically manned).
- Public Water Supply None present within 500 m of the Site.

<sup>&</sup>lt;sup>54</sup> Geo-Environmental Desk Study LT520-Braco West Substation SSEN, October 2023

<sup>55</sup> Asbestos: general information - GOV.UK (www.gov.uk)

<sup>&</sup>lt;sup>56</sup> WAT-PS-10-01 (sepa.org.uk)

- Sensitive Ecological Sites No sensitive ecological sites have been identified within 1km of the Site. The soils on site and in the immediate vicinity of the Site are not classed as nationally important or as a priority habitat.
- Archaeological Receptors No archaeological features have been identified within 1km of the Site.

#### 6.2.5 Qualitative Assessment of Source-Pathway-Receptor

Based on the information provided in this report, the following preliminary risk assessment tables have been formulated, with each identifying possible contaminants and contaminant linkages in the context of the current and Proposed Development.

At this stage, a qualitative risk assessment has been undertaken for these potential source-pathway-receptor linkages based on current DEFRA (Guidelines for Environmental Risk Assessment and Management)<sup>57</sup>, CIRIA C552<sup>58</sup>, and the Guidance for the Safe Development of Housing on Land Affected by Contamination<sup>59</sup> see **Appendix H**.

It must be noted that the following assessment is based solely on desktop study information and will require revision following any recommended intrusive site investigation works. The following assessment is based on consideration of both:

- The **likelihood** of an event (probability takes into account both the presence of the hazard and receptor and the integrity of the pathway); and
- The **severity** of the potential consequence (takes into account both the potential severity of the hazard and the sensitivity of the receptor).

The risks associated with potential on and off-site contaminants identified are detailed in the **Table 9** below. The risk matrix colour coding is presented in **Appendix H**:

<sup>&</sup>lt;sup>57</sup> Guidelines for Environmental Risk Assessment and Management - Green Leaves III (publishing.service.gov.uk)

<sup>&</sup>lt;sup>58</sup> CIRIA C552 Contaminated land risk assessment, guide to good practice, 2001 (<u>c552 (ciria.org)</u>)

<sup>&</sup>lt;sup>59</sup> R&D66 VOL 1 Guidance for the Safe Development of Housing on Land Affected by Contamination (nhbc.co.uk)

#### Table 9. Summary of Preliminary CSM and Risk Assessment

Source	Receptor		Exposure Pathway	Probability	Consequence	Risk Category	Justification	
On-site Contamination sources including Made Ground associated with construction of the existing pylon towers, the existing Braco West 275kV substation and access tracks. Possible on- site contamination from car parking.	Human Health – On-site	Current site users and the general public post development	Dermal contact with and ingestion of contaminants in soil, soil-derived dust and water. Inhalation of contaminants in soil- derived dust.	Unlikely	Medium	Low Risk	The 2023 ground investigation recorded Made Ground from surface up to maximum depth of 0.70m bgl in two trial pits (TP21 and TP23), located off-site within the area of the	
		Construction / Maintenance Workers	Dermal contact with and ingestion of contaminants in soil, soil-derived dust and water. Inhalation of ground gas, and contaminants in soil-derived dust.	Low Likelihood	Medium	Moderate/Low Risk	proposed substation and UGC. Whilst Made Ground has not been identified in ground investigation, isolated pockets being present cannot be entirely discounted. Contamination from the existing substation and car park is possible, this is considered less likely due to the modern (managed) operation of the substation. The likely limited potential for contamination significantly reduces risks to site users in future. Due to the nature of the Site, limited public access is expected and members of the public are unlikely to spend significant amounts of time at the Site, given its remote location. In addition, the use of appropriate PPE, good hygiene practice and adherence to construction health and safety legislation should mitigate against potential for exposure to construction workers	
	Water Environment- On-site and Off-site		Leaching of contaminants in the unsaturated zone to groundwater in underlying aquifers.	Unlikely	Medium	Low Risk	The 2023 Ground Investigation trial pits record groundwater strikes between 1.20m bgl and 2.00m bgl within bedrock and	
		Water Environment-Bedrock / On-site and Off-site	Bedrock Aquifer	Migration of contaminated water through preferential pathways such as underground services, pipes and granular material to groundwater in underlying aquifers.	Unlikely	Medium	Low Risk	superficial deposits. The likely limited extent of Made Ground and limited contaminative historical land uses further decreases the risk to groundwater. The presence of lower permeability superficial deposits may limit the potential for vertical migration of contamination to the bedrock aquifer, further reducing the probability.

Source	Receptor		Exposure Pathway	Probability	Consequence	Risk Category	Justification
		Surface Water	Lateral migration of contaminated groundwater with discharge to surface watercourses as base flow.	Unlikely	Medium	Low Risk	Due to the presence of peat deposits and free draining soils, and the topography of the Site, the risk to surface water features via shallow deposits and/or surface run-off cannot be entirely discounted. Bullie Burn (closest water body) is at approximately 170 m north of the Site, entrained surface runoff migration is possible, but unlikely.
	Features inc. Bullie and Muckle Burns, Superficial peat deposits, and streams	Discharge of contaminants entrained in surface water run-off followed by overland flow and discharge.	Unlikely	Medium	Low Risk	Three culverts are located at approximately 500 m southeast of the Site, and which drain into the Bullie Burn. However, there is limited potential for contamination to be present on site, reducing risks. Contamination migration via granular superficial deposits is possible, though the low likelihood of potential contamination presence sources reduces risks. Plus, as superficial groundwater bodies are expected to be limited in the immediate surrounding area, the risk of groundwater contaminants via lateral migration is low.	
	The Built Environment	Existing and future structures,	Direct contact of contaminants in soil and/or groundwater	Unlikely	Mild	Very Low Risk	Whilst risks cannot be entirely discounted, potential impacts are considered unlikely due to the isolated location of the Site and the general low level of development of the surrounding area. In addition, risks to buried concrete can be effectively managed via relatively low cost engineering solutions, if required.
Off-site contamination sources including off- site made ground associated with access roads and tracks.	Human Health – On-site	Site users post development	Dermal contact with and ingestion of contaminants in soil, soil-derived dust and water.	Unlikely	Medium	Low Risk	Off-site contamination from off-site areas of the existing substation is possible, though the relatively modern construction and
		Construction / Maintenance Workers	Dermal contact with and ingestion of contaminants in soil, soil-derived dust and water. Inhalation of ground gas, and contaminants in soil-derived dust.	Unlikely	Medium	Low Risk	management procedures reduce risks. Risks to construction workers will be managed via adherence to health and safety legislation and regulations.
	The Built Environment	Existing and future structures	Direct contact of contaminants in soil and/or groundwater	Unlikely	Mild	Very Low Risk	Whilst risks cannot be entirely discounted, potential impacts can be managed by relatively inexpensive engineered mitigation measures for a small site of this nature.

## 7. Conclusions and Recommendations

## 7.1 Conclusions

Potential sources of contamination within the Site are considered limited and relate to Made Ground associated with the existing pylon towers, existing substation, and access tracks. The existing substation includes a car park, which could also be a potential source of contamination. Made Ground is also expected to be present in the offsite access roads/tracks and unlikely to be present elsewhere across the Site or surrounding area.

Contamination from the existing substation and associated car park, and within the Made Ground could pose potential risks to human health, the water environment and the built environment if present, but it is considered to be unlikely. There is potential for contaminants to migrate off-site via surface water run-off and transportation through granular and organic soils. However, given the likely limited extent of contaminant sources, it is unlikely to represent a significant impact.

The Proposed Development comprising construction of pylon towers on a greenfield site and temporary construction works reduces potential impacts to both on-site and off-site human health, and environmental receptors as the proposed works are limited. Furthermore, the Site being on greenfield land with no past construction history severely limits the potential of asbestos fibres. The removal of roads and hardstanding surfaces could result in potential risk, but this is only temporary and so considered as low risk. Risk to human health is considered low as the Site will have limited access to the public and any workers/staff on site will wear appropriate PPE and health & safety trained prior to any works being undertaken. Surface water receptors are considered to be the most sensitive receptors in the vicinity of the Site, with granular superficial geology potentially enabling migration of contamination (if present) to surface water features.

Based on the available desk study information and the proposed highway development, the Site is classified overall as having a **Low risk** with respect to contaminated land.

## 7.2 Recommendations

The Geo-environmental Desk Study has not identified unacceptable risks in accordance with Land Contamination Risk Management guidance at the Site. However, it is possible that risks to human health and the water environment receptors are present on-site without having been recorded or reported. It is recommended that the following further work / assessment is undertaken to constrain potential risks and liabilities:

- Undertake an Environmental Appraisal (EA) report including the findings of this report, to assess the potential effects that the proposed construction may have on the natural environment.
- Submission of this report to the Perth & Kinross Council Contaminated Land Officer to obtain their approval of the report's findings.

Furthermore, the scope of the Geo-environmental Desk Study has provided a preliminary characterisation of the Site's risk profile. However, as with all desk-based studies there is a degree of uncertainty associated with them. In addition, as with any site there may be localised differences in Made Ground thicknesses, the presence of obstructions and physical or chemical composition, and unrecorded surface or ground disruptions and site activities. It is recommended that the client and their construction contractors have an unexpected contamination strategy in place throughout the construction of the Proposed Development. If contamination is identified at any point during construction work, then contact should be made with a suitably competent environmental consultant for further risk assessment to be undertaken.

## **Appendix A – Figures and Drawings**

## **Appendix B – Site Photographs**

## **Appendix C - Groundsure Report**

# Appendix D – Existing Information Review

## Appendix E - Local Authority Consultation

## **Appendix F – BGS Borehole Records**

## Appendix G – UXO Pre-Desk Study Assessment (PDSA)

## Appendix H - Approach to Risk Assessment

## **Risk Assessment Principles**

Current best practice recommends that the determination of hazards arising from contaminated land is based on the principle of risk assessment, as outlined in the Environment Agency guidance in Land Contamination Risk Management (LCRM) guidance.

For a risk to be present, there must be a viable contaminant linkage; i.e. a mechanism whereby a source impacts on a sensitive receptor via a pathway.

Assessments of risks associated with each of these contaminant linkages are discussed in the following sections.

Using criteria broadly based on those presented in the National House Building Council/Environment Agency/Chartered Institute of Environmental Health publication R&D 66 (NHBC/EA/CIEH, 2008), the magnitude of the risk associated with potential contamination at the Site has been assessed. To do this an estimate is made of:

- The magnitude of the potential consequence (i.e. severity);
- The magnitude of probability (i.e. likelihood).

The severity of the risk is classified according to the criteria in the table below.

#### **Description of Severity of Risk**

Term	Description				
Severe	<ul> <li>Highly elevated concentrations likely to result in significant harm to human health.</li> <li>Catastrophic damage to crops, buildings or property (e.g. by explosion).</li> <li>Equivalent to EA Category 1 pollution incident including persistent and/or extensive effects of water quality.</li> <li>Major damage to aquatic or other ecosystems.</li> </ul>				
Medium	<ul> <li>Elevated concentrations which could result in significant harm to human health.</li> <li>Significant damage to crops, buildings or property (e.g. damage to building rendering it unsafe).</li> <li>Equivalent to EA Category 2 pollution incident including significant effect on water quality.</li> <li>Significant damage to aquatic or other ecosystems.</li> </ul>				
Mild	<ul> <li>Exposure to human health unlikely to lead to significant harm.</li> <li>Minor damage to crops, buildings or property (e.g. surface spalling to concrete).</li> <li>Equivalent to EA Category 3 pollution incident including minimal or short-lived effect on water quality.</li> <li>Minor or short-lived damage to aquatic or other ecosystems.</li> </ul>				
Minor	<ul> <li>No measurable effect on humans.</li> <li>Repairable effects of damage to buildings, structures and services.</li> <li>Equivalent to insubstantial pollution incident with no observed effect on water quality of ecosystems.</li> </ul>				

The probability of the risk occurring is classified according to the criteria in the table below.

#### Likelihood of Risk Occurrence

Likelihood	Explanation
High	Contaminant linkage may be present that appears very likely in the short-term and risk is almost certain to occur in the long term, or there is evidence of harm to the receptor.
Likely	Contaminant linkage may be present, and it is probable that the risk will occur over the long term.
Low	Contaminant linkage may be present and there is a possibility of the risk occurring, although there is no certainty that it will do so.
Unlikely	Contaminant linkage may be present but the circumstances under which harm would occur even in the long- term are improbable.

An overall evaluation of the level of risk is gained from a comparison of the severity and probability, as shown below.

#### Risk based on Comparison of Likelihood and Severity

		Severity					
		SEVERE	MEDIUM	MILD	MINOR		
Likelihood	HIGH	Very High	High	Moderate	Low		
	LIKELY	High	Moderate	Moderate/Low	Low		
	LOW	Moderate	Moderate/Low	Low	Very Low		
	UNLIKELY	Moderate/Low	Low	Very Low	Very Low		

