Bute Energy
Aberedw Energy Park

Appendix 9.4:

Outline Drainage Strategy

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1. Introduction

1.1. Instruction

Aqua Terra Consultants Ltd was instructed by Land Use Consultants Ltd (LUC; the Client) on behalf of Aberedw Energy Park Limited (the Applicant) to provide an Outline Drainage Strategy for the proposed Aberedw Energy Park near Builth Wells (the Site). Instruction to proceed in accordance with Aqua Terra Consultants Work Scope was confirmed by LUC sub-consultant agreement 12522.

1.2. Background

The Applicant proposes to submit an application to Planning and Environment Decisions Wales (PEDW) for a Development of National Significance (DNS) consent under section 62D of the Town and Country Planning Act 1990 to develop Aberedw Energy Park (hereafter referred to as 'the Proposed Development') at the Site. The Site is located approximately 3 km east of Builth Wells. The entirety of the Site lies within Powys.

18 wind turbines and associated infrastructure are proposed to be constructed. Plans of the Proposed Development are included in Section **Error! Reference source not found.**.

This report constitutes an Outline Drainage Strategy that has been prepared to support the DNS application for the Proposed Development.

1.3. Scope of the report

The scope of this assessment is to produce an outline Sustainable urban Drainage System (SuDS) strategy to mitigate a potential increase in runoff and deterioration in water quality as well as consider the potential biodiversity and amenity benefits a SuDS scheme could provide, as a result of the Proposed Development. The report will also form the basis of a Suds Approving Body (SAB) application for the Site.

1.4. Data sources

The main sources of data utilised in this assessment are summarised below:

- Site development plans provided by the Applicant;
- Aberedw Energy Park Scoping Direction (**Appendix 2.2** of the ES);
- NRW flood map for planning datasets;
- Statutory standards for sustainable drainage systems (Welsh Government, 2018);
- LiDAR digital terrain model (DTM) data;
- Hydrological descriptor data from the Flood Estimation Handbook (FEH) website (UK Centre for Ecology & Hydrology, 2025);
- Ordnance Survey mapping; and,
- British Geological Survey (BGS) mapping data and borehole logs.

1.5. Limitations

2. This report is written strictly for the benefit of the Client and bound by the conditions presented in Appendix A.Site setting

2.1. Site description

The Site is located approximately 3 km east of Builth Wells, and is 1322.55 hectares in size. The entirety of the Site lies within Powys. The national grid reference for the approximate Site centre is SO 09397 51302.

The Site is located between the A481 (to the north of the Site boundary) and the B4567 (to the west of the Site boundary). The River Wye runs north to south just west of the Site.

The Site is located on high terrain, with the highest point being 451 m Above Ordnance Datum (AOD). It is generally defined by Aberedw Hill which is a broad hill, with steep escarpments/slopes and valleys on all sides. The deepest valley is to the west of the Site is the River Wye Valley. The majority of the Site is made up of undulating upland which is managed as open moor common land, with a small number of access tracks and small areas of scrub woodland.

Around the Site there are areas of ancient woodland, with the majority being classed as ancient seminatural woodland. BGS mapping indicates two small outcrops of peat on the Site, one across a small area of upland plateau at the peak of Aberedw Hill, and a second small patch on the upland plateau of the adjacent lobe of hill to the east.

The Site is surrounded by countryside with a few isolated settlements. Besides Builth Wells, other smaller settlements such as Hundred House (to the north of the Site), Cregina (to the east of the north-eastern edge of the Site) and Aberedw (to the south of the Site) are also located nearby. In addition, there are other roadside clusters and farmsteads, as well as more isolated properties on the surrounding hills and valley slopes.

Error! Not a valid bookmark self-reference. provides the Site location and an aerial image of the Site showing the current layout and condition. Figure 2-2 provides a typical photo of the Site.

Figure 2-1 Site location

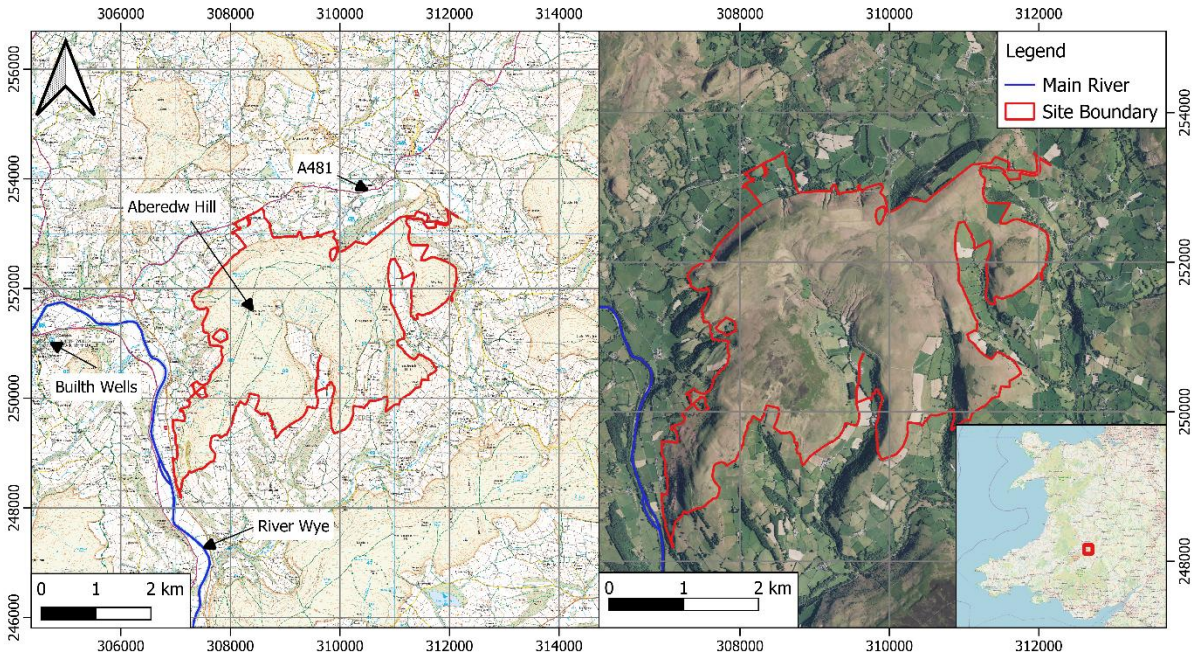
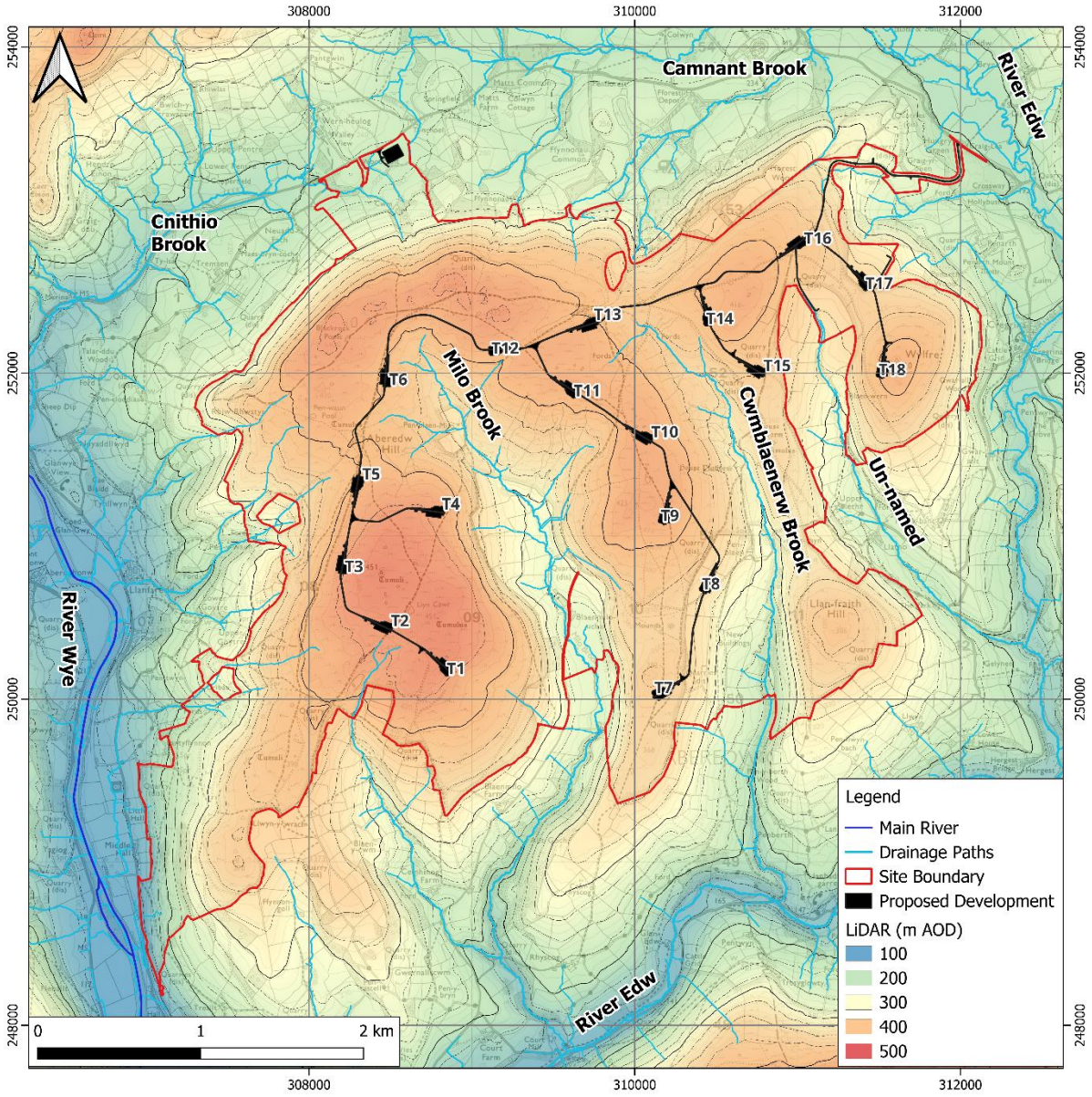


Figure 2-2 Photo of the Site

2.2. Topography

The Site is 1323.22 hectares in size, and the ground elevation falls from the peak elevations of the upland summits (at a maximum of approximately 451 m above Ordnance Datum (m aOD) to the lower elevations in the west (at the River Wye Valley) at approximately 130 m aOD. Figure 2-3 shows the latest 2020-2022 LiDAR data, along with a detailed drainage network derived from the LiDAR data.

Figure 2-3 Topography and Drainage Paths



2.3. Current drainage arrangements

There are several small watercourses present across the Site, the majority of which drain to the River Edw. A small area at the north of the Site is drained to the River Wye via Cnithio Brook and the western edge of the Site direct to the River Wye. All three catchments have a good overall status as identified by the Water Framework Directive (WFD). The River Edw is a tributary of the River Wye, with the River Edw joining the River Wye 1.35 km south of the Site in Aberedw.

Headwaters of the Rive Edw that drain the Site include the tributaries of Cwmblaenerw Brook and the tributaries of Milo Brook which follow the two valleys which extend southwards between Aberedw Hill and Llan-Fraith Hill. There is also a third un-named watercourse to the east of Cwmblaenerw Brook which drains in a north-south direction towards the River Edw. The headwaters of Cwmblaenerw Brook and Milo Brook are fed by a number of springs noted during Site surveys. A small portion of the north east of the Site drains to the River Edw via Camnant Brook.

In addition to these watercourses, the Site has several small discrete pools and ponds, many of which are man-made. These are typically located within topographical hollows within the upland landscape, the largest being Llyn Cawr, approximately 70 m in length on Aberedw Hill.

Figure 2- shows the drainage paths across the Site based on analysis of topographic data. The majority of the drainage paths are not formal watercourses, but rather gullies along which flow is likely to accumulate. However, during periods of heavy rain these may begin to form overland flow routes towards the more established watercourses.

Table 2-1 presents the FEH catchment descriptors for the Site.

Table 2-1 Hydrological descriptors for representative part of the Site

Descriptor	Abbreviation	Value
Base Flow Index associated with each HOST soil class	BFIHOST	0.462
Proportion of time when soil moisture deficit was equal to, or below, 6mm during 1961-90	PROPWET	0.49
Average Annual Rainfall (1961 – 1990)	SAAR	1018mm

2.4. Geology and hydrogeology

The following information has been compiled from the British Geological Survey (BGS) 1:50,000 scale mapping and the Cranfield University Soilscapes online soil mapping database.

2.4.1. Geology and soils

2.4.1.1. Soils

Soilscapes online mapping (Cranfield Soil and AgriFood Institute, 2023) indicates that the majority of the study area is underlain by very freely draining acid loamy soils over rock. An area in the centre of the Site (around the headwaters of Milo Brook) is classified as having slowly permeably wet very acid upland soils with a peaty surface, whilst the Milo Brook valley itself is classified as a slowly permeable seasonally wet acid loamy and clayey sails. A small area on the top of Aberedw Hill is described as Very acid loamy upland soils with a wet peaty surface.

Soils are discussed in more detail in the Outline Soil Management Plan (Appendix 9.5 of the ES).

2.4.1.2. Superficial deposits

BGS mapping indicates Superficial Deposits on Site mainly comprise of Glacial Till, which outcrops across lower elevations, and is present across the agricultural fields at the northern most point of Site and within the two valleys which extend southwards between Aberedw Hill and Llan-fraith Hill. There is also a small linear deposit of Head associated with Milo Brook at the south of the Site, a small outcrop of alluvium at the north of the Site near the A481 and two small deposits of peat towards the centre of the Site.

Phase 1 (May 2023) and 2 (March 2025) peat and soil probing has been undertaken during which three small discrete areas of peaty loam were identified, peat was noted to be absent from Site. Two of these areas lie along Cwmblaenerw Brook and the third lies south-west of the BGS mapped peat at the centre of Site.

2.4.1.3. Bedrock

The Site spans across British Geological Survey (BGS) Sheet 197 (Hay-on-Wye) and Sheet 196 (Builth Wells). The two sheets have differing detail of mapping, resulting in more detailed mapping being available for the west of the Site than the east. The bedrock in the east of the Site is simply mapped as Silurian Rocks (undifferentiated). However, the west of the Site is mapped (from north to south) as the Builth Mudstone Formation, the Irfon Formation (mudstone and siltstone), Irfon Formation (slumped mudstone and slumped siltstone), and the Cwm Graig Ddu Formation (mudstone, siltstone and sandstone), all of which are of Silurian age.

2.4.2. Hydrogeology

The bedrock across Site is classified by NRW as a Secondary B aquifer. A Secondary B aquifer is defined as *'predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering'*. The aquifer underlying the Site is rated as being "low productivity".

The superficial Glacial Till which covers the very northern extent of the Site and the two valleys which extend southwards between Aberedw Hill and Llan-fraith Hill, and the Head Deposit associated with Milo Brook, are classified as Secondary (undifferentiated) aquifers. These are aquifers where it is not possible to apply either a Secondary A or B definition because of the variable characteristics of the rock type, they have only a minor value.

The Alluvium deposit which outcrops in the north of the Site is classified as a Secondary A aquifer. This comprises of permeable layers that can support local water supplies and may form an important source of base flow to rivers.

According to the BGS, groundwater vulnerability across the majority of the Site is medium to high.

Numerous springs were noted during a Site visit by Aqua Terra. These form the headwaters to the streams that flow off the flanks of the upland areas. Many of these springs are located at the base of very incised, deep valley features, and in such cases are likely fed by a combination of groundwater baseflow and soil throughflow. Contrastingly, where springs are present on the upland plateau area, based on the geology and topography, these are considered more likely sourced from soil throughflow, with some of them having notably wetter catchment areas within the upland plateau itself.

The Site is not within a Source Protection Zone.

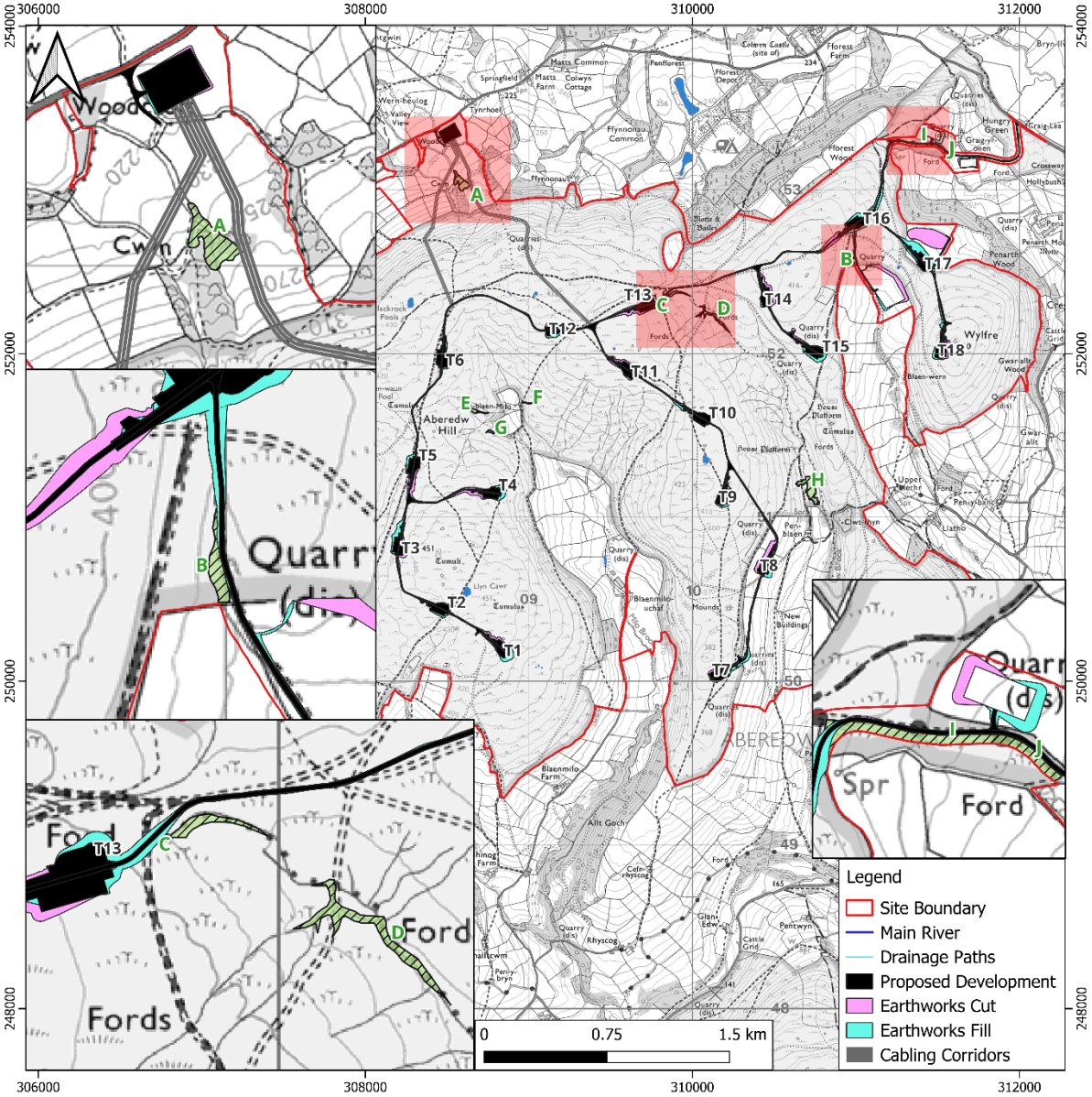
2.4.3. Infiltration capacity

The majority of the Site is covered by 'very freely draining acid loamy soils' and therefore there is potential for infiltration. Infiltration testing will be undertaken on Site post consent and prior to detailed design of the drainage strategy to determine the infiltration values across the Site where infrastructure is being proposed.

2.5. Groundwater dependent terrestrial ecosystems

As part of the environmental surveys undertaken on Site, a number of groundwater dependent terrestrial ecosystems (GWDTEs) have been identified. These are wetlands that appear to receive a moderate or high proportion of their water from groundwater, and therefore any alterations to the drainage of the Site will need to ensure that the flow to these ecosystems is maintained in as close to the existing natural processes as possible. Figure 2--4 shows the location of these GWDTEs with the proposed earthworks cut and fill locations included for reference.

Figure 2-4 Location of GWDTEs identified during Water Resources Risk Assessment



3. Proposed Development

Full details of the Proposed Development are described in detail in Chapter 4 of the Environmental Statement and summary information relevant to this Outline Drainage Strategy is presented below.

3.1. Design

The Proposed Development is described in detail in Chapter 4 of the Environmental Statement.

Figure 3-1 shows the proposed layout of the permanent features on the Site, including turbines, substation and tracks. A single watercourse crossing is required immediately adjacent to the substation where the access track passes over a surface water flow path – although no permanent watercourse is present here. It will also be necessary for the cable corridors to cross three ephemeral streams. The cables are proposed to be laid underground, with existing topsoil replaced following installation, and this will take place in the summer when the streams are likely to be dry.

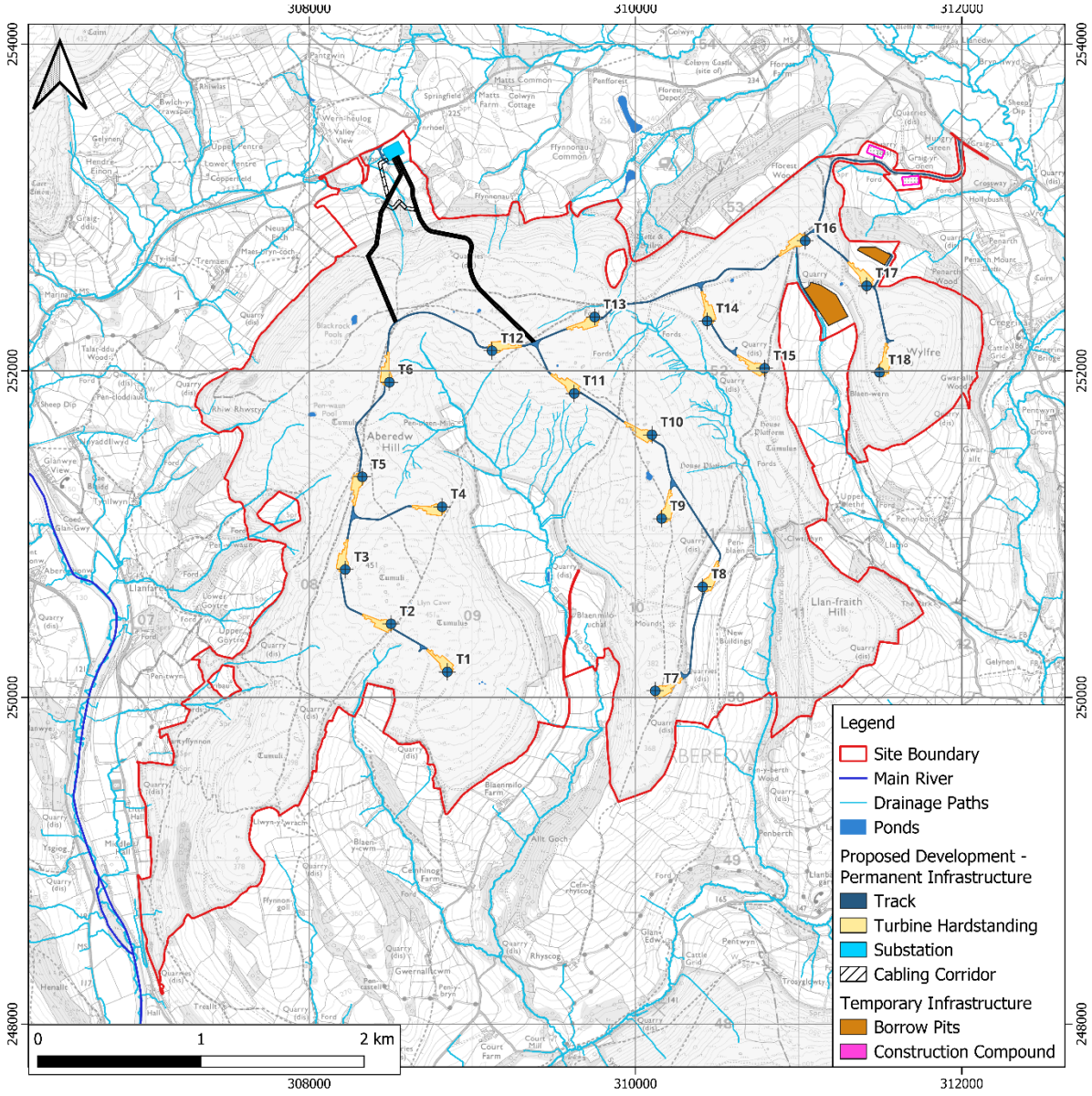
3.2. Programme

The overall construction programme is expected to take approximately 15 months

The Proposed Development will be operational for a period of 40 years. During this period, onsite activity would be low and would consist of regularly scheduled maintenance and operational checks.

At the end of the operation period, the Proposed Development would be decommissioned and the turbines removed. There may be potential to extend the life of the Proposed Development or replace the turbines, which would be the subject of a future study/ application.

Figure 3-1 Proposed site layout



4. Sustainable Drainage Strategy

4.1. Introduction

The following sections describe the SuDS Strategy for the Proposed Development with due regard to the National Planning Policy Wales (Welsh Government, 2024), the Statutory Standards for sustainable drainage systems (Welsh Government, 2018), and the CIRIA SuDS Manual (CIRIA, 2015). The Statutory Standards for sustainable drainage recommends the following hierarchy for the disposal of surface water from new developments:

- Priority Level 1: Surface water runoff is collected for use (most preferred).
- Priority Level 2: Surface water runoff is infiltrated to ground.
- Priority Level 3: Surface water runoff is discharged to a surface water body.
- Priority Level 4: Surface water runoff is discharged to a surface water sewer, highway drain, or another drainage system.
- Priority Level 5: Surface water runoff is discharged to a combined sewer. (least preferred).

In order to be permitted to discharge to a lower priority destination, one or more exception criteria need to be demonstrated for each higher priority level.

The Proposed Development will be located on previously undeveloped, 'greenfield' land. A proportion of the Site will comprise impermeable areas following its development (tracks, turbine footprints, hardstandings and substation components). Without appropriate management, this would result in an increase in both the volume and rate of surface runoff generated by the Site, which could lead to an increase in surface water flood risk elsewhere (i.e. downstream). This could also lead to re-direction of surface water, and groundwater flow routes away from or towards areas that have been identified as GWDTEs.

There is no foreseeable demand for non-potable water on the Site throughout its design life as on-site activity will be low, and would consist of regular maintenance and operation checks only. Therefore priority level 1 (collected for use) is not considered a viable option.

Surface runoff from the Proposed Development will be sustainably managed using SuDS, as described in the following sections. SuDS aim to mimic the natural drainage characteristics of a site prior to its development by controlling surface water runoff as close to where the rain falls as possible e.g. through interceptions and re-use, evaporation and infiltration into the ground. Furthermore, SuDS provide opportunities to remove pollutants from runoff and can also provide biodiversity benefits. All surface water on Site will be managed by infiltration into the ground.

4.2. Permissible discharge rates

The proportion of rainfall diverted to overland flow is a function of several key factors, including: slope gradient; soil type and land cover type. There are numerous methodologies for calculating runoff rates and volumes for a given catchment and the suitability depends upon the catchment characteristics.

The Statutory National Standards for Sustainable Drainage Systems specifies the following requirements under Standard S2 – Surface water runoff hydraulic control:

S2.1) Surface water will be managed to prevent, so far as possible, any discharge from the site for the majority of rainfall events of less than 5mm.

S2.2) The surface water runoff rate for the 1 in 1 year return period event (or agreed equivalent) will be controlled to help mitigate the negative impacts of the development runoff on the morphology and associated ecology of the receiving surface water bodies.

S2.3) The surface water runoff (rate and volume) for the 1% (1 in 100 year) return period event (or agreed equivalent) will be controlled to help mitigate negative impacts of the development in flood risk in the receiving water body.

S2.4) The surface water runoff for events up to the 1% (1 in 100 year) return period (or agreed equivalent) will be managed to protect people and property on and adjacent to the site from flooding from the drainage system.

S2.5) The risk (both on site and off site) associated with the surface water runoff for events greater than the 1% (1 in 100 year) return period will be considered. Where consequences are excessive in terms of social disruption, damage or risk to life, mitigating proposals will be developed to reduce these impacts.

S2.6) Drainage design proposal will be examined for the likelihood and consequence of any potential failure scenarios (e.g. structural failure of blockage), and the associated flood risk managed where possible.

In the context of the Proposed Development, the following guidance from the Statutory National Standards for Sustainable Drainage Systems has been followed:

- To address S2.1, as per G2.15, an approved method from Table G2.1 will be adopted for all infrastructure on Site to ensure zero runoff for the first 5mm rainfall for 80% of events during the summer and 50% in winter. (See section 4.5).
- To address S2.2, as per G2.17 all tracks that could cutoff any cross-drainage towards GWDTEs will be designed to allow the 1:1 year greenfield runoff rate to pass through them, thereby sustaining the existing morphological and ecological status. Remaining infrastructure will not discharge additional volume above greenfield runoff volumes to surface water bodies, but infiltrate to ground. (See section 4.5).
- To address S2.3 and S.4, infrastructure on site will not discharge additional volume above greenfield runoff volumes to surface water bodies up to and including the 1 in 100 year event, but infiltrate additional volume to ground. (See section 4.5).
- To address S2.5 an assessment of exceedance routes will be undertaken (See section 4.8).
- To address S2.6 the detailed SuDS design will include maintenance proposals.

4.3. Greenfield runoff rates and volumes

The ReFH2 method has been used to determine greenfield runoff rates for the substation and turbine hardstanding areas. This has been calculated as per the guidance using a 50 ha plot, and scaling down. The runoff rates are presented in

Table 4-1 and are based on the catchment descriptors presented in Table 2-1.

Table 4-1 Greenfield runoff rates for Substation and Turbines

Return period (yrs)	Runoff rate Substation (l/s) 0.88 ha	Runoff rate Turbine (l/s) 0.8 ha
1	4.1	3.8
2	4.7	4.3
30	10.3	9.4
100	13.1	11.9

4.4. Climate change

The potential increase in rainfall intensity needs to be considered when designing drainage strategies. The recommended allowances for rainfall intensity 'Flood Consequences Assessments: Climate change allowances' (Welsh Government Planning Policy Branch, 2021) are included in Table 4-2.

Table 4-2 Change to extreme rainfall intensity (compared to 1961-90 baseline)

Applies across all of Wales	Total potential change anticipated for 2020s (2015 – 2039)	Total potential change anticipated for 2050s (2040 – 2069)	Total potential change anticipated for 2080s (2070 – 2115)
Upper estimate	10%	20%	**40%**
Central estimate	5%	10%	20%

The climate change allowance guidance states that drainage systems will be designed to ensure there is no increase in site run-off when assessed against the upper estimate. The Proposed Development is likely to be operational for 40 years, (approximately 2068). It would therefore be conservative to assume a 40% increase in rainfall intensity.

4.5. SuDS features design

4.5.1. Track drainage

Access tracks will be served by a network of surface water infiltration trenches. The trenches will be sized as part of the detailed design to accommodate the runoff during a 1 in 30 year event, utilising

relief drains crossing the access track at regular intervals to ensure no surcharging. The trenches will be designed to hold as a minimum the first 5 mm of rainfall without spilling into the relief drains.

The following considerations will be incorporated into the detailed design:

- Trenches will be sufficiently wide to allow wildlife to safely enter and exit the channel.
- The banks will have a minimum slope of 1 in 2.
- Permanent check dams will be specified that will reduce the velocity, slow down sediment transport, and allow for improved infiltration by holding water back upstream of them.
- The spacing of relief drains will not exceed 200m, and will be more frequently spaced where the access tracks intersect a flow path towards a GWDTE.

Example typical track formation construction drawings are provided in Appendix B.

4.5.2. Watercourse crossings

One watercourse crossing has been identified where the access track to the sub-station crosses a dry gully that could represent a flow path during times of heavy rainfall. The watercourse crossing will be designed to maintain, and not reduce, the existing capacity of the flow path and will be sized as part of the detailed drainage study using runoff calculations to inform dimensions. A single span structure is likely to be sufficient, comprising a ring or box culvert, laid into natural ground to maintain existing hydromorphology. The watercourse crossing will be designed to maintain a self-cleansing velocity during the 1 in 30 year event.

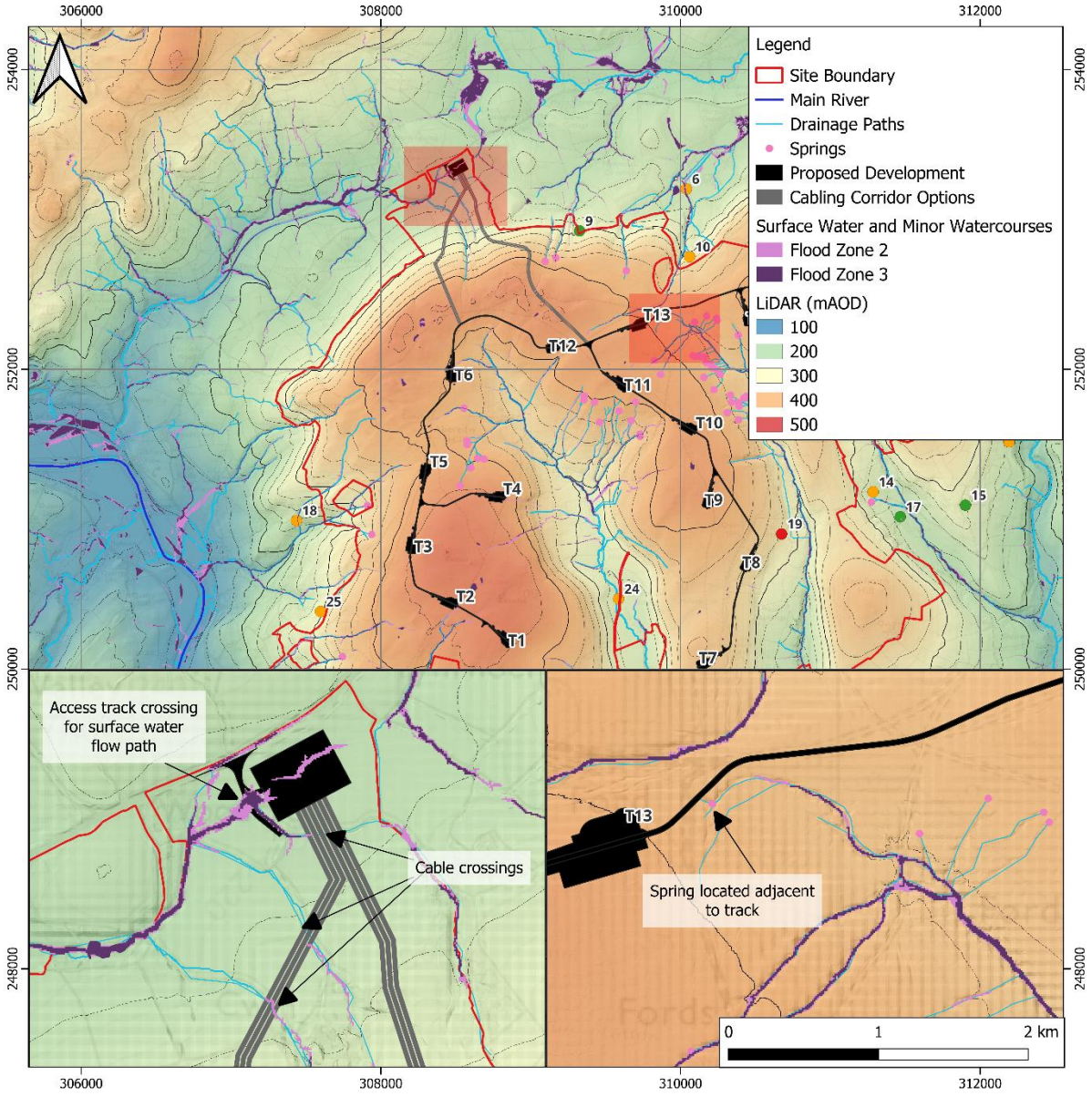
The proposed cable crossing routes cross 3 ephemeral watercourses. The cables are proposed to be underlain underground, and will be laid during the dry season when there is unlikely to be any flow and top soil can be reinstated to maintain existing conditions.

The track immediately to the east of T13 passes very close upslope of a spring, and it may be necessary to provide a watercourse crossing at this location to minimise potential impact to the spring. This potential watercourse crossing is discussed in more detail in Section 4.6 as the spring feeds a GWDTE.

Potential watercourse crossing locations are shown in

Figure 4-1, and a typical watercourse crossing construction drawings are provided in Appendix C.

Figure 4-1 Watercourse crossings



4.5.3. Substation

The substation, covering an area of 0.88 hectares (80 m x 110 m) will consist of transformer stations, raised above ground level on concrete block piles, located on and surrounded by a crushed stone/ gravel base to provide compensatory capacity and permit infiltration of stored water. Whilst not all the substation footprint will be impermeable – the full area is likely to constitute a crushed stone / gravel base, used for storage and infiltration of runoff. Therefore the full 0.88 hectares has

been used to assess runoff volumes to determine the required storage capacity within the crushed stone/ gravel base.

ReFH2 has been used to calculate greenfield (present day) and post development (incorporating climate change allowance) runoff volumes for the 1 in 100 year 6 hour storm duration including climate change, which has a rainfall depth of 81 mm. As no discharge to surface water bodies is proposed, the full 1 in 100 year 6 hour storm duration runoff would need to be stored on Site and allowed to infiltrate.

The total volume from the first 5mm of rainfall has also been calculated to confirm that there is adequate capacity to satisfy S2.1 under the National Standards for Sustainable Drainage.

Table 4-3 Substation runoff volumes

Event	Design depth rainfall (present day) (mm)	Runoff volume (greenfield present day) (m^3)	Runoff volume (Post development, present day) (m^3)	Runoff volume (Post development, inc climate change) (m^3)
First 5mm of any event	5mm			44
1 in 100 year 6 hour storm duration	81mm	189	511	715

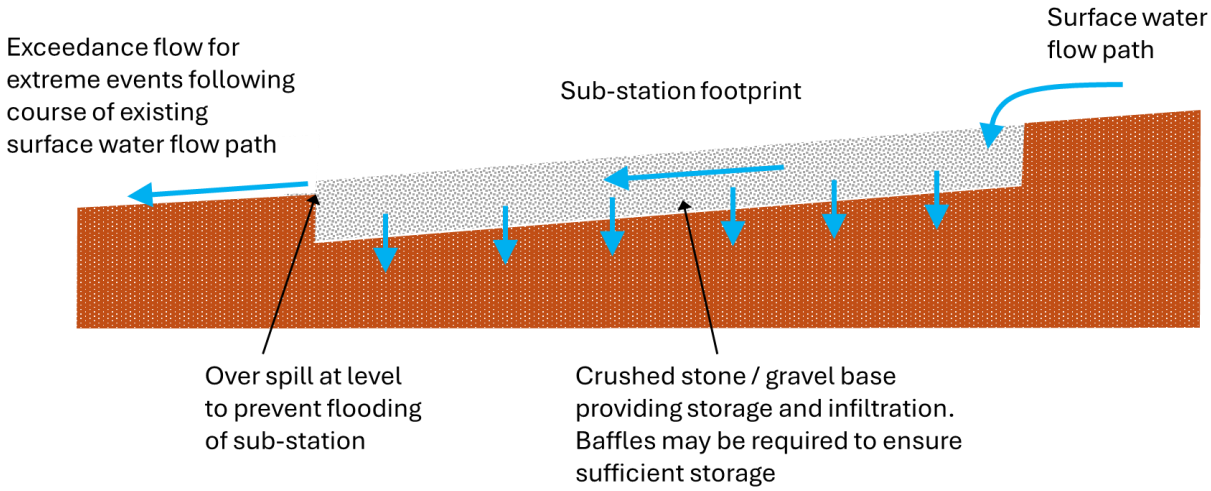
A storage capacity of 715 m^3 will therefore be incorporated into the crushed stone/ gravel base to allow for storage and infiltration of runoff during the 1 in 100 year, 6 hour storm.

The surface water and minor watercourses flood map for planning identifies that the substation is located over an area of Zone 2 flood risk – therefore at risk of flooding during events greater than the 1 in 100 year with climate change event. In order to maintain the existing flow path through the Site, ensure sufficient storage capacity during the 1 in 100 year event and manage flood risk on Site, it is proposed that:

- The site levels allow for the surface water flow path to filter through the crushed stone / gravel base.
- Flow in the crushed stone / gravel base can spill to the west once a defined level is met, with the spill location reflecting the existing exit location for the surface water flow path
- The crushed stone / gravel base has 715 m^3 of storage available below the spill level to ensure the equivalent volume of the 1 in 100 year event with climate change is maintained onsite and allowed to infiltrate.
- The crushed stone / gravel continues above the spill level to ensure that the ground levels on the sub-station are maintained flood-free.

Detailed design for the above, including proposed levels will be determined during the detailed design phase, however an indicative diagram is provided in Figure 4-2.

Figure 4-2 Indicative sub-station drainage design



4.5.4. Turbine hardstandings

For each turbine a hardstanding area of approximately 8,000 m^2 (0.8 Ha) is proposed for the foundations. The proportion of this which will become permanent impervious surface may be reduced at detailed design stage, however outline design has assumed the full hardstanding area is impervious. It is proposed that interception drains are placed at the downslope of the hardstandings, intercepting and attenuating runoff. Table 4-4 details the required storage volumes for each turbine.

Table 4-4 Turbine runoff volumes

Event	Design depth rainfall (present day) (mm)	Runoff volume (greenfield present day) (m^3)	Runoff volume (Post development, present day) (m^3)	Runoff volume (Post development, inc climate change) (m^3)
First 5mm of any event	5mm			40
1 in 100 year 6 hour storm duration	81mm	172	464	650

The interception drain will therefore need to have capacity for 650 m^3. It is proposed that the drains are designed to allow water spilling over a designed weir section to provide erosion protection during extreme events. The location of the interception drain and overspill weir will be given careful consideration in areas where turbine hardstands are situated on slopes, to ensure that shallow soil stability is not adversely impacted.

4.6. Maintaining flow to GWDTEs

The Water Resources Assessment (**Appendix 9.2** of the ES) identified four key locations where the flow path towards a GWDTE is at risk of being impacted/ impeded unless mitigation measures are

implemented. This assessment has been undertaken using guidance from SEPA (Scottish Environment Protection Agency, 2017) and has identified GWDTEs within 250 m of any excavations greater than 1m in depth.

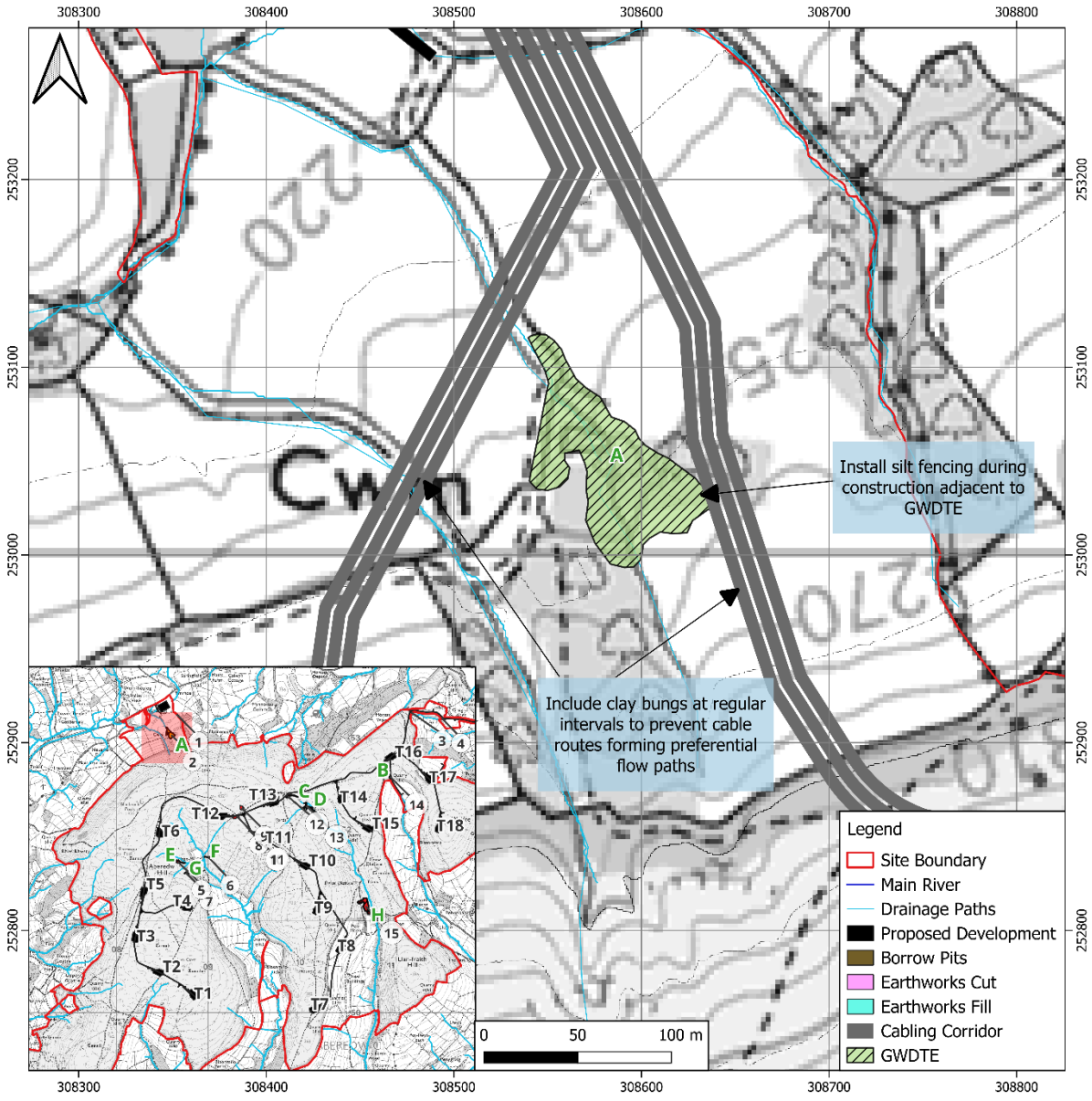
The following sections explain the mitigation proposed for each of the GWDTEs that are considered to be at risk. GWDTEs E, F, G and H were all considered to not be at risk (See **Appendix 9.2** of the ES for further discussion).

4.6.1. GWDTE A

GWDTE A (see

Figure 4-3) is located between two cable corridors. There is potential for the cable corridors to become preferential flow pathways for flow heading towards the watercourse and springs that feed the GWDTE. Mitigation measures include incorporating clay bungs at regular intervals to prevent the cable routes becoming a preferential flow path, and installing silt fencing adjacent to the GWDTE during the construction period. If micro-siting allows, the cable corridor to the east should also be moved as far as possible away from the GWDTE.

Figure 4-3 GWDTE A – Mitigation options



4.6.2. GWDTE B

GWDTE B (see

Figure 4-4) is located to the south and on the downslope of T16. There is potential for the cut on the south eastern side of T16 to provide a preferential pathway in a more north easterly direction than

the baseline. This will be monitored, and if required a drain provided at the base of the cut to direct the flow to the east and towards the drainage path that feeds the GWDTE.

The borrow pit to the south of the GWDTE is at a lower elevation, and whilst the cut on the eastern side of the borrow pit may provide a preferential path for groundwater flow from the east, this is unlikely to reduce flow towards the GWDTE. The track towards the borrow pit, whilst passing very close to the GWDTE (and its associated watercourse), is along the course of an existing track, and does not involve any cuts, therefore impact on flow regime to the GWDTE is likely to be limited if drainage through the track is maintained as per the existing scenario. The GWDTE is primarily fed from the hillside to the west of the proposed track and not from drainage passing through the track to the east.

It is recommended that the CEMP includes measures such as silt fencing along the side of the track to prevent any silt laden runoff from entering the watercourse or GWDTE, and if micro-siting allows, the track is moved further to the east.

4.6.3. GWDTE C & D

GWDTEs C and D (see Figure 4-5) are located to the south east and downslope of turbine T13. An access track cuts across the top of the saddle to the north of both GWDTEs, and T14 is located upslope to the north east of GWDTE D.

The access track eastwards from T13 lies very close a spring that feeds GWDTE C. Whilst the proposed earthworks in this area are fill rather than cut, it will be necessary to ensure that the fill does not contaminate flow emanating from the spring. A watercourse crossing, or similar construction with open base may be required to distance the fill away from the spring.

There is potential for the cut on the south western side of T13 to provide a preferential pathway for flow. This is likely to naturally direct flow towards the drainage pathway leading into the GWDTE, however if required, based on monitoring, a drain at the base of the cut will be provided to direct the flow towards GWDTE C.

GWDTE D has multiple flow sources including outflow from GWDTE C – therefore the mitigation measures described for GWDTE C will also mitigate impact from T13 to GWDTE D. The track north of GWDTE D is unlikely to impact on flow to the GWDTE as it lies along the top of the saddle and therefore groundwater and sub-surface flow through the track will be limited. The closest cut on T14 to the north east of GWDTE D is over 250 m distant and it is therefore unlikely to have an impact on flow towards the GWDTE.

Figure 4-4 GWDTE B – Mitigation options

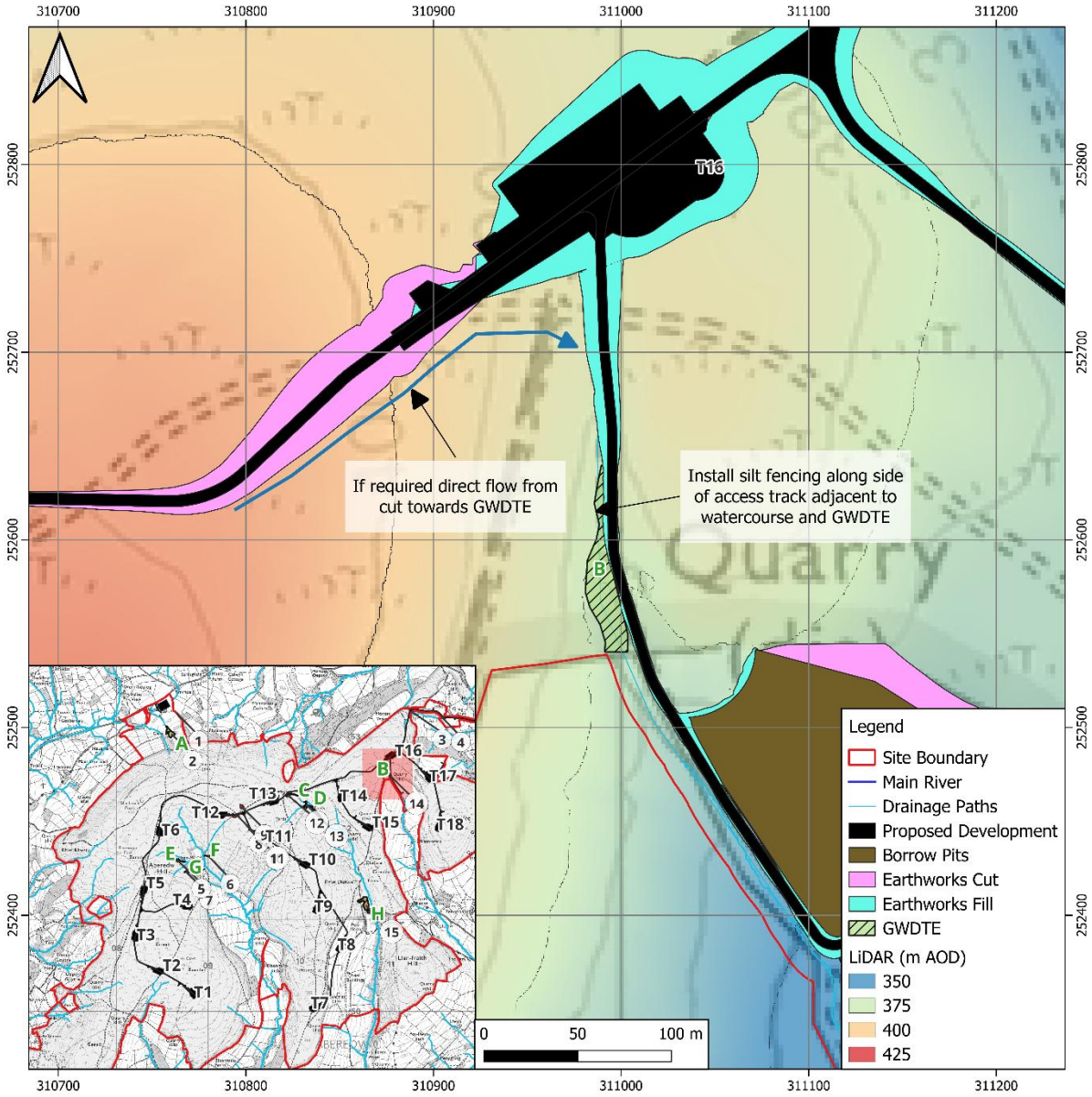
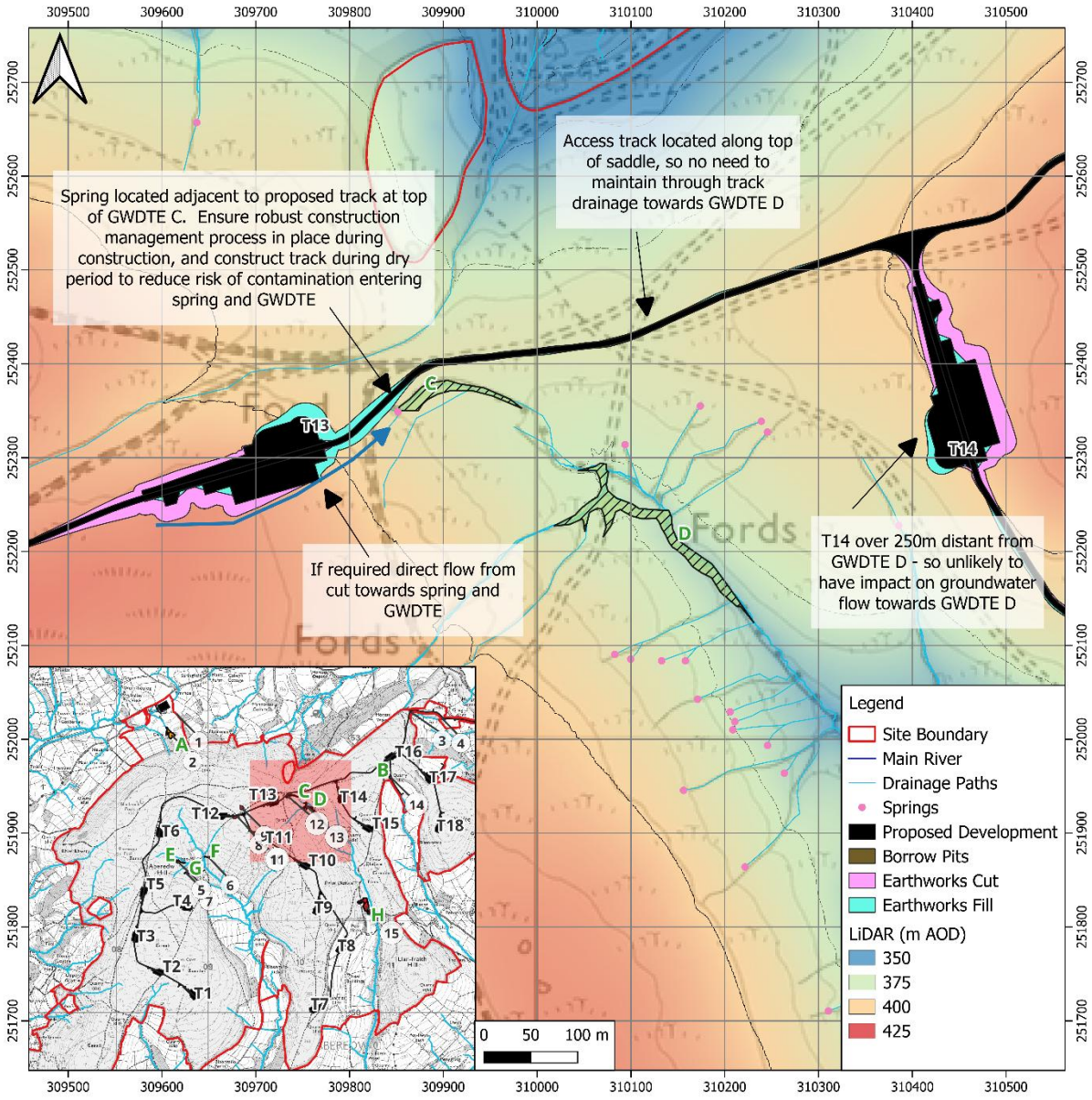


Figure 4-5 GWDTE C & D – Mitigation options



4.6.4. GWDTE I & J

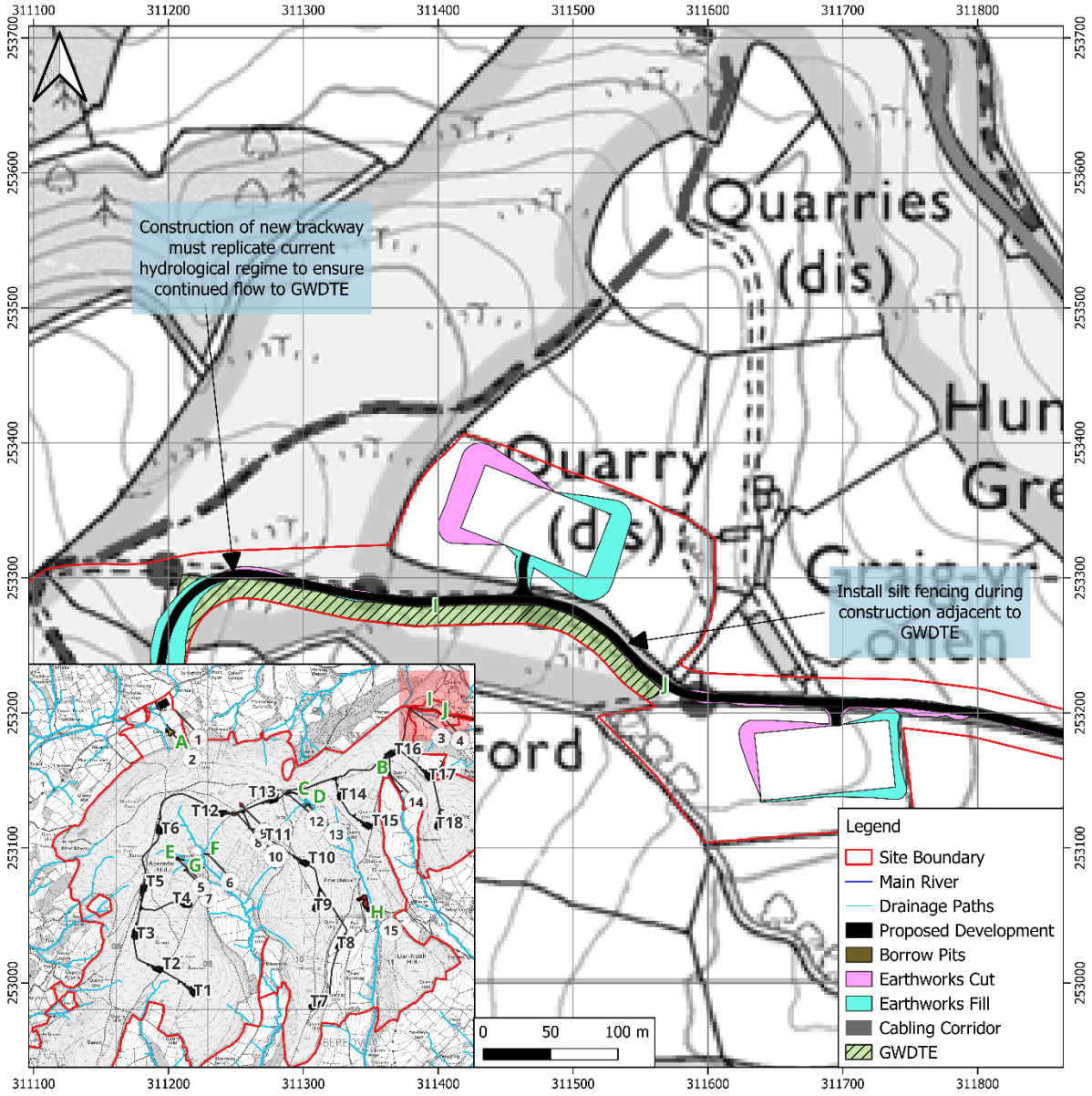
GWDTEs I and J (see Figure 4-) are located to the immediate south of the main access track to the Site, with a portion of the access track cutting across the north-west corner of GWDTE I. The GWDTE's are likely to continue to extend southwards off-site towards the watercourse that flows from west to east and is fed by a spring.

The majority of the access track lies along the route of an existing track, and therefore if flow is maintained through the new track, consistent with the existing track, then flow to the GWDTE should

not be significantly impacted. Where the proposed track deviates from the existing track, and cuts across the north-west corner of GWDTE I, this is due to a requirement to have wider turning angles for the proposed load use of the track. Measures will be taken in designing the track in this section will replicate the current hydrological regime.

It is recommended that the CEMP includes measures such as silt fencing along the side of the track to prevent any silt laden runoff from entering the GWDTE.

Figure 4-6 GWDTE I & J – Mitigation options



4.6.5. Groundwater monitoring and detailed design

Outline mitigation options are set out above to address potential impacts on GWDTE A, B, C & D. The following sequence of actions will be undertaken to inform the need for, scope of and detailed design of such measures, in order that any adverse effects are avoided, minimised or, if necessary mitigated:

- Installation of groundwater monitoring wells in the area of each of these four GWDTEs during the pre-commencement ground investigation.
- Groundwater elevation monitoring.
- Construction of a hydrogeological conceptual model for groundwater connectivity between the GWDTE and the Proposed Development.
- Micrositing to avoid adverse effects, if possible (within the 50 m micrositing allowance being applied for, noting any directional restrictions).
- Detailed drainage design work to avoid, minimise and if necessary mitigate effects (e.g. by returning groundwater captured in areas of cut back to the GWDTE).

In addition, a series of measures are set out in the outline CEMP (**Appendix 4.2, Volume 3** of the ES) to manage pollution during the construction period, such that GWDTEs are suitably protected from leaks, spills and construction site surface-water run-off.

4.7. Maintaining flow to Private Water Supplies

A private water supply risk assessment has been undertaken within the Water Resources Assessment Report (Appendix 9.2 in ES). This assessment identified 9No. PWS for which a risk level higher than 'Low' has been identified in the absence of mitigation. These are summarised in Table 4-5 and shown in Figure 4-7 along with the other 'Low' PWS's identified on and around the Site.

The following mitigation measures will be implemented to minimise the likelihood and consequence of potential impacts.

- Ensure culverts installed with sufficient capacity on watercourses which run beneath access track.
- Incorporate drains beneath hardstanding area and access track to facilitate surface water to pass.
- No plant, vehicles, chemicals or pollutants to be located or stationary within 250 m of identified PWS source locations.
- An appropriate Water Quality Monitoring Plan (WQMP) will be designed for those PWS identified as being at risk of water quality or quantity deterioration, to include a comprehensive sampling programme.
- Frequent communication and liaison with PWS property owners for the duration of time construction is within the PWS catchment areas – Principal Contractor to provide a nominated person as point of contact.
- In the event that a PWS is affected by activities associated with the construction works, contingency supply arrangements will be ready for implementation. This will include ensuring that alternative sources of drinking water and water for general use will be provided if required.
- Where a temporary alternative supply is provided, the existing supply would be reinstated following the construction and a water quality and quantity monitoring programme will be employed to ensure the water supply is reinstated to baseline conditions.

In addition to the specific mitigations in place at those PWS locations deemed to be at risk, standard good practice measures to be outlined within a Construction Environmental Management Plan (CEMP – see **Appendix 4.2** of the ES) will be in place and will limit effects on PWS.

In all cases it is considered that the above mitigation measures will provide satisfactory mitigation and reduce the residual risk level to 'Low'.

Table 4-5 includes the residual risk level after applying all of the mitigation described above.

Figure 4-7 Location of PWS on and around Site which have been assessed as having potential risk from Proposed Development

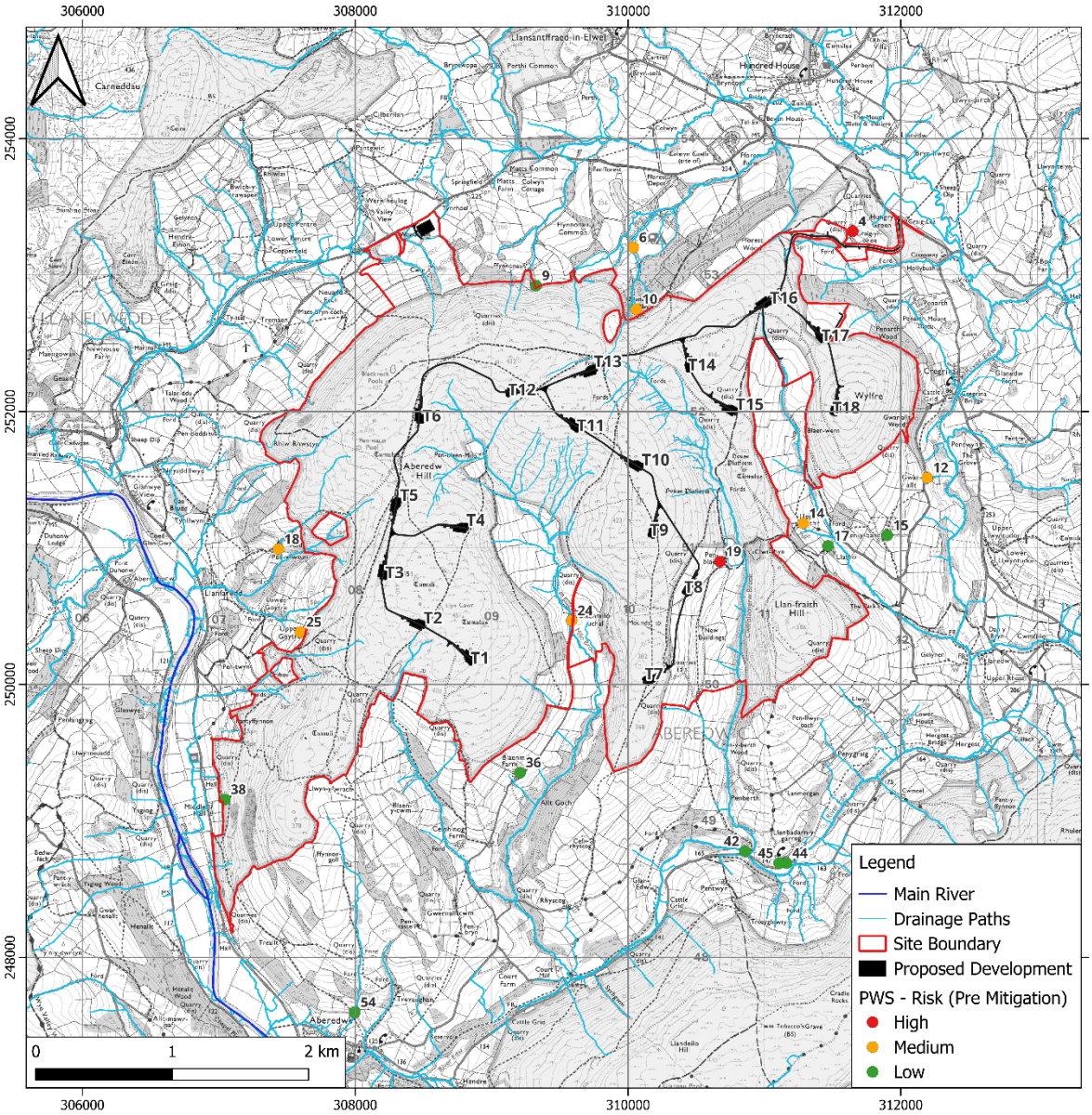


Table 4-5 PWS Risk Assessment

Field ID	Type	Property or Farm Supplied	Potential severity of impact	Likelihood of impact/ Mitigation measures (where required)	Risk level (without mitigation)	Risk level (with mitigation)
4	Spring	Graig-yr-onen	Moderate Supply of water to upper catchment may be impacted. Risk of chemical / sediment pollution during construction	Moderate Spring located 100m from access track and cross-slope. Access track may result in preferential pathways for flow.	High	Low
6	Mixed	Fforest Fields Caravan and Camping site	Moderate Supply of water to upper catchment may be impacted, severity limited due to small proportion of catchment area. Also risk of chemical / sediment pollution during construction	Low Construction of T13 and access track area may have impact, however significant head drop between proposed works and PWS, and located 750m distant.	Medium	Low
10	Spring	Unknown	Moderate Supply of water to upper catchment may be impacted, Also risk of chemical / sediment pollution during construction	Low Construction of T13 and access track area may have impact, however significant head drop between proposed works and Spring.	Medium	Low
12	Spring	Gwr allt	Low Supply of water to spring may be impacted. Risk of chemical / sediment pollution during construction	Moderate Construction of access track area 110 m away may have impact by changing preferential pathways for flow	Medium	Low
14	Unconfirmed	Upper llethr	Low Supply of water to outer catchment may be impacted, severity limited due to distance from proposed development. Also risk of chemical / sediment pollution during construction	Moderate Surrounded by multiple turbines on watershed of supply catchment, however significant head drop between proposed works and spring, with closest turbine 800m distant	Medium	Low
18	Unconfirmed	Pen-waun	Low Supply of water to upper surface water catchment may be impacted, severity limited due to distance from proposed development. Also risk of chemical / sediment pollution during construction	Moderate Surrounded by multiple turbines on watershed of supply catchment, however significant head drop between proposed works and spring, with closest turbine 700m distant	Medium	Low

Field ID	Type	Property or Farm Supplied	Potential severity of impact	Likelihood of impact/ Mitigation measures (where required)	Risk level (without mitigation)	Risk level (with mitigation)
19	Unconfirmed	Pen-blaen	Moderate Supply of water to upper catchment may be impacted, Also risk of chemical / sediment pollution during construction	Moderate PWS located 150m from access track and T8. Access track and cut and fill for T8 may result in preferential pathways for flow.	High	Low
24	Spring	Blaenmilo-uchaf	Moderate Supply of water to upper catchment may be impacted. Also risk of chemical / sediment pollution during construction	Low Surrounded by multiple turbines on watershed of supply catchment, however significant head drop between proposed works and spring, with closest turbine 700m distant	Medium	Low
25	Unconfirmed	Upper Goytre	Low Supply of water to upper surface water catchment may be impacted, severity limited due to distance from proposed development. Also risk of chemical / sediment pollution during construction	Moderate Surrounded by multiple turbines on watershed of supply catchment, however significant head drop between proposed works and spring, with closest track 600m distant	Medium	Low

4.8. Additional water features in close proximity to Proposed Development

During the design and assessment process, all watercourses and feature such as ponds had a 50 m buffer applied to them for consideration as a constraint. With the exception of the locations already discussed above (such as GWDTE's and watercourse crossings), there are two locations where ponds are located within 50 m of proposed earthworks, and three locations where watercourses are located within 50 m (See Figure 4-8).

The first pond (labelled pond 1) is located north west of T11, which is a distance of 40 m from the nearest earthworks associated with T11. The pond sits on the top of the plateau and is likely to be rainwater fed. It is therefore considered unlikely that the proposed works will have an effect on the hydrology of the feature.

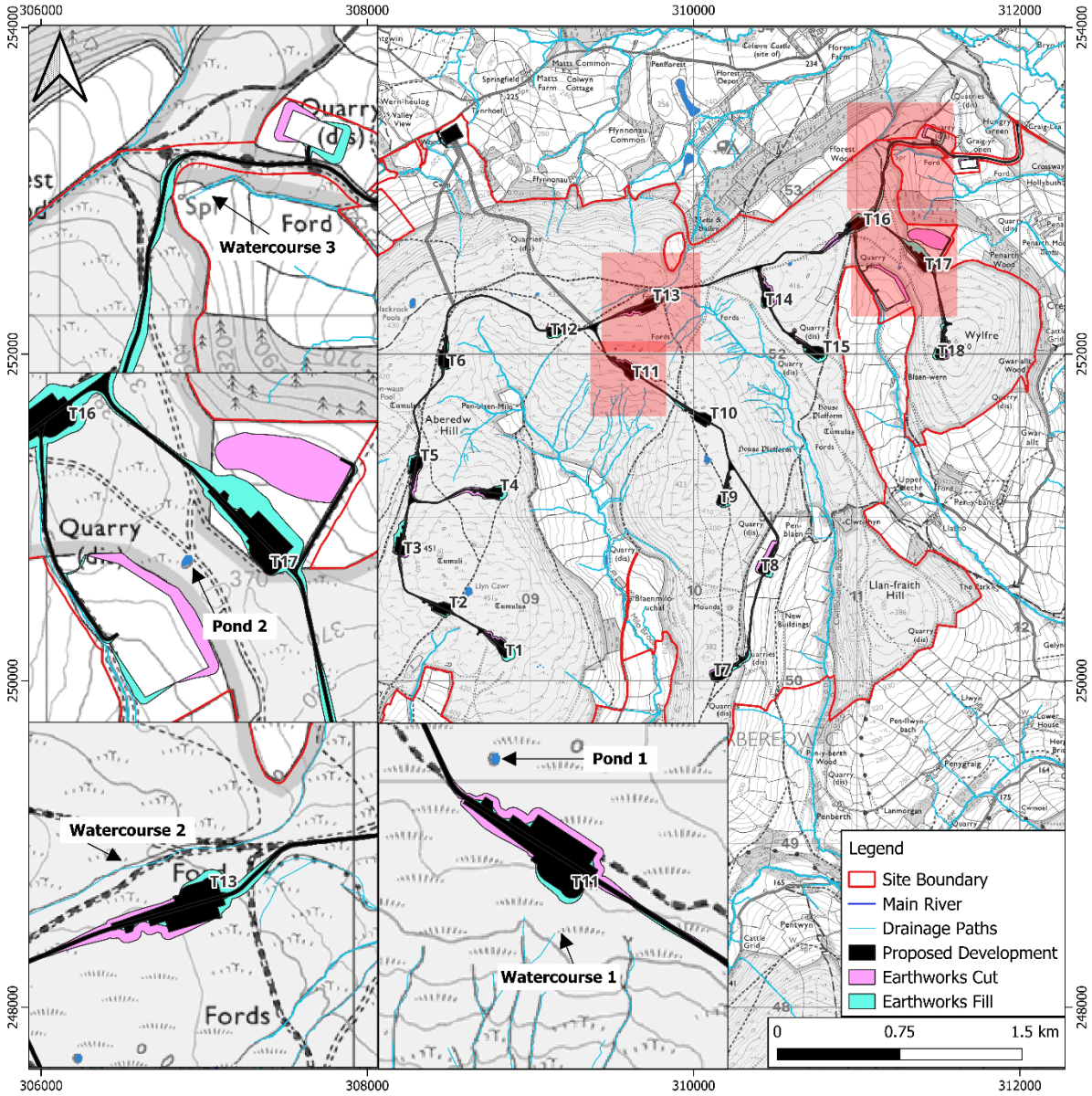
The second pond (labelled pond 2) is located to the east of the western borrow pit, at a distance of 40 m from the nearest earthworks associated with the borrow pit. Again, this pond sits on top of a saddle and is most likely fed by rainwater.

The first watercourse (labelled watercourse 1) is approximately 42 m to the south of T11. This is an area where multiple springs and flushes feed an array of minor watercourses. The Proposed Development sits on top of the plateau to the north of the watercourses, and given the distance (almost 50 m) is unlikely to affect the flow to these watercourses.

The second watercourse (labelled watercourse 2) runs parallel to the access track and hardstanding of T13. At its closest point it is 39 m from the fill associated with T13. The watercourse lies on the far side of an existing track, which will be retained as part of the Proposed Development, and therefore it is unlikely that the Proposed Development will have a significant impact on this watercourse.

The third watercourse (labelled watercourse 3) lies outside the Site and runs to the south of the access track near the main access point for the Site. It's closest point to the access track is 20m. The access track runs along the alignment of an existing track, and therefore if flow through the track is maintained as is existing, there should be limited impact on the watercourse. This location is also discussed in relation to GWDTEs I and J.

Figure 4-8 Additional water features within 50 m of Proposed Development



4.9. Exceedance routes

In all cases the exceedance routes for extreme events will be designed to overtop on the downslope of each piece of infrastructure following the natural slope of the terrain. Where there are designed as infiltration features, then a designed weir section will be provided for overtopping to minimise potential erosion and/ or scour. As mentioned above, the location of the overspill weir will be carefully considered in areas where turbine hardstands are situated on slopes, to ensure that shallow soil stability is not adversely impacted.

4.10. Water quality

SuDS techniques can be used to effectively manage the quality of surface water flowing across a site. Different methods can be used to intercept pollutants and allow them to degrade or be stored in-situ without impacting the quality of water further downstream. Frequent and short duration rainfall events are those that are most loaded with potential contaminants (silts, fines, heavy metals and various organic and inorganic contaminants). Therefore, the first 5 mm to 10 mm of rainfall will be adequately treated using SuDS.

The Proposed Development will include access tracks, a substation and wind turbine hardstandings. The CIRIA SuDS manual categorises runoff from commercial developments as presenting a medium water quality hazard level (although a low-medium risk would probably be more accurate in this instance due to the low frequency of use).

Table 4-6 Water quality hazard ratings (CIRIA, 2015)

Land use	Hazard level
Residential roof drainage	Very Low
Residential, amenity uses including low usage car parking spaces and roads, other roof drainage.	Low
Commercial uses including car parking spaces and roads (excluding low usage roads, trunk roads and motorways).	**Medium**
Sites with heavy pollution (e.g. haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemical and fuels (other than domestic fuel oil) are delivered, handled, stored used or manufactured, industrial sites.	High
Trunk roads and motorways	High

During construction, there is the likelihood that Chemical and Oil Storage will be located within the temporary construction compounds. These areas will be appropriately bunded, and the risk managed through the CEMP. During operation the diesel generator and any fuel storage on the substation will also be appropriately bunded to reduce potential for contamination of runoff.

The qualitative approach to designing a SuDS scheme set out in the CIRIA SuDS manual (CIRIA, 2015) has been applied in this instance. As the Proposed Development is commercial in nature with a medium-low hazard rating, hazard indices of 0.6 for total suspended solids (TSS), 0.6 for metals and 0.6 for hydrocarbons are considered applicable.

The following measures are examples which are suitable for inclusion in a drainage strategy for a commercial development to mitigate a potential increase in pollutant load within on-site and off-Site runoff. Removal indices are included for each feature type relative to the specific pollutant.

Table 4-7 Mitigation indices for SuDS components (discharges to ground)

Characteristics of the material overlying the proposed infiltration surface, through which the runoff percolates[1]	TSS	Metals	Hydrocarbons
A layer of dense vegetation underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.6[4]	0.5	0.6
A soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.4[4]	0.3	0.3
Infiltration trench (where a suitable depth of filtration material is included that provides treatment, ie graded gravel with sufficient smaller particles but not single size coarse aggregate such as 20 mm gravel) underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.4[4]	0.4	0.4
Constructed permeable pavement (where a suitable filtration layer is included that provides treatment, and including a geotextile at the base separating the foundation from the subgrade) underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.7	0.6	0.7
Bioretention underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.8[4]	0.8	0.8
Proprietary treatment systems[5, 6]	These must demonstrate that they can address each of the contaminant types to acceptable levels for inflow concentrations relevant to the contributing drainage area.		

The widespread use of permeable gravel surfacing on the substation, and infiltration trenches at the turbines (where pollutant load is likely to be smaller) in the SuDS Strategy for the proposed development will provide adequate treatment to mitigate the low-medium hazard associated with runoff from the development.

The inclusion of check dams along access track drainage ditches will also facilitate the settlement of suspended solids.

4.11. SuDS maintenance

Inspection and long-term maintenance of SuDS components ensures efficient operation and prevents failure. Table 4-8 describes the management and maintenance requirements which will be implemented during operation of the Proposed Development.

Table 4-8 Management and maintenance requirements for SuDS features

SuDS Device	Maintenance requirements	Maintenance frequency
Infiltration trenches with cross-track drainage	• Inspect silt accumulation rates behind check dams and in cross-track drainage • Inlet/outlet cleaning • Vegetation management • Sediment monitoring and silt removal	• Monthly for first few months • Quarterly • Quarterly • Annually or every 3 years
Watercourse crossings	• Initial monthly inspection once construction phase is over • Inspection • Remove blockages	• Monthly for first few months • Annually and after storm events • As required
Hardstanding at substation and around turbines	• Inspect for evidence of poor operation and/or weed growth	• Three-monthly, 48 hours after large storms in first six months

4.11.1. Inspections

In conjunction with the above maintenance schedules and in accordance with both the CEMP (Construction Phase) and Operational Maintenance and Management plan (Operational Phase), regular inspections of all stormwater drainage equipment will be undertaken to identify potential problems as early as possible. Routine inspections will be undertaken at least annually, with all foundations, swales, ditches, drains, culverts and track crossing inspected for blockages and/or debris. All blockages are to be cleared immediately.

4.12. Biodiversity

SuDS schemes can present opportunities to enhance habitat for wildlife on-Site and this often improves the biodiversity of the surrounding areas. Given the setting of the Site, abundance of moorland habitat, and existence of GWDTEs, the proposed SuDS scheme does not aim to introduce additional biodiversity. The measures proposed in protection of the GWDTEs and in designing of the new watercourse crossings do however ensure that the existing biodiversity is not adversely impacted by the development drainage. Riparian enhancements are also proposed as part of the Outline Habitat Management Plan (see **Appendix 7.5** of the ES).

5. Foul drainage

The Proposed Development will include a welfare unit during the operation phase, and welfare facilities will also be required on Site during the construction and decommissioning phases. As a result, there will be a requirement to manage the foul effluent for the proposed lifetime of the development. The location of the Proposed Development is such that a mains sewerage connection will not be possible.

The potential for the Proposed Development to create additional phosphate loading on the River Wye SAC during the construction and operational phases has been identified. In consultation with NRW as part of the Scoping response it has been confirmed that *"if the foul water is to be transported and treated (in accordance with the appropriate regulations) at a suitable Wastewater Treatment Works outside of a Phosphorus Sensitive Catchment with the relevant Environmental Permits in place, then we are satisfied that the increase in discharge is unlikely to have an adverse effect on site integrity."*. It is therefore proposed to retain effluent in tanks and transfer to a waste water treatment works on a regular basis. It will be necessary to work with the operator of the waste water treatment works to ensure that it has capacity to accept the effluent without detriment to its impact on the River Wye SAC.

6. Conclusions

This report provides an Outline Drainage Strategy for the Proposed Development. Infiltration features will be used within or adjacent to each piece of infrastructure on the Site to manage surface water runoff effectively for the lifetime of the development, and return runoff back to the ground as close as possible to the source. No direct discharge to surface water features have been proposed.

Locations where infrastructure has the potential to affect drainage towards GWDTEs have been identified and adequate drainage will be incorporated into the detailed design of the tracks, and ditches behind cuts to return and maintain flow to the GWDTE in question. The detailed drainage design in each of these locations will be informed by monitoring of groundwater elevations in the area of the 6 No. GWDTEs that may potentially be affected. This in turn will be delivered as part of the pre-construction ground investigation works.

Development within 250 m of a PWS has been avoided, with two exceptions. PWS 4 and PWS 19 have both been assessed as at high risk of impact from the Proposed Development prior to any mitigation. Suitable construction-phase pollution controls as set out in the CEMP, and monitoring of water quality in the PWS's themselves will ensure that these PWS's and 7 others identified as being at medium risk (although outside of 250 m from Proposed Development) are protected with the resultant risk level assessed as low. Provision for providing replacement PWSs in the unlikely event that they are adversely affected by the construction works has also been allowed for.

Appropriate management and maintenance arrangements for the proposed SuDS scheme will be in place throughout the lifetime of the Proposed Development.

7. References

CIRIA. (2015). *CIRIA SuDS manual.*

Cranfield Soil and AgriFood Institute. (2023). Retrieved from Soil Scapes map: http://www.landis.org.uk/soilscapes/

Scottish Environment Protection Agency. (2017). *Land Use Planning System SEPA Guidance note 31. Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions.*

UK Centre for Ecology & Hydrology. (2025). *Flood Estimation Handbook Web Service*. Retrieved from https://fehweb.ceh.ac.uk/GB/map

Welsh Government. (2018). *Statutory standards for sustainable drainage systems.*

Welsh Government. (2024). *Planning Policy Wales.*

Welsh Government Planning Policy Branch. (2021). *Flood Consequences Assessments: Climate change allowances.*

Appendix A Report conditions

Report Conditions

This report has been prepared by Aqua Terra Consulting Ltd. (Aqua Terra) in its professional capacity as soil and groundwater specialists, with reasonable skill, care and diligence within the agreed scope and terms of contract and taking account of the manpower and resources devoted to it by agreement with its client and is provided by Aqua Terra solely for the internal use of its client.

The advice and opinions in this report should be read and relied on only in the context of the report, taking account of the terms of reference agreed with the client. The findings are based on the information made available to Aqua Terra at the date of the report (and will have been assumed to be correct) and on current UK standards, codes, technology, and practices as at that time. They do not purport to include any manner of legal advice or opinion. New information or changes in conditions and regulatory requirements may occur in future, which will change the conclusions presented here.

Where necessary and appropriate, the report represents and relies on published information from third party, publicly and commercially available sources which is used in good faith of its accuracy and efficacy. Aqua Terra cannot accept responsibility for the work of others.

Site investigation results necessarily rely on tests and observations within exploratory holes only. The inherent variation in ground conditions mean that the results may not be representative of ground conditions between exploratory holes. Aqua Terra take no responsibility for variation in ground conditions between exploratory positions.

This report is confidential to the client. The client may submit the report to regulatory bodies, where appropriate. Should the client wish to release this report to any other third party for that party's reliance, Aqua Terra may, by prior written agreement, agree to such release, if it is acknowledged that Aqua Terra accepts no responsibility of any nature to any third party to whom this report or any part thereof is made known. Aqua Terra accepts no responsibility for any loss or damage incurred as a result, and the third party does not acquire any rights whatsoever, contractual, or otherwise, against Aqua Terra except as expressly agreed with Aqua Terra in writing. Aqua Terra reserves the right to withhold and/ or negotiate the transference of reliance on this report, subject to legal and commercial review.

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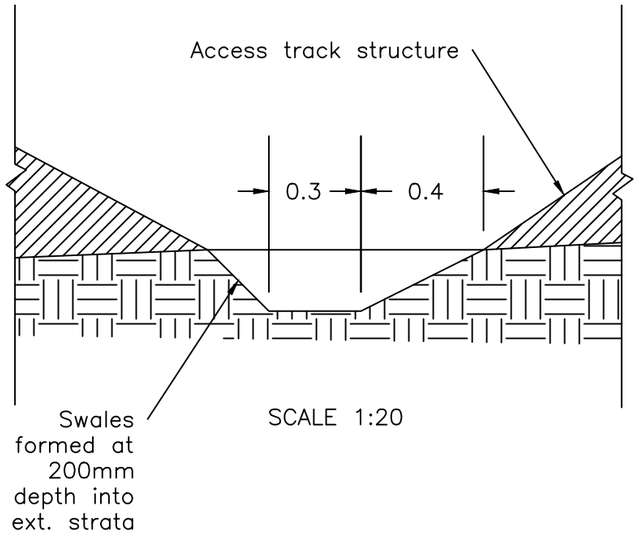
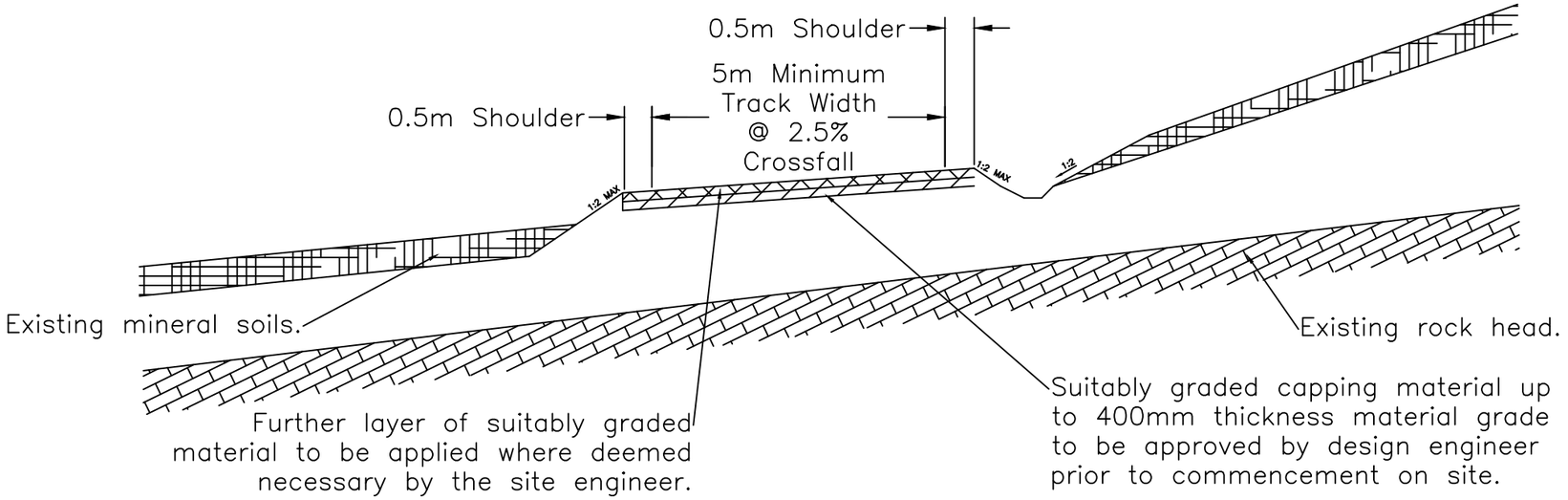
Appendix B Indicative Track Formation

Figure 4.10: Access Track Arrangement

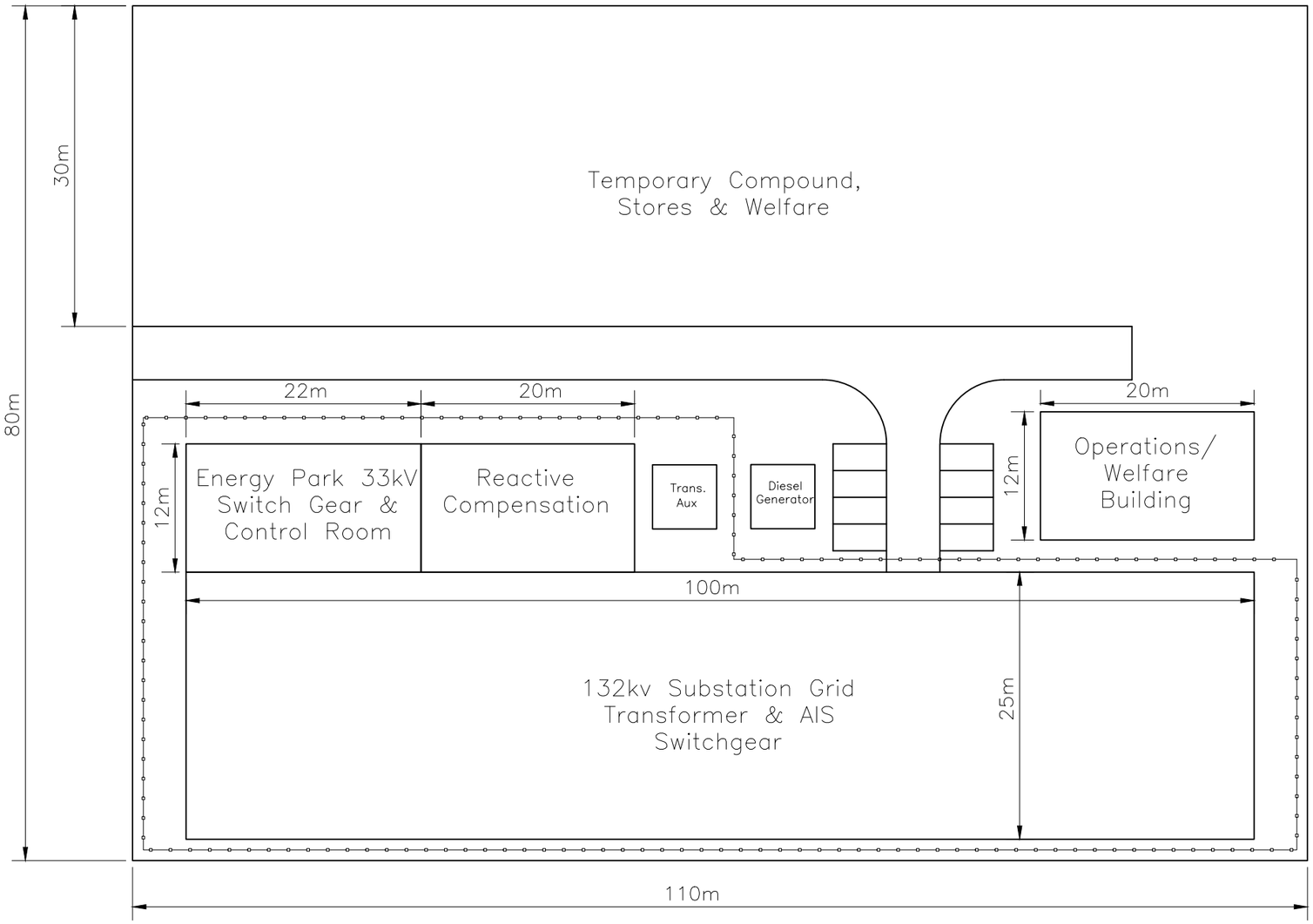




TYPICAL TRACK FORMATION ON OVERBURDEN SOIL
SCALE 1:100

Appendix C Indicative Sub-station Design

Figure 4.6a: Substation Layout



Appendix D Indicative turbine foundation design

Figure 4.3: Turbine Foundation