

# Hydrogeological Impact Assessment to support an application for a groundwater transfer licence and associated discharge consent

Penrhos 132kV Cable Replacement

Morgan Sindall

794-ENV-GDE-  
21696  
HIA  
V1  
07/11/2025

# REPORT

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## Approval for issue

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Prepared by:

**Tetra Tech RPS**

Tenzin Phuntsok

Graduate Hydrogeologist

90 Victoria Street

Bristol

BS1 6DP

**T** +44 7443657557

**E** ganden.phuntsok@tetrattech.com

Prepared for:

**Company name**

Laura Ward

Senior Environmental Advisor

Pentir Sub Station

Pentir

**T** Click or tap here to enter text.

**E** Laura.Ward@morgansindall.com

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## 1 Introduction

### 1.1 Scope of works & project overview

- 1.1.1 The project, which is being executed by the Client, Morgan Sindall, on behalf of National Grid, involves the construction of a new substation at Penrhos and the replacement of a buried electrical cable along a 3km route from Penrhos substation, Holyhead (E:226890, N:380639) to Tower EV86 (E:229387, N:379839) in Anglesey, North Wales.
- 1.1.2 Replacement of the buried cable will require excavations dug to 1.5mbgl at 20m intervals along the cable route. The cable replacement works include two options for deviation from the existing corridor to avoid existing constraints on site access.
- 1.1.3 This Hydrogeological Impact Assessment (HIA) is intended to support the application for a groundwater transfer licence and its associated discharge consent.

### 1.2 Objectives

- 1.2.1 The objective of this HIA is to support the abstraction licence and discharge consent applications submitted to NRW on the 8<sup>th</sup> and 9<sup>th</sup> of May respectively.
- 1.2.2 This HIA aims to:
- Build upon the previous Desk Study and Risk Assessment submitted, using ground investigation (GI) data to improve the previous conceptual site model (CSM).
  - Identify and quantify the hydrogeological risks of the project via an evidence-based approach.

### 1.3 Assessment area

- 1.3.1 The Penrhos 132 kV Cable Replacement Project area, hereafter referred to as the Study Area includes:
- The area of land to be temporarily or permanently occupied during the construction, operations and maintenance and decommissioning of the project.
  - Geological and hydrogeological receptors within 1km of the red line boundary. The 1km buffer was selected for the Study Area as potential impacts on hydrogeological receptors are likely to occur within this distance. Potential impacts on geological receptors may occur within a shorter distance, however a conservative approach has been followed, and a consistent buffer has been applied for all receptors.
- 1.3.2 The Study Area is shown in Figure 1-1. This area will be reviewed and modified in response to any alterations made to the cable corridor during the detailed design process. The red line boundary for the Penrhos 132 kV Cable Replacement Project encompasses two distinct areas:
- The Penrhos Substation which occupies part of the former Anglesey Aluminium Metals (AAM) Works at Penrhos, on Holyhead Island. The substation is a site of historic groundwater contamination following a transformer fire in 2008. Post remediation groundwater monitoring performed by LK Consult Ltd in 2021 exhibited a 100% reduction of the contaminants of concern and concluded the remedial aims had been met. The post remediation monitoring report is provided in Appendix A.
  - The cable corridor, measuring approximately 5 metres wide running from the Penrhos Substation, across Stanley Embankment to the point of grid connection at Tower EV86. The alignment of the corridor follows the trajectory of the existing buried cables that require replacement.

### 1.4 Proposed construction activities

1.4.1 Proposed construction activities to be undertaken by the scheme are summarised as follows:

- Construction a new substation compound occupying an area of approximately 4,360 m<sup>2</sup> upon the site of the old rectifier yard at Penrhos. Installation of foundations will entail excavation to depths of 1.5 mbgl in this area. The footprint of the new substation compound is shown in Figure 1-1.
- Construction of two transmission circuits to connect the new substation at Penrhos to the grid at Tower EV86 on Anglesey Island. This will entail open trenching to a depth of 1.5 mbgl on landwards sections of the proposed cable corridor, in successively adjacent lengths not exceeding 20 metres at a time, to facilitate the following:
  - Removal of existing oil-filled cables along the proposed cable corridor alignment
  - Installation of two new 132kV transmission circuits at a depth of approximately 1 mbgl.
  - Replacement of existing ducted cables along Stanley Embankment which exist in pre-cast concrete troughs measuring approximately 0.6m wide by 0.4m deep.

### 1.5 Ground investigation

1.5.1 A ground investigation was undertaken by CC Ground Investigations Ltd to give site-specific information of the Study Area.

1.5.2 Eighty-seven exploratory boreholes were carried out in the Study Area between the 3rd April to 15th May 2025. The Factual Report outlining all borehole locations and logs is appended in Appendix B.

1.5.3 Post-drilling groundwater monitoring was conducted by WSP and the data collected over all six monitoring rounds is found in Appendix C.

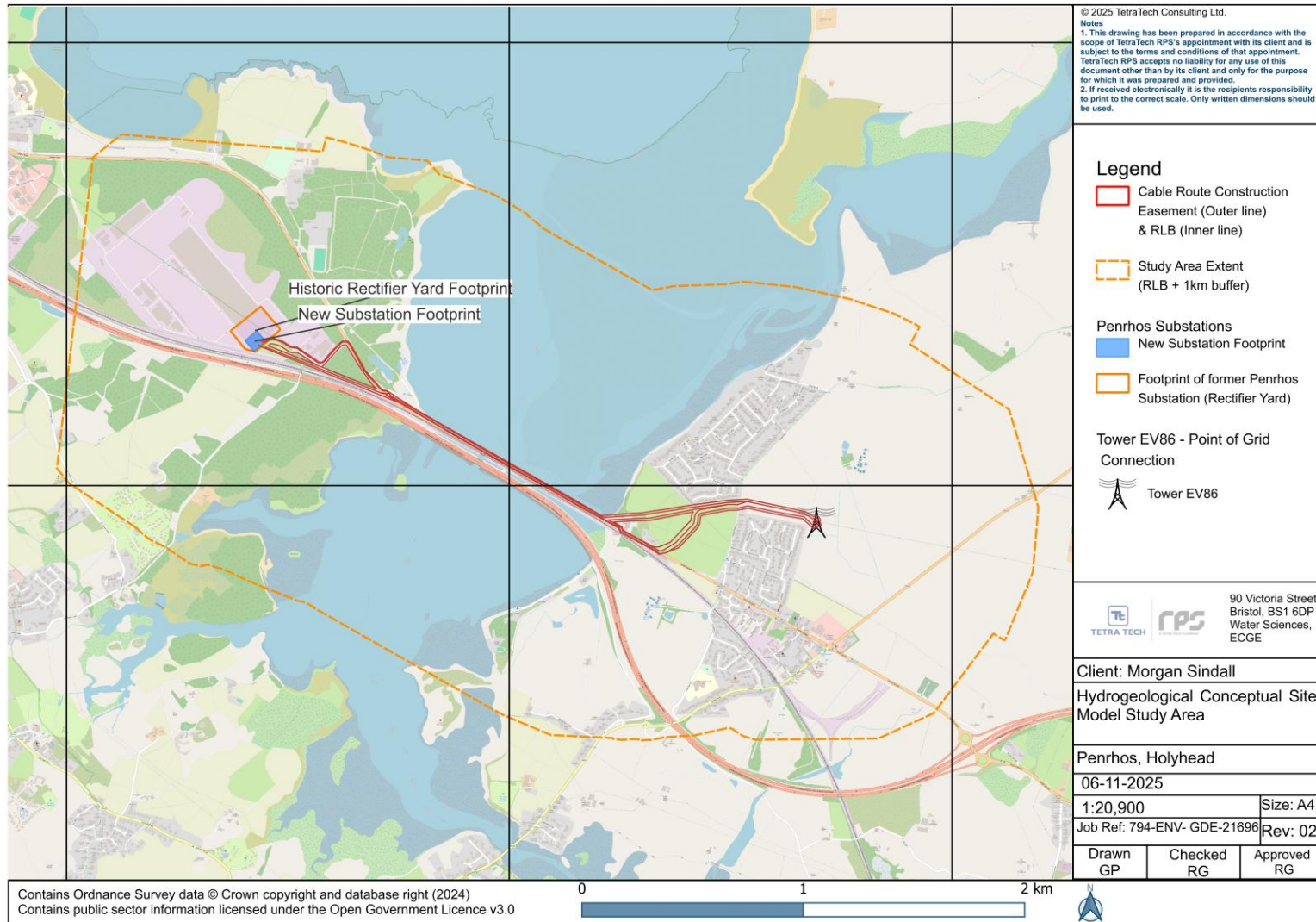
1.5.4 This report references any pertinent information from the Factual Report and groundwater monitoring data.

### 1.6 Ground and surface water management

1.6.1 All trench dewatering will be carried out according to the Client's Water Management System (document reference E STD 10, Appendix D) and Protection of Controlled Waters guidance document (document reference E GUID 10, Appendix E).

1.6.2 These include but are not limited to general control measures such as:

- Discharge of pumping out of excavations at least 10 metres away from a watercourses;
- If direct discharge to a watercourse or road gully, using settlement systems or filtering devices to reduce suspended solid loading;
- Setting up stores on the highest ground within a site and away from watercourses, typically at least 10 metres;
- Using silt traps, fences straw bales or grips to control runoff with high suspended solid loads;
- Containing contaminated materials in a dedicated areas prior to disposal; and
- Monitoring abstractions to ensure compliance with approvals.



**Figure 1-1: The Study Area showing Penrhos substation and the Cable Route Construction Easement. The Study Area extent has been defined by a 1km buffer.**

## 1.7 Assessment approach

### 1.7.1 Data sources

1.7.1 The baseline environment for the HIA has been defined through a desktop study that reviewed the following:

- Publicly available data sources available from the following organisations:
- British Geological Survey (BGS)
- Natural Resources Wales (NRW)
- Isle of Anglesey County Council (IACC)
- Information contained in a Groundsure Enviro-Geo Insights report for the Study Area. That report includes:
  - General information regarding geological, hydrogeological and hydrological setting
  - Groundwater abstraction licences
  - Current and historical landfill sites
  - Current and historical waste sites
  - Pollution incidents
  - Discharge consents
  - Current and historical land-use
  - Mining and ground working areas (coal and non-mining)
  - Geotechnical constraints
  - Historical Ordnance Survey mapping and some aerial photography
  - 2025 Ground Investigation

1.7.2 Relevant information on geology, hydrogeology and ground conditions within the Study Area was collected through a detailed desktop review of existing studies and datasets. These are summarised in Table 1-1 below.

**Table 1.1 Summary of desktop study data sources**

| Title   | Source  | Year | Author   |
|---|---|------|--|
| Geoindex (Onshore)                                  | <a href="#">BGS Map Viewers</a>   | -    | British Geological Survey                                    |
| Sheet SH28SE, (Valley), Bedrock, 1:10 000           | <a href="#">BGS Maps Portal</a>   | 2020 | British Geological Survey, (British Geological Survey, 2020) |
| Sheet SH27NE, (Four Mile Bridge), Bedrock, 1:10 000 | <a href="#">BGS Maps Portal</a>   | 2020 | British Geological Survey, (British Geological Survey, 2020) |
| Sheet SH28SE, (Penrhos), Superficials, 1:10 000     | <a href="#">BGS Maps Portal</a>   | 2014 | British Geological Survey, (British Geological Survey, 2014) |
| Sheet SH27NE, (Rhoscolyn), Superficials, 1:10 000   | <a href="#">BGS Maps Portal</a>   | 2014 | British Geological Survey, (British Geological Survey, 2014) |
| Aquifer designation – bedrock                       | <a href="#">NRW interactive map of data about the natural environment</a> | -    | Natural Resources Wales                                      |
| Aquifer designation – superficial deposits          | <a href="#">NRW interactive map of data about the natural environment</a> | -    | Natural Resources Wales                                      |

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|--|---|------|--|
| The physical properties of minor aquifers in England and Wales   | <a href="#">NERC Open Research Archive (NORA)</a>   | 2000 | British Geological Survey (Jones, H K, Morris, B L, Cheney, C S, Brewerton, L J, Merrin, P D, Lewis, M A, MacDonald, A M, Coleby, L M, Talbot, J C, McKenzie, A A, Bird, M J, Cunningham, J, and Robinson, V K.) |
| Groundwater vulnerability  | <a href="#">NRW interactive map of data about the natural environment</a> and <a href="#">GeoIndex Onshore</a>  | -    | Natural Resources Wales and BGS  |
| Groundwater safeguard zones  | <a href="#">NRW interactive map of data about the natural environment</a>   | -    | Natural Resources Wales  |
| WFD groundwater bodies (Cycle 2)   | <a href="#">Lle Geo-Portal for Wales. Spatial Dataset</a>   | -    | Partnership between Welsh Government and Natural Resources Wales   |
| WFD river water bodies (Cycle 2)   | <a href="#">Lle Geo-Portal for Wales. Spatial Dataset</a>   | -    | Partnership between Welsh Government and Natural Resources Wales   |
| Geological Conservation Review (GCR) sites   | <a href="#">Lle Geo-Portal for Wales. Spatial Dataset</a>   | -    | Partnership between Welsh Government and Natural Resources Wales   |
| Regionally Important Geological and Geomorphological Sites (RIGS)  | <a href="#">Lle Geo-Portal for Wales. Spatial Dataset</a>   | -    | Partnership between Welsh Government and Natural Resources Wales   |
| Protected Sites (Sites of Scientific Interest, Special Areas of Conservation)  | <a href="#">Lle Geo-Portal for Wales. Spatial Dataset</a> ; <a href="#">NRW interactive map of data about the natural environment</a> and Groundsure Enviro-Geo Insights Report | -    | Partnership between Welsh Government and Natural Resources Wales   |
| Main Rivers in Wales   | <a href="#">Lle Geo-Portal for Wales. Spatial Dataset</a>   | -    | Partnership between Welsh Government and Natural Resources Wales   |
| Groundsure Enviro-Insights Report for the Penrhos Substation Area  | Groundsure  | 2021 | Produced by Groundsure for WSP for the 1.25 ha area occupied by the substation at Penrhos.   |
| Orthios, Former Anglesey Aluminium, Penrhos – Post Remediation Monitoring Report (Escrow Site 1 – Rectifier Yard Area) | Appendix A  | 2021 | LK Consult Ltd (LKC)   |
| Remediation Validation Report, Escrow Site 1 (Rectifier Yard)  | Appendix A  | 2020 | LK Consult Ltd (LKC)   |

1.7.3 Following completion of the GI, site-specific data including borehole logs and groundwater monitoring data were also considered for this HIA. These can be found in Appendices B and C respectively.

### 1.7.2 Consultation

1.7.1 A summary of the key consultation activities undertaken to date to inform the HIA is presented in Table 2 below, together with how the information gained from these consultation activities has been considered in the production of this report.

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**Table 2 Summary of key consultations undertaken**

| Date       | Consultee and type of response          | Issues Raised   | Response to issue raised and how it has been considered in this report  |
|------------|---|---|---|
| 31/03/2025 | Isle of Anglesey County Council (IOACC) | Potential presence of private water supplies (PWS) within the Study Area.                                     | The location of one PWS has been identified by IOACC. The email response is given in Appendix I. This PWS has been integrated into the HIA as a sensitive receptor. |
| 03/06/2025 | Natural Resources Wales                 | Letter correspondance (ref. WRMORGANSINDALL0705.1/.2/.3) for applications PAN-029212, PAN-029213 & PAN-029214 | Requirement to provide further information including a Hydrogeological Impact Assessment (HIA) for the proposed works to support licence and consent applications.  |

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### 1.8 Limitations of assessment

- 1.8.1 GI data provided only includes four groundwater monitoring wells on the eastern side of Stanley Embankment. Based on the identified stratigraphy, the shallow groundwater data from the eastern end of the cable corridor is therefore assumed be consistent with the western end for the purposes of developing a conceptual model in support of dewatering calculations, i.e. the presence a shallow water table within permeable strata.
- 1.8.2 The critical radius of influence and dewatering calculations provided (Section 3) make conservative assumptions to provide a reasonable upper limit for the dewatering rates supporting the application for the license.

## 2 Environmental setting

### 2.1 Regional Water Resource Status

- 2.1.1 The Study Area lies within the Anglesey Catchment Abstraction Management Strategy (CAMS) area (Appendix F). River water availability for Holyhead and Holy Island is currently not assessed. However, since the proposed dewatering is relatively small-scale, is temporary and is non-consumptive, regional water resource considerations scoped out of this HIA.

### 2.2 Local Hydrological and Topographical Setting

- 2.2.1 The hydrological and topographical setting of the Study Area is captured in Figure 2-1. The Study Area is in the surface water catchment of one NRW Main River Catchment:
- Cleifiog (Valley) WFD river waterbody catchment. Occupying the eastern end of the Study Area up to its confluence with the Holy Island Straits 0.4 km south of the Study Area.
- 2.2.2 All other catchment areas occupied by the Study Area are small, undesignated coastal catchments. The hydrological area in question falls under the WFD defined Crigyll Caradog Operational Management Catchment.
- 2.2.3 There are also several small watercourses within the Study Area, many of which discharge either to the Cleifiog Main River and its tributaries or into transitional and coastal water bodies. Ordnance Survey mapping also identifies many small ponds and water bodies, most notably at low elevations along the coastlines on either side of the Holy Island Strait. These hydraulically isolated ponds are likely situated upon low permeability glacial till or tidal flat deposits.
- 2.2.4 Topography within the Study Area is also depicted in Figure. Elevation across the Study Area varies between -2 mAOD within the estuary channel to 20m AOD on the headland which comprises the most north easterly section of the Study Area on Holy Island.
- 2.2.5 Topography along the proposed alignment of the cable corridor on Holy Island from the substation to Stanley Embankment is relatively flat and gently undulating with elevation decreasing from 10 m AOD to 5 m AOD.
- 2.2.6 The proposed alignment then crosses the Cymyran Strait along Stanley Embankment at an elevation of 5 mAOD. At the point of landfall on Anglesey Island, the alignment of the cable corridor veers northwards, reaching a high of 17 m AOD just after crossing Gorad Road. There is then another decline in elevation to 2 mAOD at the point of grid connection at Tower EV86.
- 2.2.7 The gently rolling landforms across the landward sections of the Study indicate a landscape shaped by underlying superficial glacial deposits which cap a basement of ancient, eroded bedrock.

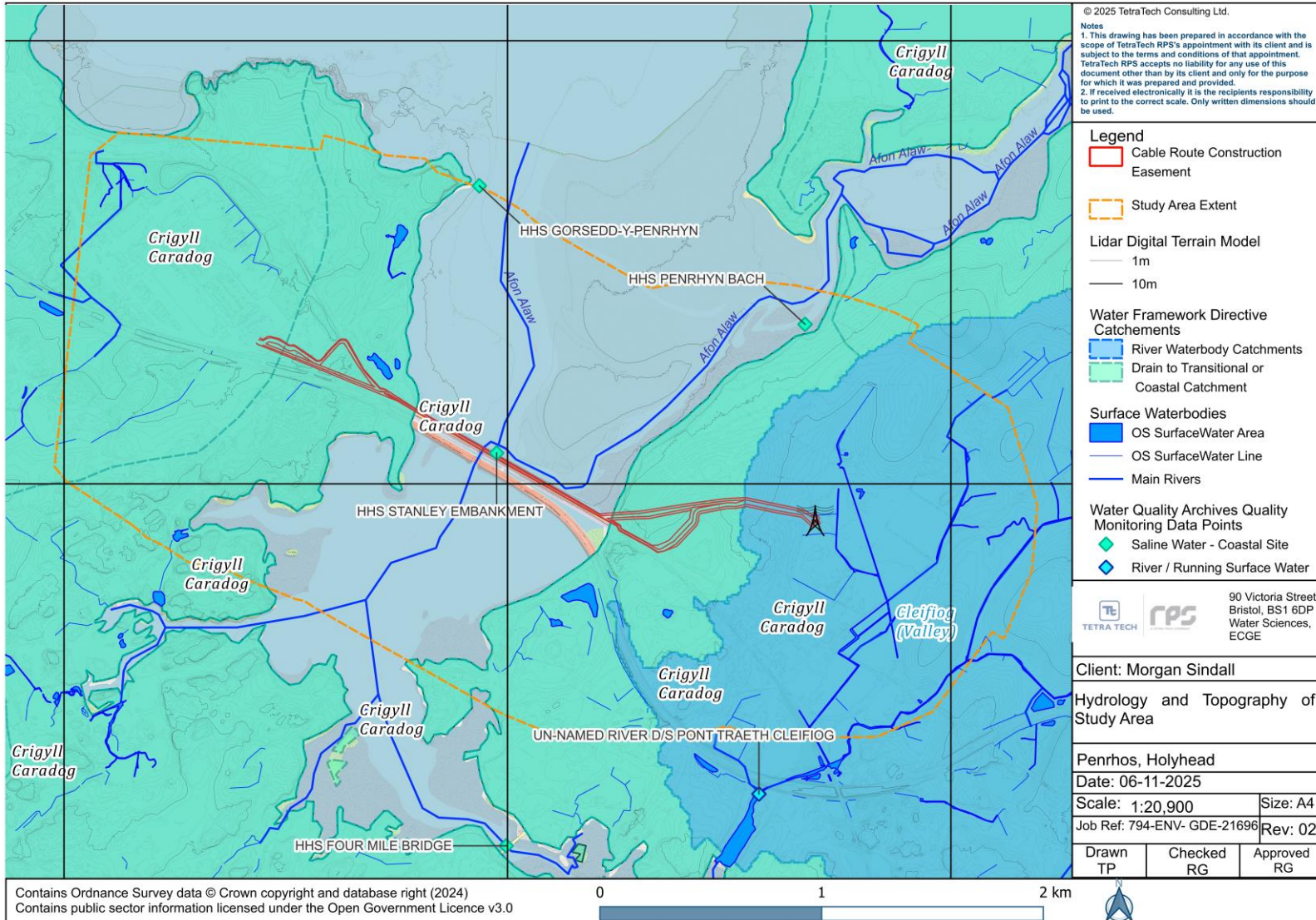


Figure 2-1 Hydrology and Topography of the Study Area

## 2.3 Geology and superficials

2.3.1 A summary of the regional geological sequence is provided in Table 2-1.

### 2.3.2 Bedrock

2.3.2.1 The regional bedrock terrain in the Anglesey area of North Wales is highly structurally deformed but generally gets progressively older from the northwest to the southeast. The oldest bedrock in the region comprises a thick sequence of Neoproterozoic mica schists which form the core of the Central Anglesey Shear Zone. The bedrock of the Study Area is composed of a complex orogenic sequence of Cambrian schists and psammites of the New Harbour Formation. Metamafic amphibolite intrusions are present within the sequence and are generally observed to strike in a SW-NE direction.

2.3.2.2 Geology in the Study Area is structurally complex, and the bedrock has been subject to multiple phases of deformation. The first of these being repeated intrusions by mafic bodies during a period of island arc volcanism in the Cambrian period. Pervasive chloritic foliation within the pelitic New Harbour Formation was secondary to the volcanism and resulted in the alteration of the mafic intrusives to amphibolites, serpentinites and metagabbros (**Phillips, 1991**). Following this, a period of ductile deformation resulted in the formation of major regional folding which resulted in further deformation to the rock fabric in the form of recumbent folding and crenulation cleavage.



**Picture 2-1 Bedrock of the of the New Harbour Formation depicting distinctive 2-phase deformation fabric SH 2755781401.**

2.3.2.3 Picture 2-1, taken from the Site Walkover Report in Appendix G, depicts the mesoscale ductile deformation that has postdated the period of mineral foliation. The resulting folding is disharmonic due to alternating degrees of competency in the foliated minerals. The picture was taken at the Penrhos Drumlin Regionally Important Geodiversity Site (see Figure 2-7) on the northern edge of the headland at the northern end of Penrhos Coastal Park.

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| Era                              | Group             | Formation                                | Description   | Thickne<br>ss | Aquifer<br>designation<br>(NRW) | BGS<br>hydrogeologi<br>cal<br>description  |
|----------------------------------|-------------------|--|---|---------------|---------------------------------|--|
| <b>Superficial geology</b>       |                   |  |   |               |                                 |  |
| Quaternary                       |                   | Tidal Flat Deposits                      | Tidal flat deposits, including mud flat and sand flat deposits. They consist of unconsolidated sediment, mainly mud and/or sand   | -             | Secondary Undifferentiated      | Not described  |
|                                  |                   | Coastal Zone Deposits (Undifferentiated) | Shingle, sand, silt and clay; may be bedded or chaotic.   | -             | Secondary Undifferentiated      | Not described  |
|                                  |                   | Blown Sand                               | A low rounded ridge of coarse materials (gravels, cobbles and boulders) piled up by very powerful storm waves at the inland margin of a beach, above the level reached by normal spring tides.                                  | -             | Secondary A                     | Not described  |
|                                  |                   | Glacial Till (Devensian)                 | Unconsolidated mixed deposit consisting of a heterogenous mixture of clay, sand, gravel, and boulders varying widely in size and shape  | -             | Secondary Undifferentiated      | Not described  |
|                                  |                   | Glaciofluvial Deposits (Devensian)       | Unconsolidated material by glacial river waters and consisting of boulders, gravel, sand, silt and clay from ice sheets or glaciers.  | -             | Secondary A                     | Not described  |
|                                  |                   | Alluvium                                 | Sorted/Semi-sorted clay, silt, sand and gravel deposited by a river, stream or other body of running water.   | -             | Secondary Undifferentiated      | Not described  |
| <b>Bedrock geology</b>           |                   |  |   |               |                                 |  |
| Late Cambrian – Early Ordovician | Holy Island Group | New Harbour Formation                    | Chlorite-muscovite schist and phyllite, semipelite predominates with subsidiary psammite. Metabasaltic rock and calcsilicate rock locally. Abundant sheet-like units of metamafic rock (amphibolite) occur locally. (BGS, 2025) | Up to 2km     | Secondary Aquifer               | Low productivity aquifer. Highly indurated pelitic rocks with limited groundwater in the near surface weathered zone and secondary fracture systems. |

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2.3.2.4 Ground investigation boreholes BH107, BH106C, BH103 reached bedrock at depths of 8.0m, 7.2m and 5.8m respectively.

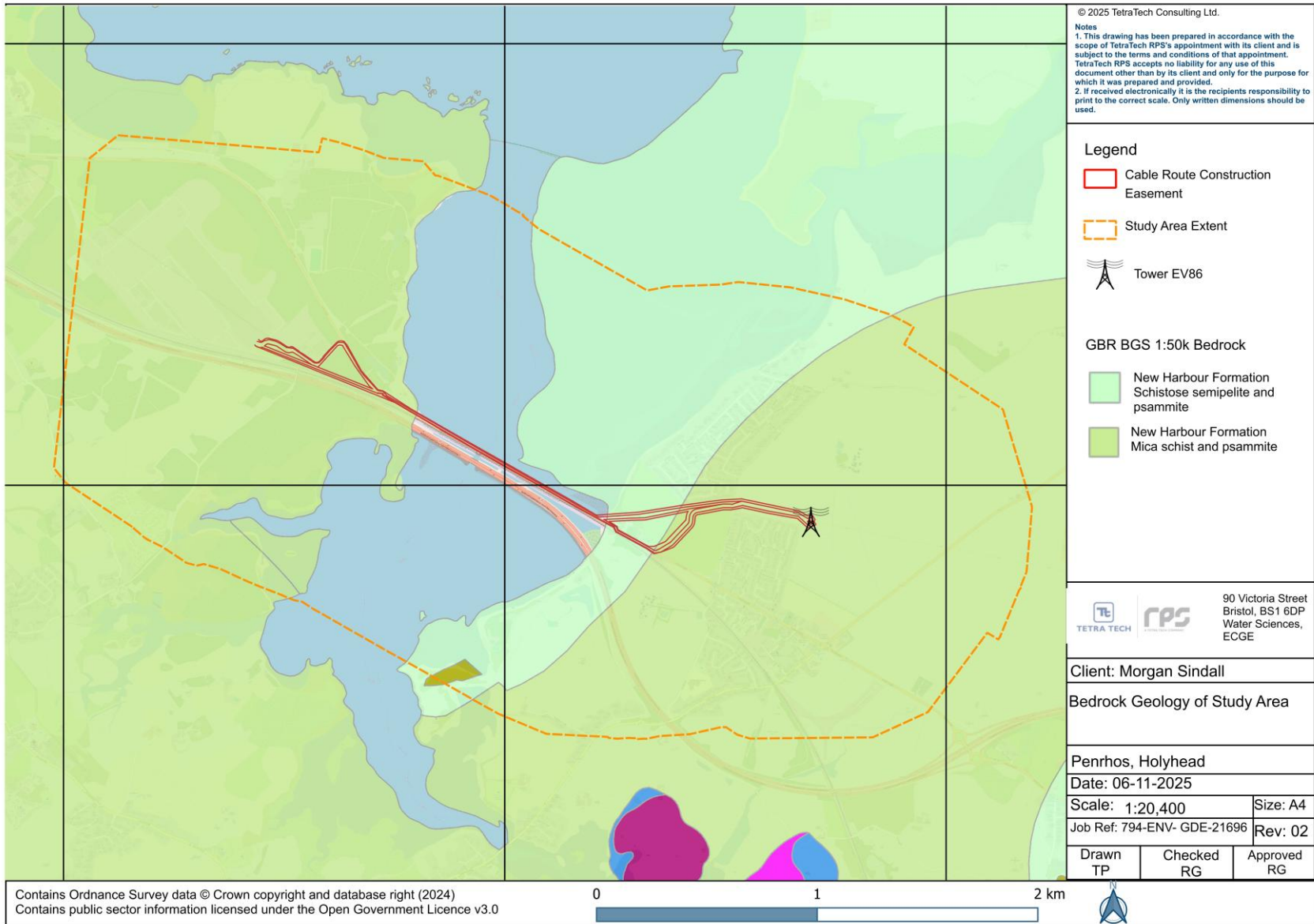
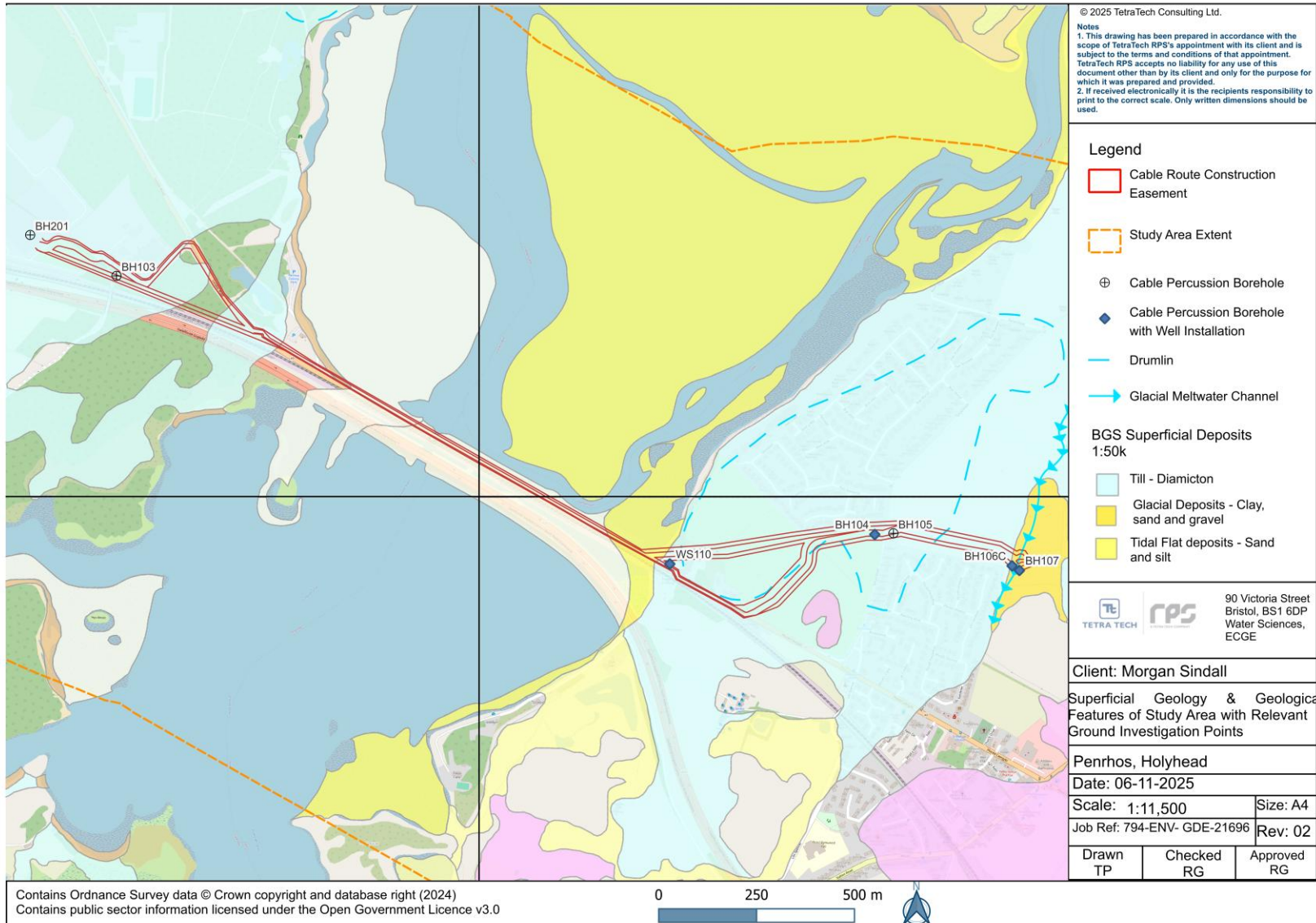


Figure 2-2 BGS 1:50k bedrock geology of the Study Area

### 2.3.3 Superficial Deposits

- 2.3.3.1 The superficial geology within landwards sections of the Study Area is dominated by diamicton glacial till and tidal flat deposits (Figure 2-4). Glacial till deposits in the Anglesey area are described as being dense and over consolidated composing of a heterogenous mixture of clay, sand gravel and boulders (**BGS, 2025**). A BGS report on the physical properties of till deposits in Anglesey also provides evidence to suggest diamicton tills in the area around Penrhos have a higher proportion of fines and are generally present in thicknesses of 4-6m in coastal areas (**Boon, Kirkham, & Naylor, 2014**). Three drumlins and other associated glacial structures are also mapped within the study area. Drumlins are low, oval or elongated mounds consisting of compacted till that were formed by the movement of glacial ice. The drumlin at Penrhos measures approximately 15m in height and is recognised as a Regionally Important Geodiversity Site (RIGS).
- 2.3.3.2 Borehole logging was conducted by CC Ground Investigations (Appendix B) during the GI stage to provide a more detailed lithological assessment of the Study Area and as a result a more refined conceptual model. Borehole logs east of Stanley Embankment support a distinct change in lithological character between the BGS-mapped Tidal Flat deposits and Glacial Tills (insert figure).
- 2.3.3.3 At the far east end of the cable route, at the site of the proposed substation, BH106C and BH107 logs show a transition from low permeability clay/silt/sand lithologies to high permeability gravels at depths of 4.20m and 4.80m respectively. Gravel layers in BH107 begin as thin ~0.30m interbedded layers with sand, before thickening to approximately 2.30m at 5.70m depth. The gravel layer at BH106C shows a similar thickness at 3.00m thick. Both boreholes coincide with Tidal Flat Deposits from BGS surface geology mapping (Figure 2-4). All mentioned borehole logs can be found in Appendix B.
- 2.3.3.4 Approximately 320m west, BH105 and BH104 coincide with Glacial Till deposits and reach gravels at shallower depths of 1.30m and 0.20m respectively. Additionally, the boreholes show gravel thicknesses of approximately 1.0m in both logs. This shows that there is a large difference in potential transmissivities of the two surface lithologies.
- 2.3.3.5 Tidal flat deposits dominate on the eastern end of the Study Area, in the flood plain of the Cleifiog River where the cable corridor joins the grid at Tower EV86. These deposits are described as being composed of unconsolidated deposits of mud and sand of variable thickness (**BGS, 2025**).
- 2.3.3.6 Figure 2-3 presents the distribution of the different mapped superficial deposits across the Study Area. Glacial till and tidal flat deposits dominate in landwards sections of the Study Area but glaciofluvial deposits are also present. Undifferentiated coastal zone deposits are the only mapped deposit below mean high water springs and the distribution of the mapped unit covers the majority of the area occupied by the Cymyran Strait and its tributaries.
- 2.3.3.7 All superficial deposits within the area are designated as Secondary (undifferentiated) aquifer units with the exception of the blown sand and glaciofluvial deposits with are designated as Secondary A aquifers and are only found in restricted areas in the vicinity of Penrhos on Holy Island.



**Figure 2-3 Superficial deposits and features of the Study Area. BGS 1:50k superficial mapping. Including relevant ground investigation points**

## 2.4 Hydrogeology

### 2.4.1 Aquifer units

- 2.4.1.1 Aquifers in Wales are classified by NRW and the BGS (British Geological Survey, 2022) on the following basis:
- 2.4.1.2 Principal aquifer – the geological unit that provides significant quantities of water and can support water supply and/or baseflow to rivers, lakes and wetlands on a strategic scale. They typically have a high intergranular and/or fracture permeability meaning they usually provide a high level of water storage
- 2.4.1.3 Secondary A aquifer – the geological unit that provides modest amounts of water, but the nature of the rock or the aquifer’s structure limits their use. They support water supplies at a local rather than strategic scale (such as for private supplies) and remain important for rivers, wetlands and lakes
- 2.4.1.4 Secondary B aquifer – Dominated by lower permeability layers that may store and yield limited amounts of groundwater
- 2.4.1.5 Secondary (undifferentiated) aquifer - Where it is not possible to apply either a Secondary A or B definition because of the variable characteristics of the rock type, but generally have only a minor resource value
- 2.4.1.6 Unproductive strata - These rocks have negligible significance for water supply or baseflow to rivers, lakes and wetlands. They consist of bedrock or superficial deposits with a low permeability that naturally offer protection to any aquifers that may be present beneath.
- 2.4.1.7 Aquifer classifications for bedrock and superficial geology within the Study Area are summarised in Table 2-1. Bedrock aquifer classification status and vulnerability status is mapped in Figure 2-4. Table 2-1 also provides the BGS hydrogeological description for the New Harbour Formation as it is the only bedrock unit present in the Study Area.
- 2.4.1.8 With regards to superficial geology, the majority of the Study Area is underlain by glacial till, coastal zone deposits and tidal flat deposits which are classified as Secondary (Undifferentiated) aquifer units. Given the clay-rich nature and low permeability of these strata, groundwater will be restricted to localised granular lenses or layers which do not typically form significant groundwater bodies. As their aquifer classification suggests, localised groundwater within these superficial units is not considered to be of significant resource value.
- 2.4.1.9 Granular glaciofluvial and blown sand deposits are found in the northwest part of the Study Area. These deposits can form locally important groundwater bodies and are classified as Secondary A aquifer units. The importance of these aquifers is dependent on their thickness and their lateral extent. As the extent of these deposits in the Study Area is limited, it is unlikely that they constitute a locally important groundwater resource.

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- 2.4.1.10 The Cambro-Ordovician bedrock of the New Harbour Formation is composed of metapelites and psammities which have little to no intergranular porosity or permeability. Groundwater in this formation is restricted to fractures and faults or associated with zones of weathering, typically at shallow depths. The presence of groundwater in shallow weathered regions of the New Harbour Formation has been observed at the Penrhos substation area where rest water levels have been recorded at depths of 1.47 to 1.84 mbgl. The New Harbour Formation is classified a Secondary B aquifer unit.
- 2.4.1.11 The vulnerability of groundwater present in both bedrock and superficial deposits is also shown in Figure 2-4. Vulnerability status for each aquifer type is determined by the BGS as follows:
- 2.4.1.12 High: areas that can easily transmit pollution to groundwater. They are characterised by high-leaching soils and the absence of low-permeability superficial deposits.
- 2.4.1.13 Medium: areas that offer some groundwater protection. Intermediate between high and low vulnerability.
- 2.4.1.14 Low: areas that provide the greatest protection to groundwater from pollution. They are likely to be characterised by low-leaching soils and/or the presence of low-permeability superficial deposits.
- 2.4.1.15 Vulnerability status varies from high to low across the Study Area with all groundwater at the western end of the Study Area being classified as 'high vulnerability' and groundwater vulnerability status varying from high to low at the eastern end of the Study Area on Anglesey Island.
- 2.4.1.16 BGS borehole records and ground investigation records local to the Penrhos substation site, provided in Appendix H, confirm the following:
- 2.4.1.17 The New Harbour Formation can exhibit artesian groundwater pressures at depth with water rising to 30mbgl from screened depths of 80-100mbgl.
- 2.4.1.18 Shallow ground installations (<10m) frequently report the absence of groundwater, indicating its occurrence is spatially variable across the site.
- 2.4.1.19 Rest water levels recorded at Penrhos substation vary between 1.47 and 1.84 mbgl and indicate the presence of groundwater in both the glacial till and the fractured surficial schists.
- 2.4.1.20 The absence of borehole records for the New Harbour Formation in the area suggests the unit is not important with respect to water resources. This also reflects its designation as a Secondary B aquifer.

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### 2.4.2 Groundwater Levels

2.4.2.1 GW strikes were frequently observed over Tidal Flat deposits at shallow depths ranging from 0.80-1.00m across almost all GI sites near the proposed substation (Table 2-2). This indicates a shallow water table in this area. Monitoring undertaken on 08/08/25 at wells BH107 and BH106C confirmed GW levels of 1.32 and 1.45m AOD respectively. Since these levels are above the depth to gravel, this suggests that the gravel unit underlying these points were saturated at the time.

**Table 2-2 GI data relevant to the hydrogeology of the Study Area. Light blue boxes indicate boreholes with well installations. Note that well installations were exclusively installed on the eastern end of Stanley Embankment.**

| Borehole / Well / Inspection Pit (IP) | Depth of installation (mbgl) | Groundwater level on 08/08/25 (mAOD) | Depth to Gravel (mbgl) | Gravel thickness (m)      | Groundwater strike depth (mbgl) |
|---------------------------------------|------------------------------|--------------------------------------|------------------------|---------------------------|---------------------------------|
| BH107                                 | 10.20                        | 1.32                                 | 4.80, 5.70             | 0.20, 2.30                | 1                               |
| BH106 (IP)                            | 0.90                         | -                                    | Didn't reach           | -                         | 0.9                             |
| BH106A (IP)                           | 0.80                         | -                                    | Didn't reach           | -                         | 0.8                             |
| BH106B (IP)                           | 0.80                         | -                                    | Didn't reach           | -                         | 0.8                             |
| TP123                                 | 1.70                         | -                                    | Didn't reach           | -                         | 0.60, 1.70 (seepage)            |
| BH106C                                | 14.70                        | 1.45                                 | 4.20                   | 3.00                      | Dry                             |
| BH105                                 | 6.00                         | -                                    | 1.30                   | 1.00                      | Dry                             |
| BH104                                 | 6.00                         | 11.38                                | 0.20                   | 1.10                      | Dry                             |
| TP119                                 | 1.70                         | -                                    | Didn't reach           | -                         | 1                               |
| TP118                                 | 1.70                         | -                                    | 1.00                   | 0.70 (lower limit)        | Dry                             |
| TP116                                 | 1.70                         | -                                    | 0.40                   | 0.70 (lower limit)        | Dry                             |
| WS110                                 | 2.00                         | 4.13                                 | 0.85                   | 0.45                      | Dry                             |
| BH103                                 | 6.00                         | -                                    | 1.30                   | ~2.50 (gravelly phyllite) | Dry                             |
| TP102                                 | 1.70                         | -                                    | 1.00                   | 0.70 (lower limit)        | Dry                             |
| TP101                                 | 1.70                         | -                                    | 1.00                   | 0.70 (lower limit)        | Dry                             |

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### 2.4.3 Groundwater Chemistry Screen

- 2.4.3.1 To assess potential groundwater contamination, lab results from the groundwater monitoring conducted on 02/07/25 were screened against UK Drinking Water Standards (Table 3). The lab Certificate of Analysis is provided in Appendix M.
- 2.4.3.2 The results of the screen against UK Drinking Water Standards show that groundwater from WS110 has unsafe concentrations of Arsenic and Total PAHs.

**Table 3 UK Drinking Water Standards for relevant chemical parameters.**

| Parameter                             | Concentration or Value maximum | Units of Measurement |
|---------------------------------------|--------------------------------|----------------------|
| Arsenic                               | 10                             | µg/l                 |
| Benzene                               | 1                              | µg/l                 |
| Boron                                 | 1                              | mg/l                 |
| Cadmium                               | 5                              | µg/l                 |
| Chromium                              | 50                             | µg/l                 |
| Copper                                | 2                              | mg/l                 |
| Cyanide                               | 50                             | µg/l                 |
| Lead                                  | 10                             | µg/l                 |
| Mercury                               | 1                              | µg/l                 |
| Nickel                                | 20                             | µg/l                 |
| Total PAHs                            | 0.1                            | µg/l                 |
| Selenium                              | 10                             | µg/l                 |
| Tetrachloroethene and Trichloroethene | 10                             | µg/l                 |
| Vinyl chloride                        | 0.5                            | µg/l                 |

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**Table 4 Lab chemical analysis results and screen. Values in red indicate screened exceedances in UK Drinking Water Standards.**

| Well   | Depth range of GW sample (m) | Arsenic (micrograms/L) | Benzene (micrograms/L) | Boron (micrograms/L) | Cadmium (micrograms/L) | Chromium (micrograms/L) | Copper (micrograms/L) | Cyanide (micrograms/L) | Lead (micrograms/L) | Mercury (micrograms/L) | Nickel (micrograms/L) |
|--------|------------------------------|------------------------|------------------------|----------------------|------------------------|-------------------------|-----------------------|------------------------|---------------------|------------------------|-----------------------|
| BH107  | 1.00-2.00                    | <b>5.04</b>            | <1                     | <b>235</b>           | <0.08                  | <b>3.41</b>             | <b>2.68</b>           | <50                    | <0.2                | <0.01                  | <b>12.6</b>           |
| BH106C | 4.20-7.00                    | <0.5                   | <1                     | <b>44</b>            | <0.08                  | <1                      | <b>0.824</b>          | <50                    | <0.2                | <0.01                  | <b>1.14</b>           |
| BH104  | 1.50-4.00                    | <b>0.628</b>           | <1                     | <b>56.6</b>          | <0.08                  | <1                      | <b>3.98</b>           | <50                    | <0.2                | <0.01                  | <b>2.21</b>           |
| WS110  | 0.80-2.00                    | <b>25.8</b>            | <1                     | <b>93.4</b>          | <0.08                  | <1                      | <0.3                  | <50                    | <0.2                | <0.01                  | <b>3.15</b>           |

**Table 4 (continued)**

| Well   | Depth range of GW sample (m) | USEPA 16 Total PAHs (micrograms/L) | Selenium (micrograms/L) | Tetrachloroethene (micrograms/L) | Trichloroethene (micrograms/L) | Sum Tetrachloroethene and Trichloroethene (micrograms/L) | Vinyl Chloride (micrograms/L) |
|--------|------------------------------|------------------------------------|-------------------------|----------------------------------|--------------------------------|--|-------------------------------|
| BH107  | 1.00-2.00                    | < <b>1.64</b>                      | <b>1.71</b>             | <1                               | <1                             | <2   | <1                            |
| BH106C | 4.20-7.00                    | < <b>0.082</b>                     | <1                      | <1                               | <1                             | <2   | <1                            |
| BH104  | 1.50-4.00                    | < <b>0.082</b>                     | <b>1.73</b>             | <1                               | <1                             | <2   | <1                            |
| WS110  | 0.80-2.00                    | <b>2.48</b>                        | <1                      | <1                               | <1                             | <2   | <1                            |

## 2.4.4 Water Framework Directive groundwater bodies

2.4.4.1 The Study Area crosses only one groundwater body as defined by the Water Framework Directive (WFD) (Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy). This groundwater body and its status is summarised in Table 5 and shown within Figure 2-4.

**Table 5 Summary of WFD groundwater bodies within the Study Area**

| Reference      | Name               | Position in Study Area                              | Overall status | Quantitative status | Chemical status |
|----------------|--------------------|---|----------------|---------------------|-----------------|
| GB41002G204400 | Ynys Mon Secondary | Defined in all landward sections of the Study Area. | Poor           | Good                | Poor            |

2.4.4.2 The Ynys Mon Secondary groundwater body currently has poor status which relates to the assessment of its chemical status.

### 2.4.5 Licensed and private groundwater abstractions

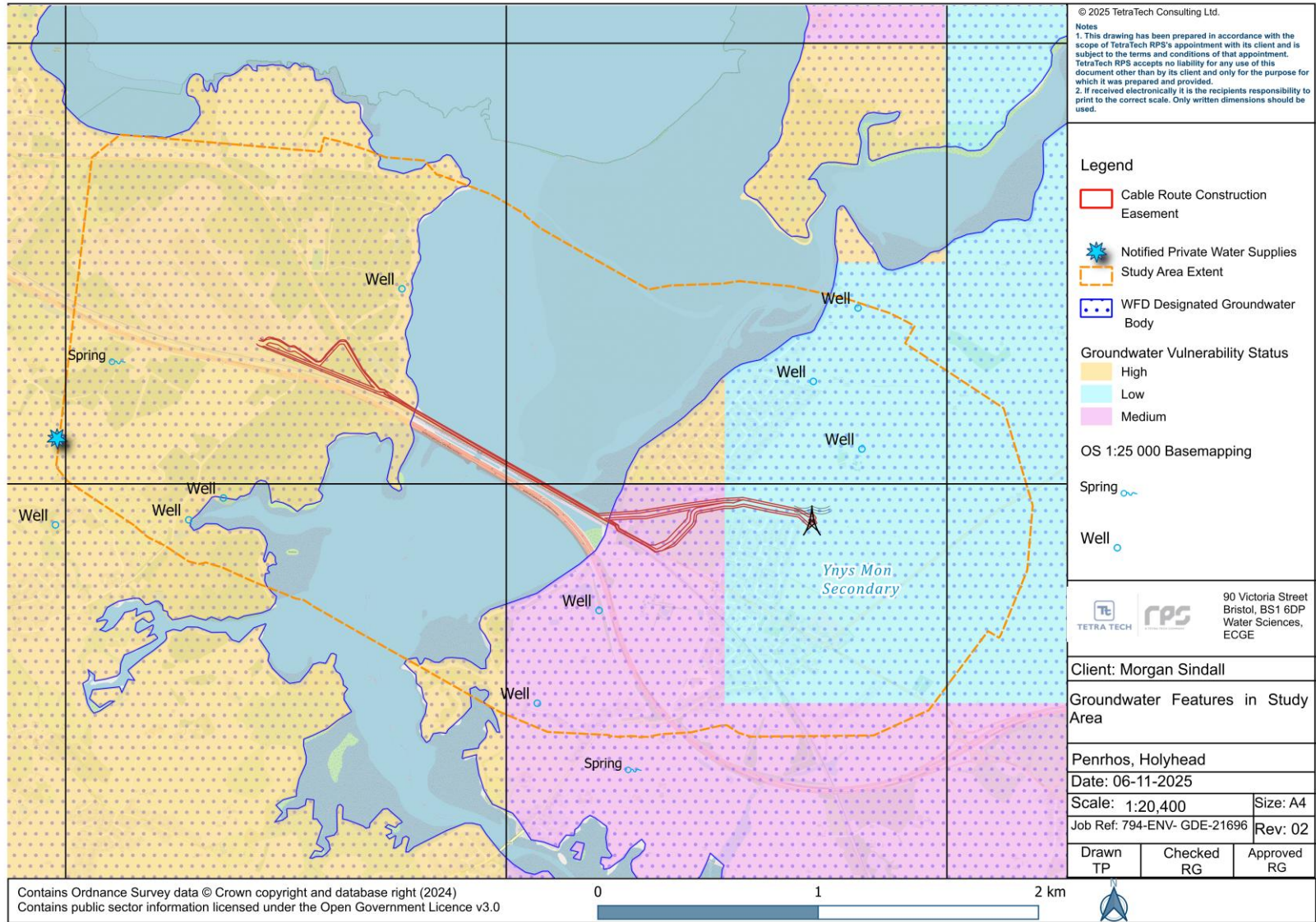
- 2.4.5.1 Ordnance Survey mapping (1:25,000 scale) identifies eight ‘wells’ and one ‘spring’ across the Study Area, most notably around the edges of areas that are overlain by glacial till. Although there are no licensed abstractions in the low permeability Silurian bedrock, the presence of these wells suggest small private abstractions may be relatively common and the water is accessible.
- 2.4.5.2 Consultation with Anglesey County Council on the potential presence of private groundwater supplies has revealed one registered supply. The approximate location of said supply is shown in 2-4. No further information on the supply type or infrastructure was given. The consultation response is provided in Appendix I.
- 2.4.5.3 The survey of potential licensed groundwater abstractions within the Study Area is yet to be undertaken. A request for further information on licensed abstractions was sent to NRW on the 20th of March 2025, see Appendix J. A response regarding the presence of licensed abstractions in the Study Area is yet to be received, however. Following receipt of information regarding potential licensed groundwater abstractions in the area, any necessary associated abstraction source risk assessments shall be completed.

### 2.4.6 Groundwater Source Protection Zones (SPZ)

- 2.4.6.1 NRW do not report any groundwater SPZs within the Study Area or on the Island of Anglesey in its entirety as of May 2025 (**NRW, 2025**).

### 2.4.7 Summary of groundwater receptors

- 2.4.7.1 The identified private water supply, despite being at the very edge of the Study Area, represents an important and sensitive groundwater receptor. In addition to this supply, the Ynys Mon Secondary groundwater body constitutes another high vulnerability groundwater receptor.
- 2.4.7.2 The surface watercourses that cross Study Area and in particular the proposed cable corridor, also constitute potential groundwater receptors, where they are in hydraulic continuity with aquifers in the underlying bedrock and/or superficial deposits. Groundwater within these aquifer units will tend to flow towards, and discharge to, these watercourses. However, the discontinuous nature of groundwater in the glacial till and tidal flat deposits and its limited resource potential suggests that the groundwater contribution to these small watercourses will be of limited importance to their flow regime.
- 2.4.7.3 The desktop study has not identified any groundwater dependent protected sites within the Study Area.
- 2.4.7.4 The ultimate receptor of groundwater in aquifers underlying the Study Area is the coastline of the Cymyran Strait and the Irish Sea to which all local watercourses ultimately flow and groundwater is discharged.



**Figure 2-4 Groundwater features in the Study Area: 'Contains British Geological Survey materials © UKRI [2025]'**

## 2.5 Environmental sensitivity

2.5.1 All protected and/or sites within the Study Area that could be affected by the construction, of the Penrhos 132 kV Cable Replacement Project were identified using the following sources:

- Lle Geo-Portal for Wales - Spatial Dataset;
- NRW interactive map of data about the natural environment and;
- Groundsure Enviro-Geo Insights Report previously obtained for the Penrhos Substation, provided in Appendix K.

2.5.2 Figure 2-5 depicts the spatial distribution of protected sites that were identified within the DTS indicating that the Study Area is situated in an area of exceptionally high environmental sensitivity, particularly the section of the cable corridor that crosses the Cymyran Strait via Stanley Embankment.

## 2.6 Site-specific surveys

2.6.1 A site-specific GI was conducted by CC Ground Investigations Ltd and is given in Appendix B. Borehole logs were used to identify superficial aquifer lithologies within the vicinity of the cable route.

2.6.2 Six groundwater monitoring rounds were carried out at BH107, BH106C, BH104 and WS110 and are given in Appendix C.

## 2.7 Summary of controlled water and environmental receptors

### Geology

2.7.1 No GCR sites are present in the study area.

2.7.2 One RIG has been identified in the study area and is summarised in Table 6.

**Table 6 Summary of RIGS in the study area**

| Site Name       | Distance from the proposed cable corridor   | Notes                        |
|-----------------|---|------------------------------|
| Penrhos Drumlin | Within 700m of the proposed cable corridor. | Quaternary glacial landform. |

### Hydrogeology

2.7.3 All PWS identified through consultation with local councils are summarised in Table 7.

**Table 7 Summary of notified PWS in the study area**

| Reference | Site Name               | Distance from the proposed cable corridor  | Notes  |
|-----------|-------------------------|--|--|
| PWS       | Lon Towyn Capel Rd. PWS | Within 1km of the proposed cable corridor. | Active PWS registered at private property address. Notification of supply through Anglesey County Council. No further details known. |

2.7.4 Groundwater bodies defined within the study area are summarised in Table 8.

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**Table 8 Summary of groundwater bodies in the study area**

| <b>Name</b>        | <b>Distance from the proposed cable corridor</b> | <b>Notes</b>  |
|--------------------|--|---|
| Ynys Mon Secondary | Within cable corridor.                           | WFD defined groundwater body. Overall status defined as poor. |

## Geological and Groundwater Dependent Protected Sites

2.7.5 Protected sites identified within the study area are shown in Figure 2-5 and summarised in Table 9.

**Table 9 Summary of designated sites in the study area**

| <b>Site Name</b>    | <b>Distance from the proposed cable corridor</b> | <b>Site Type</b>                | <b>Notes</b>  |
|---------------------|--|---------------------------------|---|
| Beddmanarch-Cymyran | Within proposed cable corridor.                  | SSSI                            | Spatial extent defined by coastline of the Cymyran Strait.  |
| Beddmanarch Bay     | 0 m from proposed cable corridor.                | Shellfish Waters Protected Area | Adjacent to the proposed cable corridor, north of Stanley Embankment.                                     |
| Ynys Mon / Anglesey | Within cable corridor                            | AONB                            | Designated in 1967. Covers all landwards sections of the Study Area to the west of the village of Valley. |

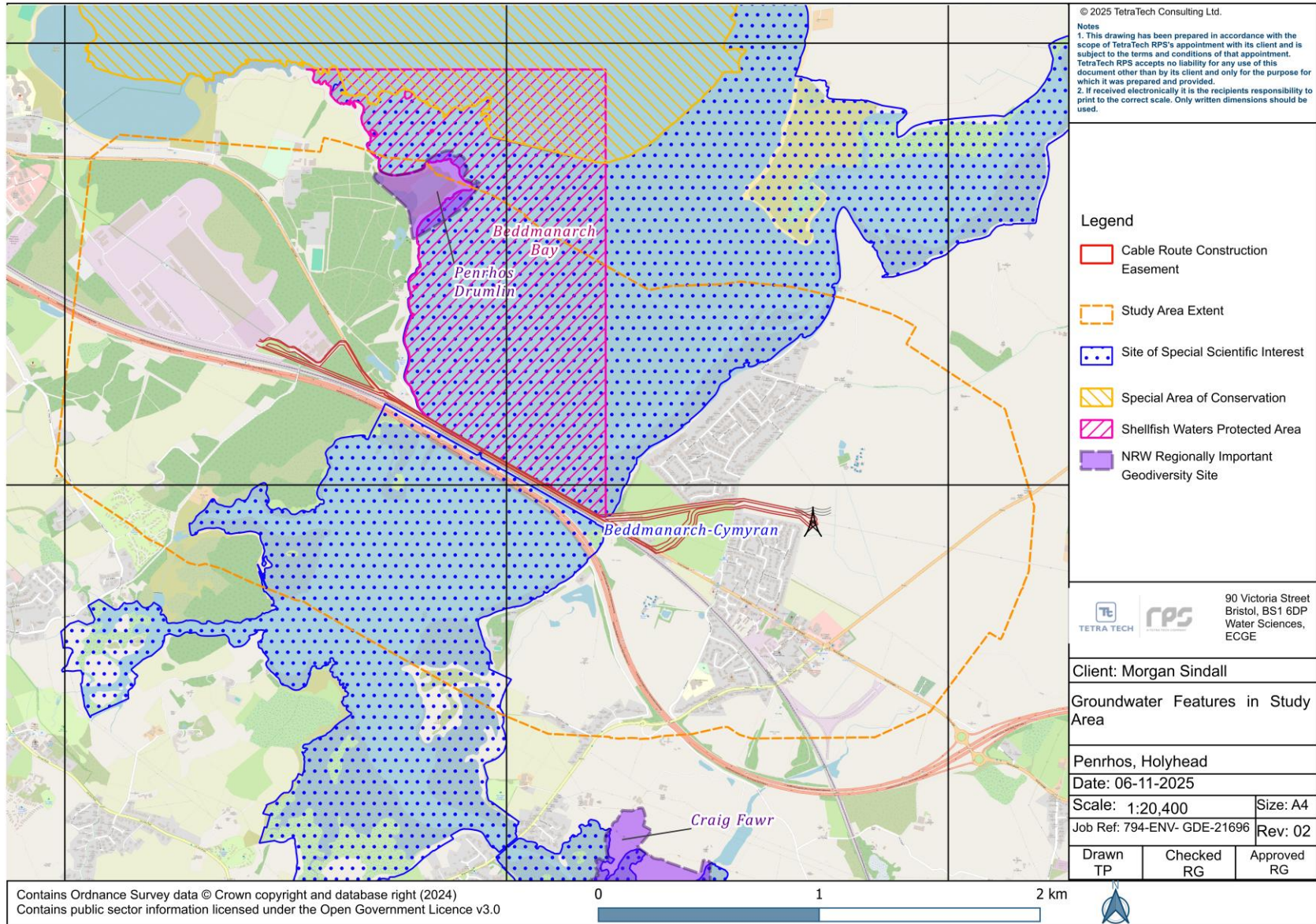


Figure 2-5 Protected Sites in the Study Area

### 3 Dewatering calculations

#### 3.1 Radius of Influence

3.1.1 The empirical Aravin and Numerov (1953) equation for unconfined aquifers was used to calculate a potential radius of influence for the proposed cable trenches:

$$R = \sqrt{1.9 \frac{K_{sat}ht}{n}}$$

- **R** = radius of influence [m]
- **K<sub>sat</sub>** = saturated hydraulic conductivity [m/s]
- **h** = height of the water table above the substratum (aquifer thickness) [m]
- **t** = time [s]
- **n** = effective porosity (specific yield) [dimensionless]

3.1.2

3.1.3 BH logs from the GI showed that layers of gravel were present throughout the site at various depths. Many of these appear at depths of lower than 1.5mbgl (the proposed depth of trenching). However, BH104 showed a change in lithology from sand to gravel at depths as shallow as 0.20m (see borehole BH104 log in Appendix B).

3.1.4 Therefore, to facilitate an appropriate dewatering calculation, parameters corresponding to gravel and sand (the highest transmissivity lithologies found in the GI) were used and are shown in the table below. The calculated radius of influence is also included.

3.1.5 A 10m radius of influence is at least an order of magnitude below the distance to the nearest water feature such as a well or spring (see Figure 2-4). Therefore, the proposed trench dewatering is unlikely to have drawdown impacts on local water features.

| Parameter                  | Unit          | Value                  | Reference   |
|----------------------------|---------------|------------------------|---|
| K <sub>sat</sub>           | m/s           | 1.0 x 10 <sup>-4</sup> | Lower range value for “Well-sorted gravel” (Fetter, 1994)                                     |
| h                          | metres        | 2                      | Water table conservatively assumed to be at surface; value of 2 used to ensure trench is dry. |
| t                          | seconds       | 86,400                 | Dewatering will be 24hrs  |
| n                          | Dimensionless | 0.35                   | Upper range value for “Sand and gravel, mixed” (Fetter, 1994)                                 |
| <b>Radius of influence</b> | <b>metres</b> | <b>10</b>              | <b>Calculated using the above values</b>  |

**Table 10 Conservative parameter values used to calculate radius of influence**

#### 3.2 Calculated Inflow

3.2.1 An analytical solution for linear unconfined flow into a trench was used to estimate pumping rates needed to maintain a dry trench (Mansur and Kaufman, 1962).

$$Q = -K \frac{(H^2 - h_d^2)}{A} L$$

Where K = hydraulic conductivity [m/s],

L = width of aquifer transverse to groundwater flow [m],

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H = head at constant-head boundary [m],

A = distance to constant-head boundary (i.e. radius of influence) [m],

and  $h_d$  = head in the excavation [m]

3.2.2 Depth to water table across all wells over six monitoring rounds (05/25 – 09/25) during the GI ranged from 2.59 – 0.11 mbgl. BH logs revealed that the highest transmissivity gravel lithologies first appear between 0.20 and 4.80 mbgl (including trial pits). To constrain this variability such that the abstraction license covers all 20m sections along the cable route, conservative values giving a likely overestimate of inflow rate are used (see table below). In particular, the calculations assume that the trench only encounters the most transmissive gravel lithology and that the water table is at ground level. The head in the excavation ( $h_d$ ) is also assumed to be 2 mbgl to ensure that the 1.5m deep trench remains dry.

3.2.3 The maximum inflow exceeds 20 m<sup>3</sup>/day so an abstraction license to maintain dry trenches is required.

**Table 11 Conservative parameter values used in trench dewatering calculations**

| Parameter   | Unit                       | Value                | Reference   |
|---|----------------------------|----------------------|---|
| K   | m/s                        | $1.0 \times 10^{-4}$ | Lower range value for “Well-sorted gravel” (Fetter, 1994)     |
| L   | metres                     | 20                   | Trenches in 20m sections                                      |
| H   | mAOD                       | 5.118                | Ground level at WS110   |
| A   | metres                     | 10                   | As calculated from Section 3.1                                |
| $h_d$   | mAOD                       | 3.118                | Ground level minus depth of trenching (2m to be conservative) |
| <b>Q (pumping rate needed to maintain dry trench)</b> | <b>m<sup>3</sup> / day</b> | <b>71</b>            | <b>Calculated using the above values</b>                      |

## **4 Land uses**

### **4.1 Landfill sites**

- 4.1.1 As shown in Figure 4-1, one historical landfill has been identified within the Study Area. Cae Glas Road Landfill is situated 100m to the south of the proposed cable route alignment and covers an area of approximately 0.1 km<sup>2</sup>. Closed in 1980, records show the site received a mixture of industrial, commercial and household waste and was likely situated on the site of Tre-Gof quarry (NRW, 2025).
- 4.1.2 The landfill site is located on the opposite side of the A5 and the North Wales Expressway within a window in the glacial till, on top of the schistose bedrock of the New Harbour Formation. Given this setting it is considered to represent a low soil and groundwater contamination risk with regards to the Penrhos Cable Replacement Project.
- 4.1.3 No active landfill sites have been identified within the Study Area (NRW, 2025).

### **4.2 Other recent and historical land-uses**

- 4.2.1 Two active petrol stations have been identified within the Study Area. Both are located on Holyhead Road within the valley. Both fuel stations are located approximately 500m away from the route of the proposed cable, down topographic gradient. Given these factors, it is not thought to represent a possible soil or groundwater contamination risk.
- 4.2.2 Derwyn Garage, also situated on Holyhead Road at the southeastern end of Stanley Embankment (see Figure 4-1), is situated on top of the proposed cable route alignment. The business consists of a workshop building, tarmacked parking area and small vehicular yard at the rear. At present, the cable route is proposed to run under the parking area and vehicular yard at the back of the building before traversing up the embankment to the northeast, onto agricultural land. Observations made during the site walkover revealed two spoil heaps situated in the parking area but no visible or olfactory evidence of fuel related spills.
- 4.2.3 Additional historical land uses identified within the Study Area include four small unspecified quarries. These historical features were identified from GeoIndex and all registered as having ceased activities. The closest site of historic quarrying is Tre-gof on Holy Island, approximately 200m to the south of the proposed cable route. As discussed in Section 4.1, this area of surficial ground workings has likely been filled in by the Cae Glas Road Landfill.

### **4.3 Pollution incidents**

- 4.3.1 Data on Category 1 & 2 Environmental Pollution Incidents sourced from NRW shows that there are no registered environmental pollution incidents identified within the Study Area (NRW, 2025).
- 4.3.2 However, the rectifier yard at Penrhos Substation is a known site of historical contamination following a transformer fire in 2008. As discussed in section 1.3.2, post remediation groundwater monitoring of the site concluded in 2021 and reported results concluded the agreed remedial aims of removal of free products and betterment of groundwater quality had been met. See Appendix A for further details.

### **4.4 Licensed discharges to groundwater**

- 4.4.1 No licensed discharges to groundwater have been identified within the study area (NRW, 2025)

## 4.5 Summary of Potential Contamination Sources

4.5.1 A summary of all identified potential sources of contamination is given below in Table 12 to Table 14. Derwyn Garage is the only current or historical land use that is thought to pose a significant degree of risk to controlled waters and environmental receptors through the construction of the Penrhos 132 kV Cable Replacement project.

### Landfill sites

4.5.2 Details of the current and historical landfill sites presented in those figures are summarised in Table 4-1.

**Table 12 Landfill sites (current & historical)**

| Site Name     | Distance from the proposed cable corridor     | Waste Type   | Landfill Status        | Notes   | Qualitative Risk Ranking | Justification  |
|---------------|---|--|------------------------|---|--------------------------|--|
| Cae Glas Road | 110m southwards from proposed cable corridor. | Inert, Industrial, Commercial, Household, Special. | Ceased operation 1980. | Contains potentially biodegradable 'household' waste. No known active monitoring. Registered with Isle of Anglesey Borough Council. | Low to moderate          | Possible biodegradable or contaminated waste mass, but situated on the 110m southwards and downgradient of cable corridor. |

### Fuel stations

4.5.3 Fuel stations represent a particular risk to land and groundwater quality. The details of three current garages identified in the study area are summarised in Table 13.

**Table 13 Summary of fuel stations within the study area**

| Name                    | Distance from the proposed cable corridor | Address   | Status | Qualitative Risk Ranking | Justification  |
|-------------------------|---|---|--------|--------------------------|--|
| Derwyn Garage           | Within proposed cable corridor.           | Derwyn Garage, Holyhead Road, Valley, Isle of Anglesey, Wales, LL65 3AF           | Open   | Moderate                 | On alignment of proposed cable corridor, currently active.                 |
| Dyffryn Service Station | 440m from proposed cable corridor.        | Dyffryn Service Station, Holyhead Road, Valley, Isle of Anglesey, Wales, LL65 3DP | Open   | Low                      | Located 440m away, down topographic gradient from proposed cable corridor. |
| Essar Service Station   | 550m from proposed cable corridor.        | Gwalia Service Station, Fford Caergybi, Valley, Isle of Anglesey, Wales, LL65 3DR | Open   | Low                      | Located 550m away, down topographic gradient from proposed cable corridor. |

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### Historical mining operations

4.5.4 Several historical mines have been identified from BGS reporting (BGS, 2020). These features are listed in Table 14 and shown in Figure 4-1.

**Table 14 Historical mines reported by the British Geological Survey**

| Name          | Position relative to search corridor | Status | Notes   | Qualitative Risk Ranking | Justification  |
|---------------|--------------------------------------|--------|---|--------------------------|--|
| Tre-gof       | Within 250m of cable corridor        | Closed | Type unknown. Likely been infilled by Cae Glas Road landfill. | Low to Moderate          | Within 250m of proposed cable corridor, extent of historical ground workings unknown.                                  |
| Penrhos       | Within 850m of cable corridor        | Closed | Type unknown.   | Low                      | Within 850m of proposed cable corridor. Raised from negligible to low as extent of historical ground workings unknown. |
| Glan-morfa    | Within 830m of cable corridor        | Closed | Type unknown.   | Low                      | Within 830m of proposed cable corridor. Raised from negligible to low as extent of historical ground workings unknown. |
| Valley Quarry | Within 820m of cable corridor        | Closed | Quarry  | Low                      | Within 820m of proposed cable corridor. Raised from negligible to low as extent of historical ground workings unknown. |

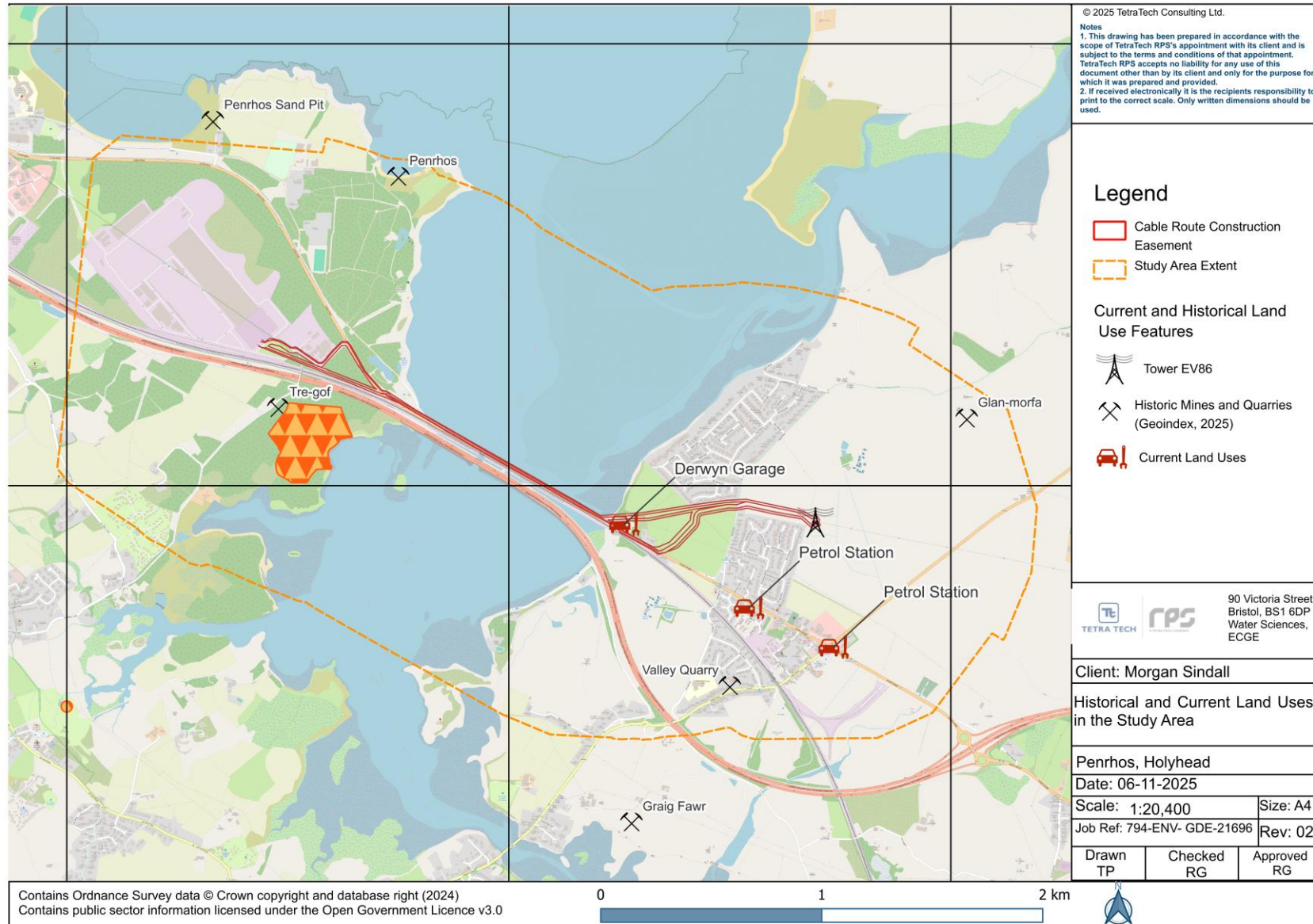


Figure 4-1 Historical and current land uses within the Study Area

## **5 Regulatory Information**

### **5.1 Land Report**

- 5.1.1 A Groundsure report on Penrhos Substation was commissioned in 2021 by WSP to support interpretative ground investigation reporting on the Penrhos Substation site with the aim of assessing the extent of any residual contamination following previous remedial works and to develop a ground model to support future construction works aiming to reestablish the substation site.
- 5.1.2 The Groundsure report is provided in Appendix K and has been used to inform this HIA.

### **5.2 Environmental Permitting**

- 5.2.1 Submission for an application for a groundwater abstraction licence to support the cable replacement works was made on the 8<sup>th</sup> of May 2025 to Natural Resources Wales. An associated application for a discharge consent was made on the 9<sup>th</sup> of May.
- 5.2.2 The purpose of these permit applications was to maintain excavations into the underlying aquifers during the installation of the new 132 kV transmission cables and lawfully discharge any abstracted groundwater and rainwater runoff back into the environment.

### **5.3 Regulatory Communications**

- 5.3.1 Preliminary consultation with NRW regarding advice on the submission of environmental permit applications was initiated on the 22<sup>nd</sup> of April 2025. No response was received however ahead of the initial groundwater abstraction license and associated discharge consent permit applications. It is expected that further consultation with NRW will be required in order for the permits to be duly made.

## 6 Preliminary Risk Assessment

### 6.1 Methodology

#### 6.1.1 Approach

6.1.1 The risk to identified controlled waters and environmental receptors is dependent on the probability that a hydrogeological pathway exists between the source and the proposed cable corridor or substation and the severity of the consequence (as a result of the construction activity) if the pathway exists. A qualitative risk ranking is assigned to each level of outcome using the risk matrix presented in Table 15.

**Table 15: Qualitative risk matrix for sensitive groundwater receptors. Criteria used to determine magnitude of consequence is laid out in Appendix L.**

| QUALITATIVE RISK MATRIX                           |                | Magnitude of consequence if pathway exists |                      |                      |                      |
|---|----------------|--|----------------------|----------------------|----------------------|
|   |                | High                                       | Medium               | Low                  | Negligible           |
| Probability that a hydrogeological pathway exists | Highly Likely  | Very High Risk                             | High Risk            | Moderate Risk        | Low to Moderate Risk |
|   | Likely         | High Risk                                  | Moderate Risk        | Low to Moderate Risk | Low Risk             |
|   | Low Likelihood | Moderate Risk                              | Low to Moderate Risk | Low Risk             | No Risk              |
|   | Unlikely       | Low to Moderate Risk                       | Low Risk             | No Risk              | No Risk              |

#### 6.1.2 Probability that a hydrogeological pathway exists

6.1.1 The probability that a hydrogeological pathway exists is based on the following criteria:

- **Highly Likely** – The groundwater receptor is known to be in same groundwater catchment and in a down hydraulic gradient position relative to the activity; and/or the groundwater flow path short; and/or the geological system is simple (e.g. shallow, sand and gravel aquifer in valley bottom); and/or the pathway proven in a more complex system.
- **Likely** – The groundwater receptor is expected to be in the same groundwater catchment and down-gradient to the construction activity; and/or it is a relatively simple geological / hydrogeological system / pathway; and/or it is a complex fractured system with known points of spring flow / discharge given position of source; and/or medium or short flow path.
- **Low Likelihood** – The groundwater receptor is unlikely to be situated in same groundwater catchment or is in an up hydraulic gradient or lateral position to the activity; and/or the geological / hydrogeological system / pathway is complex and tortuous (e.g. thick multi-layered aquifer; low and high permeability beds interbedded; fracture pathways etc); and/or simple geological system but supply source is known to be up hydraulic gradient or lateral position; and/or long flow path.
- **Unlikely** – The groundwater receptor is situated in a different groundwater catchment or up hydraulic gradient from construction activity; and/or pathway dominated by low permeability geological, units (mudstones / clays etc); and/or very long flow path.

### 6.1.3 Magnitude of consequence if pathway exists

6.1.1 The magnitude of a potential consequence from an activity should a pathway be thought to exist shall be related to the following:

- Characteristics of the pathway in terms of,
  - pathway length & flow mechanisms.
  - complexity / tortuosity of pathway & hydraulic continuity.
  - potential for attenuation.
  - the relative position of the receptor to the activity in the flow field.
  - possible travel time.
- Nature of the impact in terms of,
  - the magnitude / scale of effect (e.g. on flow, levels or water quality)
  - the duration of effect (permanent vs short term)

6.1.2 The magnitude of consequence is defined by the criteria laid out in Appendix L.

### 6.1.4 Certainty

6.1.1 The assessment also considers certainty in terms of the probability the pathway exists and the severity of outcome. This will be defined either low, medium or high.

6.1.2 The method has been designed to ensure the assessment is conservative and precautionary in nature. If the uncertainty is medium or high, it will be necessary to raise the risk ranking by a level of two (e.g. from 'Low Risk' to 'Low to Moderate Risk' or 'Moderate Risk').

## 6.2 Results

6.1 A summary of the risk assessment for the environmental receptors is provided in Table 6-2.

**Table 6-2 Hydrogeological risk assessment for environmental groundwater receptors within the Study Area**

| Receptor Name                                | Receptor Description                              | Horizontal Separation                    | Hydrogeology & Potential Pathway   | Qualitative Risk Ranking |            |                       |            |                      | Justification / Note   |
|--|---|--|--|--------------------------|------------|-----------------------|------------|----------------------|--|
|  |   | Source to CRC at closest point           |  | Pathway Probability      | Confidence | Consequence Magnitude | Confidence | Risk Class           |  |
| Penrhos Drumlin                              | RIGS  | Receptor c. 700m N of cable route.       | <ul style="list-style-type: none"> <li>The receptor is situated above the bedrock of the New Harbour Formation.</li> <li>The receptor is located a significant distance from the cable corridor and Substation site.</li> <li>The receptor is located hydraulic gradient from the cable corridor and Substation site.</li> </ul>   | Unlikely                 | High       | Negligible            | High       | No Risk              | The receptor is a RIGS site designated due to the presence of certain geological features. It has not been designated on the basis of groundwater. Additionally, the RIGS is located a significant distance from the cable corridor, up hydraulic gradient from the elevation of the scheme. |
| Private Water Supply on Lon Towyn Capel Road | PWS registered at address on Lon Towyn Capel Road | Source c. 1km SW of substation location. | <ul style="list-style-type: none"> <li>It is not known if the supply source receptor is situated above or below the topographic elevation of the cable route corridor and substation. Only the location of the registered address is known.</li> <li>The hydrogeological system is likely complex and tortuous due to fractured nature of the bedrock aquifer and heterogeneous nature of glacial till.</li> </ul> | Unlikely                 | High       | High                  | High       | Low to Moderate Risk | Hydraulic continuity between the substation site and the groundwater body feeding the supply cannot be discounted however magnitude of drawdown and associated radius of influence calculations predict no impact.<br><br>Adherence to a GSWMP.  |

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|  |                                     |   |   |               |      |            |      |                      |   |
|--|-------------------------------------|---|---|---------------|------|------------|------|----------------------|---|
| Ynys Mon Secondary Groundwater Body            | WFD defined groundwater body.       | Receptor directly underlies all landward sections of the cable corridor and substation. | <ul style="list-style-type: none"> <li>The receptor situated directly below the cable route corridor and substation.</li> <li>The construction activities will be situated directly above the groundwater body (same groundwater catchment). Relative to the proposed construction activities the groundwater body is considered to be situated down hydraulic gradient with very short flow pathways.</li> </ul> | Highly Likely | High | Low        | Low  | Low Risk             | <p>Hydraulic continuity between the cable trench dewatering activities and the groundwater body is likely. However, the magnitude of any impacts on the groundwater body are expected to be low due to low volumes of potential effluent. Additionally, the risk is considered more likely to relate to water quality through accidental emission than impacts on levels or flow, given the small drawdown that would be caused by cable trench dewatering and its temporary nature.</p> <p>Due to identified arsenic and PAH contamination, recovery and disposal of any groundwater in the vicinity of Derwyn Garage is required to be contained for off site disposal to an appropriately licensed waste management facility.</p> <p>Contol measures will be in place via GSWMP.</p> |
| Beddmanarch-Cymyran SSSI                       | Site of Special Scientific Interest | Within the proposed cable corridor.   | <ul style="list-style-type: none"> <li>The receptor is known to be in the same groundwater catchment and received discharges from highways drains along Stanley Embankment</li> </ul>   | Highly Likely | High | Negligible | High | Low to Moderate Risk | <p>It is anticipated that all effluent generated from the scheme will be composed of rainfall run off and abstracted groundwater. However, there is the potential for contaminated water to be present in the trenches containing the pre-existing cables along Stanley Embankment. No unpermitted discharges will take place be permitted. Risk management will include mandatory testing for all water prior to discharge into the SSSI. Risk shall be appropriately managed through application of a</p>   |
| Beddmanacrh Bay Shellfish Water Protected Area | Shellfish Waters Protected Area     | Adjacent to (0m) from the proposed cable corridor.                                      |   | Highly Likely | High | Negligible | High | Low to Moderate Risk |   |

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|  |  |  |  |  |  |  |  |  |   |
|--|--|--|--|--|--|--|--|--|---|
|  |  |  |  |  |  |  |  |  | Ground and Surface Water Management Plan. |
|--|--|--|--|--|--|--|--|--|---|

## 7 Conclusion

- 7.1.1 Following an application, accompanied by a preliminary Hydrogeological Risk Assessment (HIA), for a groundwater transfer licence and associate discharge consent for the proposed electricity grid upgrades at Penrhos, NRW requested further information to be provided via an updated HIA to take account of additional borehole evidence following a planned ground investigation including the acquisition of groundwater quality data.
- 7.1.2 This HIA updates the hydrogeological conceptual model and associated risk assessment previously presented and refines the estimation of reasonably worst-case dewatering flow rates required to dewater the cable trenches. These calculations used a dewatering depth of 2 metres, being 0.5 metres below the nominal trench working depth requirement of 1.5 metres. A hydraulic conductivity value of  $1 \times 10^{-4}$  m/s was used based on an inspection of the shallows geology encountered by the ground investigation to be reasonably precautionary of the presence of saturated layers of gravel identified within shallow soils.
- 7.1.3 Analytical testing of groundwater identified no constraints to water management with the exception of the Derwyn Garage at the eastern end of the embankment where arsenic and poly nuclear aromatic hydrocarbons were identified above Drinking Water Standards. It is recommended any groundwater recovered during trench dewatering in this area is contained for off-site disposal to an appropriately licensed waste management facility.
- 7.1.4 A precautionary dewatering rate was calculated for each 20 metres of trench considered representative of a daily rate of progress for trenching. This gave a daily abstraction rate of 71 m<sup>3</sup>/day. A refined zone of influence calculation was also undertaken giving a distance of 10 metres.
- 7.1.5 On the basis of these calculations, it is concluded that no significant risk of adverse impact is expected on the sensitive groundwater and surface water receptors identified within the HIA.
- 7.1.6 A Water Management Plan and a Protection of Controlled Waters Plan have been provided to demonstrate good working practices that will be followed for the control of the proposed works to prevent impact on water resources.

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## Appendices



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**Appendix C** WSP  
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**Appendix E** Morgan  
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