Denny to Wishaw Network Upgrade

Environmental Impact Assessment Report

Volume 3 Appendices

Appendix 9.4 Flood Risk Assessments

May 2026



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Denny to Wishaw Network Upgrade

Bonnybridge Substation Flood Risk Assessment and Surface Water Management Strategy

SPEN

Project number: 60602788

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1.1 Introduction

1.1.1 Context

AECOM has been commissioned by SP Energy Networks (SPEN) to undertake Flood Risk Assessments (FRAs) and develop Surface Water Management Strategies (SWMSs) for several substation sites within the Denny to Wishaw Network Upgrade (DWNO) project. This report details both the FRA and SWMS relevant to the Proposed Extension to the Bonnybridge Substation, which is being upgraded from the existing 275kV overhead line span to 400kV.

The FRA, conducted in line with CIRIA C624 guidance on Development and Flood Risk[1], details the flood risk associated with this upgrade, including the flood risk baseline, policy context, and any implications for the proposed development with regard to flood risk. The FRA and SWMS have been used to develop a coordinated drainage solution,although the proposed drainage scheme may be subject to change in the detailed design phase. In particular, the SWMS outlines the intended strategy for managing surface water at the site, with reference to national and local policy and guidance from the CIRIA C753 SuDS Manual[2].

In this report, the terms ‘proposed development’ and ‘site’ will be used to mean the Proposed Bonnybridge Substation Extension, and the site of those works, respectively.

1.1.2 Site Description

The site of the proposed development is situated at grid reference NS 83957 80916, roughly 1.7km east of Bonnybridge village centre and 2.0km west of Camelon village centre, on the northern side of the A803 (Falkirk Road). To the northeast of the site is SPEN property, including the existing Bonnybridge substation. To the east and west are agricultural farmlands and the site is bound on the south by the A803, beyond which is further agricultural famland. Across the Bonny Water river to the west of the site is the Bonnybridge Water Treatment Works and a solar power array. The site is depicted in **Error! Reference source not found.**.

[1] C624: Development and Flood Risk (2004). Construction Industry Research and Information Association..
[2] C753: The SuDS Manual (2015). Construction Industry Research and Information Association.

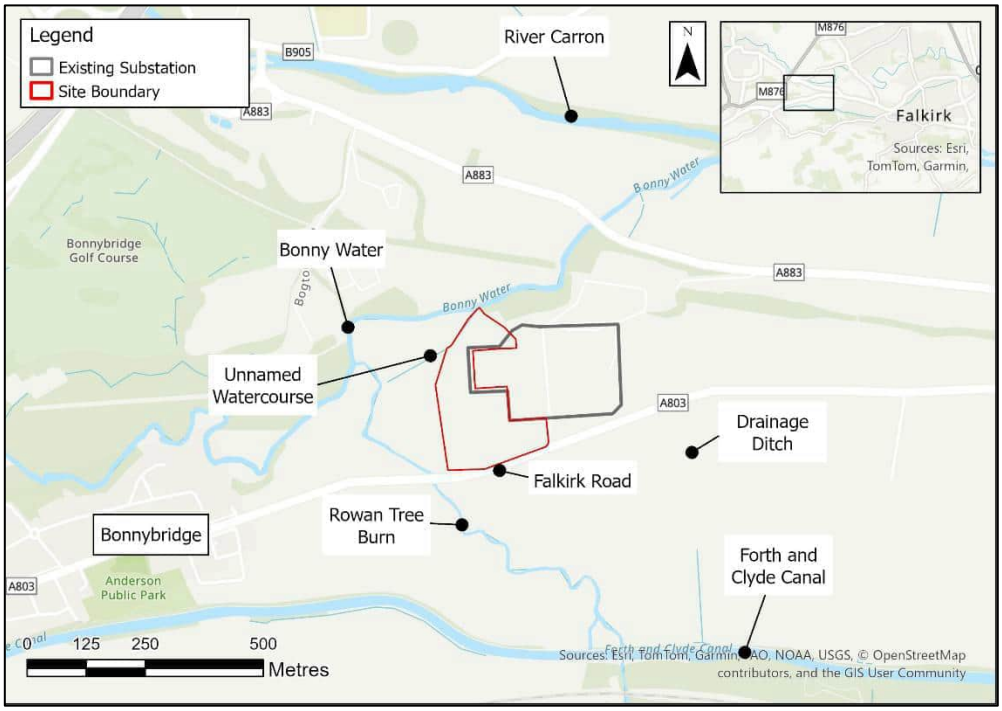


Plate 1: Site Overview

There are several features of hydrological importance in the vicinity of the site, as shown on Plate 1:

- The Bonny Water runs eastwards directly north of the site, where it ultimately joins the River Carron. The agricultural field directly to the west of the site constitutes part of the Bonny Water floodplain.
- The Rowan Tree Burn begins to the south of the site, running beneath the Forth and Clyde Canal. It carries on northwards to the southwest of the site through a culvert under the A803 Falkirk Road, and joins the Bonny Water. It passes at a minimum distance of 30m from the site, where it passes under the A803.
- Another small drainage ditch runs northwards from the Forth and Clyde Canal towards properties approximately 300m to the east of the site.
- An unnamed artificial watercourse of 2m to 3m width (based on review of LiDAR data), runs northeast roughly directly north-west of the site and connects to the Bonny Water.

The red line boundary covers an area of approximately 4.3ha, which includes the proposed substation platform approximately 1.7ha and adjacent land which may be used for construction staging and access.

1.1.3 Site Topography

Site topography has been mapped using a Phase 5, 0.5m resolution, LiDAR Digital Terrain Model (DTM)[3] , shown in Plate 2Error! Reference source not found.. The highest ground level is located in the southeast of the site, with an elevation of 31.5m Above Ordnance Datum (AOD). The site falls gradually from this point to the northwest towards the Bonny Water and the Rowan Tree Burn. The lowest ground level within the RLB is approximately 18.0mAOD, located at the bottom of a steep slope in the north of the site.

[3] LiDAR for Scotland Phase V DTM (2021). Dataset. Scottish Government. Dataset. https://remotesensingdata.gov.scot/data#/list

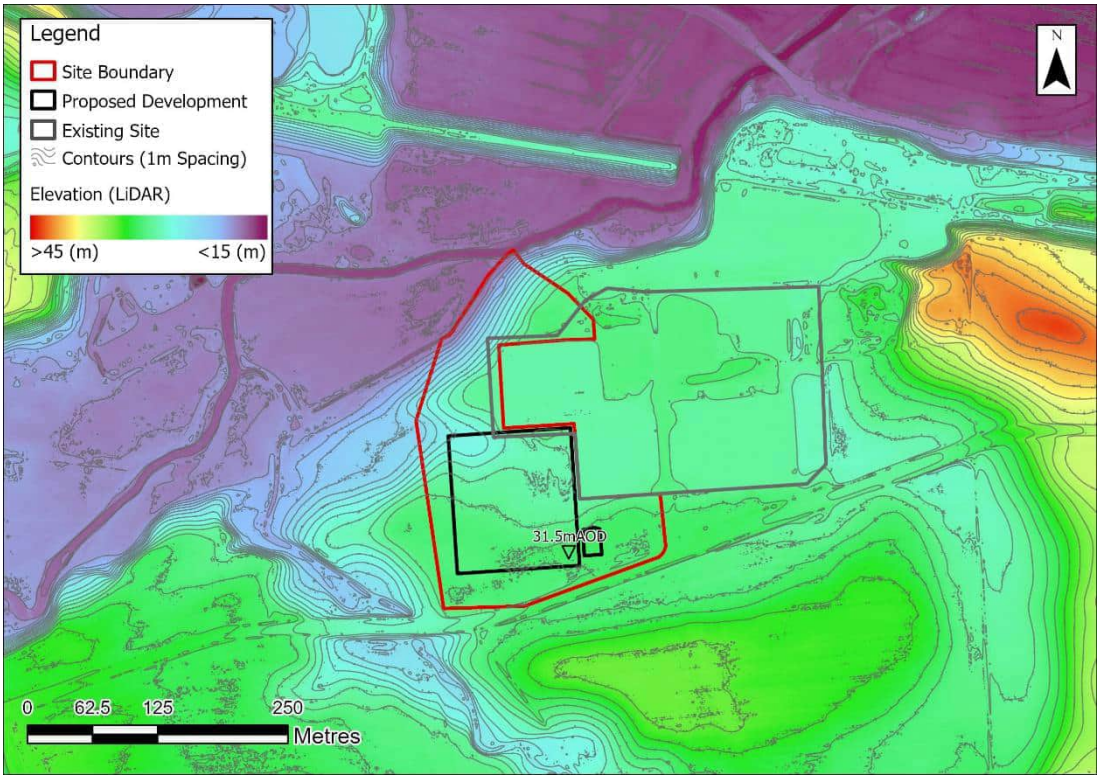


Plate 2 Site Topography. Contains public sector information licensed under the Open Government Licence v3.0, sourced from Scottish Government Scottish Public Sector LiDAR Phase 5.

1.1.4 Geology

Geology mapping provided by British Geological Survey (BGS)[4] indicates the site's superficial deposits predominantly consist of alluvium and raised Devensian marine deposits of clay, silt, sand, and gravel. The bedrock geology is made up of Passage Formation containing repeated cycles of sandstones and seatearths.

BGS historic borehole records were consulted, but there are no published records near the site.

No site-specific ground investigation information has been provided at the time of conducting this study.

1.1.5 Proposed Development

A plan view of the site area and proposed development is provided in Plate 3. The proposed development will include upgrades which comprise of an additional substation platform to the southwest of the existing substation, with new access roads, a control building, a security fence, and a Sustainable Drainage System (SuDS) retention basin. New electrical equipment would be installed on the platform including circuit breakers, inter-bus transformers, and shunt reactors. While detailed elevations of earthworks have not been confirmed, it is assumed based on the most recent conceptual design at the time of this report that the new platform will be constructed to approximately 30.0mAOD with a 1:200 northwards slope to tie in with the existing substation platforms.

While the total site area is 4.30ha, the proposed development (consisting of the substation platform itself and the associated access roads) will be assumed to be fully impermeable (as there has not yet been infiltration testing conducted on site) and constitutes an area of 1.67ha. It is assumed that the remaining area within the red line boundary will not be developed and will retain greenfield characteristics.

[4] Geology Viewer (no date). British Geological Survey. https://geologyviewer.bgs.ac.uk/?_ga=2.214158167.1385564789.1724058925-51426505.1724058925

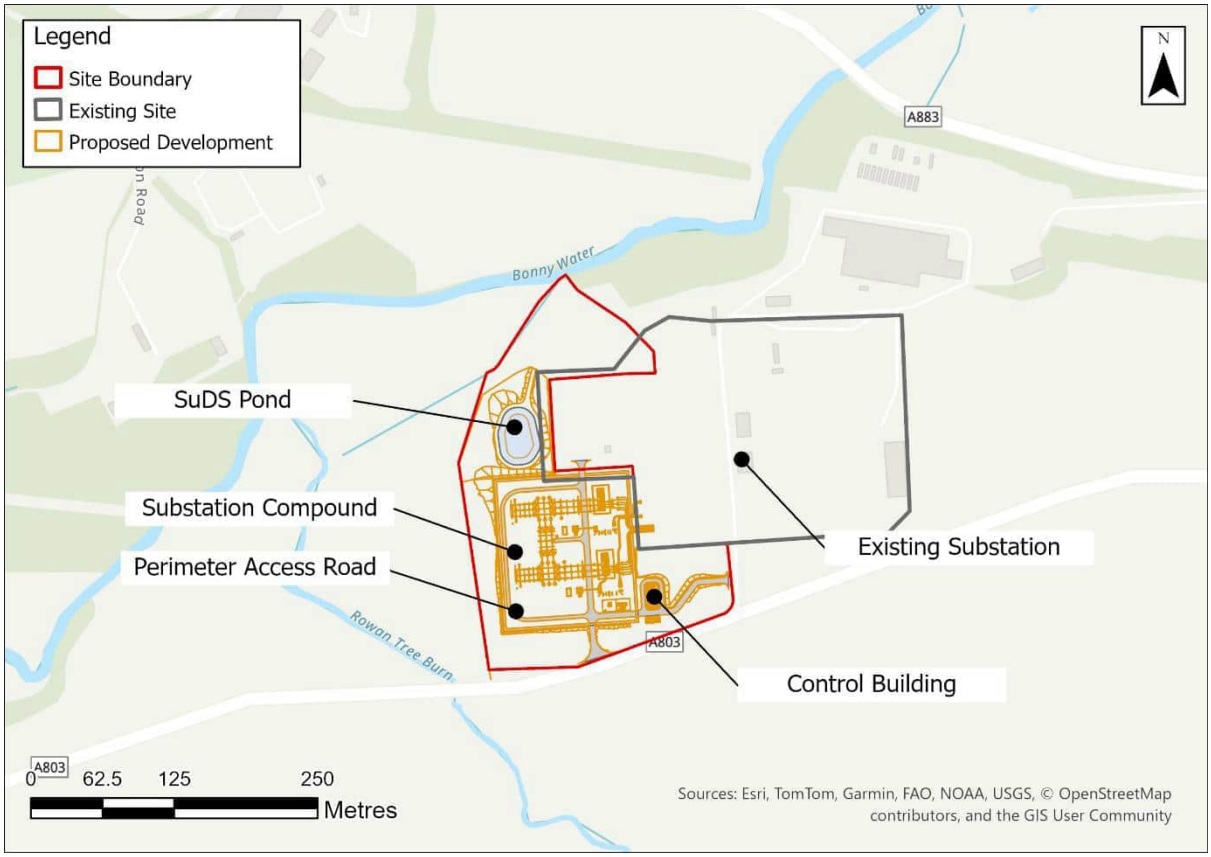


Plate 3 Proposed development layout

1.2 Policy Context

This report has been developed in accordance with the relevant national and local policies discussed below. While all the key policy frameworks covering the site have been referenced to produce this report, the following sections will highlight the most critical policy details which have bearing on the proposed development.

1.2.1 National Planning Policy

Following Policy 11.e.vii) of the *National Planning Framework 4* (NPF4)[5], proposals for energy developments should demonstrate how the effects of development on flood risk and the water environment are addressed in design, which is the purpose of this report.

The requirements for consideration of flood risk in Scotland is set out in more detail in Policy 22 of the NPF4. Policy 22 is supplemented by SEPA's *Land Use Vulnerability Guidance*[6] which categorises land uses and developments by their vulnerability to inform where exceptions to this policy may be applicable. Based on this guidance, the proposed development is categorised as 'essential infrastructure'.

Relevant sections of Policy 22 include:

a) *"Development proposals at risk of flooding or in a flood risk area will only be supported if they are for:*

   i) *essential infrastructure where the location is required for operational reasons;*

   ii) *water compatible uses;*

   iii) *redevelopment of an existing building or site for an equal or less vulnerable use; or.*

   iv) *redevelopment of previously used sites in built up areas where the LDP has identified a need to bring these into positive use and where proposals demonstrate that long term safety and resilience can be secured in accordance with relevant SEPA advice.*

   In such cases, it will be demonstrated by the applicant that:

- *all risks of flooding are understood and addressed;*
- *there is no reduction in floodplain capacity, increased risk for others, or a need for future flood protection schemes;*
- *the development remains safe and operational during floods;*
- *flood resistant and resilient materials and construction methods are used; and*
- *future adaptations can be made to accommodate the effects of climate change.*

c) *Development proposals will:*

   i) *not increase the risk of surface water flooding to others, or itself be at risk.*

   ii) *manage all rain and surface water through sustainable urban drainage systems (SUDS), which should form part of and integrate with proposed and existing blue-green infrastructure. All proposals should presume no surface water connection to the combined sewer;*

   iii) *seek to minimise the area of impermeable surface."*

[5] National Planning Framework 4 (2023). Scottish Government. https://www.gov.scot/binaries/content/documents/govscot/publications/strategy-plan/2023/02/national-planning-framework-4/documents/national-planning-framework-4-revised-draft/national-planning-framework-4-revised-draft/govscot%3Adocument/national-planning-framework-4.pdf

[6] Flood Risk and Land Use Vulnerability Guidance (2024). SEPA. https://www.sepa.org.uk/environment/land/planning/guidance-and-advice-notes/

In this context, NPF4 defines "at risk of flooding" as *"land or built form with an annual probability of being flooded of greater than 0.5% which must include an appropriate allowance for future climate change".* This will be used as the benchmark for flood risk assessment in this report.

1.2.2 Local Planning Policy

The proposed development lies within the administrative area of Falkirk Council. They provide guidance for prospective developments in their policies regarding flood risk and drainage. This report has therefore paid due consideration to the following relevant guidance documents:

- Falkirk Local Development Plan 2 (LDP2)[7]
- Supplementary Guidance SG05: Green Infrastructure and New Development[8]
- Forth Estuary Local Plan District's *Local Flood Risk Management Plan Cycle 2*[9]
- Falkirk Council Planning Application Advice on Flood Risk and Surface Water Drainage[10].

LDP2 addresses requirements for flood risk under Policy P24 (Flood Management) and for drainage under Policy IR10 (Drainage Infrastructure).

Relevant sections of Policy PE24 include:

1. *"The Council will support the delivery of the objectives and actions set out in the Local Flood Risk Management Strategies and Local Flood Risk Management Plans covering the area. There will be a presumption against development which would prejudice the implementation of the relevant actions.*
2. *Development proposals will be assessed against the Flood Risk Framework set out in Scottish Planning Policy, with development being avoided in locations at medium to high flood risk, unless it accords with the criteria set out in the Framework. There will be a presumption against new development which would:*
    - *Be likely to be at risk of flooding;*
    - *Increase the level of risk of flooding for existing development;*
    - *Result in a use more vulnerable to flooding or with a larger footprint than any previous development on site; or*
    - *Lead to an increase in the probability of flooding elsewhere.*
3. *Development proposals on land identified as being at medium to high risk from any source of flooding, and low to medium risk areas as identified by the Flood Risk Framework, or where other available information suggests there may be a risk, including proposals to restore the natural course of watercourses, will be required to provide a flood risk assessment in accordance with SEPA's Technical Flood Risk Guidance for Stakeholders that demonstrates that:*
    - *Any flood risks can be adequately managed both within and outwith the site;*
    - *An adequate allowance for climate change and freeboard has been built into the flood risk assessment;*

[7] Falkirk Local Development Plan 2 (2020). Falkirk Council. https://www.falkirk.gov.uk/development-planning/falkirk-local-development-plan-2
[8] SG05: Green Infrastructure and New Development (2021). Falkirk Council. https://www.falkirk.gov.uk/media/9c2b6e86-73ff-4c4f-ba86-2ab0ae80af55
[9] Local Flood Risk Management Plan, Cycle 2, 2022-2028 (2023). Falkirk Council. https://fcwebsites.blob.core.windows.net/www/media/2d14fbbb-2b7e-4c75-89e8-75187206357d/03%20Forth%20Estuary%20Local%20Flood%20Risk%20Management%20Plan%20Cycle%202%20-%202022-2028.pdf
[10] Planning Application Advice on Flood Risk and Surface Water Drainage (2022). Falkirk Council. https://www.falkirk.gov.uk/development-management/flood-risk-and-surface-water-drainage-advice

- *Access and egress can be provided to the site which is free of flood risk; and*
- *Water resistant materials and forms of construction will be utilised where appropriate (including any development permitted in medium to high risk areas (that accords with the exceptions in the Food Risk Framework) or is located in adjacent low to medium risk areas).*

4. *Development proposals on previously developed land which is at risk of flooding will be limited to uses which are of equal or less vulnerability as defined by SEPA's Land Use Vulnerability Guidance.*
5. *Where suitably robust evidence suggests that land contributes or has the potential to contribute towards sustainable flood management measures development will only be permitted where the land's sustainable flood management function can be safeguarded.*

Relevant sections of Policy IR10 include:

2. *Surface water management for new development should comply with current best practice on Sustainable Urban Drainage Systems (SUDS), where appropriate forming an integral part of the development's landscape structure as set out within Supplementary Guidance SG05 'Green Infrastructure and New Development'. SUDS will be required to meet the specifications as detailed in the most recent version of Sewers for Scotland should the developer wish the surface water system to vest in Scottish Water.*
3. *For developments that involve a change of use and/or redevelopment, wherever possible, opportunities should be taken to retrofit SUDS."*

Following the recommendations of IR10 parts 2-4, the Surface Water Management Strategy proposed in Section 3 of this report will be developed in accordance with the SuDS Manual.

1.2.3 SPEN Policy

SPEN's internal policy SUB 01-018: Substation Flood Resilience[11] and its implications for the assessment of flood risk and provision of flood protection has been considered throughout the Flood Risk Assessment process.

[11] SUB 01-018: Substation Flood Resilience Issue 03 (2023). SPEN. https://www.spenergynetworks.co.uk/userfiles/file/SUB-01-018.pdf

1.3 Flood Risk Assessment

This section will report on the findings of a qualitative flood risk analysis desk study which aimed to assess the potential impact of flood risk sources on the proposed development. The following structure will be used:

- A brief description of the types of flood risk considered
- A review of the data-sources used to assess flood risk on site
- An analysis of each flood risk type as they pertain to the proposed development
- A summary of the flood risk assessed from each source and recommended mitigations.

The findings of this assessment are summarised in the SEPA FRA checklist in Appendix A, in line with SEPA technical guidance[12].

1.3.1 Potential Sources of Flood Risk

Flood risk on a site may be either caused or exacerbated by a range of hazards. Each of these hazards may themselves present a flood risk or may interact with other hazards to produce an overall flood risk. Estimates of the impact of climate change on the severity and extent of these hazards will also be considered. The following flood hazards will be assessed regarding their individual contribution to flood risk and, where appropriate, their likelihood of increasing flood risk posed by other hazards:

a) **Coastal Flooding:** Extreme sea levels and wave heights can cause inundation and flooding on developments on or sufficiently near the coast.

b) **Fluvial (River) Flooding:** Extreme flood events in rivers and other large watercourses can cause rapid and significant inundation of surrounding areas

c) **Pluvial (Surface Water) Flooding:** High volume rainfall events which exceed the infiltration and storage capacity of the local soil cause flows to develop over land, potentially damaging property.

d) **Infrastructure Failure:** Water conveyance, storage, or flow control infrastructure can fail, either causing a flood risk in itself, or exacerbating the scale or extent of other flood hazards.

e) **Sewer Flooding:** The failure of sewerage can result in surface flooding.

f) **Groundwater Flooding:** Variations in the local water table and groundwater level can impact the storage capacity of the soil or subterranean storage infrastructure. While groundwater alone does not generally pose significant risk, it may exacerbate the risk posed by other flood hazards.

Consideration will also be given to the future impacts of climate change where appropriate.

1.3.2 Data Sources

The assessment of the above-described flood hazards has been informed by a range of sources. SEPA develops and maintains flood risk datasets pertaining to Coastal, Fluvial (River) and Pluvial (Surface Water) flooding, with additional consideration of the impact of climate change. The relevant sections of this report have drawn on the data provided in the SEPA Flood Map Version 3.0[13]. The flood extents in these maps have been estimated using predictive modelling covering all of Scotland and thus are limited by the specificity of the data which informs them. Thus, these maps should be seen as 'indicative' and

[12] Tehcnical Flood Risk Guidance for Stakeholders (2022). SEPA. https://www.sepa.org.uk/media/162602/ss-nfr-p-002-technical-flood-risk-guidance-for-stakeholders.pdf
[13] SEPA Flood Maps Version 3.0 (2025). Dataset. SEPA. https://map.sepa.org.uk/floodmaps

their results interpreted within the context of site characteristics. SEPA also maintains a database relating to groundwater hazards[14] which has been consulted.

In assessing the risks of infrastructure failure, the SEPA Reservoirs map[15] has been used, which identifies areas at risk of flooding from uncontrolled release of stored water.

Falkirk Council's records for past flood events[16] was also consulted.

To maintain congruity with SEPA Flood Risk Assessment methods, this report will adopt the following terminology for levels of flood risk:

- **High Risk:** Areas which are subject to flooding in the characteristic 10% Annual Exceedence Probability (AEP) (1:10 year) rainfall event. These areas have a 10% chance of flooding each year based on past rainfall data.
- **Medium Risk:** Areas which are subject to flooding in the characteristic 0.5% AEP (1:200 year) rainfall event. These areas have a 0.5% chance of flooding each year based on past rainfall data.
- **Low Risk:** Areas which are subject to flooding in the characteristic 0.1% AEP (1:1000 year) rainfall event. These areas have a 0.1% chance of flooding each year based on past rainfall data.

As current climate change models predict that the frequency and intensity of extreme rainfall events will increase in the future, a further risk category will be used when discussing flood hazards which would be impacted by rainfall uplift caused by climate change:

- **Medium Risk with Climate Change:** Areas which are subject to flooding in the characteristic 0.5% AEP (1:200 year) rainfall event. These areas have a 0.5% chance of flooding each year based on rainfall uplift estimates for the year 2080.

[14] SEPA Groundwater Map (2025). Dataset. SEPA. https://map.sepa.org.uk/floodmap/map.htm
[15] SEPA Reservoirs Map (2022). Dataset. SEPA. https://map.sepa.org.uk/reservoirsfloodmap/Map.htm
[16] Flooding Incidents (public view layer) (2025). Falkrik Council. https://falkirk-council.maps.arcgis.com/home/item.html?id=c05df6e0b627460f83f30aef419c75fc#visualize

1.3.3 Historic Flooding

From consultation with Falkirk Council flooding records, there have been no documented flood events which have affected the existing site or the surrounding area as shown in Plate 4.

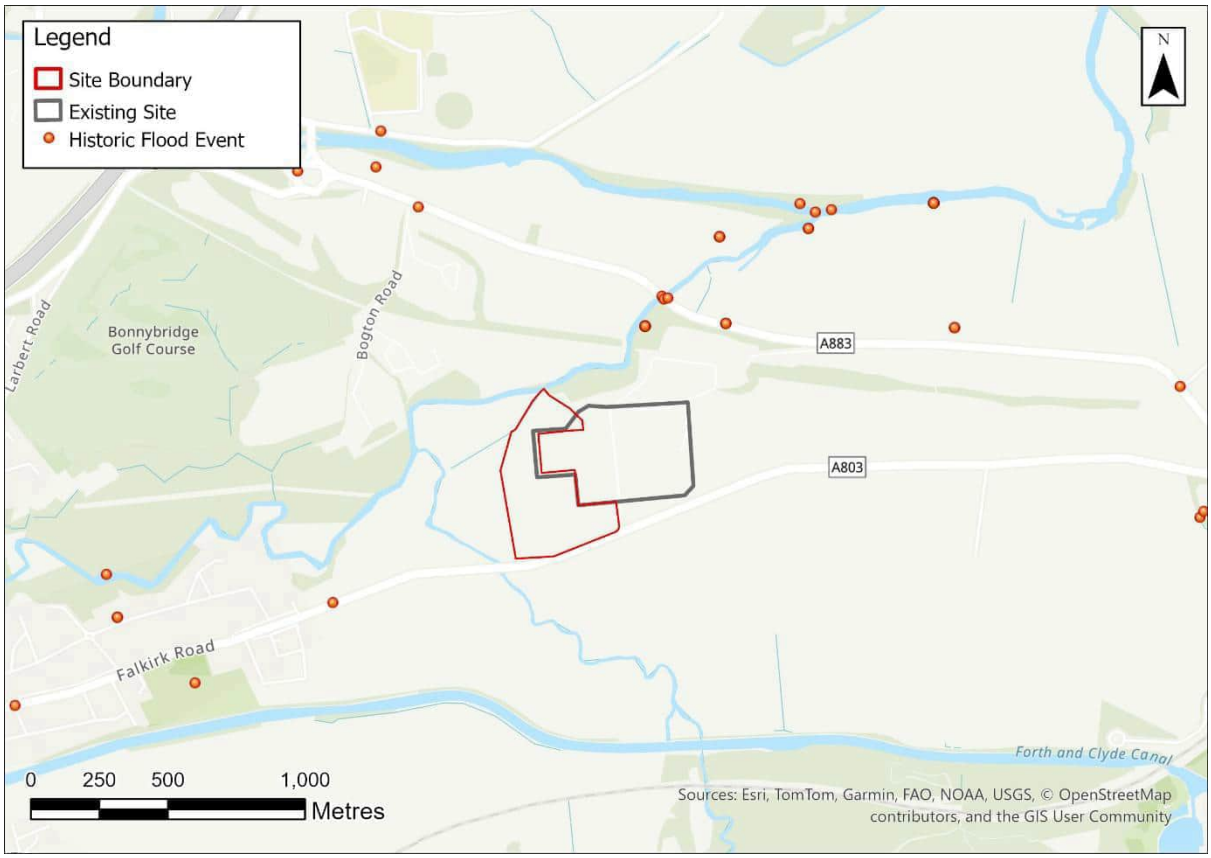


Plate 4 Excerpt of Falkirk Council flood incidents map. Incldues data from Falkirk Council[17]

1.3.4 Coastal Flooding

The coastal SEPA flood maps show the site to be outside the coastal extent, with the nearest extent located 4.1 km northeast of the site. As the proposed ground level across the site is approximately 29.1 mAOD, the site is suitably above sea level and the coastal flood risk on site is deemed **negligible.**

1.3.5 Fluvial Flooding

Flooding caused by watercourses of any size is considered fluvial in nature. Watercourses with large catchemnts (herein referred to as ‘Major Watercourses’) are best represented using the SEPA River Flood Map, while watercourses with smaller catchments (herein referred to as ‘Minor Watercourses’) are best represented in the SEPA Surface Water Flood Map. This assessment will consider both sources as indicators of fluvial flood risk.

Major Watercourses:

Plate 5 shows an extract of the SEPA Fluvial Flood Maps, indicating that the proposed development is outwith extents of fluvial flood risk from the Bonny Water floodplain up to the 0.5%AEP plus climate change (Medium + CC) risk category. While a small porton of the site is within an area of high flood risk, this part of site is not to be included in the proposed development.

Comparison to the site levels presented in Plate 2 indicates that the platform level of the site is roughly 10m above the maximum flood extents shown on the flood maps. The SuDS basin can be accommodated with a spill level of approximately 25.8mAOD (see Section 4.8.4) which is still significantly outwith the Medium + CC flood level. While the flood risk extents in SEPA mapping are only indicative, this is an acceptable margin to determine that fluvial flood risk from the Bonny Water is **negligible.**

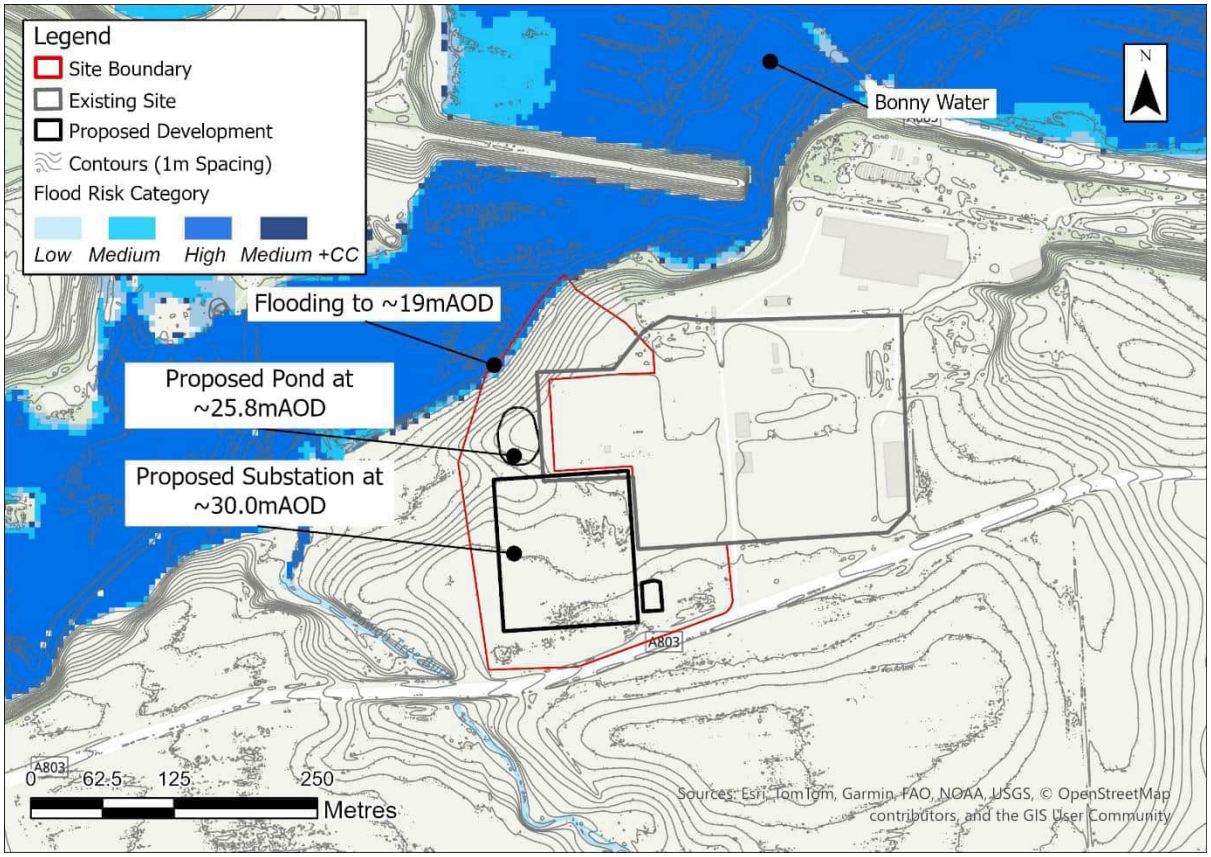


Plate 5 SEPA fluvial flood risk. Includes data from SEPA Flood Maps v3.0 © *Scottish Environment Protection Agency (SEPA) 2025; this SEPA product is licensed under the Open Government Licence v3.0.*

Minor Watercourses:

There are three small watercourses nearby the site as shown in Plate 6. The Rowan Tree Burn flows northwards to the southwest of the site and is culverted beneath the A803 Falkirk Road. Its flood extents do not pose any risk to the site.

The unnamed watercourse which connects to the Bonny Water to the north of the site indicates high flood risk, but is far below the site and so will not have an impact.

A culverted surface water drain to the east of the site does have indications of surface water flood risk to surrounding properties but will not affect the site of the proposed development as there is no pathway for flow between the two.

In the event of culvert blockage at either this feature or the Rowan Tree Burn, flow would overtop the road and continue downstream in the channel. Flood free access is maintained for the site, as it is highly unlikely that both culverts would fully block and overtop the road simultaneously.

In summary, the fluvial flood risk to site posed by minor watercourses is considered **negligible.**

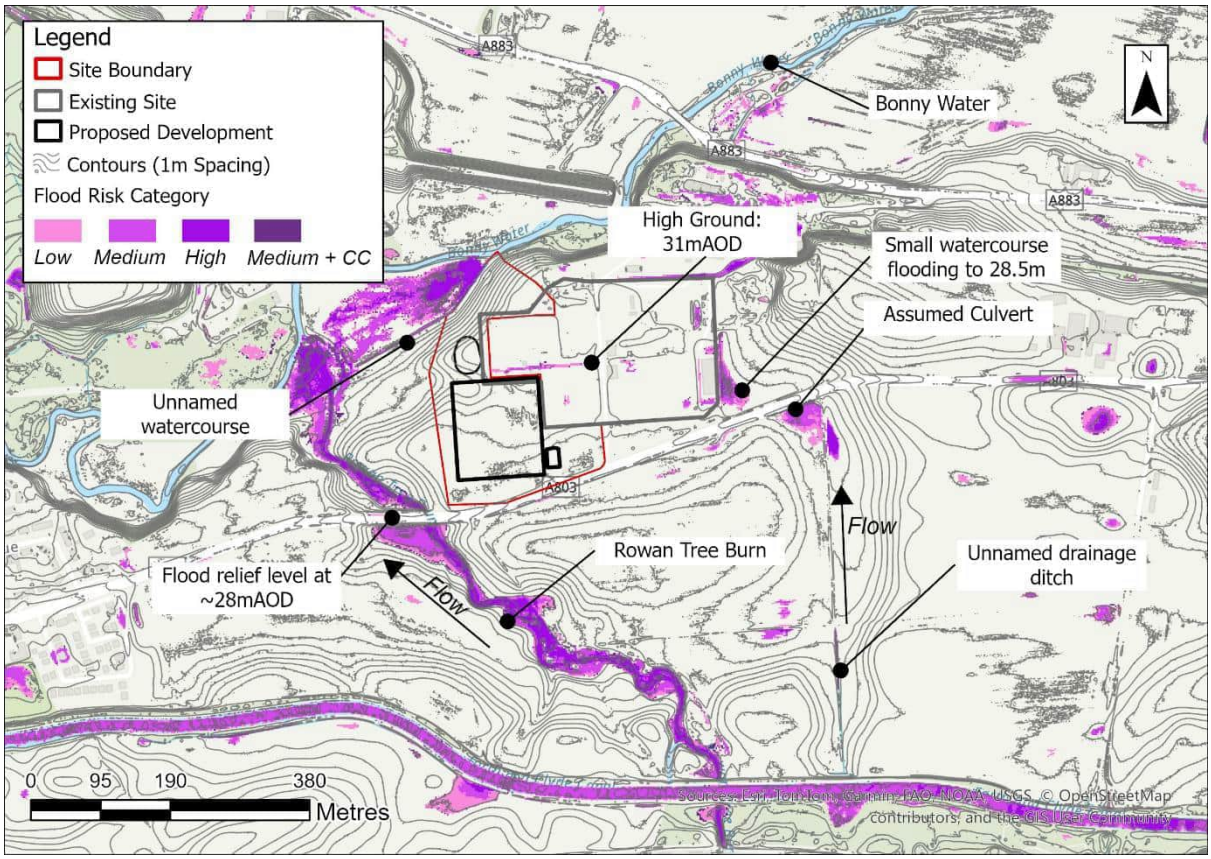


Plate 6 SEPA minor watercourse fluvial flood risk. Includes data from SEPA Flood Maps v3.0 © *Scottish Environment Protection Agency (SEPA) 2025; this SEPA product is licensed under the Open Government Licence v3.0.*

1.3.6 Surface Water Flooding

The SEPA flood map shown in Plate 7 indicates that there is no pluvial flood risk within the proposed development. There is flood risk up to the 10% AEP (High risk) category in a small portion to the north of the site, but it is not within the bounds of the proposed development itself.. A region of low and medium probability flood risk is situated to the north of the site, along an existing access road. The modelling approach used by SEPA to generate the flood extent maps often does not take into account existing site-specific surface water management. It is likely that this indication of surface water flooding is a computational relic arising from LiDAR inaccuracies, and also does not affect the proposed platform location. As a result, the surface water flood risk on site is deemed **negligible.**

The Surface Water Management Strategy (SWMS) in Section 1.4 further details the proposed strategy for managing surface water on site.

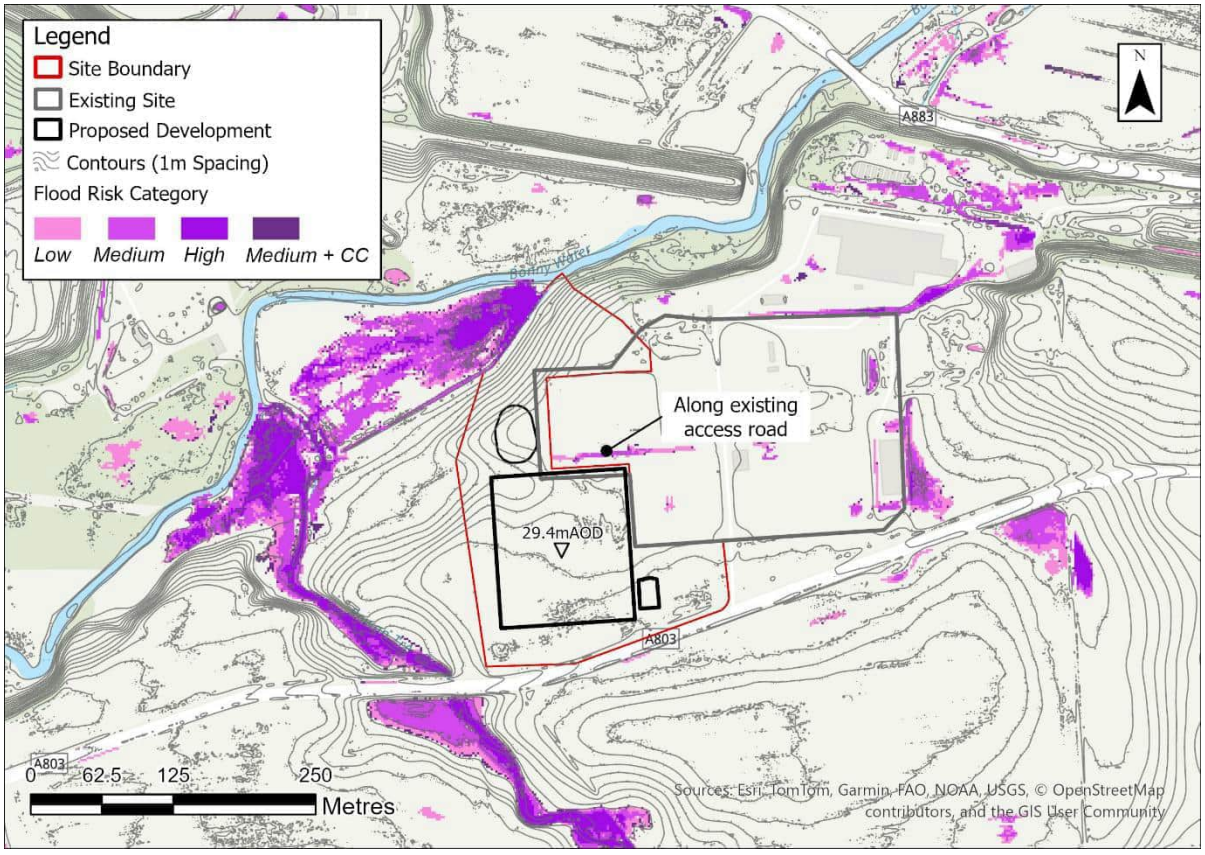


Plate 7 SEPA Pluvial flood risk. Includes data from SEPA Flood Maps v3.0 © *Scottish Environment Protection Agency (SEPA) 2025; this SEPA product is licensed under the Open Government Licence v3.0.*

1.3.7 Infrastructure Failure

The risk of flooding presented by **reservoir failure, canal failure, and mains water failure** has been assessed as follows:

Reservoir Failure: SEPA provides flood mapping to show areas which may be inundated with water in the event of a reservoir failure[17]. These maps show that the site is not at risk of flooding in the event of failure, and thus flood risk is deemed **negligible**.

Canal Failure: The nearest canal is the Forth and Clyde Canal, seen in Plate 1, which runs at a level of approximately 39mAOD approximately 350m south of the site. Were the canal to fail, the likely flow paths would be through the Rowan Tree Burn and the unnamed drainage course mentioned in Section

[17] SEPA Reservoirs Map (2022). Dataset. SEPA. https://map.sepa.org.uk/reservoirsfloodmap/Map.htm

1.3.5. However, following previous analysis, each of these watercourses has a flood relief flow path which would not impact site, so the risk to site posed by canal failure is **negligible**.

Mains Water Failure: A utility survey conducted by Sigma Surveys and supplied by SPEN found no major public mains in the direct vicinity of the site, so this flood risk is considered **negligible**.

1.3.8 Sewer Flooding

The utility survey supplied by SPEN found no wastewater or surface water sewers in the direct vicinity of the site, so sewer flooding poses **negligible** risk to the site.

1.3.9 Groundwater Flooding

Groundwater is usually a contributing factor to flooding rather than the primary source in Scotland. It is difficult to predict groundwater effects, however low-lying areas with permeable bedrock are considered to be most at risk. The description of the geology in Section 1.4, did not indicate any features which would indicate groundwater risk. The SEPA Groundwater flood map also does not indicate risk of groundwater flooding in the area, so risk of groundwater flooding is deemed **negligible**.

1.3.10 FRA Conclusion and Recommendations

The site of the proposed development is not considered to be at risk of flooding from any sources. A summary of the assessed flood risk is provided in Table 1. Under the current guidance, these results indicate that **a Level 2 or 3 FRA is not required**.

Table 1 Summary of Flood Risk Assessment

Source of Flood Risk	Brief Description	Magnitude of Risk
Coastal	The site is located 14km away from the coast at an elevation of 29.1mAOD. It is therefore far removed from areas at risk of coastal flooding.	***Negligible***
Fluvial	Flood risk posed by the Bonny Water, the Rowan Tree Burn, and a nearby drainage ditch have been assessed. In all cases, the flood extents do not affect the site, even in the event of culvert blockage. Allowance for climate change does not change this assessment.	***Negligible***
Surface Water	Some surface water flood risk is indicated adjacent to site, but not within the proposed development. This indicated risk is unlikely to affect the site given the presence of drainage. Allowance for climate change does not change this assessment. To satisfy Policy 22c) of the NPF4, a Surface Water Management Strategy is provided in Section 3 of this report. Proper management of surface water will reduce the impact on areas downstream of the site.	***Negligible***
Infrastructure Failure	Risk from reservoir failure, canal failure, and water mains failure were assessed. There are no reservoirs which would pose risk of inundating the site. Site surveys did not indicate presence of water mains near the site. Flow paths in the event of failure of the nearby Forth and Clyde Canal would follow existing watercourses which have been assessed to pose no risk.	***Negligible***
Sewer Flooding	Utility surveys did not indicate proximity to sewerage which would pose any risk.	***Negligible***
Groundwater Flooding	The site has no history of flooding and is outwith extents of possible groundwater flooding published by SEPA.	***Negligible***

1.4 Surface Water Management Strategy

1.4.1 Introduction

This Surface Water Management Strategy (SWMS) is provided in order to advise on the requirements for surface water management on the Bonnybridge Substation site. At the current planning stage, detailed drainage design information is not available. This SWMS will seek to provide a high-level assessment of the drainage demands posed by the proposed development and assess how the current proposed drainage scheme will manage surface water runoff with respect to water quality and quantity.

1.4.2 Existing Drainage

The extension to the Bonnybridge Substation will constitute its own platform, and its drainage system will not interact with the drainage system on the existing substation.

1.4.3 Principles of SuDS Best Practice

Sustainable Drainage Systems (SuDS) methods are recommended by both national and local authorities for achieving sufficient drainage of excess surface water on site while mitigating harmful downstream effects such as pollution and flooding. SuDS achieve these goals by providing flow paths for surface water which filter out pollutants, attenuate peak flows, and provide flood storage where necessary.

The CIRIA C753 SuDS Manual states the following SuDS drainage hierarchy should be utilised for new development planning proposals and requests for land drainage purposes:

1) Rainwater collection and re-use (where there is demand)
2) Infiltration to the maximum extent that is practical – where it is safe and acceptable to do so
3) Discharge to surface waters
4) Discharge to surface water sewers
5) Discharge into combined sewer

A SuDS management approach is expressed within the SuDS Manual; this approach allows the maximisation of SuDS uptake and benefits within planning proposals. The approach is expressed below:

- Use surface water as a resource,
- Manage rainfall at the source,
- Manage runoff on the surface of a site above ground,
- Allow for infiltration of runoff on site,
- Enhance evapotranspiration,
- Slow runoff and volume to greenfield runoff rates and volumes,
- Reduce water pollution by incorporating SuDS features to prevent pollution by enhancing water quality and control the runoff, and
- Use SuDS to treat runoff in urbanised catchments/sites to prevent environmental pollution.

In accordance with guidance, this SWMS will assess the proposed drainage against SuDS best practice for the treatment of surface water (Water Quality) and the conveyance, attenuation, and storage of surface water (Water Quantity).

1.4.4 Infiltration

No infiltration testing has been undertaken at the site. A conservative assumption has therefore been made to consider that no infiltration is possible. This assumption, and resulting design decisions, may be revised in later design stages should infiltration testing later be completed. As a result, the proposed drainage strategy will consider discharge to a nearby watercourse which is the next preferred option in the SuDS hierarchy.

1.4.5 Proposed Drainage Scheme

Plate 8 shows an excerpt of the proposed site drainage layout (full drawing is provided in Appendix B). This shows the site is to be drained by a series of perforated underdrain pipes which would convey flow to a perimeter filter drain network. This would outfall to a new SuDS basin which would temporarily store surface water, before discharging at a controlled rate through a Hydrobrake chamber to the Bonny Water.

The gravel compound itself will also provide a degree of attenuation storage. This has a minimum depth of 300mm and an assumed porosity of 30%. Assuming the entire gravel compound (1.54ha) is constructed at this minimum depth, and assuming 25% of the gravel compound volume is occupied by foundations and other subterranean infrastructure, this is would provide approximately 1,000m^3 of additional storage.

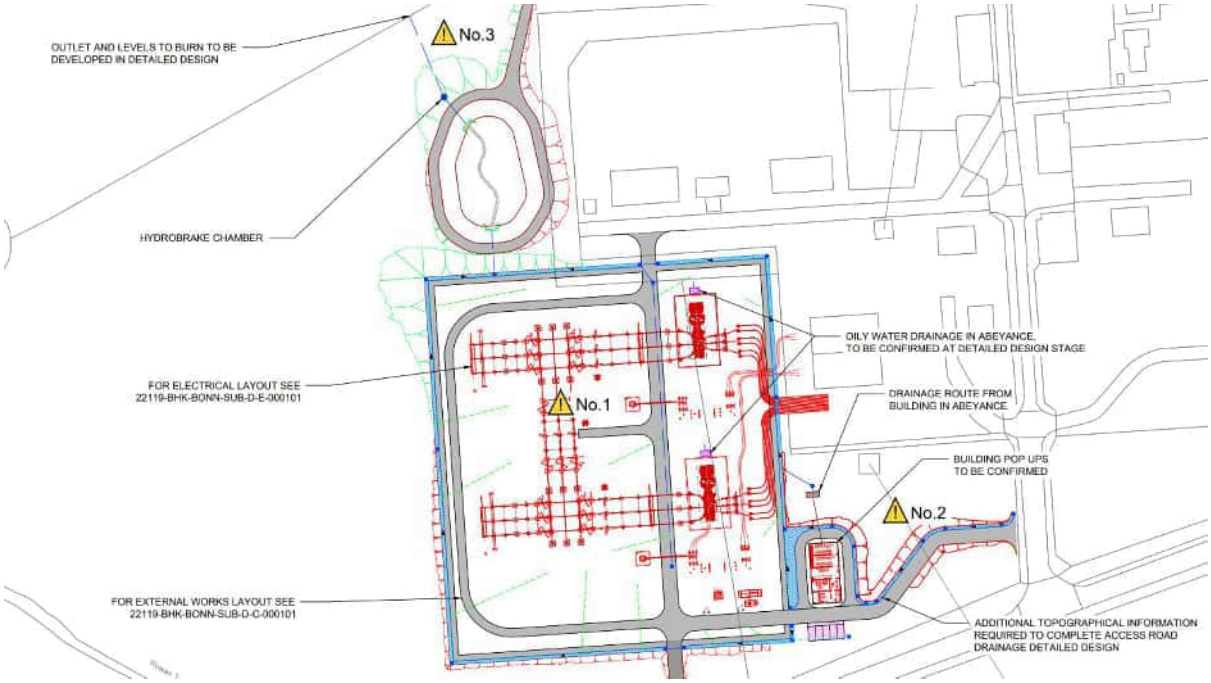


Plate 8 Proposed Drainage Layout

1.4.6 Surface Water Impact

By agreement with SPEN, the proposed substation platform is assumed to be designed following SPEN internal policy SUB-03-034[18] which sets standards for civil works involved in designing new substation platforms and requires platforms to be formed of a minimum 75mm layer of aggregate over a 225mm layer of Type 1 or 3 granular material.

The proposed development would involve the creation of new access roads and a control building which constitute a total impermeable area of approximately 0.4ha. For initial sizing of drainage elements, the total surface water catchment is 1.67ha which includes the gravel compound. This is a suitable

[18] General Specification for the Civil Engineering and Building Design and Construction of 275kV & 400kV Substations (2023) SP Energy Networks. https://www.spenergynetworks.co.uk/userfiles/file/SUB-03-034.pdf

assumption for the time being, as proposed drainage layouts indicate that that the full compound will be drained by perforated pipes beneath the site. The infiltration rates of the subsoil are unknown, as no geotechnical investigation results have been provided at the time of this report.

As stated in Planning Application Advice on Flood Risk and Surface Water Drainage, Section 3, For developments with a total impermeable area greater than 1000m^2 (0.1ha), Falkirk Council requires calculations to demonstrate the scheme's capacity to manage excess surface water on site. The FRA included in this report did not indicate that there would be any significant surface water flows entering the proposed site and thus only the development area will be taken as the catchment for further calculations in this section.

1.4.7 Water Quality

The Simple Index Approach (SIA) is a method of assessing whether the SuDS features proposed for a site are adequate to treat the collected runoff for the following pollutants: Total suspended solids (TSS), Metals, and Hydrocarbons. Based on the proposed usage of the site, a pollution index will be assigned for each of these pollutants.

The proposed SuDS features will have a rating for each pollutant corresponding to their efficacy in treating that type of pollution. By the CIRIA SuDS Manual, the sum of the treatment indices of the proposed SuDS must exceed the pollution index according to land usage. Where multiple SuDS features are used in series, the mitigation of each subsequent feature is factored by 0.5 to account for the reduction in treatment efficacy arising from a reduced concentration of pollutant at the inlet due to previous treatment.

The highest risk of pollution in the site arises from the access road which runs around the perimeter of the substation platform. The traffic load on this access road is expected to be low, so the development fits the Low Hazard level for general access roads specified by Table 26.2 of the SuDS Manual. The resulting pollution hazard indices for the site and mitigation indices for the proposed SuDS are summarised in Table 2.

Table 2 Summary of Simple Index Approach for proposed SuDS

Source	Description	TSS Index	Metals Index	Hydrocarbon Index
Land Use (pollution)	Low pollution hazard access road	0.5	0.4	0.4
Proposed SuDS 1 (mitigation)	Filter Drain	0.4	0.4	0.4
Proposed SuDS 2 (mitigation)	Basin	0.5 * 0.5 = 0.25	0.5 * 0.5 = 0.25	0.5 * 0.6 = 0.3
	Check	0.65 ≥ 0.5 OK	0.65 ≥ 0.4 OK	0.7 ≥ 0.4 OK

Following the above analysis, the proposed layout of a filter drain feeding to a basin will exceed the requirements for pollution mitigation. However, it should be noted that filter drains generally require more frequent maintenance if they are used to remove coarse sediments; this should be considered when developing the maintenance plan for the proposed drainage network as discussed further in Section 1.4.9.

1.4.8 Water Quantity

4.8.1 Approach

This section will provide initial calculations based on currently available data to illustrate that the proposed drainage scheme will be capable of conveying and attenuating the volume of additional surface water which will be generated by the impermeable area of the proposed scheme. This will be achieved through several steps: first by identifying the limiting outflow from the system in order to mitigate flood risk downstream of the site, then by modelling the drainage scheme to indicate approximate element sizes which would be required for sufficient attenuation. Following local council guidance, the following calculations will use the 0.5% AEP storm, with a 39% rainfall uplift for climate change as the design event following SEPA recommendations for the Forth river basin[19].

4.8.2 Discharge Rate

The rate at which the proposed drainage system discharges to the Bonny Water is critical for estimating the required attenuation storage within the scheme. This rate must be controlled in order to reduce the risk of flooding downstream of the site.

In accordance with Falkirk Council guidance, the maximum allowable discharge from a new development is the greater of 3l/s or 3.2l/s/ha. Based on a contributing catchment area of 1.67ha to the SuDS basin, the maximum allowable discharge rate is therefore 3.2 x 1.67 = 5.34l/s.

4.8.3 Attenuation Capacity

InfoDrainage 2025.3[20] was used to carry out a high-level assessment of the post-development surface water attenuation volume requirements on site. The drainage software simulates the post-development flow of the site using existing rainfall data to calculate the volume required.

The attenuation volume has been modelled as a SuDS basin with a depth of 2m, footprint area of 2150m^2 and 1:4 side slopes, resulting in 3112m^3 of storage. This sizing was determined iteratively to find an attenuation volume which is suitable for the site.

The post-development run-off routing has conservatively assumed a 100% runoff coefficient, which routes rainfall directly from the catchment to the storage volume. The rainfall catchment for the model was 1.67ha.

A rainfall uplift allowance for climate change has been taken as 39% in line with local guidance. Rainfall values on site were calculated using the FEH22 model using point descriptors obtained from the FEH Web Service. Storm durations were simulated through the full range of InfoDrainage's capabilities from 15 minutes to 10080 minutes.

The Hydrobrake outlet was modelled with a control of 5.3l/s at 2m design depth, in line with the proposed design for the basin.

Following Falkirk Council guidance[21], results were obtained for the 0.5% AEP+CC, 1%AEP+CC, and 3.33%AEP+CC events. To achieve the most resilient design possible, the attenuation will be designed with no flooding in the 0.5%AEP+CC case, although policy only requires this to the 1%AEP+CC case.

While a critical storm could not be determined, the 10080-minute storm was taken as the limiting event as it is the maximum storm duration that InfoDrainage can model. In reality, the critical event is likely to be longer, but results began to plateau for high durations, and several conservative assumptions have been made in the estimation of surface water impact, so this assumption is deemed acceptable.

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[19] Climate change allowances for flood risk assessment in land use planning, version 6. (2025). SEPA. https://www.sepa.org.uk/media/jjwpxuso/climate-change-allowances-guidance_v6.pdf

[20] InfoDrainage 2025.3. (2024) Autodesk. Software.

[21] Planning Application Advice on Flood Risk Assessment and Surface Water Management (2022). Falkirk council. https://www.falkirk.gov.uk/development-management/flood-risk-and-surface-water-drainage-advice

The model found that the provided volume of 3112m^3 was sufficient for the critical 10080-minute Summer storm in the 0.5%AEP+CC case.

The maximum resident volume for each return period of the 10080 minute storm is summarised in Table 3. In reality, the gravel substation compound and filter drains would also provide storage capacity, but for simplicity this storage has not been considered in this analysis. Based on these assumptions, this scheme constitutes an upper bound of the attenuation volume required on site which can be refined in further design stages, particularly if ground investigations determine that infiltration is possible. Full results are tabulated in Appendix C.

Table 3 Summary of attenuation sizing

Annual Exceedance Probability	Maximum Resident Volume	Utilisation
3.33%AEP+CC	2166.22m^3	70%
1%AEP+CC	2726.03m^3	88%
0.5%AEP+CC	3049.92m^3	98%

4.8.4 Outlet and Basin Location

Following the drainage hierarchy outlined in Section 1.4.3, discharging to a local watercourse is the best option. Due to lack of demand, rainwater cannot be collected for reuse on site, and there is assumed to be no infiltration capacity at this stage of design. The nearest location to discharge to a watercourse is to the un-named artificial watercourse which runs between the Rowan Tree Burn and Bonny Water, as indicated in Plate 9. This watercourse runs close to the site, and is the same watercourse which would receive surface water runoff from the site pre-development. If this feature is found to not be a suitable outlet location, the Bonny Water is sufficiently close to the development to route the discharge there.

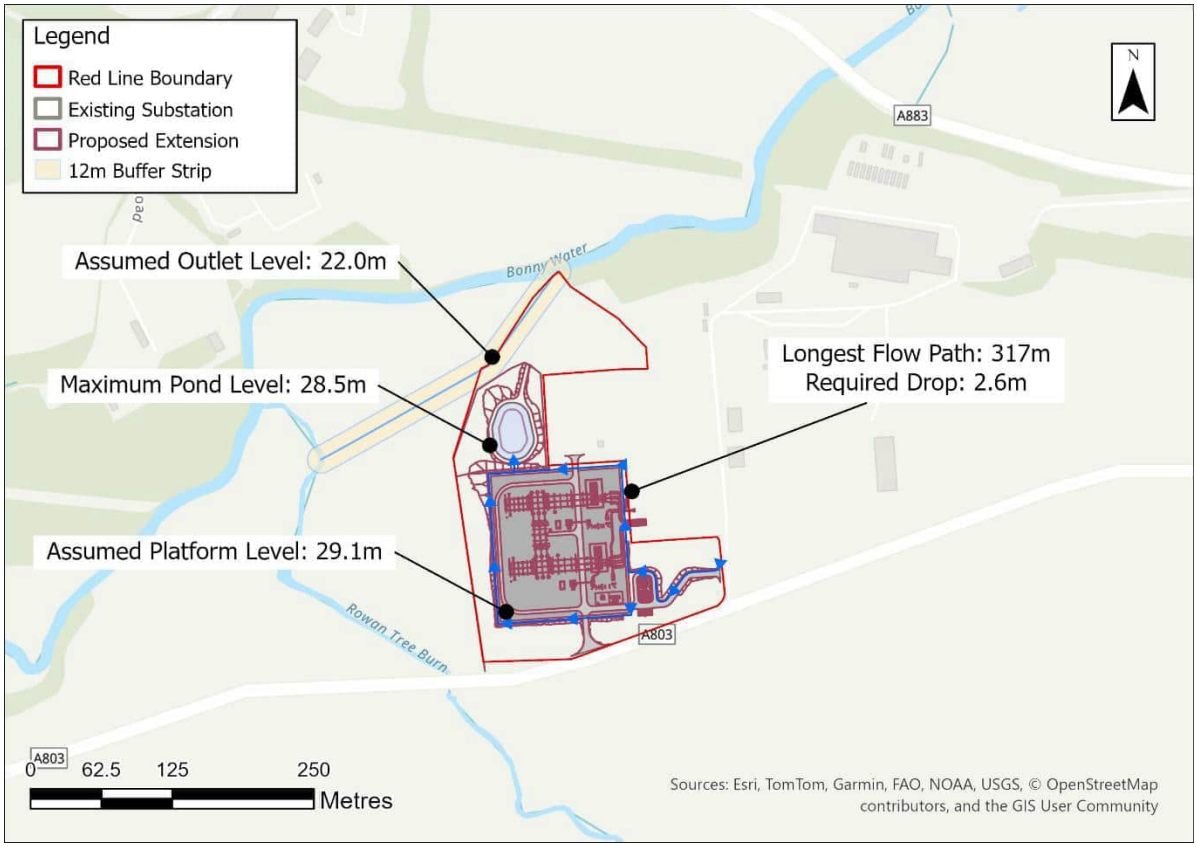


Plate 9 Recommended locations of basin and outlet

The specific siting of the SuDS scheme proposed is restricted by guidance and physical drainage principles. The proposed outlet watercourse is approximately 2-3m wide based on LiDAR analysis, requiring a 12m buffer strip on either side according to Falkirk Council[10]and SEPA policies as seen in Plate 9. Further, the levels of each element must allow for gravity-fed drainage from the substation platform to the basin and on to the watercourse.

Approximate levels and distances between points in the recommended scheme are shown in the Plate. Assuming an average bed slope of 1:150 for the filter drain network and 1m deep filter trench with an underdrain at 0.5m depth, a hydraulic drop of 2.6m is required. Based on an assumed platform elevation of 29.1mAOD, this means that the basin base level can be situated at a maximum of 26.5mAOD, with a spill-over level at 28.5mAOD. These levels demonstrate that the required 2m depth basin can be accommodated in the site footprint without impinging on the 12m buffer strip and meeting guidance on filter drain slopes. These levels indicate a maximum limit for performance of the system, but can be lowered to facilitate tying into existing levels as required. As the site elevations have not been confirmed, this arrangement may be amended in the future, and drainage levels should be checked at the detailed design phase.

1.4.9 Maintenance Schedule

To ensure the continued functionality and performance of the proposed SuDS, a maintenance schedule must be produced. SPEN will be responsible for the proper maintenance of SuDS assets on site, unless they appoint a suitable factor. Each element requires inspection and maintenance, possibly through a factoring agreement for the development. Failure to properly maintain the surface water drainage can lead to increased flooding on site and pollution downstream. According to the SuDS Manual, the minimum requirements for each SuDS component are tabulated as follows:

Table 4 Summary of Recommended Maintenance for Filter Drains

Maintenance schedule	Required Action	Typical Frequency
Regular Maintenance	Remove litter and debris from filter drain surface, access chambers, and any pre-treatment devices	Monthly, or as required
	Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage	Monthly
	Inspect pre-treatment systems, inlets, and perforated pipework for silt accumulation and establish appropriate silt removal frequencies	Six monthly
	Remove sediment from pre-treatment devices	Six monthly, or as required
Occasional Maintenance	Remove or control tree roots where they are encroaching on the sides of the filter drain, using recommended methods (BS 3998:2010[22])	As required
	At locations with high pollution loads, remove surface geotextiles and replace, and wash or replace overlying filter medium	Five yearly, or as required
	Clear perforated pipework of blockages.	As required

Table 5 Summary of Recommended Maintenance for SuDS Basin

Maintenance schedule	Required Action	Typical Frequency
Regular Maintenance	Remove litter and debris	Monthly, or as required
	Cut grass – public areas	Monthly (during growing season), or as required
	Cut grass – meadow grass in and around the basin	Half yearly (spring, before nesting season, and autumn)
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
	Inspect inlets, outlets, and overflows for blockages and clear if required.	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Monthly (first year), then annually or as required
	Check any mechanical devices, eg penstocks	Annually
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets, outlets, and forebay	Annually (or as required)

[22] BS 3998:2010 – Tree Work. (2010). British Standards Institution.

Maintenance schedule	Required Action	Typical Frequency
	Manage wetland plants in outlet pool – where provided	Annually
Occasional Maintenance	Reseed areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years, or as required
	Remove sediment from inlets, outlets, forebay, and main basin when required	Every 5 years, or as requird (likely to be minimal requirements where effectuve upstream source control is provided)
Remedial actions	Repair erosion or other damage by reseeding or re-turfing	As required
	Realignment of rip-rap	As required
	Rehabilitation of inlets, outlets, and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required

1.4.10 Construction Phase SuDS

Prior to construction commencing, a Construction Method Statement will be drafted by the appointed contractor. This should include a section describing how surface water will be managed during construction to prevent any uncontrolled discharge into nearby watercourses, in line with SuDS Manual. This document should be issued to the relevant authorities, either SEPA or the planning authority, for approval before construction commences on site.

1.4.11 SWMS Conclusion and Recommendations

The proposed scheme for draining the new substation platform, consisting of peripheral filter drains conveying to a SuDS basin and ultimately discharging to a nearby watercourse, was deemed sufficient for treating surface water runoff for Total Suspended Solids, metals, and hydrocarbons following application of the Simple Index approach.

In line with Falkirk Council Guidance, the limiting discharge rate for the site is 3.2 l/s/ha (5.34 l/s). The impermeable surface of the extension is estimated to be 1.67 ha and is conservatively assumed to be have a 100% runoff coefficient.

The total attenuation requirement for the site was modelled using InfoDrainage software and for a 0.5% AEP plus climate change (39% rainfall uplift) critical storm event. A single catchment area was modelled with no delay inflow into a single drainage basin. The preliminary sized basin was modelled to a depth of 2m, 1:4 side slopes, footprint area of 2150m^2, and a Hydrobrake controlled outlet. This sizing relies on conservative assumptions and can be refined in further design phases when further data is available.

Using the preliminary size of the basin, design recommendations of the SuDS Manual, and watercourse buffer strip requirements of Falkirk Council, it was demonstrated that the proposed scheme is feasible within the footprint of the site. A maintenance schedule for each SuDS feature was recommended following CIRIA guidance.

As the site is still under planning, the proposed treatment path may be subject to change in the detailed design phase; update to the Simple Index Approach may be required. A full drainage design is recommended to be carried out in the detailed design phase when geotechnical data is available for the site.

1.5 Summary and Conclusion

AECOM were commissioned by SP Energy Networks (SPEN) to consult on flood risk and surface water management for the proposed extension of the Bonnybridge substation as part of the Denny to Wishaw Network Upgrade project. This report has been undertaken to provide a Level 1 Flood Risk Assessment (FRA) to assess the level of flood risk on site and to prepare a Surface Water Management Strategy (SWMS) for managing surface water on site.

Following a full review of site conditions and common mechanisms for flooding, this FRA has determined that the Bonnybridge substation site is not at risk of fluvial, coastal, groundwater, or infrastructure-related flooding. The SEPA Flood Maps indicated small portions of the existing site which may be subject to surface water flooding, but it is not expected to impact the proposed development as this will be managed by the proposed drainage scheme Based on this analysis, a further assessment of flood risk (Level 2 or 3 FRA) is not required. The assessment of flood risk is considered satisfactory under SPEN SUB-01-018, as flood protection is not required.

This report also offers a Surface Water Management Strategy (SWMS) in support of the proposed development assessing the outline drainage design and providing recommendations for further design development. The requirements for surface water drainage are presented, as well as the principles of SuDS best practice which informed the SWMS. The proposed development include a filter drain network to service the platform extension, which would feed into a SuDS basin, discharging to the unnamed drainage ditch to the north of the site.

The proposed SuDS treatment path was assessed using the Simple Index Approach and found to be sufficient for treating surface water runoff from the proposed access roads. A high-level assessment of the storage required onsite was undertaken to ensure that the proposed scheme can provide sufficient surface water attenuation to mitigate flood risks downstream. A simplified catchment and basin model identified that approximately 3112m^3 of storage would be required to service the entire 1.67ha site, assuming no infiltration to ground and controlling basin outflow to 5.3 l/s (3.2 l/s/ha). An assessment of the site geometry found that this size basin could be accommodated in the planned location, without impinging on a buffer zone around the nearby watercourse and allowing sufficient bed slopes for drainage elements to function. Finally, recommendations are provided as to the proper maintenance schedule for the proposed SuDS systems.

As the Bonnybridge site is still under planning, the proposed drainage scheme may be subject to change in the detailed design phase; update to the Simple Index Approach may be required and a full drainage design is recommended to be carried out in the detailed design phase.

Appendix A – SEPA FRA Checklist

Flood Risk Assessment (FRA) Checklist

Scotland's 4th National Planning Framework has recently been published. This document is therefore being reviewed and updated to reflect the new policies. You can still find useful and relevant information here but be aware that some parts may be out of date and our responses to planning applications may not match the information set out here.

(SS-NFR-F-001 - Version 16 - Last updated 27/08/2019

This document must be attached within the front cover of any Flood Risk Assessments issued to Local Planning Authorities (LPA) in support of a development proposal which may be at risk of flooding. The document will take only a few minutes to complete and will assist SEPA in reviewing FRAs, when consulted by LPAs. This document should not be a substitute for a FRA.

Development Proposal Summary							
Site Name:		Bonnybridge Substation					
Grid Reference:	Easting:	283957	Northing:	680916			
Local Authority:		Falkirk Council					
Planning Reference number (if known):							
Nature of the development:		Utility Infrastructure	If residential, state type:				
Size of the development site:		1.67 Ha					
Identified Flood Risk:	Source:	Pluvial	Source name:	Surface Water			
Land Use Planning							
Is any of the site within the functional floodplain? (refer to SPP para 255)		No	If yes, what is the net loss of storage?			m^3	
Is the site identified within the local development plan?		No	Local Development Plan Name:		Year of Publication:		
			Allocation Number / Reference:				
If yes, what is the proposed use for the site as identified in the local plan?		Select from List	If Other please specify:				
Does the local development plan and/or any pre-application advice, identify any flood risk issues with or requirements for the site.		No	If so, please specify:				
What is the proposed land use vulnerability?		Essential Infrastructure	Do the proposals represent an increase in land use vulnerability?		Yes		
Supporting Information							
Have clear maps / plans been provided within the FRA (including topographic and flood inundation plans)?		Yes					
Has sufficient supporting information, in line with our Technical Guidance, been provided? For example: site plans, photos, topographic information, structure information and other site specific information.		Yes					
Has a historic flood search been undertaken?		Yes	If flood records in vicinity of the site please provide details:				
Is a formal flood prevention scheme present?		No	If known, state the standard of protection offered:				
Current / historical site use:		Greenfield					
Is the site considered vacant or derelict?		No					
Development Requirements							
Freeboard on design water level:		0.6 m					
Is safe / dry access and egress available?		Vehicular and Pedestrian	Min access/egress level:		29.1	m AOD	
Design levels:	Ground level:	29.1 m AOD	Min FFL:		29.7	mAOD	
Mitigation							
Can development be designed to avoid all areas at risk of flooding?		Yes					
Is mitigation proposed?		No					
If yes, is compenstory storage necessary?		No					
Demonstration of compensatory storage on a "like for like" basis?		No					
Should water resistant materials and forms of construction be used?		Yes					

Flood Risk Assessment (FRA) Checklist

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Hydrology

Is there a requirement to consider fluvial flooding?		No			
Area of catchment:			km^2	Is a map of catchment area included in FRA?	Select from List
Estimation method(s) used (please select all that apply):		Pooled Analysis ☐		If Pooled analysis have group details been included?	Select from List
		Single Site Analysis ☐			
		Enhanced Single Site ☐			
		ReFH2 ☐			
		FEH RRM ☐			
		Other ☐		If other (please specify methodology used):	
Estimate of 200 year design flood flow:			m^3/s		
Qmed estimate:			m^3/s	Method:	Select from List
Statistical Distribution Selected:		Select from List		Reasons for selection:	

Hydraulics

Hydraulic modelling method:		Select from List		Software used:	Select from List
				If other please specify:	
Number of cross sections:					
Source of data (i.e. topographic survey, LiDAR etc):				Date obtained / surveyed:	
Modelled reach length:			m		
Any changes to default simulation parameters?				If yes please provide details:	
Model timestep:					
Model grid size:					
Any structures within the modelled length?		Select from List		Specify, if combination:	
Maximum observed velocity:			m/s		
Brief summary of sensitivity tests, and range:					
variation on flow (%)			%	Please specify climate change scenario considered:	
variation on channel roughness (%)			%		
blockage of structure (range of % blocked)			%		
boundary conditions:		**Upstream**		**Downstream**	
(1) type		Flow		Select from List	
	Specify if other			Specify if other:	
(2) does it influence water levels at the site?		Select from List		Select from List	
Has model been calibrated (gauge data / flood records)?		Select from List			
Is the hydraulic model available to SEPA?		Select from List			
Design flood levels:	200 year		m AOD	200 year plus climate change	m AOD
Cross section results provided?		Select from List			
Long section results provided?		Select from List			
Cross section ratings provided?		Select from List			
Tabular output provided (i.e. levels, velocities)?					
Mass balance error:			%		

Coastal

Is there a requirement to consider coastal / tidal flooding?		No		
Estimate of 200 year design flood level:			m AOD	
Estimation method(s) used:		Select from List		If other please specify methodology used:
Allowance for climate change (m):			m	
Allowance for wave action etc (m):			m	
Overall design flood level:			m AOD	

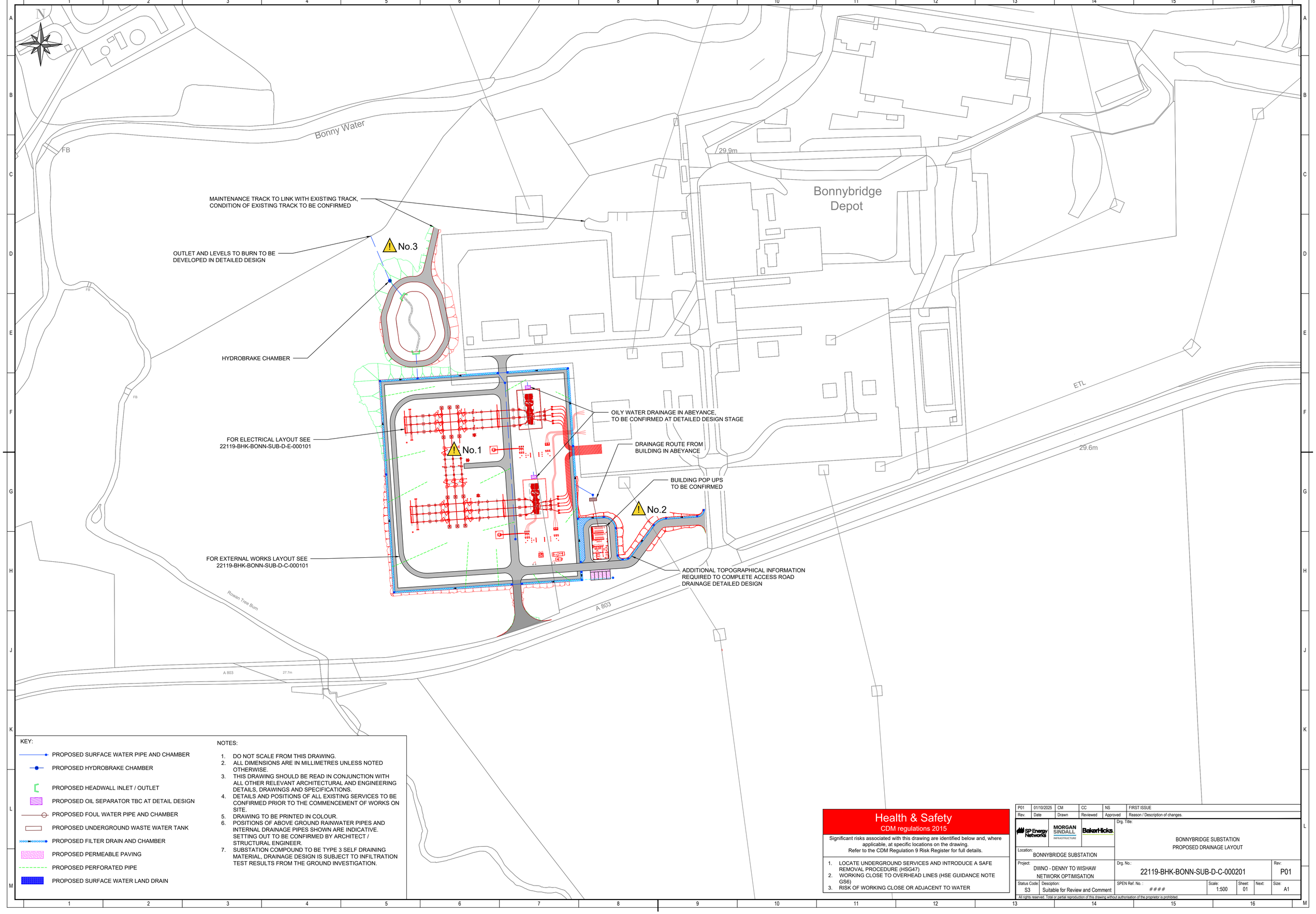
Comments

Any additional comments:	

Approved by: [redacted]
Organisation: AECOM
Date: 14/01/2025

Note: Further details and guidance is provided in 'Technical Flood Risk Guidance for Stakeholders' which can be accesssed here:- CLICK HERE

Appendix B – Proposed Drainage Layout



KEY:

- PROPOSED SURFACE WATER PIPE AND CHAMBER
- PROPOSED HYDROBRAKE CHAMBER
- PROPOSED HEADWALL INLET / OUTLET
- PROPOSED OIL SEPARATOR TBC AT DETAIL DESIGN
- PROPOSED FOUL WATER PIPE AND CHAMBER
- PROPOSED UNDERGROUND WASTE WATER TANK
- PROPOSED FILTER DRAIN AND CHAMBER
- PROPOSED PERMEABLE PAVING
- PROPOSED PERFORATED PIPE
- PROPOSED SURFACE WATER LAND DRAIN

NOTES:

1. DO NOT SCALE FROM THIS DRAWING.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
3. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ARCHITECTURAL AND ENGINEERING DETAILS, DRAWINGS AND SPECIFICATIONS.
4. DETAILS AND POSITIONS OF ALL EXISTING SERVICES TO BE CONFIRMED PRIOR TO THE COMMENCEMENT OF WORKS ON SITE.
5. DRAWING TO BE PRINTED IN COLOUR.
6. POSITIONS OF ABOVE GROUND RAINWATER PIPES AND INTERNAL DRAINAGE PIPES SHOWN ARE INDICATIVE. SETTING OUT TO BE CONFIRMED BY ARCHITECT / STRUCTURAL ENGINEER.
7. SUBSTATION COMPOUND TO BE TYPE 3 SELF DRAINING MATERIAL, DRAINAGE DESIGN IS SUBJECT TO INFILTRATION TEST RESULTS FROM THE GROUND INVESTIGATION.

Health & Safety
CDM regulations 2015

Significant risks associated with this drawing are identified below and, where applicable, at specific locations on the drawing.
Refer to the CDM Regulation 9 Risk Register for full details.

1. LOCATE UNDERGROUND SERVICES AND INTRODUCE A SAFE REMOVAL PROCEDURE (HSG47)
2. WORKING CLOSE TO OVERHEAD LINES (HSE GUIDANCE NOTE GS6)
3. RISK OF WORKING CLOSE OR ADJACENT TO WATER

Rev.	Date	Drawn	Reviewed	Approved	Reason / Description of changes.
P01	01/10/2025	CM	CC	NS	FIRST ISSUE

SP Energy Networks | MORGAN SINDALL INFRASTRUCTURE | Baker Hicks

Drg. Title: BONNYBRIDGE SUBSTATION PROPOSED DRAINAGE LAYOUT

Location: BONNYBRIDGE SUBSTATION

Project: DWNO - DENNY TO WISHAW NETWORK OPTIMISATION

Drg. No.: 22119-BHK-BONN-SUB-D-C-000201 | Rev.: P01

Status Code:	Description:	SPEN Ref. No. :	Scale:	Sheet:	Next:	Size:
S3	Suitable for Review and Comment	####	1:500	01		A1

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Appendix C – InfoDrainage Results

Project:	Date: 25/07/2025		
	Designed by: [redacted]	Checked by:	Approved By:
Report Details: Type: Inflows Storm Phase: Phase	Company Address:		



Catchment Area

Type : Catchment Area

Area (ha)	1.67

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	1.000
Winter Volumetric Runoff	1.000
Time of Concentration (mins)	5
Percentage Impervious (%)	100

Project:	Date: 25/07/2025		
	Designed by: [redacted]	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Storm Phase: Phase	Company Address:		

Pond Type : Pond

Dimensions

Exceedance Level (m)	0.000
Depth (m)	2.000
Base Level (m)	-2.000
Freeboard (mm)	0
Initial Depth (m)	0.000
Porosity (%)	100
Average Slope (1:X)	4.027
Total Volume (m³)	3112.080

Depth (m)	Area (m²)	Volume (m³)
0.000	1030.00	0.000
2.000	2150.00	3112.080

Inlets

Inlet

Inlet Type	Point Inflow
Incoming Item(s)	Catchment Area
Bypass Destination	(None)
Capacity Type	No Restriction

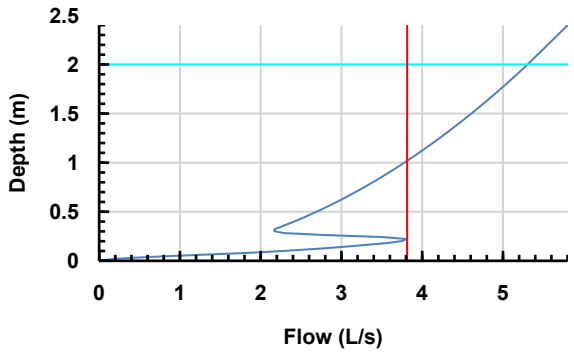
Outlets

Outlet

Outgoing Connection	(None)
Outlet Type	Hydro-Brake®

Invert Level (m)	-2.000
Design Depth (m)	2.000
Design Flow (L/s)	5.3
Objective	Minimise Upstream Storage Requirements
Application	Surface Water Only
Sump Available	☐

Unit Reference	CHE-0089-5300-2000-5300



Project:	Date: 25/07/2025		
	Designed by: [redacted]	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Storm Phase: Phase	Company Address:		

Advanced

Perimeter	Circular
Length (m)	68.997
Friction Scheme	Manning's n
n	0.5

Project:	Date: 25/07/2025		
	Designed by: [redacted]	Checked by:	Approved By:
Report Details: Type: Inflow Summary Storm Phase: Phase	Company Address:		

Inflow Label	Connected To	Flow (L/s)	Runoff Method	Area (ha)	Percentage Impervious (%)	Urban Creep (%)	Adjusted Percentage Impervious (%)	Area Analysed (ha)
Catchment Area	Pond		Time of Concentration	1.67	100	10	110	1.837
TOTAL		**0.0**		**1.67**				**1.837**

Project:	Date: 25/07/2025		
	Designed by: [redacted]	Checked by:	Approved By:
Report Title: Rainfall Analysis Criteria	Company Address:		

Runoff Type	Dynamic
Output Interval (mins)	5
Time Step	Default
Urban Creep	Apply Global Value
Urban Creep Global Value (%)	10
Junction Flood Risk Margin (mm)	300
Perform No Discharge Analysis	☐

Rainfall

FEH

Type: FEH

Site Location	GB 283996 680913 NS 83996 80913
Rainfall Version	2022
Summer	☑
Winter	☑

Return Period

Return Period (years)	Increase Rainfall (%)
200.0	39.000
100.0	39.000
30.0	39.000

Storm Durations

Duration (mins)	Run Time (mins)
15	30
30	60
60	120
120	240
180	360
240	480
360	720
480	960
600	1200
720	1440
960	1920
1440	2880
2160	4320
2880	5760
4320	8640
5760	11520
7200	14400
8640	17280
10080	20160

Project:	Date: 25/07/2025		
	Designed by: [redacted]	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Summary Storm Phase: Phase	Company Address:		

Summary Results for Pond: Rank By: Max. Flooded Volume

Storm Event	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Percentage Available (%)	Status
FEH: 200 years: +39 %: 15 mins: Summer	628.404	0.000	79.808	OK
FEH: 200 years: +39 %: 15 mins: Winter	628.984	0.000	79.789	OK
FEH: 200 years: +39 %: 30 mins: Summer	892.809	0.000	71.312	OK
FEH: 200 years: +39 %: 30 mins: Winter	892.699	0.000	71.315	OK
FEH: 200 years: +39 %: 60 mins: Summer	1194.069	0.000	61.631	OK
FEH: 200 years: +39 %: 60 mins: Winter	1194.157	0.000	61.628	OK
FEH: 200 years: +39 %: 120 mins: Summer	1359.429	0.000	56.318	OK
FEH: 200 years: +39 %: 120 mins: Winter	1359.746	0.000	56.307	OK
FEH: 200 years: +39 %: 180 mins: Summer	1464.400	0.000	52.945	OK
FEH: 200 years: +39 %: 180 mins: Winter	1464.911	0.000	52.928	OK
FEH: 200 years: +39 %: 240 mins: Summer	1545.251	0.000	50.347	OK
FEH: 200 years: +39 %: 240 mins: Winter	1545.862	0.000	50.327	OK
FEH: 200 years: +39 %: 360 mins: Summer	1673.996	0.000	46.210	OK
FEH: 200 years: +39 %: 360 mins: Winter	1676.057	0.000	46.144	OK

FEH: 200 years: +39 %: 480 mins: Summer	1783.908	0.000	42.678	OK
FEH: 200 years: +39 %: 480 mins: Winter	1786.336	0.000	42.600	OK
FEH: 200 years: +39 %: 600 mins: Summer	1880.517	0.000	39.574	OK
FEH: 200 years: +39 %: 600 mins: Winter	1883.386	0.000	39.481	OK
FEH: 200 years: +39 %: 720 mins: Summer	1967.475	0.000	36.779	OK
FEH: 200 years: +39 %: 720 mins: Winter	1971.016	0.000	36.666	OK
FEH: 200 years: +39 %: 960 mins: Summer	2120.272	0.000	31.870	OK
FEH: 200 years: +39 %: 960 mins: Winter	2125.176	0.000	31.712	OK
FEH: 200 years: +39 %: 1440 mins: Summer	2358.247	0.000	24.223	OK
FEH: 200 years: +39 %: 1440 mins: Winter	2366.190	0.000	23.968	OK
FEH: 200 years: +39 %: 2160 mins: Summer	2588.736	0.000	16.817	OK
FEH: 200 years: +39 %: 2160 mins: Winter	2601.763	0.000	16.398	OK
FEH: 200 years: +39 %: 2880 mins: Summer	2730.317	0.000	12.267	OK
FEH: 200 years: +39 %: 2880 mins: Winter	2750.095	0.000	11.632	OK
FEH: 200 years: +39 %: 4320 mins: Summer	2865.411	0.000	7.926	OK
FEH: 200 years: +39 %: 4320 mins: Winter	2901.086	0.000	6.780	OK
FEH: 200 years: +39 %: 5760 mins: Summer	2940.881	0.000	5.501	OK

FEH: 200 years: +39 %: 5760 mins: Winter	2963.089	0.000	4.788	OK
FEH: 200 years: +39 %: 7200 mins: Summer	2991.237	0.000	3.883	OK
FEH: 200 years: +39 %: 7200 mins: Winter	3005.132	0.000	3.437	OK
FEH: 200 years: +39 %: 8640 mins: Summer	3029.781	0.000	2.644	OK
FEH: 200 years: +39 %: 8640 mins: Winter	3037.930	0.000	2.383	OK
FEH: 200 years: +39 %: 10080 mins: Summer	3062.071	0.000	1.607	OK
FEH: 200 years: +39 %: 10080 mins: Winter	3059.289	0.000	1.696	OK
FEH: 100 years: +39 %: 15 mins: Summer	554.879	0.000	82.170	OK
FEH: 100 years: +39 %: 15 mins: Winter	555.201	0.000	82.160	OK
FEH: 100 years: +39 %: 30 mins: Summer	787.104	0.000	74.708	OK
FEH: 100 years: +39 %: 30 mins: Winter	787.196	0.000	74.705	OK
FEH: 100 years: +39 %: 60 mins: Summer	1053.086	0.000	66.161	OK
FEH: 100 years: +39 %: 60 mins: Winter	1053.189	0.000	66.158	OK
FEH: 100 years: +39 %: 120 mins: Summer	1207.779	0.000	61.191	OK
FEH: 100 years: +39 %: 120 mins: Winter	1208.039	0.000	61.182	OK
FEH: 100 years: +39 %: 180 mins: Summer	1306.264	0.000	58.026	OK
FEH: 100 years: +39 %: 180 mins: Winter	1306.636	0.000	58.014	OK

FEH: 100 years: +39 %: 240 mins: Summer	1381.405	0.000	55.612	OK
FEH: 100 years: +39 %: 240 mins: Winter	1382.044	0.000	55.591	OK
FEH: 100 years: +39 %: 360 mins: Summer	1499.162	0.000	51.828	OK
FEH: 100 years: +39 %: 360 mins: Winter	1500.984	0.000	51.769	OK
FEH: 100 years: +39 %: 480 mins: Summer	1596.952	0.000	48.685	OK
FEH: 100 years: +39 %: 480 mins: Winter	1599.587	0.000	48.601	OK
FEH: 100 years: +39 %: 600 mins: Summer	1682.262	0.000	45.944	OK
FEH: 100 years: +39 %: 600 mins: Winter	1685.330	0.000	45.846	OK
FEH: 100 years: +39 %: 720 mins: Summer	1758.347	0.000	43.499	OK
FEH: 100 years: +39 %: 720 mins: Winter	1762.101	0.000	43.379	OK
FEH: 100 years: +39 %: 960 mins: Summer	1891.013	0.000	39.236	OK
FEH: 100 years: +39 %: 960 mins: Winter	1896.189	0.000	39.070	OK
FEH: 100 years: +39 %: 1440 mins: Summer	2100.977	0.000	32.490	OK
FEH: 100 years: +39 %: 1440 mins: Winter	2109.459	0.000	32.217	OK
FEH: 100 years: +39 %: 2160 mins: Summer	2307.390	0.000	25.857	OK
FEH: 100 years: +39 %: 2160 mins: Winter	2321.417	0.000	25.406	OK
FEH: 100 years: +39 %: 2880 mins: Summer	2433.539	0.000	21.803	OK

FEH: 100 years: +39 %: 2880 mins: Winter	2454.538	0.000	21.129	OK
FEH: 100 years: +39 %: 4320 mins: Summer	2554.648	0.000	17.912	OK
FEH: 100 years: +39 %: 4320 mins: Winter	2587.848	0.000	16.845	OK
FEH: 100 years: +39 %: 5760 mins: Summer	2625.589	0.000	15.632	OK
FEH: 100 years: +39 %: 5760 mins: Winter	2641.750	0.000	15.113	OK
FEH: 100 years: +39 %: 7200 mins: Summer	2672.177	0.000	14.135	OK
FEH: 100 years: +39 %: 7200 mins: Winter	2685.656	0.000	13.702	OK
FEH: 100 years: +39 %: 8640 mins: Summer	2707.635	0.000	12.996	OK
FEH: 100 years: +39 %: 8640 mins: Winter	2713.750	0.000	12.799	OK
FEH: 100 years: +39 %: 10080 mins: Summer	2736.931	0.000	12.055	OK
FEH: 100 years: +39 %: 10080 mins: Winter	2730.322	0.000	12.267	OK
FEH: 30 years: +39 %: 15 mins: Summer	436.183	0.000	85.984	OK
FEH: 30 years: +39 %: 15 mins: Winter	436.546	0.000	85.973	OK
FEH: 30 years: +39 %: 30 mins: Summer	611.320	0.000	80.357	OK
FEH: 30 years: +39 %: 30 mins: Winter	611.644	0.000	80.346	OK
FEH: 30 years: +39 %: 60 mins: Summer	815.985	0.000	73.780	OK
FEH: 30 years: +39 %: 60 mins: Winter	815.964	0.000	73.781	OK

FEH: 30 years: +39 %: 120 mins: Summer	958.377	0.000	69.205	OK
FEH: 30 years: +39 %: 120 mins: Winter	958.399	0.000	69.204	OK
FEH: 30 years: +39 %: 180 mins: Summer	1046.461	0.000	66.374	OK
FEH: 30 years: +39 %: 180 mins: Winter	1046.813	0.000	66.363	OK
FEH: 30 years: +39 %: 240 mins: Summer	1112.583	0.000	64.250	OK
FEH: 30 years: +39 %: 240 mins: Winter	1113.109	0.000	64.233	OK
FEH: 30 years: +39 %: 360 mins: Summer	1213.695	0.000	61.001	OK
FEH: 30 years: +39 %: 360 mins: Winter	1215.126	0.000	60.955	OK
FEH: 30 years: +39 %: 480 mins: Summer	1292.421	0.000	58.471	OK
FEH: 30 years: +39 %: 480 mins: Winter	1295.074	0.000	58.386	OK
FEH: 30 years: +39 %: 600 mins: Summer	1359.369	0.000	56.320	OK
FEH: 30 years: +39 %: 600 mins: Winter	1362.555	0.000	56.217	OK
FEH: 30 years: +39 %: 720 mins: Summer	1417.663	0.000	54.446	OK
FEH: 30 years: +39 %: 720 mins: Winter	1421.527	0.000	54.322	OK
FEH: 30 years: +39 %: 960 mins: Summer	1518.024	0.000	51.222	OK
FEH: 30 years: +39 %: 960 mins: Winter	1523.423	0.000	51.048	OK
FEH: 30 years: +39 %: 1440 mins: Summer	1674.898	0.000	46.181	OK

FEH: 30 years: +39 %: 1440 mins: Winter	1683.822	0.000	45.894	OK
FEH: 30 years: +39 %: 2160 mins: Summer	1830.804	0.000	41.171	OK
FEH: 30 years: +39 %: 2160 mins: Winter	1846.061	0.000	40.681	OK
FEH: 30 years: +39 %: 2880 mins: Summer	1924.584	0.000	38.158	OK
FEH: 30 years: +39 %: 2880 mins: Winter	1947.642	0.000	37.417	OK
FEH: 30 years: +39 %: 4320 mins: Summer	2021.019	0.000	35.059	OK
FEH: 30 years: +39 %: 4320 mins: Winter	2044.684	0.000	34.298	OK
FEH: 30 years: +39 %: 5760 mins: Summer	2080.945	0.000	33.133	OK
FEH: 30 years: +39 %: 5760 mins: Winter	2095.460	0.000	32.667	OK
FEH: 30 years: +39 %: 7200 mins: Summer	2120.705	0.000	31.856	OK
FEH: 30 years: +39 %: 7200 mins: Winter	2128.804	0.000	31.595	OK
FEH: 30 years: +39 %: 8640 mins: Summer	2150.974	0.000	30.883	OK
FEH: 30 years: +39 %: 8640 mins: Winter	2147.454	0.000	30.996	OK
FEH: 30 years: +39 %: 10080 mins: Summer	2175.284	0.000	30.102	OK
FEH: 30 years: +39 %: 10080 mins: Winter	2157.754	0.000	30.665	OK

Denny to Wishaw Network Upgrade

Denny North Substation Flood Risk Assessment and Surface Water Management Strategy

SPEN

Project number: 60602788

Delivering a better world

Quality information

Prepared by	Checked by	Verified by	Approved by
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Revision History

Revision	Revision date	Details	Authorized	Name	Position
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Plate 2-2 Site topography, Contains public sector information licensed under the Open Government Licence v3.0, sourced from Scottish Government – Scottish Public Sector LiDAR Phase 5. 30

Plate 2-3 Proposed Works Layout 31

Plate 2-4 Excerpt of Falkirk Council flood incidents map. 37

Plate 2-5 SEPA fluvial flood risk. Includes data from SEPA Flood Maps v3.0 © *Scottish Environment Protection Agency (SEPA) 2025; this SEPA product is licensed under the Open Government Licence v3.0.* 38

Plate 2-6 SEPA minor watercourse fluvial flood risk. Includes data from SEPA Flood Maps v3.0 © *Scottish Environment Protection Agency (SEPA) 2025; this SEPA product is licensed under the Open Government Licence v3.0.* 39

Plate 2-7 SEPA Pluvial flood risk. Includes data from SEPA Flood Maps v3.0 © *Scottish Environment Protection Agency (SEPA) 2025; this SEPA product is licensed under the Open Government Licence v3.0.* 40

Plate 2-8 Excerpt of as-built drawing of drainage swale. Filter drains inputting to swale from platform not shown. 43

Plate 2-9 Proposed drainage scheme. Excerpt from 22119-BHK-DENN-SUB-D-C-000201. 45

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Table 2-3 Summary of Recommended Maintenance for Filter Drains 47

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2.1 Introduction

2.1.1 Context

AECOM has been commissioned by SP Energy Networks (SPEN) to undertake Flood Risk Assessments (FRAs) and develop Surface Water Management Strategies (SWMSs) for several substation sites within the Denny to Wishaw Network Upgrade (DWNO) project. This report details both the FRA and SWMS relevant to the Proposed Works to the Denny North Substation, which is being upgraded to support changes to the overhead line.

The FRA, conducted in line with CIRIA C624 guidance on Development and Flood Risk[1], details the flood risk associated with these proposed works, including the flood risk baseline, policy context, and any implications for the proposed works with regard to flood risk. The FRA and SWMS have been used to develop a coordinated drainage solution, although the proposed drainage scheme may be subject to change in the detailed design phase. In particular, the SWMS outlines the intended strategy for managing surface water at the site, with reference to national and local policy and guidance from the CIRIA C753 SuDS Manual[2].

In this report, the terms ‘proposed works’ and ‘site’ will be used to refer to the Proposed Works to the Denny North Substation, and the site of those works, respectively.

2.1.2 Site Description

The proposed works constitute upgrades to the existing Denny North substation, situated at grid reference NS 82567 84571 approximately 2.5km north-east of Denny town centre. The site is located in a rural area dominated by grassland and farmland, bordered on the north by Langlard’s Farm, to the southwest by Doghillock Farm, the south and east by Pamphellgoat and Tor Woods, and the west by an unnamed road stemming from the A872. The site is depicted in Plate 2-1.

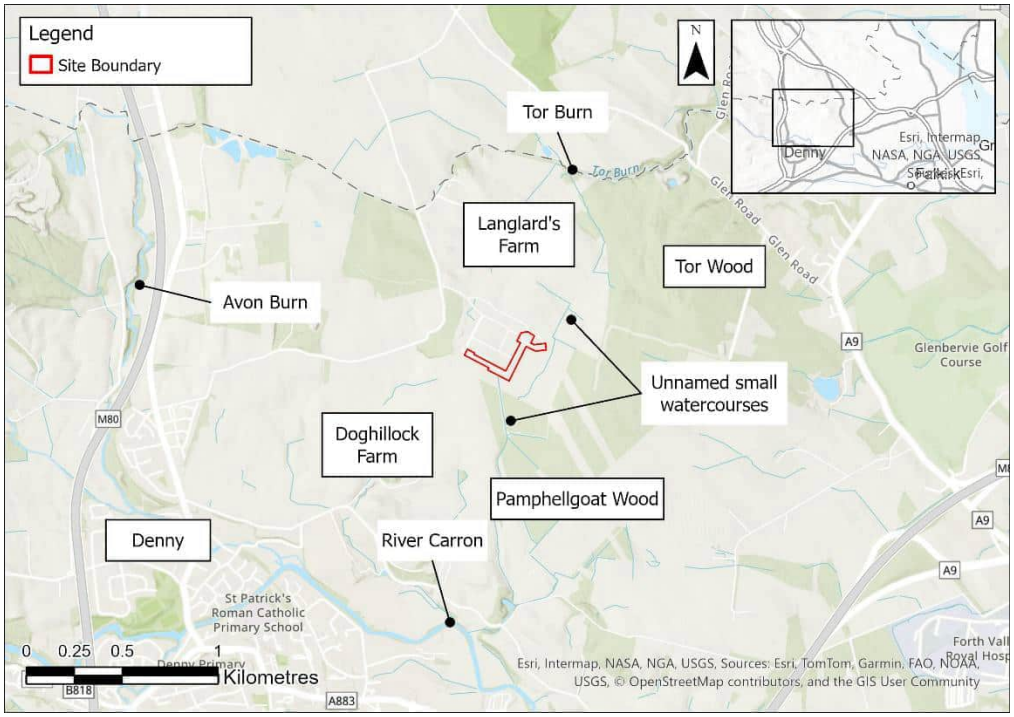


Plate 2-1: Site Overview

[1] C624: Development and Flood Risk (2004). Construction Industry Research and Information Association.
[2] C753: The SuDS Manual (2015). Construction Industry Research and Information Association.

There are several features of hydrologic importance in the vicinity of the site:

- The River Carron which runs south-east through Denny roughly 1.5km south-west of the site.
- The Avon Burn runs southwards 1.8km west of the site, before joining the River Carron.
- The Tor Burn runs eastward, 900m north of the site, fed by small waterways and agricultural drainage ditches.
- Several small drains and natural watercourses are located in the direct environs of the site.

The red line boundary covers an area of approximately 2.23ha, comprising primarily the southern and eastern borders of the existing substation.

2.1.3 Site Topography

The topography of the site has been assessed using a Phase 5, 0.5m resolution LiDAR Digital Terrain Model (DTM)[3]. The existing site is located on a saddle point on the ridgeline between two unnamed hills with approximately 100m prominence. Development of the original substation footprint has levelled the local terrain within the site extents. As a result, the site is largely flat, with a slight slope from 100.2m AOD on the west side of the site to 99.8m AOD on the east side of the site where the proposed works would be located. The land is lower than platform level to the east and west, and higher than platform level to the north and south.

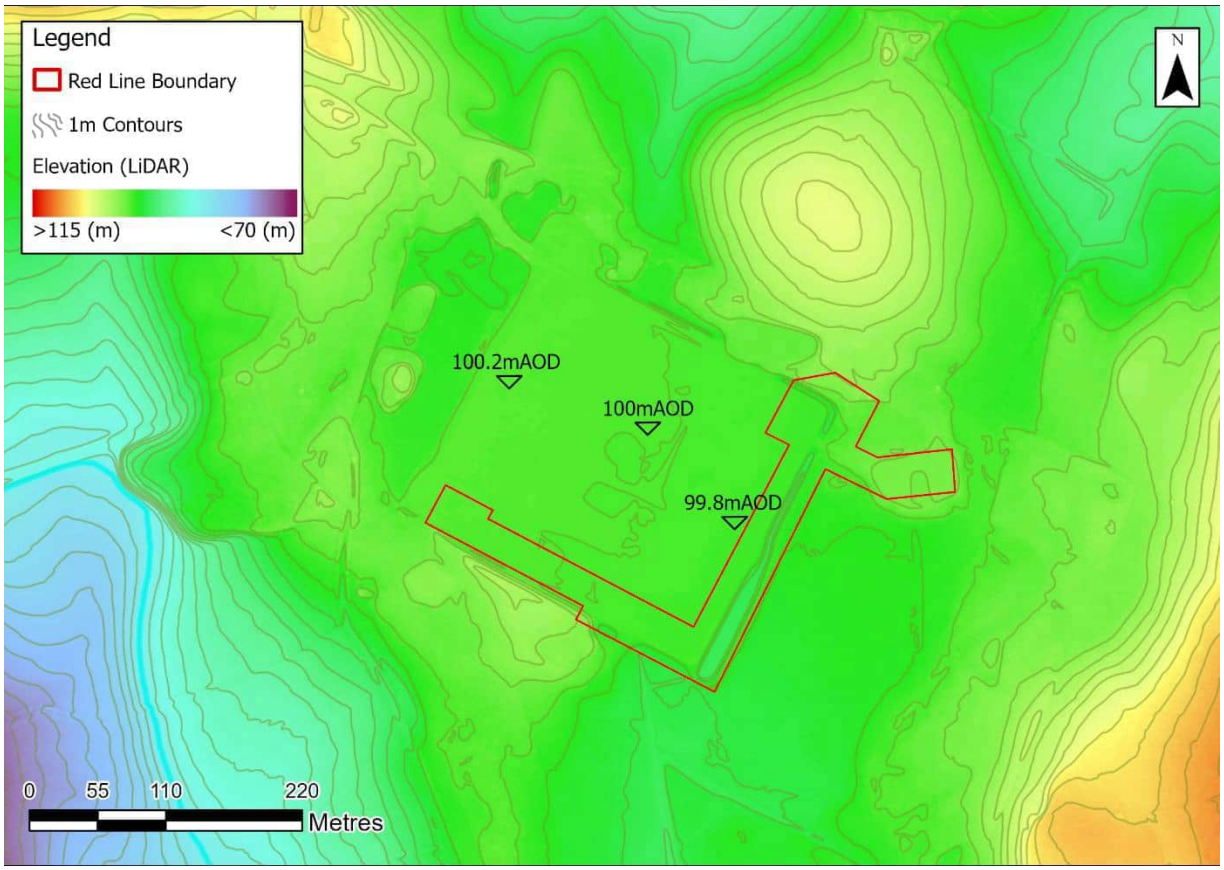


Plate 2-2 Site topography, Contains public sector information licensed under the Open Government Licence v3.0, sourced from Scottish Government – Scottish Public Sector LiDAR Phase 5.

[3] LiDAR for Scotland Phase V DTM (2021). Dataset. Scottish Government. Dataset. https://remotesensingdata.gov.scot/data#/list

2.1.4 Geology

Geology mapping provided by British Geological Survey (BGS)[4] indicates the sites superficial deposits predominantly consist till, with peat layers in some areas north of the site. The bedrock geology is made up of upper formation limestone of the Clackmannan Group.

The site lies over "moderately productive aquifers," which are multilayered and generally low yield unless disturbed by mining.

BGS Borehole record NS88SW215/4[5] conducted in 1967 directly to the south of the site identified water at a depth of 0.6m, however the remaining 9 boreholes conducted at the same time to the north of the site were dry to a depth of at least 6.7m.

No site-specific ground investigation information has been provided at the time of conducting this study.

2.1.5 Proposed Works

A plan view of the site area and proposed works are provided in Plate 2-3. The upgrades on site, hereafter referred to as 'the proposed works', constitute an extension of the site platform of approximately 1030m^2 which includes a new paved access road of approximately 310m^2. The surface of the substation compound will be composed of a minimum 75mm depth layer of aggregate over a 225mm layer of Type 1 or 3 granular material, following SPEN specification SUB-03-034[6]. An existing access road of approximately 160m^2 will be removed.

The works will also include the upgrade of existing electrical plant, and the installation of a new bay containing air insulated switchgear and an overhead line gantry tower. The works are proposed to take place in the northern half of the existing substation, within the extents of the site.

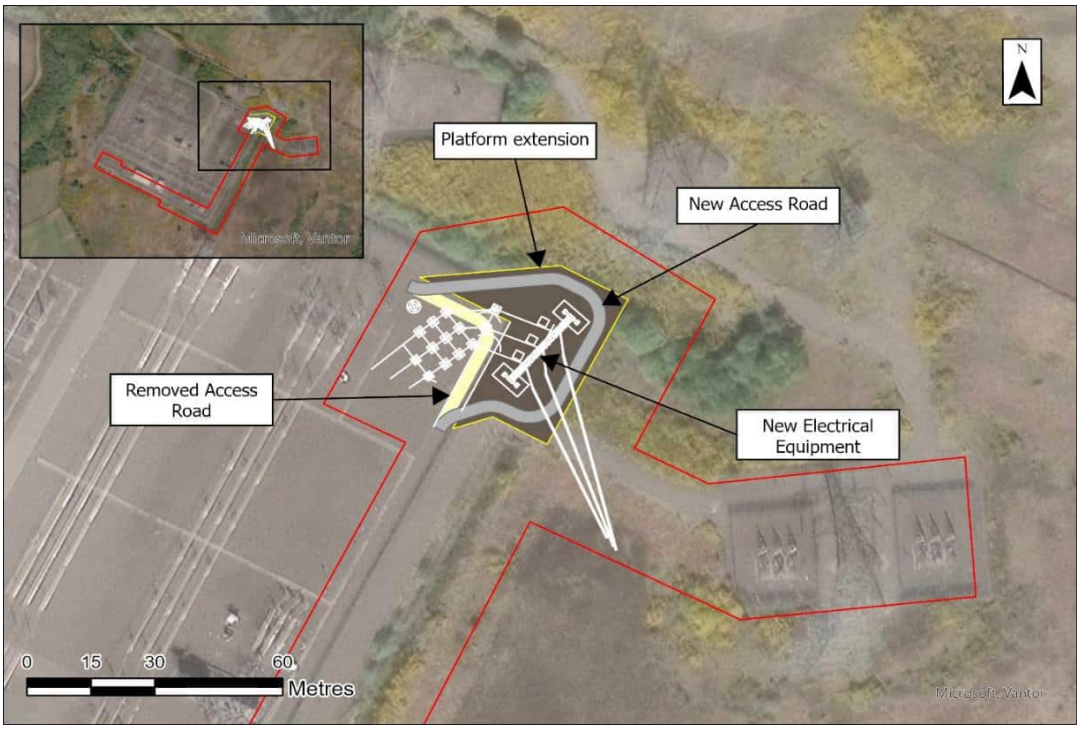


Plate 2-3 Proposed Works Layout

[4] Geology Viewer (no date). British Geological Survey. https://geologyviewer.bgs.ac.uk/?_ga=2.214158167.1385564789.1724058925-51426505.1724058925
[5] Borehole Record NS88SW215/4 (1967). British Geological Survey. Available at https://api.bgs.ac.uk/sobi-scans/v1/borehole/scans/items/862777

[6] General Specification for the Civil Engineering and Building Design and Construction of 275kV & 400kV Substations (2023). SP Energy Networks. https://www.spenergynetworks.co.uk/userfiles/file/SUB-03-034.pdf

2.2 Policy Context

This report has been developed in accordance with the relevant national and local policies discussed below. While all the key policy frameworks covering the site have been referenced to produce this report, the following sections will highlight the most critical policy details which have bearing on the proposed works.

2.2.1 National Planning Policy

Following Policy 11.e.vii) of the *National Planning Framework 4* (NPF4)[7], proposals for energy developments should demonstrate how the effects of development on flood risk and the water environment are addressed in design, which is the purpose of this report.

The requirements for consideration of flood risk in Scotland is set out in more detail in Policy 22 of the NPF4. Policy 22 is supplemented by SEPA's *Land Use Vulnerability Guidance*[8] which categorises land uses and developments by their vulnerability to inform where exceptions to this policy may be applicable. Based on this guidance, the proposed development is categorised as 'essential infrastructure'.

Relevant sections of Policy 22 include:

a) *"Development proposals at risk of flooding or in a flood risk area will only be supported if they are for:*

   i) *essential infrastructure where the location is required for operational reasons;*

   ii) *water compatible uses;*

   iii) *redevelopment of an existing building or site for an equal or less vulnerable use; or.*

   iv) *redevelopment of previously used sites in built up areas where the LDP has identified a need to bring these into positive use and where proposals demonstrate that long term safety and resilience can be secured in accordance with relevant SEPA advice.*

   In such cases, it will be demonstrated by the applicant that:

- *all risks of flooding are understood and addressed;*
- *there is no reduction in floodplain capacity, increased risk for others, or a need for future flood protection schemes;*
- *the development remains safe and operational during floods;*
- *flood resistant and resilient materials and construction methods are used; and*
- *future adaptations can be made to accommodate the effects of climate change.*

c) *Development proposals will:*

   i) *not increase the risk of surface water flooding to others, or itself be at risk.*

   ii) *manage all rain and surface water through sustainable urban drainage systems (SUDS), which should form part of and integrate with proposed and existing blue-green infrastructure. All proposals should presume no surface water connection to the combined sewer;*

   iii) *seek to minimise the area of impermeable surface."*

[7] National Planning Framework 4 (2023). Scottish Government. https://www.gov.scot/binaries/content/documents/govscot/publications/strategy-plan/2023/02/national-planning-framework-4/documents/national-planning-framework-4-revised-draft/national-planning-framework-4-revised-draft/govscot%3Adocument/national-planning-framework-4.pdf

[8] Flood Risk and Land Use Vulnerability Guidance (2024). SEPA. https://www.sepa.org.uk/environment/land/planning/guidance-and-advice-notes/

In this context, NPF4 defines “at risk of flooding” as “land or built form with an annual probability of being flooded of greater than 0.5% which must include an appropriate allowance for future climate change”. This will be used as the benchmark for flood risk assessment in this report.

2.2.2 Local Planning Policy

The proposed works lie within the administrative area of Falkirk Council. They provide guidance for prospective developments on their policies regarding flood risk and drainage. This report has therefore paid due consideration to the following relevant guidance documents:

- Falkirk Local Development Plan 2 (LDP2)[9]
- Supplementary Guidance SG05: Green Infrastructure and New Development[10]
- Forth Estuary Local Plan District’s *Local Flood Risk Management Plan Cycle 2*[11]
- Falkirk Council Planning Application Advice on Flood Risk and Surface Water Drainage[12].

LDP2 addresses requirements for flood risk under Policy P24 (Flood Management) and for drainage under Policy IR10 (Drainage Infrastructure).

Relevant sections of Policy PE24 include:

1. *“The Council will support the delivery of the objectives and actions set out in the Local Flood Risk Management Strategies and Local Flood Risk Management Plans covering the area. There will be a presumption against development which would prejudice the implementation of the relevant actions.*
2. *Development proposals will be assessed against the Flood Risk Framework set out in Scottish Planning Policy, with development being avoided in locations at medium to high flood risk, unless it accords with the criteria set out in the Framework. There will be a presumption against new development which would:*
    - *Be likely to be at risk of flooding;*
    - *Increase the level of risk of flooding for existing development;*
    - *Result in a use more vulnerable to flooding or with a larger footprint than any previous development on site; or*
    - *Lead to an increase in the probability of flooding elsewhere.*
3. *Development proposals on land identified as being at medium to high risk from any source of flooding, and low to medium risk areas as identified by the Flood Risk Framework, or where other available information suggests there may be a risk, including proposals to restore the natural course of watercourses, will be required to provide a flood risk assessment in accordance with SEPA’s Technical Flood Risk Guidance for Stakeholders that demonstrates that:*
    - *Any flood risks can be adequately managed both within and outwith the site;*

[9] Falkirk Local Development Plan 2 (2020). Falkirk Council. https://www.falkirk.gov.uk/development-planning/falkirk-local-development-plan-2
[10] SG05: Green Infrastructure and New Development (2021). Falkirk Council. https://www.falkirk.gov.uk/media/9c2b6e86-73ff-4c4f-ba86-2ab0ae80af55
[11] Local Flood Risk Management Plan, Cycle 2, 2022-2028 (2023). Falkirk Council. https://fcwebsites.blob.core.windows.net/www/media/2d14fbbb-2b7e-4c75-89e8-75187206357d/03%20Forth%20Estuary%20Local%20Flood%20Risk%20Management%20Plan%20Cycle%202%20-%202022-2028.pdf%23:~:text=The%20Plan%20identifies%20where%20the%20risk%20of%20flooding,and%20will%20be%20delivered%20between%202022%20and%202028.
[12] Planning Application Advice on Flood Risk and Surface Water Drainage (2022). Falkirk Council. https://www.falkirk.gov.uk/development-management/flood-risk-and-surface-water-drainage-advice

- *An adequate allowance for climate change and freeboard has been built into the flood risk assessment;*
- *Access and egress can be provided to the site which is free of flood risk; and*
- *Water resistant materials and forms of construction will be utilised where appropriate (including any development permitted in medium to high risk areas (that accords with the exceptions in the Food Risk Framework) or is located in adjacent low to medium risk areas).*

4. *Development proposals on previously developed land which is at risk of flooding will be limited to uses which are of equal or less vulnerability as defined by SEPA's Land Use Vulnerability Guidance.*
5. *Where suitably robust evidence suggests that land contributes or has the potential to contribute towards sustainable flood management measures development will only be permitted where the land's sustainable flood management function can be safeguarded.*

Relevant sections of Policy IR10 include:

2. *Surface water management for new development should comply with current best practice on Sustainable Urban Drainage Systems (SUDS), where appropriate forming an integral part of the development's landscape structure as set out within Supplementary Guidance SG05 'Green Infrastructure and New Development'. SUDS will be required to meet the specifications as detailed in the most recent version of Sewers for Scotland should the developer wish the surface water system to vest in Scottish Water.*
3. *For developments that involve a change of use and/or redevelopment, wherever possible, opportunities should be taken to retrofit SUDS."*

Following the recommendations of IR10 parts 2-4, the Surface Water Management Strategy proposed in Section 3 of this report will be developed in accordance with the SuDS Manual.

2.2.3 SPEN Policy

SPEN's internal policy SUB 01-018: Substation Flood Resilience[13] and its implications for the assessment of flood risk and provision of flood protection has been considered throughout the Flood Risk Assessment process.

[13] SUB 01-018: Substation Flood Resilience Issue 03 (2023). SPEN. https://www.spenergynetworks.co.uk/userfiles/file/SUB-01-018.pdf

2.3 Flood Risk Assessment

This section will report on the findings of a flood risk analysis desk study with the aims of qualifying but not quantifying the extents of flood risk sources which may impact the proposed works. The following structure will be used:

- A brief description of the types of flood risk considered
- A review of the data-sources used to assess flood risk on site
- An analysis of each flood risk type as they pertain to the proposed works
- A summary of the flood risk assessed from each source and recommended mitigations.

The findings of this assessment are summarised in the SEPA FRA checklist in Appendix A, in line with SEPA technical guidance[14].

2.3.1 Potential Sources of Flood Risk

Flood risk on a site may be either caused or exacerbated by a range of hazards. Each of these hazards may themselves present a flood risk or may interact with other hazards to produce an overall flood risk. Estimates of the impact of climate change on the severity and extent of these hazards will also be considered. The following flood hazards will be assessed regarding their individual contribution to flood risk and, where appropriate, their likelihood of increasing flood risk posed by other hazards:

a) **Coastal Flooding:** Extreme sea levels and wave heights can cause inundation and flooding on developments on or sufficiently near the coast.

b) **Fluvial (River) Flooding:** Extreme flood events in rivers and other large watercourses can cause rapid and significant inundation of surrounding areas

c) **Pluvial (Surface Water) Flooding:** High volume rainfall events which exceed the infiltration and storage capacity of the local soil cause flows to develop over land, potentially damaging property.

d) **Infrastructure Failure:** Water conveyance, storage, or flow control infrastructure can fail, either causing a flood risk in itself, or exacerbating the scale or extent of other flood hazards.

e) **Sewer Flooding:** The failure of sewerage can result in surface flooding.

f) **Groundwater Flooding:** Variations in the local water table and groundwater level can impact the storage capacity of the soil or subterranean storage infrastructure. While groundwater alone does not generally pose significant risk, it may exacerbate the risk posed by other flood hazards.

Consideration will also be given to the future impacts of climate change where appropriate.

2.3.2 Data Sources

The assessment of the above-described flood hazards has been informed by a range of sources. SEPA develops and maintains flood risk datasets pertaining to Coastal, Fluvial (River) and Pluvial (Surface Water) flooding, with additional consideration of the impact of climate change. The relevant sections of this report have drawn on the data provided in the SEPA Flood Map Version 3.0[15]. The flood extents in these maps have been estimated using predictive modelling covering all of Scotland and thus are limited by the specificity of the data which informs them. Thus, these maps should be seen as 'indicative' and

[14] Technical Flood Risk Guidance for Stakeholders (2022). SEPA https://www.sepa.org.uk/media/162602/ss-nfr-p-002-technical-flood-risk-guidance-for-stakeholders.pdf
[15] SEPA Flood Map Version 3.0 (2025). Dataset. SEPA. https://map.sepa.org.uk/floodmaps

their results interpreted within the context of site characteristics. SEPA also maintains a database relating to groundwater hazards[16] which has been consulted.

In assessing the risks of infrastructure failure, the SEPA Reservoirs map[17] has been used, which identifies areas at risk of flooding from uncontrolled release of stored water.

Falkirk Council's records for past flood events was also consulted.

To maintain congruity with SEPA Flood Risk Assessment methods, this report will maintain the following terminology for levels of flood risk:

- **High Risk:** Areas which are subject to flooding in the characteristic 10% AEP (1:10 year) rainfall event. These areas have a 10% chance of flooding each year based on past rainfall data.
- **Medium Risk:** Areas which are subject to flooding in the characteristic 0.5% AEP (1:200 year) rainfall event. These areas have a 0.5% chance of flooding each year based on past rainfall data.
- **Low Risk:** Areas which are subject to flooding in the characteristic 0.1% AEP (1:1000 year) rainfall event. These areas have a 0.1% chance of flooding each year based on past rainfall data.

As current climate change models predict that the frequency and intensity of extreme rainfall events will increase in the future, a further risk category will be used when discussing flood hazards which would be impacted by rainfall uplift caused by climate change:

- **Medium Risk with Climate Change:** Areas which are subject to flooding in the characteristic 0.5% AEP (1:200 year) rainfall event. These areas have a 0.5% chance of flooding each year based on rainfall uplift estimates for the year 2080.

2.3.3 Historic Flooding

From consultation with Falkirk Council flooding records, there have been no documented flood events which have affected the existing site or the surrounding area as shown in Plate 2-4.

[16] SEPA Groundwater Map (2025). Dataset. SEPA. https://map.sepa.org.uk/floodmap/map.htm
[17] SEPA Reservoirs Map (2022). Dataset. SEPA. https://map.sepa.org.uk/reservoirsfloodmap/Map.htm

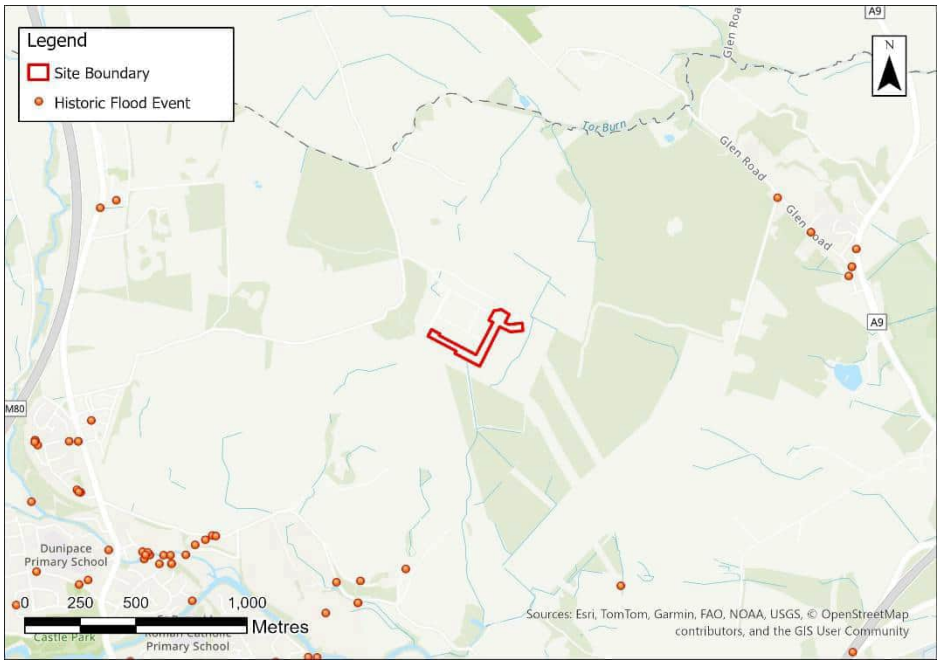


Plate 2-4 Excerpt of Falkirk Council flood incidents map.

2.3.4 Coastal Flooding

The coastal SEPA flood maps show the site to be outside the coastal extent, with the nearest extent located over 6 km northeast of the site. As the proposed ground level across the site is approximately 99.8mAOD, the site is suitably above sea level and the coastal flood risk on site is deemed **negligible.**

2.3.5 Fluvial Flooding

Flooding caused by watercourses of any size is considered Fluvial in nature. Watercourses with large catchemnts (herein referred to as 'Major Watercourses') are best represented using the SEPA River Flood Map, while watercourses with smaller catchments (herein referred to as 'Minor Watercourses') are best represented in the SEPA Surface Water Flood Map. This assessment will consider both sources as indicators of fluvial flood risk

Major Watercourses:

Plate 2-5 shows an extract of the SEPA Fluvial Flood Maps, indicating that the proposed works are outwith the floodplains of any major watercourses. The nearest flood extents are in the River Carron floodplain 1.4km to the south of the site. Thus, the fluvial flood risk to the site from large watercourses is **negligible.**

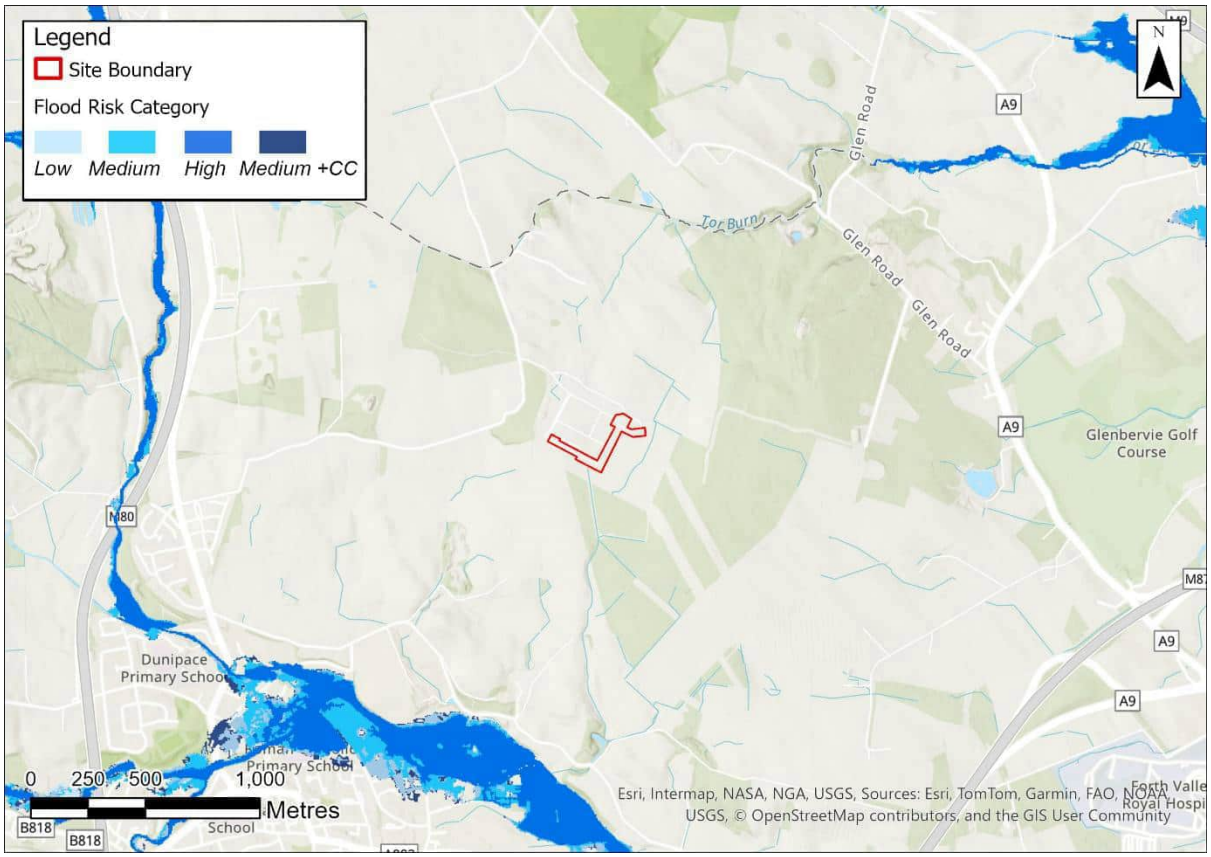


Plate 2-5 SEPA fluvial flood risk. Includes data from SEPA Flood Maps v3.0 © *Scottish Environment Protection Agency (SEPA) 2025; this SEPA product is licensed under the Open Government Licence v3.0.*

Minor Watercourses: As discussed in Section 2.1.2, there are several minor watercourses arising from small catchments and surface water drainage in the vicinity of the site. Due to the size of their catchments, these watercourses are not included in the SEPA River Flood Map, but are included in the SEPA Surface Water Flood Map as shown in Plate 2-6. These are small burns or field drains, all of which flow downhill away from the site. None of the flood risk areas arising from these small watercourses intersect the site, and due to the significant differences in elevation, are not expected to increase flood risk on site. The small watercourse flood risk to site is still considered **negligible.**

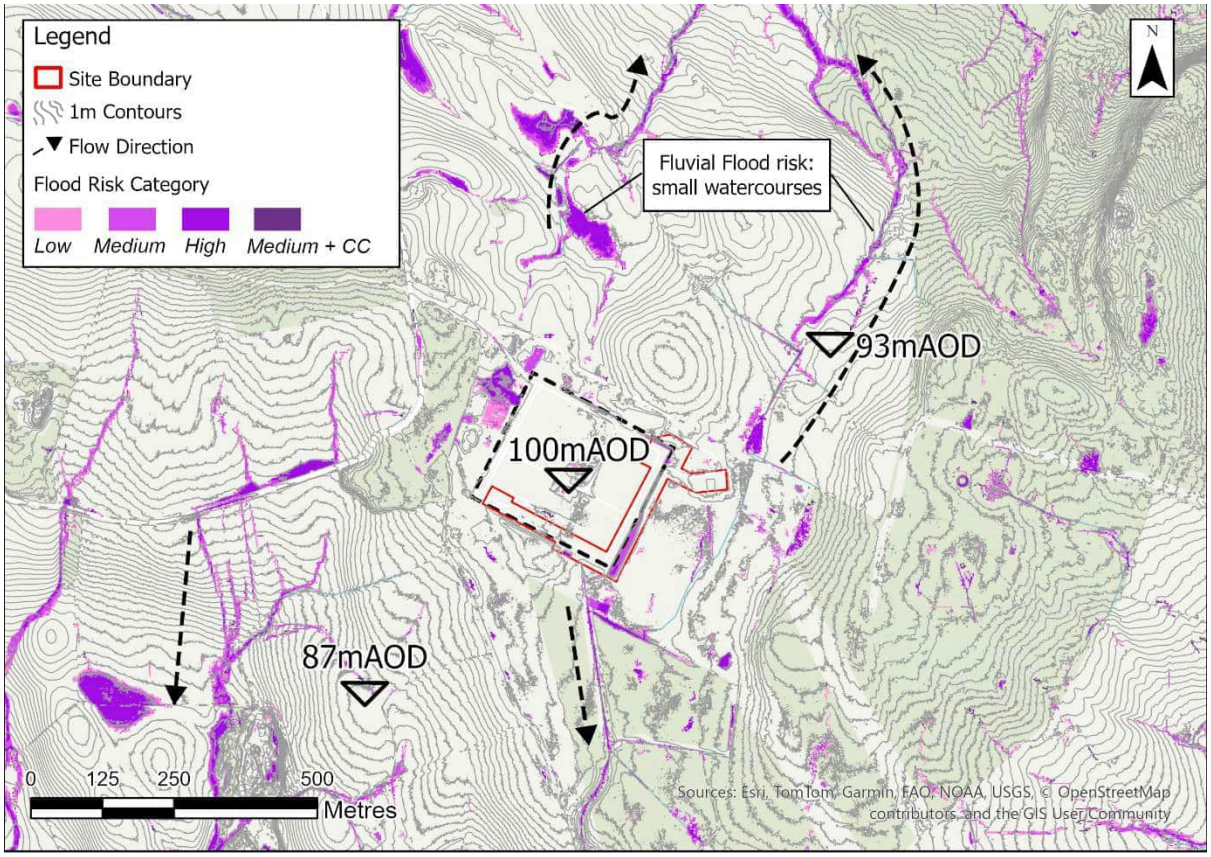


Plate 2-6 SEPA minor watercourse fluvial flood risk. Includes data from SEPA Flood Maps v3.0 *© Scottish Environment Protection Agency (SEPA) 2025; this SEPA product is licensed under the Open Government Licence v3.0.*

2.3.6 Surface Water Flooding

The SEPA Surface Water Flood Map shown in Plate 2-7 indicates that portions of the RLB of the proposed works may be subject to varying levels of surface water flooding events as shown in Plate 2-7. Some ponding is expected to occur in a permanent wetland to the west of the site up to the High risk category. This feature does not pose flood risk to the platform itself. Isolated ponding on the main site platform is shown in the Low risk and Medium risk with climate change (Medium + CC) events, but this may result from small inaccuracies in the lidar data used to generate this dataset. The flood extents shown on the map do not impinge safe access to and egress from the site, nor would they impact the safety of the site.

High pluvial flood risk is indicated along the eastern border of the site; however, this is consistent with the observations of a designed drainage swale in situ and likely indicates proper function of this feature rather than genuine flood risk. Notably, the proposed platform extension crosses this swale, which is discussed in Section 2.4.

As these extents do not affect the proposed works, the flood surface water flood risk is **negligible.**

The Surface Water Management Strategy (SWMS) in Section 4 further details the proposed strategy for managing surface water on site.

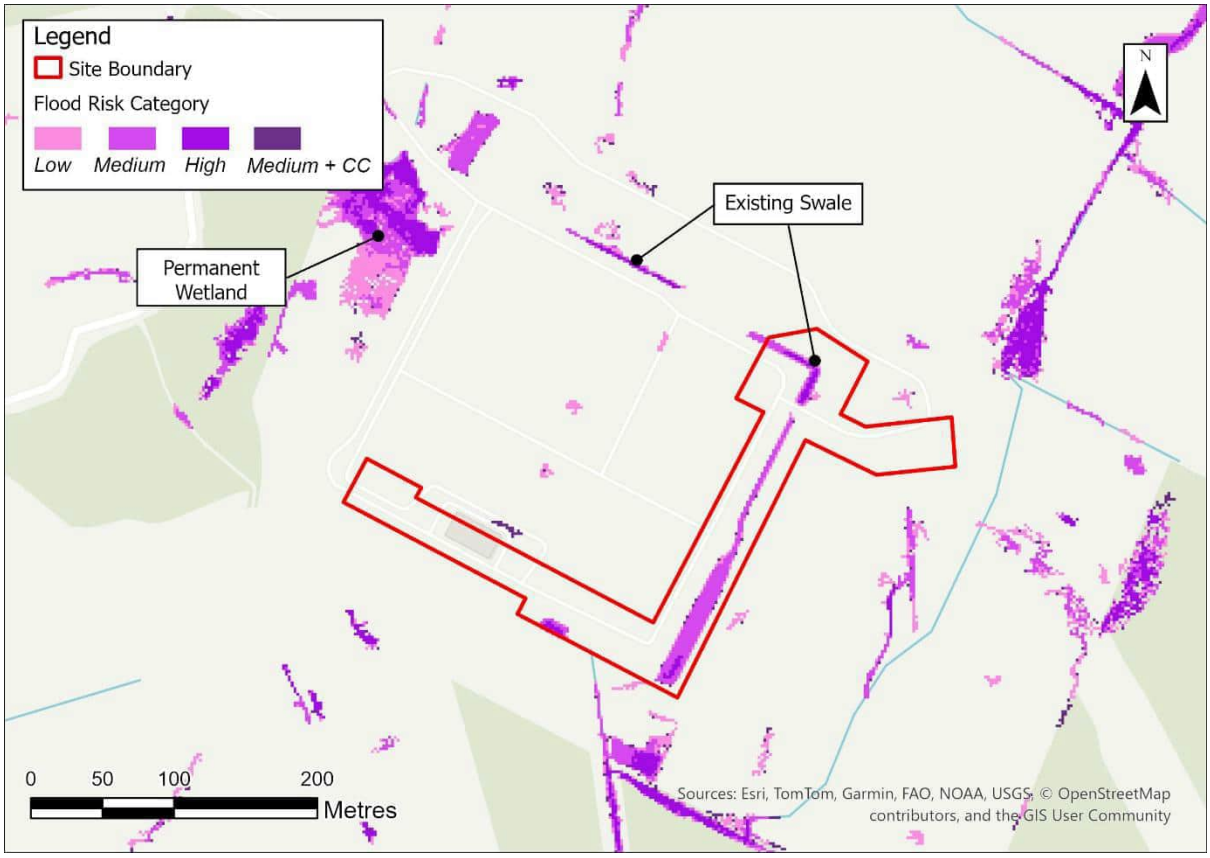


Plate 2-7 SEPA Pluvial flood risk. Includes data from SEPA Flood Maps v3.0 © *Scottish Environment Protection Agency (SEPA) 2025; this SEPA product is licensed under the Open Government Licence v3.0.*

2.3.7 Infrastructure Failure

The risk of flooding presented by **reservoir failure** and **canal failure** has been assessed as follows:

Reservoir Failure: SEPA provides flood mapping to show areas which may be inundated with water in the event of a reservoir failure[18]. The nearest region likely to be affected by flooding in the case of reservoir failure is the Carron River Valley, roughly 1.5km south of the site, and approximately 70m lower in elevation, and thus flood risk is **negligible.**

Canal Failure: Due to the hilltop position of the site and absence of nearby canal infrastructure, flood risk from canal failure is **negligible**.

2.3.8 Sewer Flooding

The utility survey supplied by SPEN found no wastewater or surface water sewers in the direct vicinity of the site, so sewer flooding poses **negligible** risk to the site.

2.3.9 Groundwater Flooding

Groundwater is usually a contributing factor to flooding rather than the primary source in Scotland. It is difficult to predict groundwater effects, however low-lying areas with permeable bedrock are considered to be most at risk. The description of the geology in Section 1.4, did not indicate any features which would indicate groundwater risk. The SEPA Groundwater flood map also does not indicate risk of groundwater flooding in the area, so risk of groundwater flooding is deemed **negligible**.

[18] Scottish Environment Protection Agency (2022) 'Reservoirs Maps'. Available at: https://map.sepa.org.uk/reservoirsfloodmap/Map.htm [Accessed: 10th June 2025].

2.3.10 FRA Conclusions and Recommendations

The site of the proposed works is not considered to be at risk of flooding from any sources. A summary of the assessed flood risk is provided in Table 2-1. Under the current guidance, these results indicate that **a Level 2 or 3 FRA is not required**

Table 2-1 Summary of Flood Risk Assessment

Source of Flood Risk	Brief Description	Magnitude of Risk
Coastal	The site is located 6km away from nearest coastal flood extents at an elevation of approximately 100mAOD. It is therefore far removed from areas at risk of coastal flooding.	***Negligible***
Fluvial	There is nearby flood risk areas generated by small watercourses, but these flow away from the site and would have no impact on the proposed works.	***Negligible***
Surface Water	Some surface water flood risk is indicated adjacent to site, but only within the drainage swale which is water compatible.	***Negligible***
Infrastructure Failure	Risk from reservoir failure, canal failure, and water mains failure were assessed. There are no reservoirs which would pose risk of inundating the site. Site surveys did not indicate presence of water mains near the site. Flow paths in the event of failure of the nearby Forth and Clyde Canal would follow existing watercourses which have been assessed to pose no risk.	***Negligible***
Sewer Flooding	Utility surveys did not indicate proximity to sewerage which would pose any risk.	***Negligible***
Groundwater Flooding	The site has no history of flooding and is outwith extents of possible groundwater flooding published by SEPA.	***Negligible***

.

2.4 Surface Water Management Strategy

2.4.1 Introduction

This Surface Water Management Strategy (SWMS) is provided to advise on the requirements for surface water management on the Denny North Substation site. At the current planning stage, detailed drainage design information is not available, so discussion will be limited to a high-level assessment of the current concept design. This SWMS will seek assess the existing drainage on site, the further demands placed on it by the proposed works and assess how the proposed drainage scheme will address these demands through treatment of water quality and quantity.

2.4.2 Existing Drainage

In the current arrangement, the majority of the surface runoff on the site is drained through perforated pipes and filter drains in the primary substation compound, which run into the swale to the east of the site. The swale which outlets southwards into a watercourse leading to the River Carron. The swale is culverted in several locations, as indicated in Plate 2-8. A small portion of the south of the site drains through a similar but smaller network to the same watercourse. Layouts of the existing drainage network are shown in Appendix B.

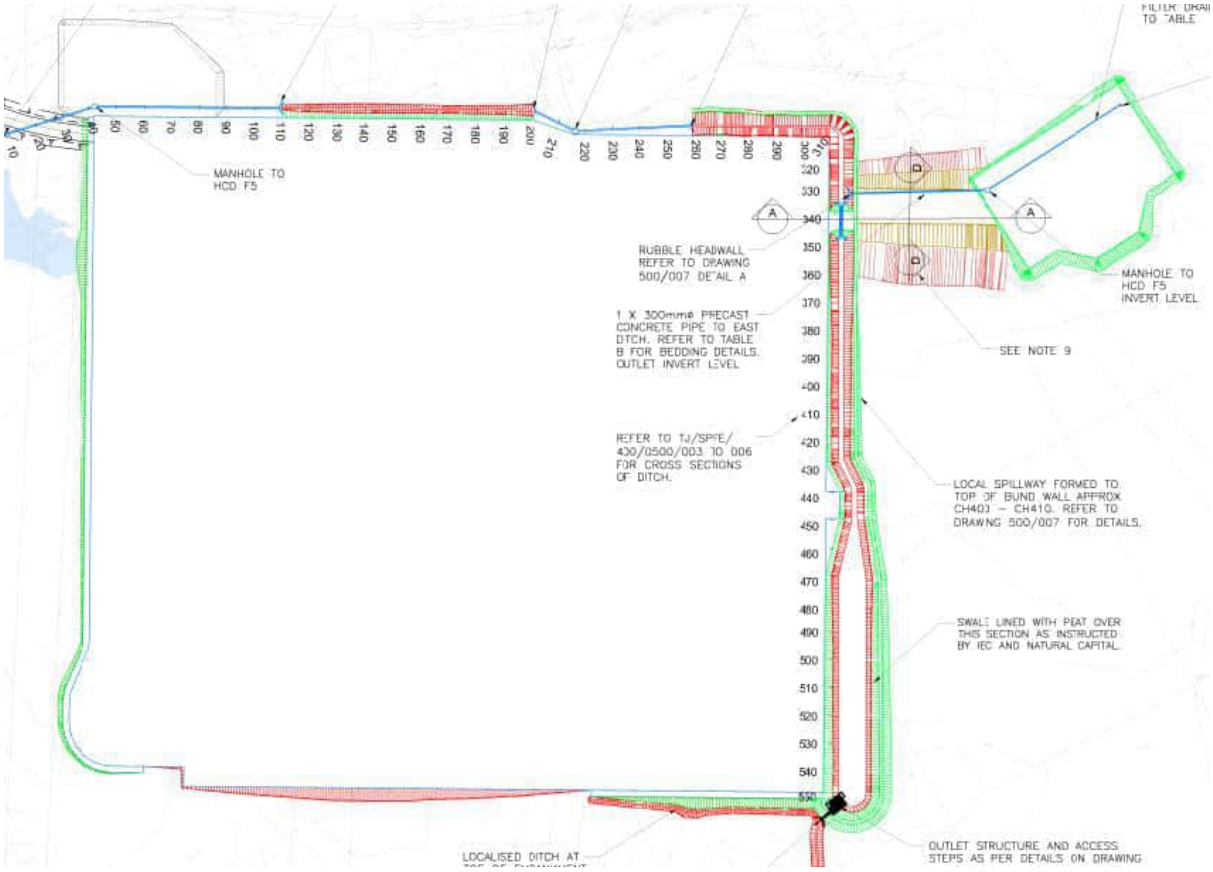


Plate 2-8 Excerpt of as-built drawing of drainage swale. Filter drains inputting to swale from platform not shown.

2.4.3 Principles of SuDS Best Practice

Sustainable Drainage Systems (SuDS) are recommended by both national and local authorities for achieving sufficient drainage of excess surface water on site while mitigating harmful downstream effects such as pollution and flooding. SuDS achieve these goals by providing flow paths for surface water which filter out pollutants, attenuate peak flows, and provide flood storage where necessary.

The CIRIA C753 SuDS Manual states the following SuDS drainage hierarchy should be utilised for new development planning proposals and requests for land drainage purposes:

1) Rainwater collection and re-use (where there is demand)
2) Infiltration to the maximum extent that is practical – where it is safe and acceptable to do so
3) Discharge to surface waters
4) Discharge to surface water sewers
5) Discharge into combined sewer

A SuDS management approach is expressed within the SuDS Manual; this approach allows the maximisation of SuDS uptake and benefits within planning proposals. The approach is expressed below:

- Use surface water as a resource,
- Manage rainfall at the source,
- Manage runoff on the surface of a site above ground,
- Allow for infiltration of runoff on site,
- Enhance evapotranspiration,
- Slow runoff and volume to greenfield runoff rates and volumes,
- Reduce water pollution by incorporating SuDS features to prevent pollution by enhancing water quality and control the runoff,
- Use SuDS to treat runoff in urbanised catchments/sites to prevent environmental pollution.

In accordance with guidance, this SWMS will assess the proposed drainage against SuDS best practice for the treatment of surface water (Water Quality) and the conveyance, attenuation, and storage of surface water (Water Quantity).

2.4.4 Infiltration

No infiltration testing has been undertaken at the site. A conservative assumption has therefore been made to consider that no infiltration is possible. This assumption, and resulting design decisions, may be revised in later design stages should infiltration testing later be completed. As a result, the proposed drainage strategy will consider retrofitting the existing drainage, which outlets to a nearby watercourse.

2.4.5 Proposed Drainage Scheme

The proposed works constitute an extension of the existing substation platform in its north-east corner. A 3m wide peripheral access road is proposed to tie in with the existing access roads. This additional hardstanding will be drained through a filter drain, which will outlet to the existing swale. To accommodate the platform extension, it is proposed that flow through the existing swale within the footprint of the proposed extension be redirected through the new filter drain. This scheme follows local and national guidance by following SuDS best practice, and retrofitting existing drainage features where possible[19]. The proposed arrangement is illustrated in Plate 2-9, with the full drawing included in Appendix C.

[19] Local Development Plan 2. Policy IR10 (2020. Falkirk Council https://www.falkirk.gov.uk/development-planning/falkirk-local-development-plan-2

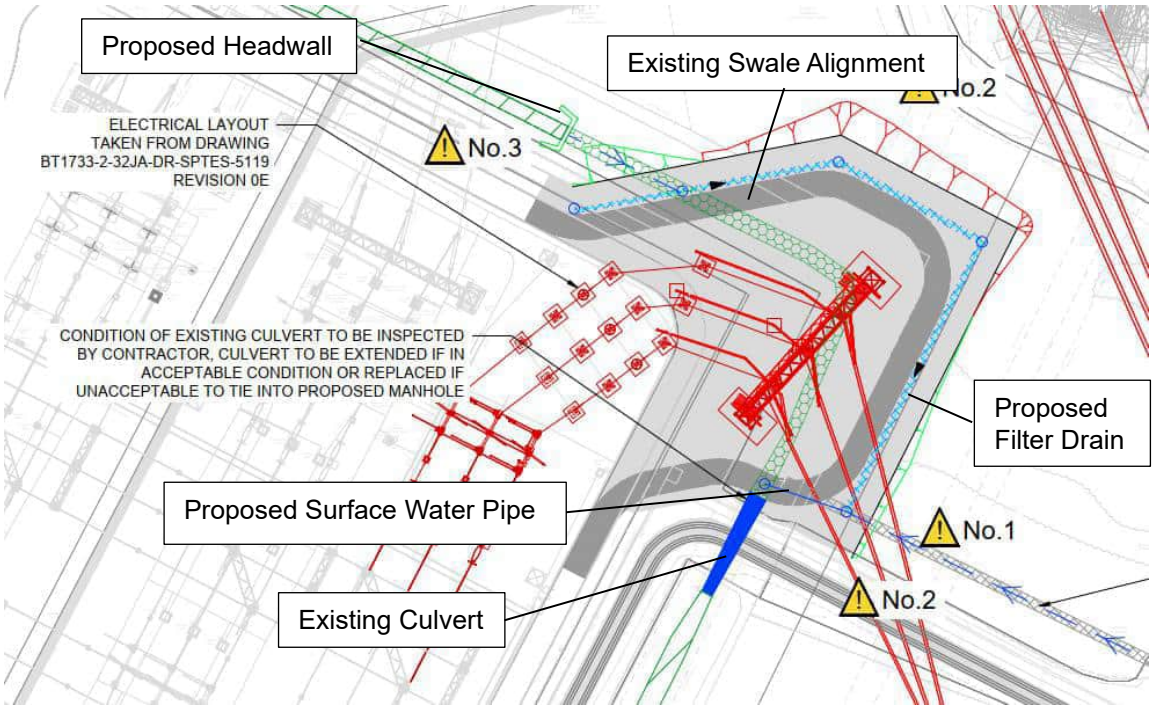


Plate 2-9 Proposed drainage scheme. Excerpt from 22119-BHK-DENN-SUB-D-C-000201.

2.4.6 Surface Water Impact

Considering the removal of some portions of the existing access road and the installation of a new length of access road, the net increase in impermeable area resulting from the proposed works would be approximately 150m^2. For developments with proposed increase in impermeable area less than 1,000m^2, Falkirk Council Planning Application Advice on Flood Risk and Surface Water Drainage[20] does not require a full Drainage Impact Assessment.

However, as discussed in Section2.4.5, the proposed works would require the substation compound to be extended over the existing drainage swale. The following sections will illustrate how this is proposed to be enacted and will demonstrate how best practice has been followed.

2.4.7 Water Quality

The Simple Index Approach (SIA) is a method of assessing whether the SuDS features proposed for a site are adequate to treat the collected runoff for the following pollutants: Total suspended solids (TSS), Metals, and Hydrocarbons. Based on the proposed usage of the site, a pollution index will be assigned for each of these pollutants.

The proposed SuDS features will have a rating for each pollutant corresponding to their efficacy in treating that type of pollution. By the CIRIA SuDS Manual, the sum of the treatment indices of the proposed SuDS must exceed the pollution index according to land usage. Where multiple SuDS features are used in series, the mitigation of each subsequent feature is factored by 0.5 to account for the reduction in treatment efficacy arising from a reduced concentration of pollutant at the inlet due to previous treatment.

The highest risk of pollution in the site arises from the access road which runs around the perimeter of the substation platform. The traffic load on this access road is expected to be low, so the development fits the Low Hazard level for general access roads specified by Table 26.2 of the SuDS Manual. The

[20] Planning Application Advice on Flood Risk and Surface Water Drainage (2020). Falkirk Council https://www.falkirk.gov.uk/development-management/flood-risk-and-surface-water-drainage-advice

resulting pollution hazard indices for the site and mitigation indices for the proposed SuDS are summarised in Table 2-2.

Table 2-2 Summary of Simple Index Approach for proposed SuDS

Source	Description	TSS Index	Metals Index	Hydrocarbon Index
Land Use (pollution)	Low pollution hazard access road	0.5	0.4	0.4
Proposed SuDS 1 (mitigation)	Filter Drain	0.4	0.4	0.4
Proposed SuDS 2 (mitigation)	Swale	0.5 * 0.5 = 0.25	0.5 * 0.6 = 0.3	0.5 * 0.6 = 0.3
	Check	0.65 ≥ 0.5 OK	0.7 ≥ 0.4 OK	0.7 ≥ 0.4 OK

Following the above analysis, the proposed layout of a filter drain feeding to a swale will exceed the requirements for pollution mitigation. However, it should be noted that filter drains generally require more frequent maintenance if they are used to remove coarse sediments; this should be considered when developing the maintenance plan for the proposed drainage network which is further discussed in Section 2.4.9.

2.4.8 Water Quantity

As the proposed drainage is intended to link into the existing drainage network, it is not possible at this stage to fully model the performance of the altered drainage scheme. The additional hardstanding area created by the proposed works is negligible (<1,000m^2), and the existing swale uses a Hydrobrake flow control, thus it is assumed that there will be negligible increase in the discharge from the site, and the existing drainage scheme is sufficient to attenuate flows.

However, the proposed drainage scheme for the development will involve a re-alignment of flow from the existing swale to the proposed filter drain, which could change the hydraulic performance of the system. Without more information on the existing and proposed drainage network, a detailed model to assess this plan is not within the scope of this report. However, design recommendations to ensure the performance of the proposed drainage system are outlined below.

For the proposed scheme to sufficiently manage the surface water on site and mitigate flood risk downstream, the conveyance and attenuation capacities of the scheme should be either maintained or improved:

- The conveyance capacity of this scheme will be controlled by the internal pipe diameter and gradient of the proposed filter drain. To prevent backing up the existing swale upstream, this must be designed with a flow capacity that is the same or better than the existing culvert downstream of the proposed works.
- The current swale is demonstrated to provide necessary flood storage to the site, which should not be compromised. At the detailed design phase, the storage capacity of the new scheme should be assessed to be at least as great as that of the existing scheme. If this cannot be provided through the filter drain and manholes alone, then further storage should be added by increasing the size of the downstream swale or providing other SuDS-based storage.

To ensure adequate performance of the proposed drainage system, these conditions should be verified during the detailed design phase.

2.4.9 Maintenance Schedule

To ensure the continued functionality and performance of the proposed SuDS, a maintenance schedule must be produced. SPEN will be responsible for the proper maintenance of SuDS assets on site, unless they appoint a suitable factor. Each element requires inspection and maintenance, possibly through a factoring agreement for the development. Failure to properly maintain the surface water drainage can lead to increased flooding on site and pollution downstream. According to the SuDS Manual, the minimum requirements for each SuDS component are tabulated as follows:

Table 2-3 Summary of Recommended Maintenance for Filter Drains

Maintenance schedule	Required Action	Typical Frequency
Regular Maintenance	Remove litter and debris from filter drain surface, access chambers, and any pre-treatment devices	Monthly, or as required
	Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage	Monthly
	Inspect pre-treatment systems, inlets, and perforated pipework for silt accumulation and establish appropriate silt removal frequencies	Six monthly
	Remove sediment from pre-treatment devices	Six monthly, or as required
Occasional Maintenance	Remove or control tree roots where they are encroaching on the sides of the filter drain, using recommended methods (BS 3998:2010 [21])	As required
	At locations with high pollution loads, remove surface geotextiles and replace, and wash or replace overlying filter medium	Five yearly, or as required
	Clear perforated pipework of blockages	As required

[21] BS 3998:2010 – Tree Work. (2010). British Standards Institution.

Table 2-4 Summary of Recommended Maintenance for Swale

Maintenance schedule	Required Action	Typical Frequency
Regular Maintenance	Remove litter and debris	Monthly, or as required
	Cut grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
	Inspect inlets, outlets, and overflows for blockages, and clear if required.	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for >48 hours	Monthly, or when required
	Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
	Inspect inlets and facility surfaces for silt accumulation, establish appropriate silt removal frequencies	Half yearly
Occasional Maintenance	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required	With effective pre-treatment, only required rarely
Remedial actions	Repair erosion or other damage by re-turfing or re-seeding	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil slater to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface.	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader, or at top of filter strip.	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

2.4.10 Construction Phase SuDS

Prior to construction commencing, a Construction Method Statement will be drafted by the appointed contractor. This should include a section describing how surface water will be managed during construction to prevent any uncontrolled discharge into nearby watercourses, in line with SuDS Manual. This document should be issued to the relevant authorities, either SEPA or the planning authority, for approval before construction commences on site.

2.4.11 SWMS Conclusion and Recommendations

The proposed works constitute a small increase to the impermeable area on site— approximately 150m^2— and will not significantly increase demand on the existing drainage network. A high-level drainage scheme to manage additional surface water on site has been provided by the client, consisting of a new filter drain to serve the added access road and to realign the existing swale underneath the proposed platform extension.

In absence of detailed design information, this scheme has been assessed against principles of SuDS best practice. This assessment concludes that the proposed scheme will provide sufficient treatment for surface water run-off and will likely have the capacity to sufficiently convey and attenuate additional surface water provided that the internal diameter and bed gradient of the proposed filter drain are sufficient to match the flow capacity of the downstream culvert, and the total storage volume of the scheme remains the same or is improved by the proposed works

2.5 Summary and Conclusion

AECOM were commissioned by SP Energy Networks (SPEN) to consult on flood risk and surface water management for the proposed works to the Denny North substation as part of the Denny to Wishaw Network Upgrade project. This report has undertaken to provide a Level 1 Flood Risk Assessment (FRA) to assess the level of flood risk on site and to prepare a Surface Water Management Strategy (SWMS) for managing surface water on site.

Following a full review of site conditions and common mechanisms for flooding, this FRA has determined that the Denny North substation site is not at risk of fluvial, coastal, groundwater, or infrastructure-related flooding. The SEPA Flood Maps indicated small portions of the site which may be subject to surface water flooding in the 10% and 0.5% AEP flood events. However, following a comparison of these areas to the site plan, it is identified that these areas lie within the site's existing surface water storage and so indicate that site drainage is sufficient to prevent actual surface water flood risk. Based on this analysis, a further assessment of flood risk (Level 2 or 3 FRA) is not required. The assessment of flood risk is considered satisfactory under SPEN SUB-01-018, as flood protection is not required.

This report also offers a Surface Water Management Strategy (SWMS) in support of the proposed works assessing the outline drainage design and providing recommendations for further design development. The proposed works include adjustments to the existing drainage scheme to integrate the new platform area, as well as the provision of a new filter drain to serve the new access road. Initial analysis determined that the added demand on the existing drainage system is negligible, as the proposed new hardstanding area is small (150m^2). The proposed SuDS treatment path was assessed using the Simple Index Approach and found to be sufficient for treating surface water runoff from the proposed access road.

However, as the proposed works will alter the existing drainage recommendations are provided which should be followed in the detailed design stage to ensure that the hydraulic performance of the site is maintained and flood risk downstream is mitigated. These recommendations included: a) ensuring that the internal diameter and bed gradient of the proposed filter drain are sufficient to match the flow capacity of the downstream culvert, and b) ensuring that the total storage volume of the scheme remains the same or is improved by the proposed works. As the drainage is still subject to detailed design, treatment and attenuation capacities should be confirmed at this stage, but the analysis conducted in this report indicates that this can be achieved within the site and thus the development is in line with policy.

As the Denny site is still under planning, the proposed drainage scheme may be subject to change in the detailed design phase; update to the Simple Index Approach may be required and a full drainage design is recommended to be carried out in the detailed design phase.

Appendix A – SEPA Flood Risk Checklist

Flood Risk Assessment (FRA) Checklist

Scotland's 4th National Planning Framework has recently been published. This document is therefore being reviewed and updated to reflect the new policies. You can still find useful and relevant information here but be aware that some parts may be out of date and our responses to planning applications may not match the information set out here.

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This document must be attached within the front cover of any Flood Risk Assessments issued to Local Planning Authorities (LPA) in support of a development proposal which may be at risk of flooding. The document will take only a few minutes to complete and will assist SEPA in reviewing FRAs, when consulted by LPAs. This document should not be a substitute for a FRA.

Development Proposal Summary							
Site Name:		Denny North Substation					
Grid Reference:	Easting:	282544	Northing:	684576			
Local Authority:		Falkirk Council					
Planning Reference number (if known):							
Nature of the development:		Utility Infrastructure	If residential, state type:				
Size of the development site:		2.3 Ha					
Identified Flood Risk:	Source:	Pluvial	Source name:	Surface Water			
Land Use Planning							
Is any of the site within the functional floodplain? (refer to SPP para 255)		No	If yes, what is the net loss of storage?			m^3	
Is the site identified within the local development plan?		No	Local Development Plan Name:		Year of Publication:		
			Allocation Number / Reference:				
If yes, what is the proposed use for the site as identified in the local plan?		Select from List	If Other please specify:				
Does the local development plan and/or any pre-application advice, identify any flood risk issues with or requirements for the site.		No	If so, please specify:				
What is the proposed land use vulnerability?		Essential Infrastructure	Do the proposals represent an increase in land use vulnerability?		No		
Supporting Information							
Have clear maps / plans been provided within the FRA (including topographic and flood inundation plans)?		Yes					
Has sufficient supporting information, in line with our Technical Guidance, been provided? For example: site plans, photos, topographic information, structure information and other site specific information.		Yes					
Has a historic flood search been undertaken?		Yes	If flood records in vicinity of the site please provide details:				
Is a formal flood prevention scheme present?		No	If known, state the standard of protection offered:				
Current / historical site use:		Electrical Substation					
Is the site considered vacant or derelict?		No					
Development Requirements							
Freeboard on design water level:		0.6 m					
Is safe / dry access and egress available?		Vehicular and Pedestrian	Min access/egress level:		99.8	m AOD	
Design levels:	Ground level:	99.8 m AOD	Min FFL:		100.4	mAOD	
Mitigation							
Can development be designed to avoid all areas at risk of flooding?		Yes					
Is mitigation proposed?		No					
If yes, is compenstory storage necessary?		No					
Demonstration of compensatory storage on a "like for like" basis?		No					
Should water resistant materials and forms of construction be used?		Yes					

Flood Risk Assessment (FRA) Checklist

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Hydrology

Is there a requirement to consider fluvial flooding?		No			
Area of catchment:			km^2	Is a map of catchment area included in FRA?	Select from List
Estimation method(s) used (please select all that apply):		Pooled Analysis ☐		If Pooled analysis have group details been included?	Select from List
		Single Site Analysis ☐			
		Enhanced Single Site ☐			
		ReFH2 ☐			
		FEH RRM ☐			
		Other ☐		If other (please specify methodology used):	
Estimate of 200 year design flood flow:			m^3/s		
Qmed estimate:			m^3/s	Method:	Select from List
Statistical Distribution Selected:		Select from List		Reasons for selection:	

Hydraulics

Hydraulic modelling method:		Select from List		Software used:	Select from List
				If other please specify:	
Number of cross sections:					
Source of data (i.e. topographic survey, LiDAR etc):				Date obtained / surveyed:	
Modelled reach length:			m		
Any changes to default simulation parameters?				If yes please provide details:	
Model timestep:					
Model grid size:					
Any structures within the modelled length?		Select from List		Specify, if combination:	
Maximum observed velocity:			m/s		
Brief summary of sensitivity tests, and range:					
variation on flow (%)			%	Please specify climate change scenario considered:	
variation on channel roughness (%)			%		
blockage of structure (range of % blocked)			%		
boundary conditions:		**Upstream**		**Downstream**	
(1) type		Flow		Select from List	
	Specify if other			Specify if other:	
(2) does it influence water levels at the site?		Select from List		Select from List	
Has model been calibrated (gauge data / flood records)?		Select from List			
Is the hydraulic model available to SEPA?		Select from List			
Design flood levels:	200 year		m AOD	200 year plus climate change	m AOD
Cross section results provided?		Select from List			
Long section results provided?		Select from List			
Cross section ratings provided?		Select from List			
Tabular output provided (i.e. levels, velocities)?					
Mass balance error:			%		

Coastal

Is there a requirement to consider coastal / tidal flooding?		No		
Estimate of 200 year design flood level:			m AOD	
Estimation method(s) used:		Select from List		If other please specify methodology used:
Allowance for climate change (m):			m	
Allowance for wave action etc (m):			m	
Overall design flood level:			m AOD	

Comments

Any additional comments:	

Approved by: [redacted]
Organisation: AECOM
Date: 14/01/2025

Note: Further details and guidance is provided in 'Technical Flood Risk Guidance for Stakeholders' which can be accesssed here:- CLICK HERE

Appendix B – Existing Drainage Layout

AREA RESERVED FOR FUTURE SWITCHGEAR

FUTURE GANTRY FOUNDATION

STORM WATER CROSS FLOW DRAINAGE TO INCORPORATE A 5.0m LENGTH OF 150mmø PERFORATED PIPE LAID AT 1:100 TO A 0.5x0.5x1.0m DEEP SOAKAWAY (TYPICAL)

1750 (TYPICAL FOR DRAINAGE RUNNING UNDER 275kV TRENCHES)

STORM WATER CROSS FLOW DRAINAGE TO BE 150mmø PERFORATED PIPE LAID AT 1:100 INTO DRAINAGE DITCH WITH A RUBBLE SURROUND (TYPICAL)

1200 (TYPICAL FOR DRAINAGE RUNNING UNDER MULTI-CORE TRENCHES)

100.000+

1:590 FALL (APPROX)

OWMH07(B) CL=100.089 IL=99.099

OWMH05(B) CL=100.029 IL=99.025

OWMH11(B) CL=99.899 IL=98.865

OWMH14(B) CL=99.905 IL=98.896

OWMH13(B) CL=99.905 IL=98.806

OWMH16 CL=100.175 IL=99.387

OWMH15 CL=100.175 IL=99.353

OWMH08(B) CL=100.115 IL=99.137

1:120 FALL

TAIL PROVISION TO BE INCLUDED WITHIN MANHOLE FOR FUTURE BUND CONNECTION

1:115 FALL

1:170 FALL

150mmø DUCTILE IRON DRAINAGE PIPES AT 1:200 (UNLESS NOTED OTHERWISE)

ACO SLIMLINE DRAINAGE CHANNEL DRAINAGE CHANNEL TO DISCHARGE INTO LOCAL 1.0x1.0x1.0m DEEP SOAKAWAY

OWMH06(B) CL=100.094 IL=98.992

OWMH04(B) CL=100.034 IL=98.696

OWMH03(B) CL=99.965 IL=98.367

OWMH10(B) CL=99.904 IL=98.561

OWMH12(B) CL=99.846 IL=98.762

200mmø DUCTILE IRON PIPES AT 1:200 (UNLESS NOTED OTHERWISE)

OWMH02(B) CL=99.965 IL=98.177

150mmø TWINWALL HALF PERFORATED UPVC PIPES. PERFORATIONS TO BE INSTALLED WITHIN THE UPPER CROWN OF THE PIPE TO PROVIDE FILTER DRAINAGE TO THE TROUGH UNITS. BETWEEN SWMH01 AND SWMH02 ONLY.

SWMH08(B) CL=100.069 IL=98.953

SWMH07(B) CL=99.999 IL=98.698

1:150 FALL

OWMH01(B) CL=99.965 IL=98.047

INTERCEPTOR-SPEL PURACEPTOR P015/2CSC/NG FULL RETENTION OIL SEPARATOR IN ACCORDANCE WITH SEPA PPG AND NGTS 2.2, SEPARATOR TO HAVE A FULL SHUT OFF VALVE, SEPARATOR VENT TO BE ATTACHED TO PROPOSED FENCE LINE INLET IL=98.000 OUTLET IL=97.940

AREA RESERVED FOR FUTURE SWITCHGEAR

100.075+ RWP +100.006

FWMH04(A) CL=100.076 IL=99.476

SVP

FWMH05(A) CL=100.076 IL=99.340

110mmø TWINWALL UPVC PIPES AT 1:80 (UNLESS CONTROL DRAWING NOTE OTHERWISE) FFL=100.755

1:100 FALL

FWMH02(B) CL=100.002 IL=98.850

1:120 FALL

225mmø TWINWALL UPVC PIPES AT 1:200

KLARGESTER ALPHA GRP SEPTIC TANK (2800 LRRES) INLET=98.725 OUTLET=98.675

FWMH01(B) CL=99.999 IL=98.280

1:70 FALL

225mmø TWINWALL UPVC PIPES AT 1:120

99.795+

FWMH03(A) CL=100.076 IL=99.311

1:75 FALL

SWMH06(B) CL=100.067 IL=98.996

SWMH05(B) CL=100.037 IL=98.521

SWMH03(B) CL=99.991 IL=98.150

SWMH01(B) CL=99.924 IL=97.538

SWMH02(B) CL=100.003 IL=97.835

SPEL 300 SERIES RAINSAVE WATER HARVESTING UNDERGROUND STORAGE TANK, 4000 LITRE CAPACITY INCORPORATING A BACKFLOW PREVENTION VALVE CHAMBER 2 CL=99.989 INLET IL=98.071 OUTLET IL=98.071 SWM04

SPEL SILT/DEBRIS FILTER CHAMBER CL=100.029 INLET IL=98.471

600mm DIA PPIC CL=98.340 IL=98.025

150mm DIA PERFORATED PIPES

600mm DIA PPIC CL=98.340 IL=97.443

REED BED

225mm DIA UPVC PIPE TO EXISTING DITCH

DITCH TO BE GRADED TO SUIT PROPOSED OUTFALLS BY GROUNDWORKS CONTRACTOR

SILT AT BOTTOM OF EXISTING DITCH TO BE CLEANED TO SUIT PROPOSED INVERT LEVELS

HEADWALL 1 IL=97.200

EAST DITCH CHAMBER / OUTFALL WITH A RESTRICTED FLOW OF 46.6L/S IL=97.000

NOMINAL 400mm WIDE V SHAPED DITCH TO BE FORMED AND TIED INTO EXISTING UN-NAMED BURN

OUTFALL DITCH TO BE GRADED AT 1:200 TO TIE INTO EXISTING BURN AT IL=96.793 E=282404442, N=684348918 OUTFALL TO BE BENCHED TO MAINTAIN LAMINAR FLOW

PLEASE NOTE: FALLS GIVEN ARE APPROXIMATE AND ARE TO BE USED AS REFERENCE ONLY. REFER TO INVERT LEVELS FOR LEVELING OF DRAINAGE RUNS

DRAINAGE LAYOUT
SCALE 1:500

DRAINAGE LEGEND

- PROPOSED SURFACE WATER SEWER
- PROPOSED FOUL WATER SEWER
- PROPOSED OIL WATER SEWER
- SWMH01(A) CL=100.000 IL=99.000 — PROPOSED SURFACE WATER MANHOLE LABEL SHOWING: NUMBER, TYPE AND LEVELS
- FWMH01(A) CL=100.000 IL=99.000 — PROPOSED FOUL WATER MANHOLE LABEL SHOWING: NUMBER, TYPE AND LEVELS
- OWMH01(A) CL=100.000 IL=99.000 — PROPOSED OIL WATER MANHOLE LABEL SHOWING: NUMBER, TYPE AND LEVELS
- RAIN WATER PIPE POSITIONS
- SOIL VENT PIPE POSITIONS
- R.E. RODDING EYE POSITION

SCALE AT 1:500

0m 12.5m 25.0m 37.5m

ENTERPRISE REFERENCE DRAWINGS	
QWP-1-6000	GENERAL CIVIL NOTES
QWP-1-6010	CIVIL LAYOUT
QWP-1-6025-6028	DRAINAGE DETAILS
QWP-1-6030	HAROSTANDINGS LAYOUT
QWP-1-6040	FENCE LAYOUT
QWP-1-6050	MULTI-CORE CABLE TRENCH LAYOUT

SCOTTISH POWER ENERGY NETWORKS REFERENCE DRAWINGS	
SP4068407	PROPOSED ELECTRICAL LAYOUT

NOTES

1. DO NOT SCALE FROM THIS DRAWING. USE ONLY SPECIFIED DIMENSIONS.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
3. ALL LEVELS ARE IN METRES TO ORDNANCE DATUM UNLESS NOTED OTHERWISE.
4. THIS DRAWING IS BASED ON THE ELECTRICAL LAYOUT ISSUED AT TENDER STAGE THEREFORE IS SUBJECT TO RECEIPT OF AN APPROVED ELECTRICAL LAYOUT.
5. DRAINAGE LAYOUT PROPOSALS ARE SUBJECT TO AGREEMENT WITH SCOTTISH POWER/IEC AND SITE DISCHARGE CONSENT HOLDERS.
6. ALL MANHOLE COVERS AND FRAMES SHALL BE IN ACCORDANCE WITH BS EN 124, GRADE D400.
7. THIS DRAWING HAS BEEN PREPARED IN COGNIZANCE OF THE NATIONAL GRID TECHNICAL SPECIFICATION NGTS 2.20.
8. RAINWATER DOWNPIPES SHALL BE A MINIMUM 75x75 SQUARE, CONNECTED TO A 150x200mm WIDE DRAINAGE GUTTER. GUTTER OUTLETS SHALL BE A MAXIMUM OF 20m CENTRES.
9. ALL INTERNAL FOUL WATER DRAINAGE SHALL BE IN ACCORDANCE WITH BS 8301, WITH ALL PIPEWORK BEING 150mmø UPVC IN ACCORDANCE WITH BS 4660.
10. DUCTILE IRON PIPES AND COMPONENTS TO BE IN ACCORDANCE WITH BS EN 598. ALL OTHER STORM WATER PIPES TO BE UPVC TWINWALL PIPES IN ACCORDANCE WITH BS EN 752. FOUL WATER PIPES TO BE PVC TO BS EN 1401.

INTERNAL DESIGN CHECK BOX

CIVIL	ELECTRICAL	PRIMARY	PROTECTION

SHE HAZARD BOX

IN ADDITION TO THE HAZARDS / RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORKS DETAILED ON THIS DRAWING, NOTE THE FOLLOWING SPECIFIC HAZARDS WHICH REQUIRE SPECIAL CONSIDERATIONS.

MAINTENANCE / CLEANING / OPERATION

TO SUIT THE PROVIDED OUTFALLS THE DRAINAGE RUNS HAVE BEEN DESIGNED AT A MAXIMUM 1:200 FALL AND LIKE DRAINAGE SCHEMES SHALL BE APPLICABLE TO MAINTENANCE PROCEDURES.

OIL INTERCEPTOR SHALL BE CLEANED PRIOR TO BEING BROUGHT INTO SERVICE.

FUTURE CONTRACTORS TO BE CONSCIOUS OF ADJACENT FOUNDATIONS AND CONSIDER POTENTIAL UNDERMINING CONCERNS SHOULD MAINTENANCE BE REQUIRED ON APPLICABLE DRAINAGE RUNS.

THE INCLUSION OF THE PLATFORM DRAINAGE RUNS WILL REQUIRE ROUTINE INSPECTION AND MAINTENANCE REGIME.

CONSTRUCTION

CONTRACTOR SHALL CONSTRUCT ALL DRAINAGE IN ADVANCE OF FOUNDATIONS OR INTRODUCE TEMPORARY WORKS TO AVOID UNDERMINING OF ADJACENT FOUNDATIONS (IF APPLICABLE)

GROUNDWORKS CONTRACTOR TO ENSURE THAT THE DRAINAGE OUTFALLS ARE CONSTRUCTED TO SUIT THE LEVELS AND DETAILS SHOWN ON THIS DRAWING.

DECOMMISSIONING / DEMOLITION

N/A

REV	DESCRIPTION	DATE	DRAWN	CHKD	APPD
09	UPDATED FOR CONSTRUCTION	12/10/15	BH	JB	MC
08	DRAINAGE AROUND SGT3 REVISED.	29/07/15	DWB	JB	MC
07	SW PIPE ø REVISED TO H/WALL 1.	07/01/15	BH	JB	MC
06	DRAINAGE IN SGT1 AREA REVISED.	03/11/14	JB	JB	MC
05	ACO CONNECTED TO OIL WATER DRAINAGE, RODDING EYE'S MOVED TO AVOID CLASHES WITH FOUNDS.	27/05/14	RH	SD	MC
04	DRAINAGE AROUND SGT1 UPDATED. FWMH05 ADDED.	17/03/14	RH	JB	MC
03	DRAINAGE AMENDED TO TIE INTO EX BURN. NEW DITCH ADDED FROM SITE O/F TO EX BURN.	04/10/13	RH	JB	MC
02	DRAINAGE UPDATED AT OUTFALLS.	14/03/13	RH	JB	MC
01	ISSUED FOR CONSTRUCTION	14/03/13	RH	JB	MC

DRAWING STATUS: FOR CONSTRUCTION

DATE:	SCALE:	SIZE:
14/12/12	1:500	CAD A1
DRAWN BY: RH	CHECKED BY: JB	APPROVED BY: MC

FOR INFORMATION

amey

Unit 2A-2E International House. Stanley Boulevard
Hamilton International Technology Park,
High Blantyre, G72 0BN.
Telephone.01698 404690 Fax.01698 404691
E-mail: communications@amey.co.uk Website: www.amey.co.uk

Drawing to BS 8888 unless otherwise stated

DRAWING TITLE: DRAINAGE LAYOUT

CLIENT NAME: SPEN

PROJECT NAME: BEAULY – DENNY NORTH 400/275/132kV SUBSTATION

SITE NAME: DENNY NORTH SUBSTATION

DRAWING NUMBER: QWP-1-6020

SHEET No. 1 of 1

REVISION: 09

FOR CONSTRUCTION

APPROVED

03/03/03/02/01

SUPPLIER CONTROL A1+ CAD

ALSTOM

Customer Project No. 635847

Alstom Project No. N/A

DENN4 - Denny North 400kV

N3416P0741

00-Common

QWP-1-6020 – REV 09 – DRAINAGE LAYOUT.DWG

1 X 450mmø 30m LONG PRECAST CONCRETE PIPE LAID @ 1:100 FALL UNDER EMBANKMENT TO REPLACE AND CONNECT TO EXISTING FIELD DRAINAGE.
APPROX CH 45m,
START: E 282289.525, N 684788.633, IL 99.490
END: E 282286.079, N 684776.336, IL 99.405
REFER TO DRAWING 500/007 FOR BEDDING DETAILS.

RUBBLE HEADWALLS REFER TO DRAWING 500/007 DETAIL A

AREA OF WETLANDS TO NORTH OF ACCESS ROAD TO BE INFILLED WITH CLASS 2(1) FILL. EXTENT

BUILDING DEMOLISHED AS PART OF PREVIOUS CONTRACT

1 X 450mmø PRECAST CONCRETE PIPE TO NORTH DITCH. REFER TO DRAWING 500/002–006 FOR SECTIONS AND TO DRAWING 500/007 AND TABLE B FOR PIPE BEDDING DETAILS.

RUBBLE HEADWALL REFER TO DRAWING 500/007 DETAIL A

MANHOLE TO HCD F5

RUBBLE HEADWALL REFER TO DRAWING 500/007 DETAIL A

150mm DIA FILTER DRAIN TO TABLE

RODDING EYE AT START OF RUN. INVERT LEVEL TO BE 99.4m (1.4m COVER). REFER TO DRAWING 500/007 FOR DETAILS.

FLOW OF CHANNEL

SEE NOTE 6

SEE NOTE 7

EXTENTS OF DRAINAGE CHANNEL

DRAINAGE CHANNEL TO EXTEND TO POND/WETLANDS

MANHOLE TO HCD F5

1 X 450mmø 30m LONG PRECAST CONCRETE PIPE LAID @ 1:100 FALL UNDER EMBANKMENT. APPROX CH 215m,
START E 282260.297, N 684746.624, IL 98.922
END E 282270.186, N 684727.904, IL 98.582
REFER TO DRAWING 500/007 FOR PIPE BEDDING DETAILS.

RUBBLE HEADWALLS REFER TO DRAWING 500/007 DETAIL A

RUBBLE HEADWALL REFER TO DRAWING 500/007 DETAIL A

1 X 300mmø PRECAST CONCRETE PIPE TO EAST DITCH. REFER TO TABLE B FOR BEDDING DETAILS. OUTLET INVERT LEVEL

MANHOLE TO HCD F5 INVERT LEVEL

SEE NOTE 9

REFER TO TJ/SPFE/ 400/0500/003 TO 006 FOR CROSS SECTIONS OF DITCH.

LOCAL SPILLWAY FORMED TO TOP OF BUND WALL APPROX CH400 – CH410. REFER TO DRAWING 500/007 FOR DETAILS.

APPROXIMATE LINE OF POND/WETLANDS. WATER LEVEL TO BE MAINTAINED. GLACIAL TILL BUND TO LINE SURFACE OF EMBANKMENT. REFER TO SERIES 600 DRAWINGS EARTHWORKS GA AND CROSS SECTIONS.

SWALE LINED WITH PEAT OVER THIS SECTION AS INSTRUCTED BY IEC AND NATURAL CAPITAL.

Thorndyke Quarry (disused)

LOCALISED DITCH AT TOE OF EMBANKMENT

RUBBLE HEADWALL REFER TO DRAWING 500/007 DETAIL A

OUTFALL DITCH TO DISCHARGE INTO UNNAMED BURN

OUTLET STRUCTURE AND ACCESS STEPS AS PER DETAILS ON DRAWING 500/010 & 0500/011. HYDROBRAKE TO RESTRICT OUTFLOW TO 47 l/s PER HECTARE.

SEE NOTE 8

N684540.00m
N684440.00m
E282380.00m
E282480.00m

FOR INFORMATION

NOTES:

1. THIS DRAWING IS TO READ IN CONJUNCTION WITH THE RELEVANT SPECIFICATION AND ALL OTHER RELEVANT DRAWINGS.
2. ALL DIMENSIONS TO BE CHECKED ON SITE AND ANY DISCREPANCIES IDENTIFIED PRIOR TO COMMENCEMENT OF THE WORK.
3. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
4. ALL LEVELS IN METRES UNLESS OTHERWISE NOTED.
5. ROAD WIDTH SHOWN IS MINIMUM REQUIRED IN PERMANENT SITUATION, CONTRACTOR MAY WISH TO WIDEN FOR USE AS TEMPORARY ACCESS / HAUL ROAD.
6. REFER TO DRAWING TJ/SPFE/400/0700/003 FOR SECTION E–E. AND DETAILS OF ACCESS ROAD COMPLETION, ROAD MAKE UP ETC.
7. REFER TO DRAWING TJ/SPFE/400/0500/007 FOR SECTION F–F AND DRAINAGE DETAILS AT ROAD CROSSINGS.
8. REFER TO DRAWING TJ/SPFE/400/0500/007 FOR SECTION G–G AND DRAINAGE DETAILS.
9. REFER TO DRAWING TJ/SPFE/400/0500/008 FOR SECTION A–A & D–D AND DUCT DETAILS.

This Drawing is based on ScottishPower EnergyNetworks Drawing No. SP4068407 Rev 9

AS BUILT

Rev	By	Chkd	Apprvd	Date	Description
D	DA	ST	DAU	09.10.13	SECOND ACCESS REMOVED AS BUILT ISSUE
C	SL	ST	MT	02.08.12	FINAL ISSUE
B	ST	AS	MT	30.04.12	REVISED TO SUIT CLIENT COMMENTS AND DWG NO SP4068407 Rev9
A	ST	AS	MT	09.03.12	DRAINAGE DETAILS REVISED TO SUIT NEW LAYOUT

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Project: DENNY NORTH SUBSTATION

Drawing: PHASE 1 PLATFORM DRAINAGE GENERAL ARRANGEMENT

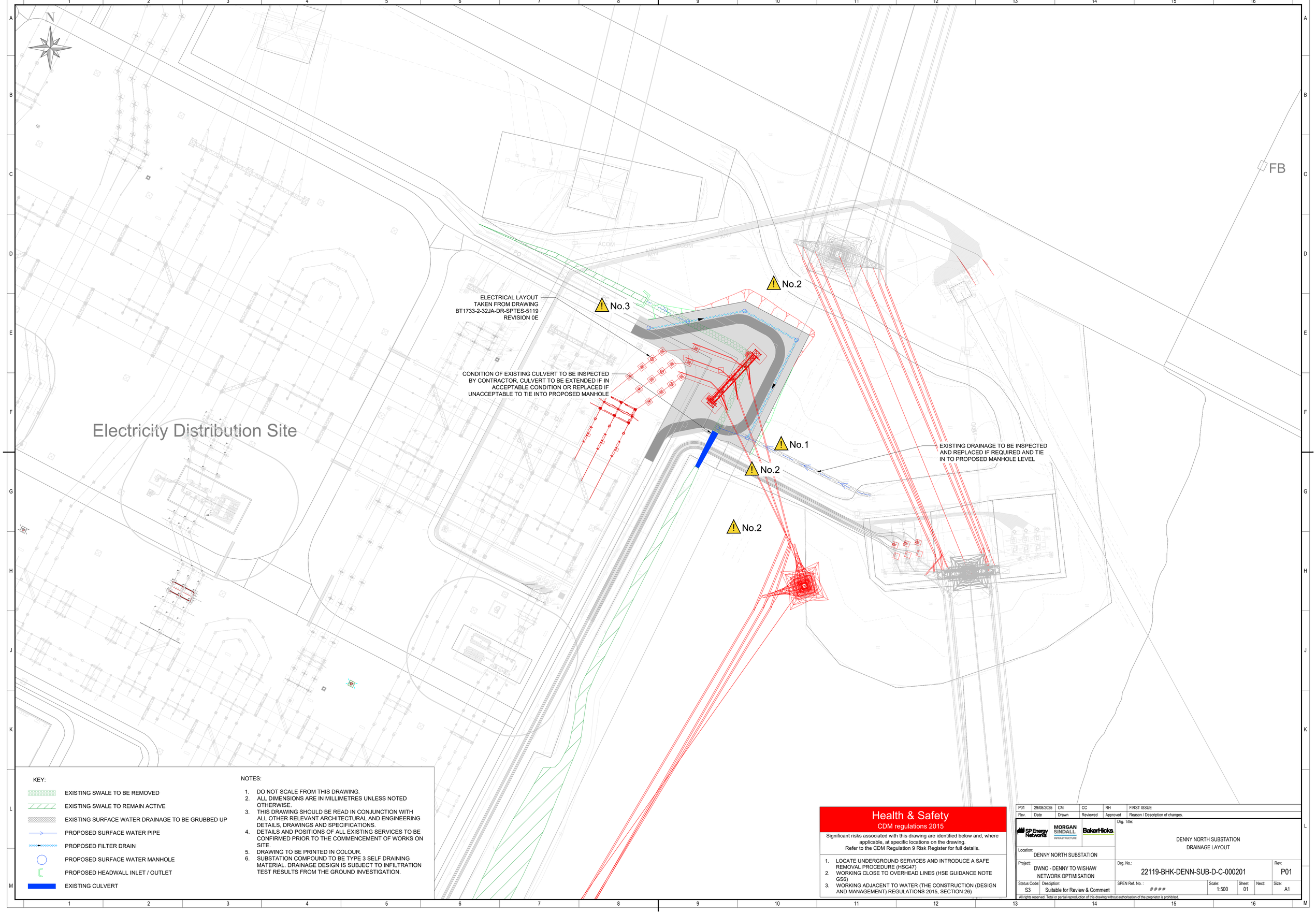
Drawn by: GK	Date: MARCH 2011
Checked by: SG	Date: MARCH 2011
Approved by: MT	Date: MARCH 2011

Drawing No. TJ/SPFE/400/0500-001

Revision D

Drawing Scale: 1:1000 at A1

Appendix C – Proposed Drainage Layout



KEY:

- EXISTING SWALE TO BE REMOVED
- EXISTING SWALE TO REMAIN ACTIVE
- EXISTING SURFACE WATER DRAINAGE TO BE GRUBBED UP
- PROPOSED SURFACE WATER PIPE
- PROPOSED FILTER DRAIN
- PROPOSED SURFACE WATER MANHOLE
- PROPOSED HEADWALL INLET / OUTLET
- EXISTING CULVERT

NOTES:

1. DO NOT SCALE FROM THIS DRAWING.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
3. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ARCHITECTURAL AND ENGINEERING DETAILS, DRAWINGS AND SPECIFICATIONS.
4. DETAILS AND POSITIONS OF ALL EXISTING SERVICES TO BE CONFIRMED PRIOR TO THE COMMENCEMENT OF WORKS ON SITE.
5. DRAWING TO BE PRINTED IN COLOUR.
6. SUBSTATION COMPOUND TO BE TYPE 3 SELF DRAINING MATERIAL. DRAINAGE DESIGN IS SUBJECT TO INFILTRATION TEST RESULTS FROM THE GROUND INVESTIGATION.

Health & Safety
CDM regulations 2015

Significant risks associated with this drawing are identified below and, where applicable, at specific locations on the drawing.
Refer to the CDM Regulation 9 Risk Register for full details.

1. LOCATE UNDERGROUND SERVICES AND INTRODUCE A SAFE REMOVAL PROCEDURE (HSG47)
2. WORKING CLOSE TO OVERHEAD LINES (HSE GUIDANCE NOTE GS6)
3. WORKING ADJACENT TO WATER (THE CONSTRUCTION (DESIGN AND MANAGEMENT) REGULATIONS 2015, SECTION 26)

Rev.	Date	Drawn	Reviewed	Approved	Reason / Description of changes.
P01	29/08/2025	CM	CC	RH	FIRST ISSUE

SP Energy Networks | MORGAN SINDALL INFRASTRUCTURE | BakerHicks

Drg. Title: DENNY NORTH SUBSTATION DRAINAGE LAYOUT

Location: DENNY NORTH SUBSTATION

Project: DWNO - DENNY TO WISHAW NETWORK OPTIMISATION

Drg. No.: 22119-BHK-DENN-SUB-D-C-000201 | Rev: P01

Status Code:	Description:	SPEN Ref. No.:	Scale:	Sheet:	Next:	Size:
S3	Suitable for Review & Comment	####	1:500	01		A1

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Denny to Wishaw Network Upgrade

Wishaw Substation Flood Risk Assessment and Surface Water Management Strategy

SPEN

Project number: 60602788

Delivering a better world

Quality information

Prepared by	Checked by	Verified by	Approved by
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Graduate Engineer	Engineer	Technical Director	Project Manager

Revision History

Revision	Revision date	Details	Authorized	Name	Position
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3.1 Introduction

3.1.1 Context

AECOM has been commissioned by SP Energy Networks (SPEN) to undertake Flood Risk Assessments (FRAs) and develop Surface Water Management Strategies (SWMSs) for several substation sites within the Denny to Wishaw Network Upgrade (DWNO) project. This report details both the FRA and SWMS relevant to the Proposed Development to the Wishaw Substation, which is being upgraded to support the new overhead line.

The FRA, conducted in line with CIRIA C624 guidance on Development and Flood Risk[1], details the flood risk associated with this upgrade, including the flood risk baseline, policy context, and any implications for the proposed works with regard to flood risk. The FRA and SWMS have been used to develop a coordinated drainage solution, although the proposed drainage scheme may be subject to change in the detailed design phase. In particular, the SWMS outlines the intended strategy for managing surface water at the site, with reference to national and local policy and guidance from the CIRIA C753 SuDS Manual[2].

In this report, the terms ‘proposed development’ and ‘site’ will be used to mean the Proposed Wishaw Substation Extension, and the site of those works, respectively.

3.1.2 Site Description

The site of the proposed development is situated at grid reference NS 79186 53934, set in a generally urban context within the town of Wishaw. To the north of the site is a railway line and the existing Wishaw substation compound, comprising an area of roughly 6.8ha. To the east is a grass field which slopes towards the site, and to the south is the residential housing neighbourhood of Gowkthrapple. Finally, the west of the site is bounded by the B754 (Castlehill Road). Plate 3-1 shows the site in the context of its surroundings.

[1] C624: Development and Flood Risk (2004). Construction Industry Research and Information Association..
[2] C753: The SuDS Manual (2015). Construction Industry Research and Information Association.

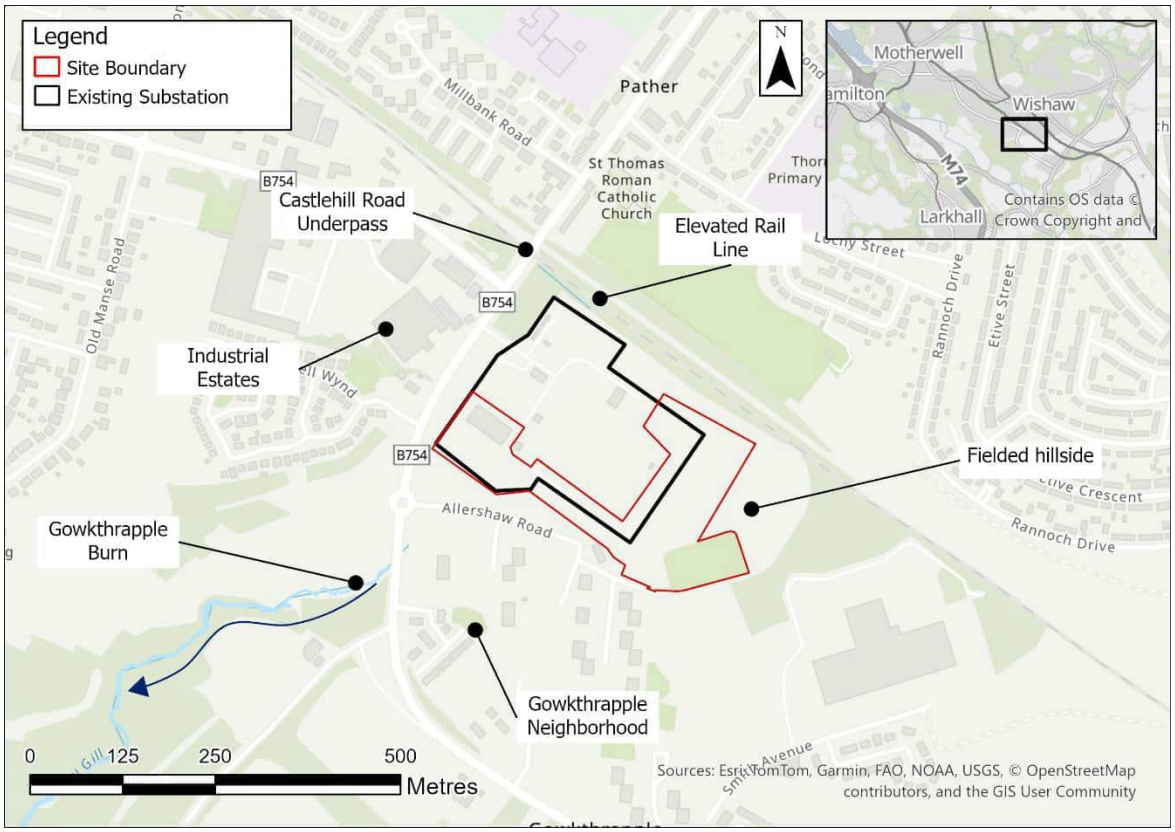


Plate 3-1: Site Overview

The nearest watercourse is the Gowkthrapple Burn, which emerges from a culvert under Castlehill Road circa 165m south-west of the site. From here, it continues south-west for approximately 1.8km towards its confluence with the River Clyde.

The Proposed Development would extend the substation platform by 0.6ha along its southeastern and southwestern borders. This extension would provide space for new Gas Insulated Busbars (GIBs) required to support the Proposed Uprated Overhead Line. No impermeable area will be added as part of the Extension.

3.1.3 Site Topography

Site topography has been mapped using a Phase 5, 0.5m resolution LiDAR Digital Terrain Model (DTM)[3] – shown in Plate 3-2.

The existing substation platform is predominantly flat with spot levels between 109.6 – 110.2m AOD, and is generally depressed below local ground level except in the southwestern corner where the site borders the junction of Allershaw Road and Castlehill Road. On the eastern border of the site, where excavations are to be made to accommodate the proposed development, the terrain rises steeply to 112.5 m AOD, then continues to rise gently uphill to the east. An elevated rail line forms a barrier between the site and higher ground on the north.

The Proposed Development is assumed to be approximately 109.6mAOD to tie in to the existing substation platform.

[3] LiDAR for Scotland Phase V DTM (2025). Dataset. Scottish Government.https://remotesensingdata.gov.scot/data#/download

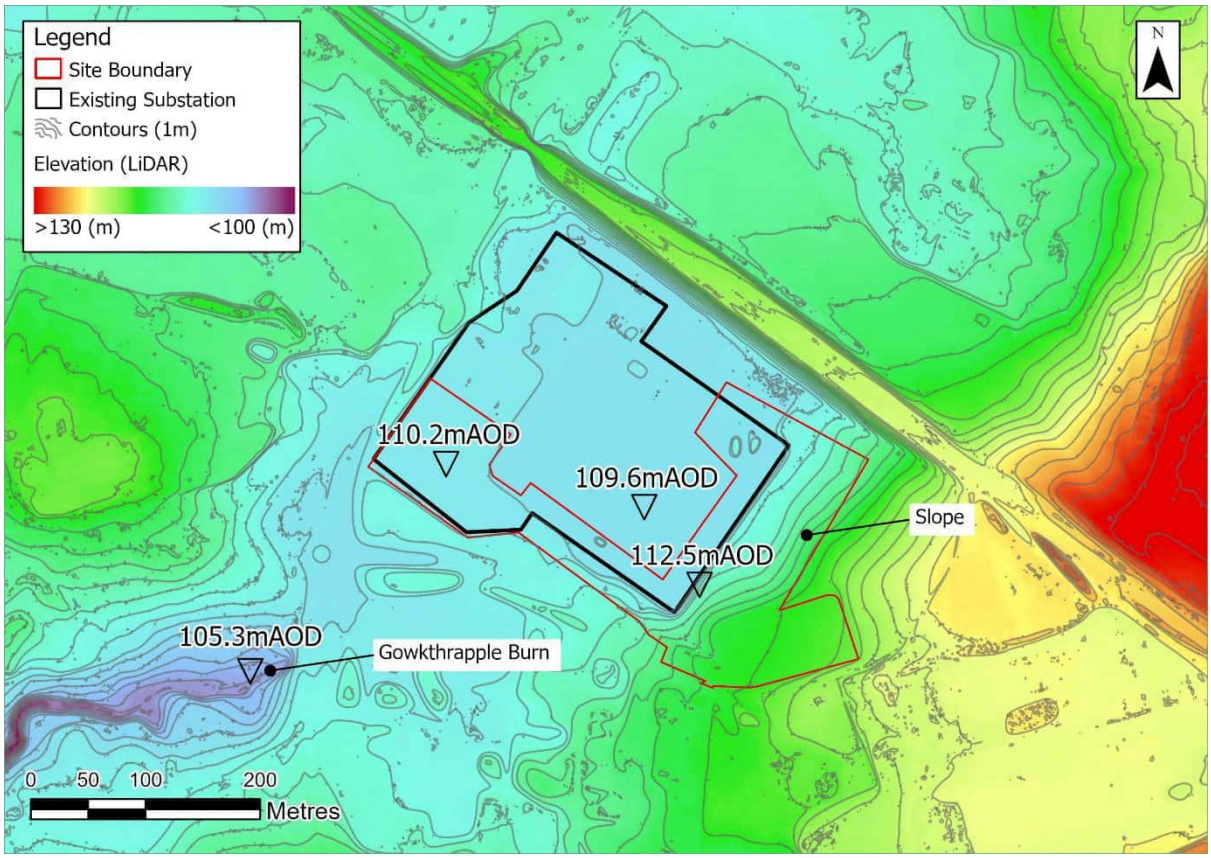


Plate 3-2 Site Topography. Contains public sector information licensed under the Open Government Licence v3.0, sourced from Scottish Government –Scottish Public Sector LiDAR Phase 5.

3.1.4 Geology

Geology mapping provided by British Geological Survey (BGS)[4] indicates the site's superficial deposits predominantly consist of glaciolacustrine deposits of clay, silt, and sand. The bedrock geology is made up of Scottish Middle Coal Measures Formation containing sedimentary cycles of sandstone, siltstone, and mudstone. This parent geology is characterised by moderately productive aquifers.

BGS historic borehole records[5] were consulted, but there are no published records near the site.

No site-specific ground investigation information has been provided at the time of conducting this study.

3.1.5 Proposed Development

A plan view of the site area and proposed development is provided in Plate 3- 3. The proposed upgrade would involve a 0.6ha extension to the substation platform to the east and south to accommodate a bay of GIBs relaying a new 400kV cable route. The proposed works do not include development of additional hard-standing access tracks. Extending the platform in this area would require further excavation into the hillside to the east of the substation. Exact levels have not been determined at this stage, but the extension is assumed to match the existing platform level of 109.6mAOD.

[4] Geology Viewer (2025). Webmap. British Geological Survey.: https://geologyviewer.bgs.ac.uk
[5] Geoindex Onshore Viewer (2025). Webmap. British Geological Survey. https://mapapps2.bgs.ac.uk/geoindex/home.html?layer=BGSBoreholes&_ga=2.97769951.1190298851.1769594413-451922500.1769594413

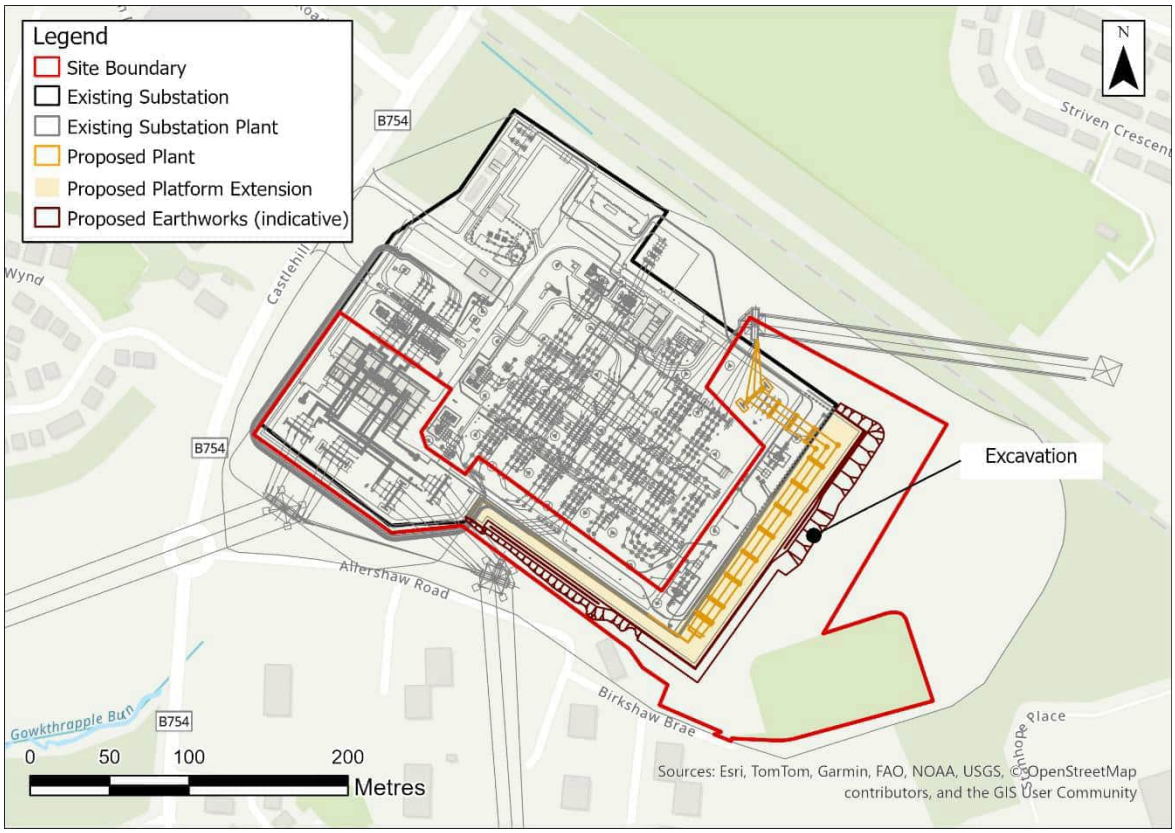


Plate 3- 3 Proposed development

3.2 Policy Context

This report has been developed in accordance with the relevant national and local policies discussed below. While all the key policy frameworks covering the site have been referenced to produce this report, the following sections will highlight the most critical policy details which have bearing on the proposed development.

3.2.1 National Planning Policy

Following Policy 11.e.vii) of the *National Planning Framework 4* (NPF4)[6], proposals for energy developments should demonstrate how the effects of development on flood risk and the water environment are addressed in design, which is the purpose of this report.

The requirements for consideration of flood risk in Scotland is set out in more detail in Policy 22 of the NPF4. Policy 22 is supplemented by SEPA's *Land Use Vulnerability Guidance*[7] which categorises land uses and developments by their vulnerability to inform where exceptions to this policy may be applicable. Based on this guidance, the proposed development is categorised as 'essential infrastructure'.

Relevant sections of Policy 22 include:

a) *"Development proposals at risk of flooding or in a flood risk area will only be supported if they are for:*

   i) *essential infrastructure where the location is required for operational reasons;*

   ii) *water compatible uses;*

   iii) *redevelopment of an existing building or site for an equal or less vulnerable use; or.*

   iv) *redevelopment of previously used sites in built up areas where the LDP has identified a need to bring these into positive use and where proposals demonstrate that long term safety and resilience can be secured in accordance with relevant SEPA advice.*

   In such cases, it will be demonstrated by the applicant that:

- *all risks of flooding are understood and addressed;*
- *there is no reduction in floodplain capacity, increased risk for others, or a need for future flood protection schemes;*
- *the development remains safe and operational during floods;*
- *flood resistant and resilient materials and construction methods are used; and*
- *future adaptations can be made to accommodate the effects of climate change.*

c) *Development proposals will:*

   i) *not increase the risk of surface water flooding to others, or itself be at risk.*

   ii) *manage all rain and surface water through sustainable urban drainage systems (SUDS), which should form part of and integrate with proposed and existing blue-green infrastructure. All proposals should presume no surface water connection to the combined sewer;*

   iii) *seek to minimise the area of impermeable surface."*

[6] National Planning Framework 4 (2023). Scottish Government. https://www.gov.scot/binaries/content/documents/govscot/publications/strategy-plan/2023/02/national-planning-framework-4/documents/national-planning-framework-4-revised-draft/national-planning-framework-4-revised-draft/govscot%3Adocument/national-planning-framework-4.pdf

[7] Flood Risk and Land Use Vulnerability Guidance (2024). SEPA. https://www.sepa.org.uk/environment/land/planning/guidance-and-advice-notes/

In this context, NPF4 defines “at risk of flooding” as “land or built form with an annual probability of being flooded of greater than 0.5% which must include an appropriate allowance for future climate change”. This will be used as the benchmark for flood risk assessment in this report.

3.2.2 Local Planning Policy

The proposed development lies within the administrative area of the North Lanarkshire Council. They provide guidance for prospective developments in their policies regarding flood risk and drainage. This report has therefore paid due consideration to the following relevant guidance documents:

- North Lanarkshire Council Development Plan 2 (LDP2)[8]
- Supplementary Planning Guidance (SPG) 09: Flooding and Drainage[9]
- Clyde and Loch Lomond Local Plan District Flood Risk Management Plan[10]

Specific advice on planning policy relating to flood and drainage management is provided in the SPG09. Section D.8 states that a) drainage assessments are required for ‘*developments or extensions with floodspace or hardstandings of 1,000 sq. m or over’*, and b) Flood Risk Assessments are required for ‘*developments within a medium to high risk flooding area (SEPA 1:200 Flood Map)*’. Developments with a proposed hardstanding footprint less than 1,000m^2 , such as the proposed extension to the Wishaw Substation, may not require a full drainage assessment, but should still include a demonstration of the best surface water drainage option following policy E.10 from SPG09.

In the Clyde and Loch Lomond Local Plan District Flood Risk Management Plan, the Wishaw South region which encompasses the present site is listed as a Target Area subject to generally high risk of surface water flooding, and uncertainty in the capacity of stormwater drainage. SEPA’s Sewer Flood Risk Assessment for the region has not yet been published.

3.2.3 SPEN Policy

SPEN’s internal policy SUB 01-018: Substation Flood Resilience[11] and its implications for the assessment of flood risk and provision of flood protection has been considered throughout the Flood Risk Assessment process.

[8] North Lanarkshire Council Local Development Plan (2022).North Lanarkshire Council. https://www.northlanarkshire.gov.uk/sites/default/files/2022-11/North%20Lanarkshire%20Local%20Development%20Plan.pdf
[9] North Lanarkshire Council (2010). *SPG 09: Flooding and Drainage.* Available at: https://www.northlanarkshire.gov.uk/sites/default/files/2020-09/09%20Flooding%20and%20Drainage.pdf
[10] Clyde and Loch Lomond Local Plan District Flood Risk Management Plan (2021). SEPA. https://www2.sepa.org.uk/frmplans/
[11] SUB 01-018: Substation Flood Resilience Issue 03 (2023). SPEN. https://www.spenergynetworks.co.uk/userfiles/file/SUB-01-018.pdf

3.3 Flood Risk Assessment

This section will report on the findings of a qualitative flood risk analysis desk study which aimed to assess the potential impact of flood risk sources on the proposed development. The following structure will be used:

- A brief description of the types of flood risk considered
- A review of the data-sources used to assess flood risk on site
- An analysis of each flood risk type as they pertain to the proposed development.
- A summary of the flood risk assessed from each source and recommended mitigations.

The findings of this assessment are summarised in the checklist in Appendix A, in line with SEPA technical guidance[12].

3.3.1 Potential Sources of Flood Risk

Flood risk on a site may be either caused or exacerbated by a range of hazards. Each of these hazards may themselves present a flood risk or may interact with other hazards to produce an overall flood risk. Estimates of the impact of climate change on the severity and extent of these hazards will also be considered. The following flood hazards will be assessed regarding their individual contribution to flood risk and, where appropriate, their likelihood of increasing flood risk posed by other hazards:

a) **Coastal Flooding:** Extreme sea levels and wave heights can cause inundation and flooding on developments on or sufficiently near the coast.

b) **Fluvial (River) Flooding:** Extreme flood events in rivers and other large watercourses can cause rapid and significant inundation of surrounding areas

c) **Pluvial (Surface Water) Flooding:** High volume rainfall events which exceed the infiltration and storage capacity of the local soil cause flows to develop over land, potentially damaging property.

d) **Infrastructure Failure:** Water conveyance, storage, or flow control infrastructure can fail, either causing a flood risk in itself, or exacerbating the scale or extent of other flood hazards.

e) **Sewer Flooding:** The failure of sewerage can result in surface flooding.

f) **Groundwater Flooding:** Variations in the local water table and groundwater level can impact the storage capacity of the soil or subterranean storage infrastructure. While groundwater alone does not generally pose significant risk, it may exacerbate the risk posed by other flood hazards.

Consideration will also be given to the future impacts of climate change where appropriate.

3.3.2 Data Sources

The assessment of the above-described flood hazards has been informed by a range of sources. SEPA develops and maintains flood risk datasets pertaining to Coastal, Fluvial (River) and Pluvial (Surface Water) flooding, with additional consideration of the impact of climate change. The relevant sections of this report have drawn on the data provided in the SEPA Flood Map Version 3.0[13]. The flood extents in these maps have been estimated using predictive modelling covering all of Scotland and thus are limited by the specificity of the data which informs them. Thus, these maps should be seen as 'indicative' and

[12] Technical Flood Risk Guidance for Stakeholders (2022). SEPA.ss-nfr-p-002-technical-flood-risk-guidance-for-stakeholders.pdf
[13] SEPA Flood Map Version 3.0 (2025). Dataset.SEPA : https://map.sepa.org.uk/floodmaps

their results interpreted within the context of site characteristics. SEPA also maintains a database relating to groundwater hazards[14] which has been consulted.

In assessing the risks of infrastructure failure, the SEPA Reservoirs map[15] has been used, which identifies areas at risk of flooding from uncontrolled release of stored water.

To maintain congruity with SEPA Flood Risk Assessment methods, this report will maintain the following terminology for levels of flood risk:

- **High Risk:** Areas which are subject to flooding in the characteristic 10% AEP (1:10 year) rainfall event. These areas have a 10% chance of flooding each year based on past rainfall data.
- **Medium Risk:** Areas which are subject to flooding in the characteristic 0.5% AEP (1:200 year) rainfall event. These areas have a 0.5% chance of flooding each year based on past rainfall data.
- **Low Risk:** Areas which are subject to flooding in the characteristic 0.1% AEP (1:1000 year) rainfall event. These areas have a 0.1% chance of flooding each year based on past rainfall data.

As current scientific knowledge expects the frequency and intensity of extreme rainfall events to increase in the future, a further risk category will be used when discussing flood hazards which would be impacted by rainfall uplift caused by climate change:

- **Medium Risk with Climate Change:** Areas which are subject to flooding in the characteristic 0.5% AEP (1:200 year) rainfall event. These areas have a 0.5% chance of flooding each year based on rainfall uplift estimates for the year 2080.

3.3.3 Historic Flooding

There is no record of historic flooding for this site and SPEN have not provided any note of historical flooding on the site.

3.3.4 Coastal Flooding

The coastal SEPA flood maps show the site to be outside of any flood risk areas, with the nearest extent located 22km north-west of the site. As the proposed ground level across the site is approximately 109.6 mAOD, the site is suitably above sea level and the coastal flood risk on site is deemed **negligible.**

3.3.5 Fluvial Flooding

Fluvial flooding can be caused by either major watercourses, which are documented in the SEPA River Flood Map, or by smaller watercourses which are represented in the SEPA Surface Water Flood Map. This assessment will consider both sources as indicators of fluvial flood risk. The Fluvial flood risk to the site is shown in Plate 3-4.

Major Watercourses: The nearest major watercourse is the Gowkthrapple Burn, located circa 180m southwest of the site where it emerges from a culvert beneath the Gowkthrapple neighbourhood. The culvert outfall is approximately 5m below proposed site levels and flows away from the site. This watercourse is therefore deemed to pose **negligible** flood risk to the site.

Minor Watercourses: As discussed in the following section, the surface water flood risk areas indicated by SEPA around the site are more characteristic of over-land flow than small watercourse flow. There are no known small watercourses in the area which are expected to contribute to flood risk on site.

Thus, the risk of fluvial flooding on site is **negligible.**

[14] SEPA Groundwater Map (2025). Dataset. SEPA. https://map.sepa.org.uk/floodmap/map.htm
[15] SEPA Reservoirs Map (2022). Dataset. SEPA. https://map.sepa.org.uk/reservoirsfloodmap/Map.htm

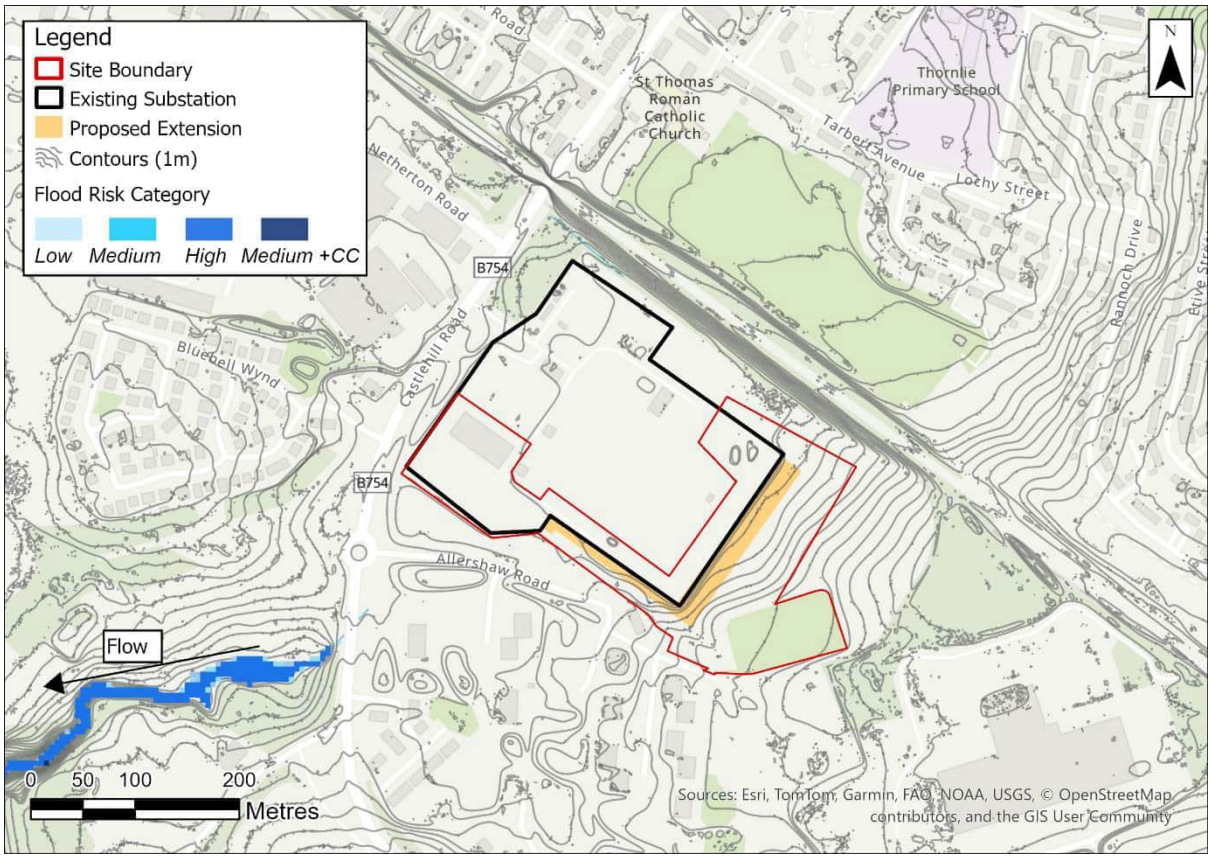


Plate 3-4 SEPA Fluvial flood risk. Includes data from SEPA Flood Maps v3.0 © Scottish Environment Protection Agency (SEPA) 2025; this SEPA product is licensed under the Open Government Licence v3.0.

3.3.6 Surface Water Flooding

Portions of the site are shown to be at risk of surface water flooding on the SEPA Flood Maps, as shown in Plate 3-5.

These maps indicate that an area to the north of the existing platform is subject to flood risk from low to high probability, likely arising from surface flow through the Castlehill Road Underpass. This ponding appears to be restricted to the portions of the site off the used platform, and do not affect the site of the Proposed Development.

Significant portions of the rest of the existing platform are indicated with low risk and medium risk with climate change (Medium + CC) flood extents, with some small pockets of medium risk.. However, these indicators of flood risk may be inaccurate, as the SEPA models from which they are derived do not account for on-site drainage infrastructure or the substation gravel sub-base, which can store and attenuate surface water even in absence rapid infiltration to soil.

There is only one isolated region of ponding within the area of the Proposed Development, which would likely be satisfactorily managed by the provision of adequate surface water drainage. The proposed electrical plant to be included in the Proposed Development is not susceptible to damage from this type of flooding as it is naturally elevated at least 1m above ground level (See Appendix B for electrical elevations).

Based on this analysis, surface water flood risk is considered **low** for this site, which is acceptable for an essential infrastructure development following the NPF4.

Direct access to and egress from the site is unaffected by flooding, however all nearby roads are subject to flood risk.

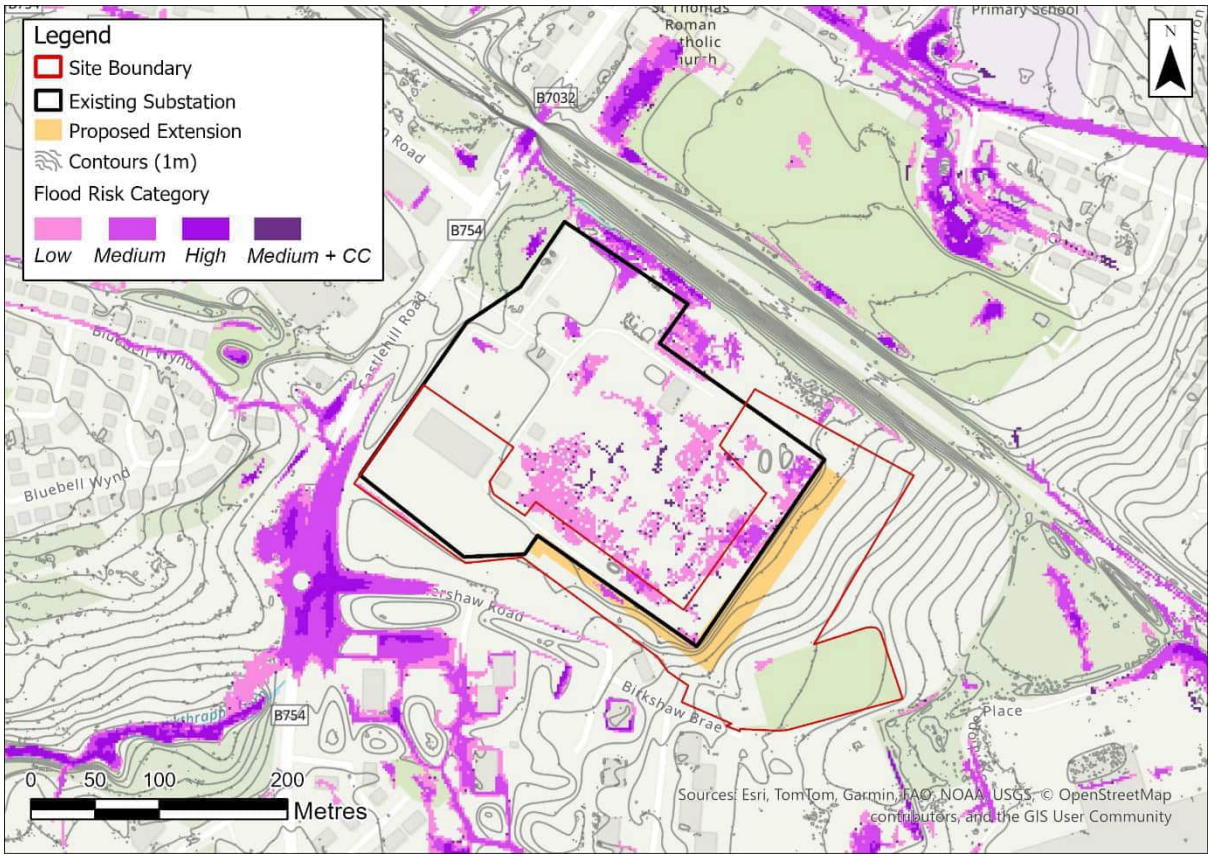


Plate 3-5 SEPA surface water flood risk. Includes data from SEPA Flood Maps v3.0 © *Scottish Environment Protection Agency (SEPA) 2025; this SEPA product is licensed under the Open Government Licence v3.0.*

3.3.7 Infrastructure Failure Infrastructure Failure

The risk of flooding presented by **reservoir failure** and **canal failure** has been assessed as follows:

Reservoir Failure: SEPA provides flood mapping to show areas which may be inundated with water in the event of a reservoir failure[16]. These maps show that the site is not at risk of flooding in the event of failure, and thus flood risk is deemed **negligible**.

Canal Failure: There are no nearby canals, so flood risk from canal failure is **negligible**.

Water Mains: Scottish Water records show distribution mains in the area of Birkshaw Road and Brikshaw Brae to the south of the site. If these mains burst, some flow could route downhill towards site, although it is likely to be constrained by the roads and route downhill towards Allershaw road to the west. The risk of flooding from bursting of water mains is **negligible.**

3.3.8 Sewer Flooding

The proposed site is located in a highly urbanised area, with wastewater, and stormwater sewerage networks in the area. Specifically, there are several surface water and foul water sewerages of unknown condition in the area of Birkshaw Road and Birkshaw Brae to the south of the site, which could route downhill towards site in the event of failure. However any flows in the event of failure are more likely to be constrained by the roads kerbs and routed towards Allershaw road to the west. A detailed

[16] SEPA Reservoirs Map (2022). Dataset. SEPA. https://map.sepa.org.uk/reservoirsfloodmap/Map.htm

assessment of the capacity and resilience of these networks is out-with the scope of the present flood risk assessment, but as there is not a record of historic flooding, the likelihood of sewer flooding is **low.**

3.3.9 Groundwater Flooding

Groundwater is usually a contributing factor to flooding rather than the primary source in Scotland. It is difficult to predict groundwater effects, however low-lying areas with permeable bedrock are considered to be most at risk. The description of the geology in Section 3.1.4, did not indicate any features which would suggest groundwater risk. The SEPA Groundwater flood map also does not indicate risk of groundwater flooding in the area, so risk of groundwater flooding is deemed **negligible**.

3.3.10 FRA Conclusion and Recommendations

The site of the proposed development has been assessed against six possible sources of flooding, finding that the risk posed by the majority of these is **negligible.** Risk posed by surface water and sewerage flooding is considered to be **low,** which is deemed acceptable for the nature of the infrastructure. A summary of the assessed flood risk is provided in Table 3-1.

Table 3-1 Summary of Flood Risk Assessment

Source of Flood Risk	Brief Description	Magnitude of Risk
Coastal	The site is located away from the coast. It is therefore far removed from areas at risk of coastal flooding.	***Negligible***
Fluvial	There are nearby flood risk areas generated by the Gowkthrapple Burn, however this flows away from the site and would have no impact on the proposed development.	***Negligible***
Surface Water	Some surface water flood risk is indicated on the substation platform in the 0.5%AEP with climate change case. However, this is likely exaggerated by the coarse predictive modelling method which informs SEPA flood maps, and the known makeup of the substation compound and existence of storm drainage on site would likely reduce this to isolated ponding. As the proposed development consists of a small platform extension with no hardstanding, no reduction of functional flood storage, and all proposed plant is elevated in nature, ponding would not impinge on the safety of the development, nor would the development increase flood risk elsewhere.	***Low***
Infrastructure Failure	Risk from reservoir failure and canal failure were assessed concluding no risk due to the distance of the site from any such infrastructure and consultation of SEPA Reservoir Inundation mapping.	***Negligible***
Sewer Flooding	The location of the site indicates minimal risk from sewerage flooding.	***Low***
Groundwater Flooding	The site has no history of flooding and is outwith extents of possible groundwater flooding published by SEPA.	***Negligible***

Under the current guidance, these results indicate that **a Level 2 or 3 FRA is not required**.

3.4 Surface Water Management Strategy

3.4.1 Introduction

This Surface Water Management Strategy (SWMS) is provided in order to advise on the requirements for surface water management on the Wishaw Substation site. At the current planning stage, detailed drainage design information is not available. This SWMS will seek to provide a high-level assessment of the drainage demands posed by the proposed development and assess how the current proposed drainage scheme will manage surface water runoff with respect to water quality and quantity.

The proposed development constitutes an increase in the platform area of roughly 6,000m^2 (0.6ha) none of which is to be formed of hardstanding. Thus, following Policy D.08 in the North Lanarkshire Council SPG09 document, a full drainage assessment is not required. However, it is still recommended that a justification of the proposed surface water drainage scheme be provided. This SWMS will seek to demonstrate the adequacy of the proposed drainage scheme in improving the quality and attenuating the quantity of surface water runoff from the site.

3.4.2 Existing Drainage

Plans of the existing drainage scheme on the substation platform have been provided by SPEN. This scheme operates by collecting surface water in filter drains and perforated pipes within the platform and conveying it to the Gowkthrapple Burn. See Appendix C for existing drainage plans.

3.4.3 Principles of SuDS Best Practice

Sustainable Drainage Systems (SuDS) methods are recommended by both national and local authorities for achieving sufficient drainage of excess surface water on site while mitigating harmful downstream effects such as pollution and flooding. SuDS achieve these goals by providing flow paths for surface water which filter out pollutants, attenuate peak flows, and provide flood storage where necessary.

The CIRIA C753 SuDS Manual states the following SuDS drainage hierarchy should be utilised for new development planning proposals and requests for land drainage purposes:

1) Rainwater collection and re-use (where there is demand)
2) Infiltration to the maximum extent that is practical – where it is safe and acceptable to do so
3) Discharge to surface waters
4) Discharge to surface water sewers
5) Discharge into combined sewer

A SuDS management approach is expressed within the SuDS Manual; this approach allows the maximisation of SuDS uptake and benefits within planning proposals. The approach is expressed below:

- Use surface water as a resource,
- Manage rainfall at the source,
- Manage runoff on the surface of a site above ground,
- Allow for infiltration of runoff on site,
- Enhance evapotranspiration,
- Slow runoff and volume to greenfield runoff rates and volumes,
- Reduce water pollution by incorporating SuDS features to prevent pollution by enhancing water quality and control the runoff, and
- Use SuDS to treat runoff in urbanised catchments/sites to prevent environmental pollution.

In accordance with guidance, this SWMS will assess the proposed drainage against SuDS best practice for the treatment of surface water (Water Quality) and the conveyance, attenuation, and storage of surface water (Water Quantity).

3.4.4 Infiltration

No infiltration testing has been undertaken at the site. A conservative assumption has therefore been made to consider that no infiltration is possible. This assumption, and resulting design decisions, may be revised in later design stages should infiltration testing later be completed. As a result, the proposed drainage strategy will consider discharge to a nearby watercourse, the Gowkthrapple Burn, which is the next preferred option in the SuDS hierarchy.

3.4.5 Proposed Drainage Scheme

Plate 3-6 shows an excerpt from the proposed site drainage layout full drawing is provided in Appendix D. This shows the site is to be drained by a series of filter drains and swales, which will attenuate and treat the water before tying into to the existing platform drainage.

The total length of filter drains would be 170m and the total length of swale would be 90m. While detailed drainage design has not been carried out, this report will assume the following dimensions of the relevant features following guidance in the SuDS Manual. The filter drains will be assumed to have a cross section of 0.9m x 1.5m depth, 300mm dia. pipes, and 30% material porosity. Swales will be assumed to have a trapezoidal section with 4.5m width at ground level, 0.5m width at bed level, and 0.5m depth (resulting in 1:4 side slopes).

Attenuation storage is provided within the gravel subbase of the substation, which is built to a minimum 300mm depth following SPEN policy SUB-03-034[17]. With an assumed porosity of 30%, the subbase of the Proposed Development will be capable of holding approximately 540m^3 surface water.

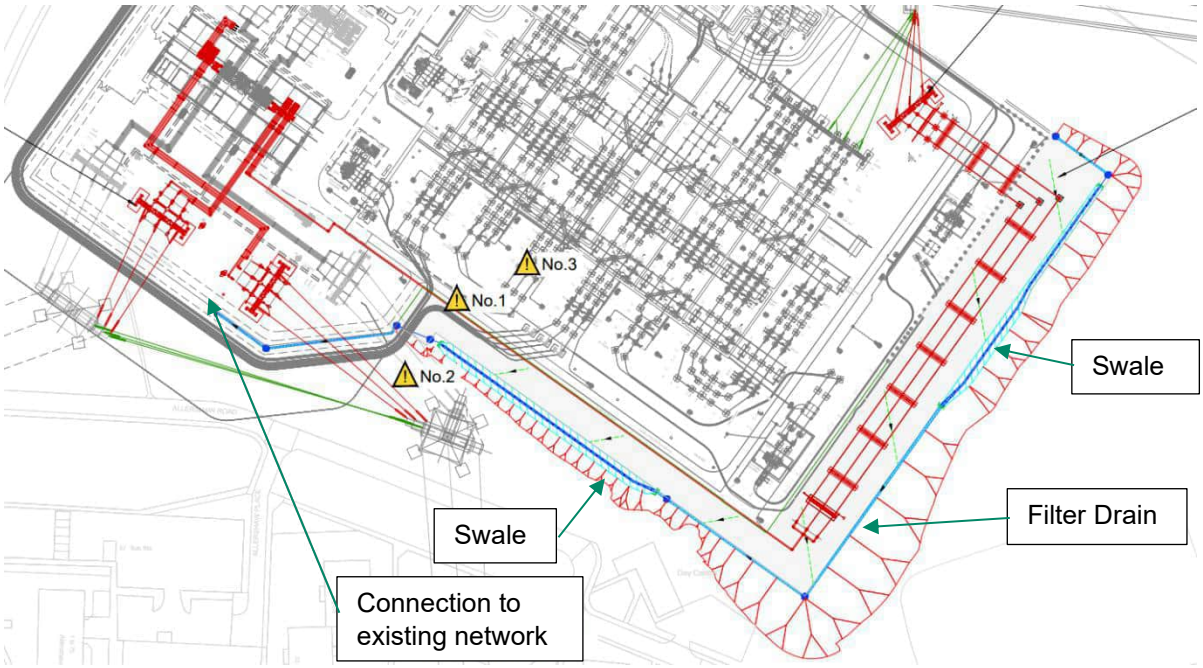


Plate 3-6 Proposed Drainage Layout

[17] General Specification for the Civil Engineering and Building Design and Construction of 275kV & 400kV Substations (2023). SP Energy Networks. https://www.spenergynetworks.co.uk/userfiles/file/SUB-03-034.pdf

3.4.6 Surface Water Impact

By agreement with SPEN, the proposed substation platform is assumed to be designed following SPEN internal policy SUB-03-034[22] which sets standards for civil works involved in designing new platforms and requires platforms to be formed of a minimum 300mm depth of Type 3 well-draining granular material.

The area of the proposed development will be affected by surface water from direct rainfall on the platform extension, and from any surface water runoff that flows into site from uphill.

As the proposed works will require an excavation of the hillside to the east, it is expected that some surface water runoff will flow down the excavated section of the hill. Further analysis will assume that the plan area of the cut and an additional buffer area of 5m will flow to the platform level and require drainage.

Following the above discussion, the surface water catchment considered for the remainder of this report will consist of the entirety of the platform extension area (0.60ha), which will be assumed to be have no infiltration to ground, as well as the earthworks cut and associated buffer zone (0.58ha), which will be assumed to have greenfield runoff characteristics as shown in Plate 3-7.

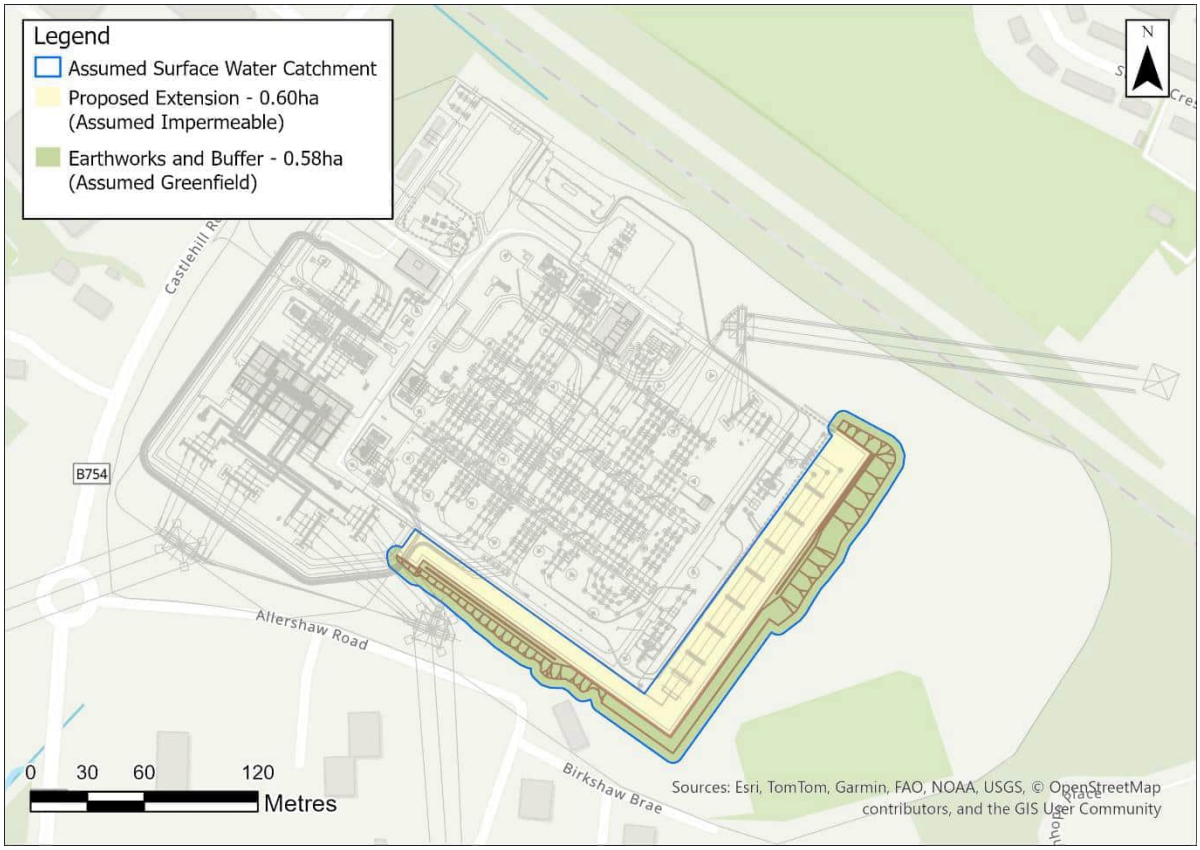


Plate 3-7 Surface water catchment of proposed extension

3.4.7 Water Quality

The Simple Index Approach (SIA) is a method of assessing whether the SuDS features proposed for a site are adequate to treat the collected runoff for the following pollutants: Total suspended solids (TSS), Metals, and Hydrocarbons. Based on the proposed usage of the site, a pollution index will be assigned for each of these pollutants.

The proposed SuDS features will have a rating for each pollutant corresponding to their efficacy in treating that type of pollution. By the CIRIA SuDS Manual, the sum of the treatment indices of the proposed SuDS must exceed the pollution index according to land usage. Where multiple SuDS features are used in series, the mitigation of each subsequent feature is factored by 0.5 to account for the reduction in treatment efficacy arising from a reduced concentration of pollutant at the inlet due to previous treatment.

The highest risk of pollution in the site arises from the internal access roads. While there are no roads proposed on the platform extension, the pollution index associated with low traffic access roads (following Table 26.2 of the SuDS Manual[18]) will be taken as a conservative value. The resulting pollution hazard indices for the site and mitigation indices for the proposed SuDS are summarised in Table 3-2.

Table 3-2 Summary of Simple Index Approach for proposed SuDS

Source	Description	TSS Index	Metals Index	Hydrocarbon Index
Land Use (pollution)	Low pollution hazard access road	0.5	0.4	0.4
Proposed SuDS 1 (mitigation)	Filter Drain	0.4	0.4	0.4
Proposed SuDS 2 (mitigation)	Swale	0.5 * 0.5 = 0.25	0.5 * 0.6 = 0.3	0.5 * 0.6 = 0.3
	Check	0.65 ≥ 0.5 OK	0.7 ≥ 0.4 OK	0.7 ≥ 0.4 OK

Following the above analysis, the proposed layout of a filter drain feeding to a swale, and through to the existing drainage will exceed the requirements for pollution mitigation. Where the proposed perforated pipe underdrains feed directly into the swale, these act similar to filter drains from a treatment perspective as they are embedded within the gravel sub-base. However, it should be noted that filter drains generally require more frequent maintenance if they are used to remove coarse sediments; this should be considered when developing the maintenance plan for the proposed drainage network.

3.4.8 Water Quantity

3.4.8.1 Approach

The proposed development constitutes an increase in the platform area of roughly 6,000m^2. While the increased area is not a hardstanding, this analysis will conservatively assume that the underlying soil is fully impermeable and that the entire area must be positively drained and thus will ensure that adequate attenuation is provided.

This section will provide initial calculations based on currently available data to illustrate that the proposed drainage scheme is capable of conveying and attenuating the volume of additional surface water which will be generated by the impermeable area of the proposed scheme. This will be achieved through several steps: first by identifying the limiting outflow from the system in order to mitigate flood risk downstream of the site, then by modelling the drainage scheme to indicate the approximate storage

[18] The SuDS Manual (2015). CIRIA .

volume which would be required for sufficient attenuation. Following local council guidance in the SPG09[13], the following calculations will use the 200-year return period storm, with a 41% uplift for climate change as the design event following SEPA recommendations for the Clyde River basin[19].

3.4.8.2 Outlet Rate

The rate at which the proposed drainage system outlets to the existing drainage network is critical for estimating storage capacities required within the scheme. This rate must be controlled in order to mitigate the risk of flooding downstream of the site. Best practice is to limit this flow to the greenfield (predevelopment) runoff rate of the site.

The greenfield runoff rate was calculated using the HR Wallingford tool[20] and applying the Institute of Hydrology (IH124) method[21] using local catchment data obtained from the FEH web service[22] and a representative 1.0ha catchment to output the area-normalised runoff rate. The results of this calculation are presented in Table 3-3. Full results of the calculation are presented in Appendix E.

Table 3-3 Wishaw Substation Greenfield Runoff Rate

Return period (yrs)	Annual Exceedance Probability (AEP)	Greenfield Runoff Rate (l/s/ha)
1	100%	7.8
2 (Q_{BAR})	50%	8.2
30	3.33%	17.5
100	1%	23.6
200	0.5%	26.9

Table 3-3 above shows that the greenfield runoff rate of the site is 26.9L/s/ha for the 0.5% AEP storm. Based on the total 1.18ha catchment area discussed in section 3.4.6, the outlet flow from the extended drainage system must be controlled to 31.74L/s in order to match the greenfield runoff rate.

3.4.8.3 Attenuation Capacity

InfoDrainage 2025.3 was used to carry out a high-level assessment of the post-development surface water attenuation volume requirements on site. The drainage software simulates the post-development flow of the site using existing rainfall data to calculate the volume required.

The rainfall catchment for the model was split into two elements, one 0.60ha catchment of impermeable area for the platform extension and one 0.58ha catchment of greenfield for the earthworks and buffer zone. A runoff coefficient of 1.0 was applied to the platform extension, and a runoff coefficient of 0.6 applied to the earthworks and buffer zone, consistent with the nature of the ground.

The storage volume—which is assumed to be supplied by the storage within the subbase—was schematised as a single storage tank feature with 1m depth and 540m^3 volume (as identified in Section 3.4.5). This simplified approach is not intended to be a precise model of the interaction between the proposed drainage features but is considered sufficient to provide a high-level assessment of the

[19] Climate Change Allowances for Flood Risk Assessment in Land Use Planning, Version 6 (2025). SEPA. https://www.sepa.org.uk/media/jjwpxuso/climate-change-allowances-guidance_v6.pdf
[20] HR Wallingford. Webtool. Available online at: https://www.uksuds.com/tools/greenfield-runoff-rate-estimation
[21] Flood Esimation for Small Catchments. (1994). Institute of Hydrology. Available at: https://nora.nerc.ac.uk/id/eprint/7367/1/IH_124.pdf

[22] UK Centre for Ecology and Hydrology. Web Service. Available online at: https://fehweb.ceh.ac.uk/

attenuation required. This can be refined in the detailed design stage when further design data is available.

A controlled outlet of 31.74L/s was applied to the storage volume, consistent with the calculation of the greenfield runoff rate for the site of the Proposed Development calculated in Section 3.4.8.2.

Rainfall values on site were calculated using the FEH22 model using point descriptors obtained from the FEH Web Service. Results were obtained for the 3.33%, 1%, and 0.5% AEP events with 41% uplift for climate change. Storm durations were simulated through the full range of InfoDrainage's capabilities from 15 minutes to 10080 minutes.

The model found the critical event to be the 0.5% AEP (+41% rainfall) 120 minute Winter event, where the scheme held 518.7m^3, resulting in a utilisation of approximately 96%. This indicates that the proposed scheme is sufficient for handling the surface water attenuation needs of the site.

Results from the critical storm in each return period event are summarised in Table 3-4, and full results given in Appendix F.

Table 3-4 Summary of attenuation sizing

Annual Exceedance Probability (AEP)	Critical Storm	Maximum Resident Volume (m^3)	Utilisation (%)
3.33% AEP + CC	120 minute, Summer	342.8m^3	63%
1% AEP + CC	120 minute, Winter	449.6m^3	83%
0.5% AEP + CC	120 minute, Winter	518.7m^3	96%

3.4.9 Maintenance Schedule

To ensure the continued functionality and performance of the proposed SuDS, a maintenance schedule must be produced. SPEN will be responsible for the proper maintenance of SuDS assets on site, unless they appoint a suitable factor. Each element requires inspection and maintenance, possibly through a factoring agreement for the development. Failure to properly maintain the surface water drainage can lead to increased flooding on site and pollution downstream. According to the SuDS Manual, the minimum requirements for each SuDS component are tabulated as follows:

Table 3-5 Summary of Recommended Maintenance for Filter Drains

Maintenance schedule	Required Action	Typical Frequency
Regular Maintenance	Remove litter and debris from filter drain surface, access chambers, and any pre-treatment devices	Monthly, or as required
	Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage	Monthly
	Inspect pre-treatment systems, inlets, and perforated pipework for silt accumulation and establish appropriate silt removal frequencies	Six monthly
	Remove sediment from pre-treatment devices	Six monthly, or as required
Occasional Maintenance	Remove or control tree roots where they are encroaching on the sides of the filter drain, using recommended methods (eg NJUG, 2007 or BS 3998:2010)	As required
	At locations with high pollution loads, remove surface geotextiles and replace, and wash or replace overlying filter medium	Five yearly, or as required
	Clear perforated pipework of blockages	As required

Table 3-6 Summary of Recommended Maintenance for SuDS Swales

Maintenance schedule	Required Action	Typical Frequency
Regular Maintenance	Remove litter and debris	Monthly, or as required
	Cut grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
	Inspect inlets, outlets, and overflows for blockages, and clear if required.	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for >48 hours	Monthly, or when required
	Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly

Maintenance schedule	Required Action	Typical Frequency
	Inspect inlets and facility surfaces for silt accumulation, establish appropriate silt removal frequencies	Half yearly
Occasional Maintenance	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required	With effective pre-treatment, only required rarely
Remedial actions	Repair erosion or other damage by re-turfing or re-seeding	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil slater to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface.	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader, or at top of filter strip.	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

3.4.10 Construction Phase SuDS

Prior to construction commencing, a Construction Method Statement will be drafted by the appointed contractor. This should include a section describing how surface water will be managed during construction to prevent any uncontrolled discharge into nearby watercourses, in line with SuDS Manual. This document should be issued to the relevant authorities, either SEPA or the planning authority, for approval before construction commences on site.

3.4.11 SWMS Conclusion and Recommendations

The proposed scheme for draining the new substation platform, consisting of peripheral filter drains and swales conveying to the existing drainage network and ultimately outletting to a nearby watercourse, was deemed sufficient for treating surface water runoff for Total Suspended Solids, metals, and hydrocarbons following application of the Simple Index approach.

In line with standard practice, the discharge rate from the new drainage must be limited to 31.74L/s, equivalent to the greenfield runoff rate based on FEH catchment descriptors. The drainage catchment was taken to be the new area of the extension (0.6ha) plus a portion of the field uphill of the proposed extension (0.58ha) to account for surface water runoff and infiltration through the slope.

The total attenuation requirement for the site was modelled using Info-drainage and designed for a 0.5%AEP plus climate change (41%) critical storm event. The surface water catchment was divided into two parts, one representing the Proposed Development and one representing the area of the excavation and a small buffer zone. The preliminary storage size was taken as 540m^2 based on assumed geometry of the proposed SuDS and platform subbase. The outlet was controlled to the greenfield runoff rate using a model Hydrobrake with 1.0m design depth. This initial sizing was found to be sufficient, with a maximum utilisation of 96% in the 0.5% AEP 120 minute Winter storm.

In line with North Lanarkshire Council guidance, a maintenance schedule for each drainage feature was provided along with brief recommendations on the provision of construction-phase SuDS.

As the Wishaw Substation site is still under planning, the proposed treatment path may be subject to change in the detailed design phase; update to the Simple Index Approach may be required. A full drainage design is recommended to be carried out in the detailed design phase when geotechnical data is available for the site.

3.5 Summary and Conclusion

AECOM were commissioned by SP Energy Networks (SPEN) to consult on flood risk and surface water management for the proposed extension of the Wishaw substation as part of the Denny to Wishaw Network Upgrade project. This report has been undertaken to provide a Level 1 Flood Risk Assessment (FRA) to assess the level of flood risk on site and to prepare a Surface Water Management Strategy (SWMS) for managing surface water on site.

The proposed works involved an extension of the substation platform to the east of the site to accommodate a new line of gantry towers. The extension would increase the platform area by approximately 6,000m^2 (0.6ha).

Following a full review of site conditions and common mechanisms for flooding, this FRA has determined that the Wishaw substation site is not at risk of fluvial, coastal, groundwater, or infrastructure-related flooding. The SEPA Flood Maps indicated regions to the north of the existing site which may be subject to surface water flooding resulting from overland flows from the north of the site. This area of flood risk did not appear to affect the site platform. Some other regions of low to medium probability flood risk were identified within the existing substation platform, corresponding to pluvial ponding. However these did not appear to be linked to overland flow routes, and it is assumed that the extent of this ponding would likely be reduced by the porous nature of the substation platform and the existing drainage network. As the proposed development is small, contributes no hardstandings, removes no functional storage, and has a minimum elevation of over 1.0m for any electrical equipment, this report concludes that the pluvial flood risk associated with the proposed development is negligible and a further assessment of flood risk (Level 2 or 3 FRA) is not required. The assessment of flood risk is considered satisfactory under SPEN SUB-01-018, as flood protection is not required.

This report also offers a Surface Water Management Strategy (SWMS) in support of the proposed development assessing the outline drainage design and providing recommendations for further design development. The requirements for surface water drainage are presented, as well as the principles of SuDS best practice which inform the SWMS. The proposed works include a filter drain and swale network to service the platform extension, which would feed into the existing drainage network at a controlled rate, eventually feeding to the Gowkthrapple Burn.

The proposed SuDS flow path was assessed using the Simple Index Approach and found to be sufficient for treating surface water runoff. A high-level assessment of the storage required onsite was undertaken to ensure that the proposed scheme can provide sufficient surface water attenuation to mitigate flood risks downstream. A simplified catchment and tank model identified that approximately 540m^3 of storage would be required to service the surface water catchment of the extension, which is supplied by the void capacity in the platform subbase. Recommendations are provided as to the proper maintenance schedule for the proposed SuDS systems.

As the Wishaw site is still under planning, the proposed drainage scheme may be subject to change in the detailed design phase; update to the Simple Index Approach may be required and a full drainage design is recommended to be carried out in the detailed design phase.

Appendix A – SEPA FRA Checklist

Flood Risk Assessment (FRA) Checklist

(SS-NFR-F-001 - Version 16 - Last updated 27/08/2019

This document must be attached within the front cover of any Flood Risk Assessments issued to Local Planning Authorities (LPA) in support of a development proposal which may be at risk of flooding. The document will take only a few minutes to complete and will assist SEPA in reviewing FRAs, when consulted by LPAs. This document should not be a substitute for a FRA.

Development Proposal Summary

Site Name:		Wishaw Substation				
Grid Reference:	Easting:	279060	Northing:	654011		
Local Authority:		North Lanarkshire Council				
Planning Reference number (if known):						
Nature of the development:		Utility Infrastructure	If residential, state type:			
Size of the development site:		0.6 Ha				
Identified Flood Risk:	Source:	Pluvial	Source name:	Surface Water		

Land Use Planning

Is any of the site within the functional floodplain? (refer to SPP para 255)	No	If yes, what is the net loss of storage?		m^3		
Is the site identified within the local development plan?	No	Local Development Plan Name:		Year of Publication:		
		Allocation Number / Reference:				
If yes, what is the proposed use for the site as identified in the local plan?	Select from List	If Other please specify:				
Does the local development plan and/or any pre-application advice, identify any flood risk issues with or requirements for the site.	No	If so, please specify:				
What is the proposed land use vulnerability?	Essential Infrastructure	Do the proposals represent an increase in land use vulnerability?	No			

Supporting Information

Have clear maps / plans been provided within the FRA (including topographic and flood inundation plans)?	Yes		
Has sufficient supporting information, in line with our Technical Guidance, been provided? For example: site plans, photos, topographic information, structure information and other site specific information.	Yes		
Has a historic flood search been undertaken?	Yes	If flood records in vicinity of the site please provide details:	
Is a formal flood prevention scheme present?	No	If known, state the standard of protection offered:	
Current / historical site use:	Electricity distribution substation		
Is the site considered vacant or derelict?	No		

Development Requirements

Freeboard on design water level:		0.6 m				
Is safe / dry access and egress available?		Vehicular and Pedestrian	Min access/egress level:	109.6	m AOD	
Design levels:	Ground level:	109.6 m AOD	Min FFL:	109.6	mAOD	

Mitigation

Can development be designed to avoid all areas at risk of flooding?	Yes
Is mitigation proposed?	No
If yes, is compenstory storage necessary?	No
Demonstration of compensatory storage on a "like for like" basis?	No
Should water resistant materials and forms of construction be used?	Yes

Flood Risk Assessment (FRA) Checklist

(SS-NFR-F-001 - Version 16 - Last updated 27/08/2019

Hydrology

Is there a requirement to consider fluvial flooding?	No			
Area of catchment:		km^2	Is a map of catchment area included in FRA?	Select from List
Estimation method(s) used (please select all that apply):	Pooled Analysis		If Pooled analysis have group details been included?	Select from List
	Single Site Analysis			
	Enhanced Single Site			
	ReFH2			
	FEH RRM			
	Other		If other (please specify methodology used):	
Estimate of 200 year design flood flow:		m^3/s		
Qmed estimate:		m^3/s	Method:	Select from List
Statistical Distribution Selected:	Select from List		Reasons for selection:	

Hydraulics

Hydraulic modelling method:	Select from List		Software used:	Select from List
			If other please specify:	
Number of cross sections:				
Source of data (i.e. topographic survey, LiDAR etc):			Date obtained / surveyed:	
Modelled reach length:		m		
Any changes to default simulation parameters?			If yes please provide details:	
Model timestep:				
Model grid size:				
Any structures within the modelled length?	Select from List		Specify, if combination:	
Maximum observed velocity:		m/s		
Brief summary of sensitivity tests, and range:				
variation on flow (%)		%	Please specify climate change scenario considered:	
variation on channel roughness (%)		%		
blockage of structure (range of % blocked)		%		
boundary conditions:	**Upstream**		**Downstream**	
(1) type	Flow		Select from List	
	Specify if other		Specify if other:	
(2) does it influence water levels at the site?	Select from List		Select from List	
Has model been calibrated (gauge data / flood records)?	Select from List			
Is the hydraulic model available to SEPA?	Select from List			
Design flood levels:	200 year	m AOD	200 year plus climate change	m AOD
Cross section results provided?	Select from List			
Long section results provided?	Select from List			
Cross section ratings provided?	Select from List			
Tabular output provided (i.e. levels, velocities)?				
Mass balance error:		%		

Coastal

Is there a requirement to consider coastal / tidal flooding?	No			
Estimate of 200 year design flood level:		m AOD		
Estimation method(s) used:	Select from List		If other please specify methodology used:	
Allowance for climate change (m):		m		
Allowance for wave action etc (m):		m		
Overall design flood level:		m AOD		

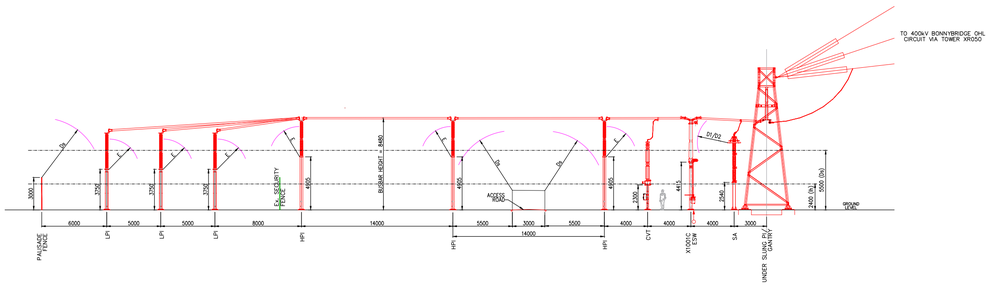
Comments

Any additional comments:	

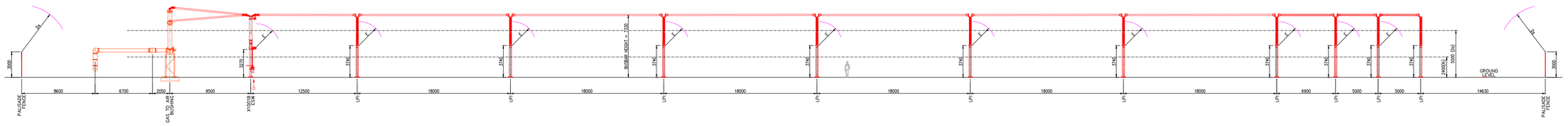
Approved by: [redacted]
Organisation: AECOM
Date: 9/12/2025

Note: Further details and guidance is provided in 'Technical Flood Risk Guidance for Stakeholders' which can be accesssed here:- CLICK HERE

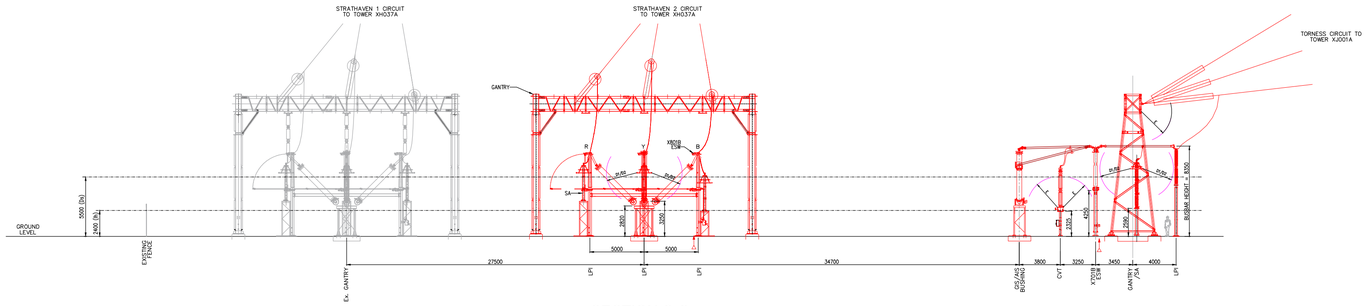
Appendix B – Electrical Component Elevations



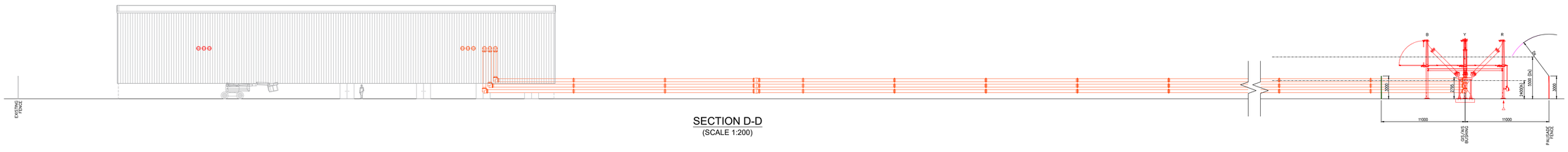
SECTION A-A
(SCALE 1:200)



SECTION B-B
(SCALE 1:200)



SECTION C-C
GIB CONNECTIONS OMITTED FOR CLARITY
(SCALE 1:200)



SECTION D-D
(SCALE 1:200)

0 10m 20m
1:200



KEY PLAN
SCALE 1:3500

ASSOCIATED DRAWINGS:

22119-BHK-WISH-SUB-D-E-000101	–	400kV ELECTRICAL SUBSTATION LAYOUT
BT1733-2-0000-DK-SPTES-4118	–	PROPOSED SWITCHGEAR NUMBERING FOR WISHAW 400kV SUBSTATION
1HC5114794	–	GIS LAYOUT & REQUIREMENTS (HITACHI)

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SPECIFIED.
2. ALL EQUIPMENT UPGRADE WORKS SHALL BE AS PER ASENG-11-855.
3. DESIGN OF ALL NEW PRIMARY PLANT EQUIPMENT AND SYSTEMS SHALL BE AS PER EPS-03-0313 & ASSET-02-0005.
4. ALL NEW MAIN PLANT PROPOSED IS SHOWN INDICATIVE TO BE UPDATED UPON RECEIPT OF CONTRACT GA's IN AUTOCAD FORMAT.
5. ELECTRO-MECHANICAL LOADING TO BE VERIFIED UPON RECEIPT OF CONTRACT GA's.
6. TO BE UPDATED ONCE OHL DESIGN HAS BEEN SUITABLY PROGRESSED INLINE WITH GANTRY.
7. THE PROPOSED DESIGN FOR GIS EXTENSION, GIB WORKS UP TO GAS TO AIR BUSHING SHOWN IN MAGENTA ARE BY OTHERS.
8. LV/ CONTROL CABLE CONDUIT AND MANHOLE TO BE CONFIRMED IN STAGE 1B.

LEGENDS & ABBREVIATION:

ESW	EARTH SWITCH
CVT	CAPACITIVE VOLTAGE TRANSFORMER
SA	SURGE ARRESTER
US PI	UNDERSLUNG POST INSULATOR
HPI	HIGH POST INSULATOR
LPI	LOW POST INSULATOR
	PROPOSED MAIN PLANT
	EXISTING MAIN PLANT
	TO BE REMOVED
	PROPOSED GIS (BY HITACHI)
	CLEARANCES AND SAFETY DISTANCES
←d	EARTH SWITCH MOTOR/MANUAL MECH. BOX

400kV MAIN PLANT EQUIPMENT SCHEDULE

EQUIPMENT REF.	DESCRIPTION	QUANTITY	MANUFACTURER	TYPE	GA DRAWING No.
ESW	3 PHASE EARTH SWITCH	4	TBC	TBC	TBC
CVT	CAPACITIVE VOLTAGE TRANSFORMER	9	TBC	TBC	TBC
SA	SURGE ARRESTER	9	TBC	TBC	TBC
HPI	HIGH POST INSULATOR	9	TBC	TBC	TBC
LPI	LOW POST INSULATOR	30	TBC	TBC	TBC
US PI	UNDERSLUNG POST INSULATOR	3	TBC	TBC	TBC

ELECTRICAL SAFETY CLEARANCE REFERENCE TABLE

REF	DESCRIPTION	400kV
E	PHASE TO EARTH CLEARANCE	2.8m
Ph	PHASE TO PHASE CLEARANCE	3.6m
SD	SAFETY DISTANCE*	3.1m
Ds	DESIGN CLEARANCE FOR SAFETY – VERTICAL	5.5m
Dsh	DESIGN CLEARANCE FOR SAFETY –HORIZONTAL	4.6m
D1	SURGE ARRESTER TO LIVE EQUIPMENT OF SAME PHASE	2.8m
D2	SURGE ARRESTER TO EARTH	2.8m
D3	SURGE ARRESTER TO SURGE ARRESTER, BETWEEN PHASES	3.6m
Ds (MEWP)	MEWP DESIGN FOR SAFETY – VERTICAL	7.5m
Dsh (MEWP)	MEWP DESIGN FOR SAFETY – HORIZONTAL	6.6m
Ih	INSULATION HEIGHT – PEDESTRIAN ACCESS	2.4m
	STANDARDISED PHASE TO PHASE BUSBAR SPACING	5.0m
	MAXIMUM CLEARANCE TO ROADWAYS	7.9m

* A DISTANCE OF 300mm SHALL ALSO BE MAINTAINED FROM THAT PORTION OF THE INSULATORS SUPPORTING EXPOSED HV CONDUCTORS WHICH IS OUTSIDE THE APPROPRIATE SAFETY DISTANCE (SD) FROM THE CONDUCTORS – REFER TO SPEN SAFETY BASIC SAFETY RULE A2.6

GIB DESIGN CLEARANCES (BY GIS SUPPLIER)

REF	DESCRIPTION	400kV
TC	MINIMUM ELECTRICAL CLEARANCE FROM EXPOSED CONDUCTORS SUBJECT TO 400kV GIS TESTING.	3.4m
TP	MINIMUM ELECTRICAL CLEARANCE FROM EXPOSED CONDUCTORS SUBJECT TO 400kV GIS TESTING.	8.2m

Rev.	Date	Drawn	Reviewed	Approved	Reason / Description of changes
P01	01/09/2025	PCC	SJ	US	FIRST ISSUE

SP Energy Networks | MORGAN SINDALL INFRASTRUCTURE | Balfour Beatty

Location: WISHAW

Project: DWNO - DENNY TO WISHAW NETWORK OPTIMISATION

Drg. Title: 400kV ELECTRICAL SUBSTATION ELEVATIONS

Drg. No.: 22119-BHK-WISH-SUB-D-E-000201

Rev: P01

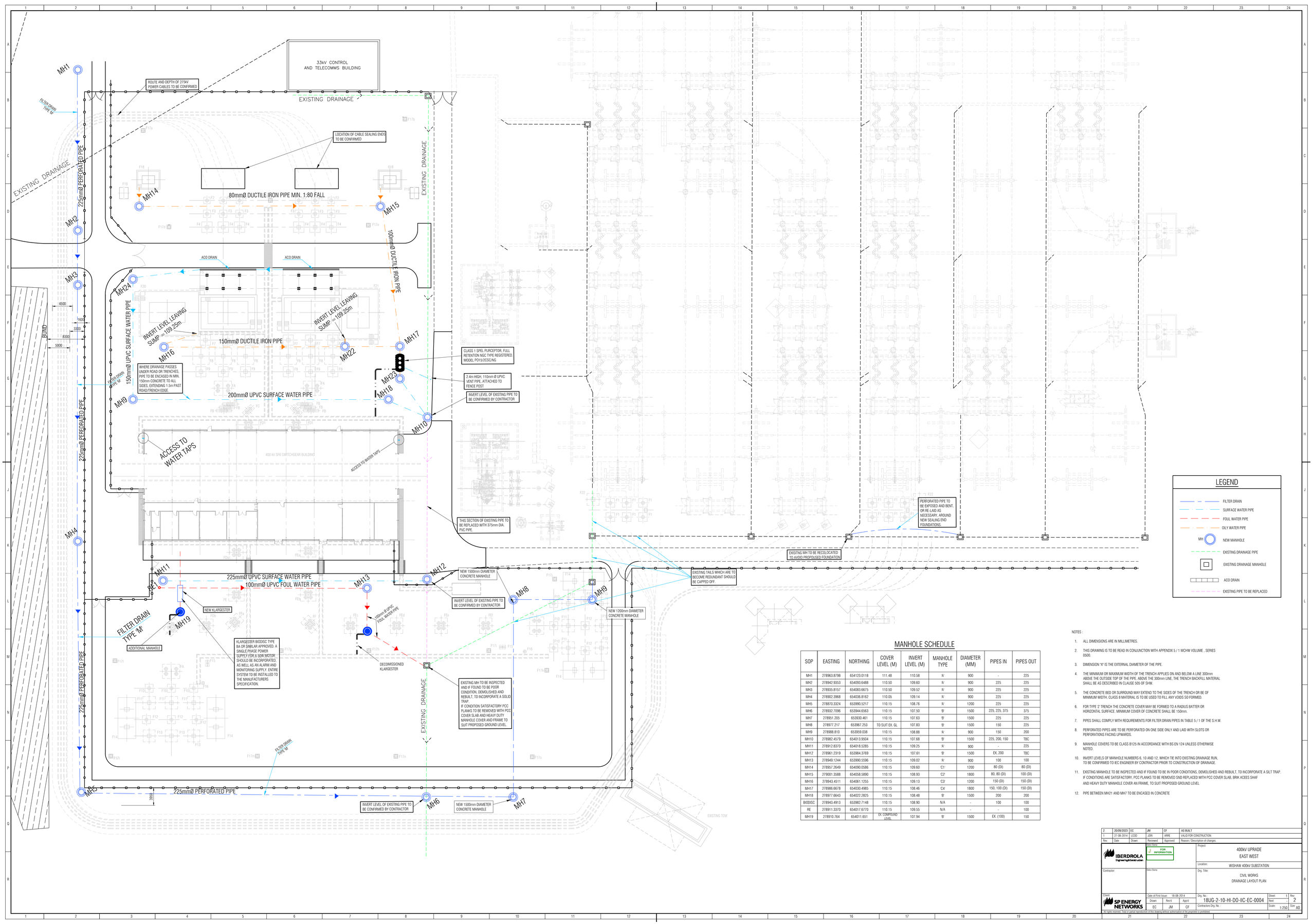
Status Code: Description:

SPEN Ref. No. :

Scale: AS SHOWN | Sheet: 01 | Next: - | Size: A0

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Appendix C – Existing Drainage Layout



LEGEND

- FILTER DRAIN
- SURFACE WATER PIPE
- FOUL WATER PIPE
- OILY WATER PIPE
- MH — NEW MANHOLE
- EXISTING DRAINAGE PIPE
- EXISTING DRAINAGE MANHOLE
- ACO DRAIN
- EXISTING PIPE TO BE REPLACED

MANHOLE SCHEDULE

SOP	EASTING	NORTHING	COVER LEVEL (M)	INVERT LEVEL (M)	MANHOLE TYPE	DIAMETER (MM)	PIPES IN	PIPES OUT
MH1	278963.8798	654123.0118	111.48	110.58	'A'	900	-	225
MH2	278942.9353	654093.6488	110.50	109.60	'A'	900	225	225
MH3	278935.8157	654083.6675	110.50	109.52	'A'	900	225	225
MH4	278902.3968	654036.8162	110.05	109.14	'A'	900	225	225
MH5	278870.3324	653990.5217	110.15	108.76	'A'	1200	225	225
MH6	278932.7096	653944.6563	110.15	107.50	'B'	1500	225, 225, 375	375
MH7	278951.205	653930.461	110.15	107.63	'B'	1500	225	225
MH8	278977.217	653967.253	TO SUIT EX. GL	107.83	'B'	1500	150	225
MH9	278988.810	653959.038	110.15	108.88	'A'	900	150	200
MH10	278982.4579	654013.9504	110.15	107.68	'B'	1500	225, 200, 150	TBC
MH11	278912.8370	654018.5285	110.15	109.25	'A'	900	-	225
MH12	278961.2319	653984.3769	110.15	107.61	'B'	1500	EX. 200	TBC
MH13	278949.1244	653990.5596	110.15	109.02	'A'	900	100	100
MH14	278957.2649	654090.0586	110.15	109.60	'C1'	1200	80 (DI)	80 (DI)
MH15	279001.3588	654058.5890	110.15	108.93	'C2'	1800	80, 80 (DI)	100 (DI)
MH16	278943.4511	654061.1255	110.15	109.13	'C2'	1200	150 (DI)	150 (DI)
MH17	278986.6678	654030.4985	110.15	108.46	'C4'	1800	150, 100 (DI)	150 (DI)
MH18	278977.6643	654022.2825	110.15	108.48	'B'	1500	200	200
BIODISC	278943.4913	653982.7148	110.15	108.90	N/A	-	100	100
RE	278911.3370	654017.6770	110.15	109.55	N/A	-	-	100
MH19	278910.764	654011.651	EX. COMPOUND LEVEL	107.94	'B'	1500	EX. (100)	150

NOTES :

1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH APPENDIX 5 / 1 MCHW VOLUME , SERIES 0500.
3. DIMENSION "X" IS THE EXTERNAL DIAMETER OF THE PIPE.
4. THE MINIMUM OR MAXIMUM WIDTH OF THE TRENCH APPLIES ON AND BELOW A LINE 300mm ABOVE THE OUTSIDE TOP OF THE PIPE. ABOVE THE 300mm LINE, THE TRENCH BACKFILL MATERIAL SHALL BE AS DESCRIBED IN CLAUSE 505 OF SHW.
5. THE CONCRETE BED OR SURROUND MAY EXTEND TO THE SIDES OF THE TRENCH OR BE OF MINIMUM WIDTH, CLASS 8 MATERIAL IS TO BE USED TO FILL ANY VOIDS SO FORMED.
6. FOR TYPE '2' TRENCH THE CONCRETE COVER MAY BE FORMED TO A RADIUS BATTER OR HORIZONTAL SURFACE. MINIMUM COVER OF CONCRETE SHALL BE 150mm.
7. PIPES SHALL COMPLY WITH REQUIREMENTS FOR FILTER DRAIN PIPES IN TABLE 5 / 1 OF THE S.H.W.
8. PERFORATED PIPES ARE TO BE PERFORATED ON ONE SIDE ONLY AND LAID WITH SLOTS OR PERFORATIONS FACING UPWARDS.
9. MANHOLE COVERS TO BE CLASS B125 IN ACCORDANCE WITH BS EN 124 UNLESS OTHERWISE NOTED.
10. INVERT LEVELS OF MANHOLE NUMBERS 6, 10 AND 12, WHICH TIE INTO EXISTING DRAINAGE RUN, TO BE CONFIRMED TO IEC ENGINEER BY CONTRACTOR PRIOR TO CONSTRUCTION OF DRAINAGE.
11. EXISTING MANHOLE TO BE INSPECTED AND IF FOUND TO BE IN POOR CONDITIONS, DEMOLISHED AND REBUILT, TO INCORPORATE A SILT TRAP. IF CONDITIONS ARE SATISFACTORY, PCC PLANKS TO BE REMOVED SND REPLACED WITH PCC COVER SLAB, BRIK ACEES SHAF AND HEAVY DUTY MANHOLE COVER AN FRAME, TO SUIT PROPOSED GROUND LEVEL
12. PIPE BETWEEN MH21 AND MH7 TO BE ENCASED IN CONCRETE

Rev	Date	Drawn	Reviewed	Approved	Reason / Description of changes.
2	20/09/2023	EC	JM	CF	AS BUILT
1	27-08-2014	LCOD	JSRI	ARRE	VALID FOR CONSTRUCTION.

IBERDROLA Engineering&Construction

Contractor:

Client: SP ENERGY NETWORKS

Status Stamp: FOR INFORMATION

Project: 400kV UPRADE EAST WEST

Location: WISHAW 400kV SUBSTATION

Drg. Title: CIVIL WORKS DRAINAGE LAYOUT PLAN

Date of First Issue: 18-08-2014		
Drawn	Rev'd	Apprd
EC	JM	CF

Drg. No.: 18UG-2-10-HI-DO-IIC-EC-0004

Contractors Drg. No. :

Sheet: 1 Next: - Rev. 2

Scale: 1:250 Size: A0

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HEALTH, SAFETY & ENVIRONMENTAL INFORMATION

IN ADDITION TO THE HAZARDS/RISKS TYPICALLY ASSOCIATED WITH THE WORKS SHOWN ON THESE DRAWINGS – THE FOLLOWING HAZARDS HAVE BEEN IDENTIFIED AS REQUIRING PARTICULAR CONSIDERATION

1. WORKS TO BE CARRIED OUT IN A HIGH VOLTAGE ENVIRONMENT ALL WORKS TO PROCEED IN ACCORDANCE WITH 'HSG 47' (UNDERGROUND CABLES) & 'GS6' (OVERHEAD LINES) & SCOTTISH POWER ELECTRICAL & MECHANICAL SAFETY RULES HANDBOOK 4th EDITION. TREAT ALL CABLES AS LIVE UNTIL PROVEN OTHERWISE.
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ENSURING THAT HIS OPERATIONS DO NOT IN ANY WAY IMPAIR THE SAFETY OR CONDITION OF STRUCTURES/INFRASTRUCTURE. PARTICULAR CARE IS TO BE TAKEN WHEN EXCAVATING IN THE VICINITY OF FOUNDATIONS TO PREVENT SURCHARGING OR UNDERMINING.
3. EXCAVATIONS SHOULD BE ADEQUATELY SUPPORTED AND PROTECTED DURING CONSTRUCTION. ADEQUATE CONTROL MEASURES MAY BE REQUIRED FOR EXCAVATING BELOW GWL SUCH AS SUMP AND PUMP.
4. CONTRACTOR TO REFER UTILITY SURVEY DRAWINGS ISSUED FOR ANY UNDERGROUND SERVICES LOCATED IN PROXIMITY PRIOR TO START OF EXCAVATION OR DEMOLITION ACTIVITY WITHIN SUBSTATION COMPOUND.
5. ASBESTOS CONTAMINATION – ASBESTOS SURVEY CARRIED OUT FOR THIS PROJECT TO BE REFERRED IN ADVANCE OF ANY WORKS TO BE CARRIED OUT AT SITE. ALL MAIN PLANT ITEMS SHALL BE ASSUMED TO CONTAIN ASBESTOS.
6. EXISTING HIGH PRESSURE COMPRESSED AIR RINGS FOR AIR BLAST CIRCUIT-BREAKERS (OBR60) ARE INSTALLED IN EXISTING CABLE TRENCHES. CONTRACTOR TO IDENTIFY THE SERVICE AND CARRY OUT ALL WORKS IN/IN CLOSE PROXIMITY WITH PRECAUTION AND UNDER THE GUIDANCE OF SPEN SAP.

THIS DRAWING HAS BEEN PREPARED WITH THE USE OF ARCHIVE RECORDS. THEREFORE, ALL DIMENSIONS AND PLANT POSITIONS MUST BE VERIFIED PRIOR TO THE COMMENCEMENT OF WORKS.

NEWARTHILL 1

NEWARTHILL/ COATBRIDGE 2

SGT 1 · SGT 2 · SGT 3 · SGT 5 · SGT 6 · SGT 7

DIESEL GENERATOR

CP1 1200ø CL 109.550 IL 108.740

CP2 1200ø CL 109.550 IL 108.640

CP3 1200ø CL 109.550 IL 108.550

CP4 1200ø CL 109.550 IL 108.460

CP5 1200ø CL 109.550

CP5A 1200ø CL 109.550

CP6 1200ø CL 109.550 IL 108.450

CP7 900ø CL 109.550 IL 108.041

CP8 900ø CL 109.550 IL 107.986

CP9 900ø CL 109.550 IL 107.931

MH1 1500ø CL 109.550 IL 109.085

MH2 1200ø CL 109.550 IL 108.820

MH3 1200ø CL 109.550 IL 108.585

MH4 1500ø CL 109.550 IL 108.518

MH5 1200ø (SAMPLING CHAMBER) CL 109.550 INLET LEVEL 108.440 OUTLET LEVEL 108.290

"SEPARATOR TO BE SPEL FULL RETENTION DOUBLE CHAMBER (SEE NOTES) INLET LEVEL 108.510 OUTLET LEVEL 108.450

SLOPE 1:630 450ø PVC-U/PE PERFORATED PIPE TYPE "M" FILTER DRAIN

SLOPE 1:630 700ø PVC-U/PE PERFORATED PIPE TYPE "M" FILTER DRAIN

SLOPE 1:400 450ø PVC-U/PE PIPE TYPE "S" CONNECTED INTO EXISTING MANHOLE (NOT PERFORATED)

SLOPE 1:150 450ø PVC-U/PE PERFORATED PIPE TYPE "M" FILTER DRAIN

100ø DI PIPE AT 1:200 FALL

150ø PVC PIPE AT 1:200 FALL

300ø PVC PIPE

PERIMETER FILTER DRAIN

FIELD DRAINS SEE SECTION A–A

COMPRESSED AIR RING

REFERENCE AXIS

X = 279036.381 Y = 654039.993

X = 279153.057 Y = 653956.970

TEMPORARY PUMP AND HOSE TO BE INSTALLED BETWEEN CP7 & CP8 UNTIL DEMOLITION OF SGT5 BAY. CONTRACTOR TO PROPOSE SUITABLE INSPECTION/MAINTENANCE REGIME FOR THIS SOLUTION UNTIL PERMANENT DRAINAGE CAN BE INSTALLED. PERMANENT SOLUTION TO CONSIST OF 300MM DIAMETER PIPE INSTALLED BETWEEN CP7 & CP8 DURING SGT5 CONSTRUCTION WORKS.

EXISTING DRAINAGE TO BE MODIFIED AS REQUIRED AND CONNECTED TO NEW MANHOLE.

EXISTING DRAINAGE TO BE REMOVED AND NEW 300MM DIAMETER PIPE TO BE INSTALLED

EXISTING DRAINAGE TO BE CAPPED ONLY AFTER PERMANENT SOLUTION HAS BEEN INSTALLED.

EXISTING COLLAPSED DRAINAGE PIPE TO BE REMOVED AND REPLACED WITH NEW 300MM DIAMETER PIPE. LEVELS TO MATCH EXISTING. ALL EXISTING MANHOLES TO BE MODIFIED TO ACCEPT NEW PIPE

3 VENT PIPES TO VENT AT 2.5m ABOVE GROUND LEVEL

22.5° BEND

SECTION A–A SCALE 1:300

PERIMETER FILTER DRAIN TYPICAL DETAIL
SCALE 1:25

75mm STONE CHIPPINGS · FGL · FCL · EXISTING FIELD DRAIN · TYPE 3 SUB-BASE MATERIAL (LAID BY CONTRACTOR) · TERRAM 2000 OR APPROVED EQUAL · TYPE B FILTER MATERIAL · SLOTTED TWIN WALL PIPE · GRANULAR BEDDING · 525 MIN · GENERALLY 500 · 375 · 35 · TYPE B FILTER MATERIAL TO SHW 505 20/40 STONE · TERRAM 1000 MEMBRANE · 300 MIN

CROSS SECTION B–B
SCALE 1:30

NOTES:

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE NOTED. LEVELS ARE IN METRES.
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH THE PROJECT SPECIFICATIONS, ELECTRICAL DRAWINGS, SERVICE DRAWINGS AND CONTRACT DOCUMENTS
3. ALL SERVICES TO BE COORDINATED BEFORE COMMENCING THE WORK AT SITE
4. ALL DRAINAGE INSTALLATION SHALL COMPLY WITH RELEVANT BRITISH & EUROPEAN STANDARDS AND CODES OF PRACTICE.
5. ALL DRAINAGE WORKS SHALL BE IN ACCORDANCE WITH THE NATIONAL GRID TECHNICAL SPECIFICATION(NGTS 3.10).
6. MANHOLE ACCESS COVERS TO BE IN ACCORDANCE WITH BS EN 124, GRADE B125.
7. ALL UNDERGROUND DRAINAGE PIPES, FITTINGS AND JOINTS SHALL HAVE FLEXIBLE SPIGOT AND SOCKET JOINTS. WHERE FLANGED PIPES AND FITTINGS ARE REQUIRED, THE FLANGES SHALL BE TO PN16
8. ALL PIPES SHALL BE SURROUNDED BY A MINIMUM 100MM THICK, 10MM SINGLE SIZED GRANULAR BEDDING IN ACCORDANCE WITH BS 882
9. ALL BRICK TO BE CLASS B ENGINEERING BRICK IN ACCORDANCE WITH BS EN 771 PART 1:2003. ALL MORTAR TO BE CLASS M12 MORTAR RESPECTIVELY IN ACCORDANCE WITH BS 5628 PART 1:2005
10. ALL CONCRETE WORKS TO BE C16/20 MIX
11. NEW INTERCEPTOR TO BE SPEL FULL RETENTION CLASS 1 DOUBLE CHAMBER SEPARATOR, MODEL P015/2CSC/NG OR EQUAL APPROVED IN ACCORDANCE WITH ENVIRONMENT AGENCY POLLUTION PREVENTION GUIDELINES PPG3 & BS EN 858–1. INTERCEPTOR TO BE FITTED WITH AUTOMATIC ALARM SYSTEM INSTALLED IN STRICT ACCORDANCE WITH THE MANUFACTURERS INSTRUCTIONS.
12. ALARM AND LVAC CABLING FOR INTERCEPTOR TO BE INSTALLED BY BOP CONTRACTOR
13. ALL LEVELS TO BE CONFIRMED ON SITE PRIOR TO INSTALLATION OF NEW DRAINAGE BY CONTRACTOR.
14. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ENSURING THAT HIS OPERATIONS DO NOT IN ANY WAY IMPAIR THE SAFETY OR CONDITION OF STRUCTURES/INFRASTRUCTURE. PARTICULAR CARE IS TO BE TAKEN WHEN EXCAVATING IN THE VICINITY OF FOUNDATIONS TO PREVENT SURCHARGING OR UNDERMINING.
15. ALL PIPEWORK UPSTREAM OF INTERCEPTOR SHALL BE CHEMICALLY RESISTANT TO ALL TYPES OF TRANSFORMER OIL AT 80°C INCLUDING JOINTS AND VALVES.

LEGEND:

- EXISTING DRENAGE
- PVC-U/PE PIPE TYPE "S" FIELD LOADING
- DUCTILE IRON PIPES
- BACKSTOP GATE VALVE CHAMBER
- NON RETURN VALVE CHAMBER
- MANHOLES
- PVC-U/PE PERFORATED PIPE TYPE "M" FILTER DRAIN (INSTALLED BY CIVIL CONTRACTOR)
- CATCHPITS (INSTALLED BY CIVIL CONTRACTOR)

KEY:

MH – MANHOLE
CL – COVER LEVEL
IL – INVERT LEVEL
DI – DUCTILE IRON
FT – FLAME TRAP

SETTING OUT MANHOLES SCHEDULE

MH	INTERNAL DIAMETER MH	X EASTING	Y NORTHING
MH1	1500	279187.778	653979.202
MH2	1200	279156.856	653935.746
MH3	1200	279129.667	653897.538
MH4	1500	279121.146	653895.696
MH5	1200	279113.060	653901.449
CP1	1200	279183.665	654040.862
CP2	1200	279234.019	654005.032
CP3	1200	279199.398	653956.273
CP4	1200	279164.858	653907.825
CP5	1200	279136.217	653867.575
CP5A	1200	279090.595	653937.853
CP6	1200	279101.457	653884.455
CP7	900	279072.637	653935.644
CP8	900	279054.725	653948.390
CP9	900	279036.600	653961.288

* COORDINATE SHOWS CENTER OF PIPE LINE

ASSOCIATED DRAWING:

1ATD-2-100D-DA-ADICOREC–0201	GENERAL CIVIL LAYOUT
1ATD-2–00JA–DA–ADICORES–0401	275 kV ELECTRICAL SUBSTATION LAYOUT
1ATD-2–10HJ–DA–ADICOREC–0210	FOUNDATION LAYOUT
1ATD-2–10HI–DA–ADICOREC–0260	CABLE TRENCH & DUCT LAYOUT
1ATD-2–10HF–DA–ADICOREC–0285	FENCE LAYOUT
1ATD–2–10HG–DO–ADICOREC–0271	TYPICAL DRAINAGE DETAILS I WATER DRAINAGE
1ATD–2–10HG–DO–ADICOREC–0272	TYPICAL DRAINAGE DETAILS II (BEFORE INTERCEPTOR)
1ATD–2–10HG–DO–ADICOREC–0273	TYPICAL DRAINAGE DETAILS III INTERCEPTOR

Rev.	Date	Prepared	Reviewed	Approved	Reason / Description of changes
3	28/01/2022	ALV	ACM	CF	AS BUILT
2	19/12/2017	ALV	ACM	AGM	MANHOLES 3 & 4 RELOCATED
1	06/09/2017	ALV	ADM	AGM	FOUNDATIONS AND DUCTS FOR SGT5 BAY RELOCATED
0	19/04/2017	ALV	MRA	AGM	FIRST ISSUE FOR CONSTRUCTION

SP ENERGY NETWORKS

Contractor: Adícora

Status Stamp: FOR INFORMATION

Project: WISHAW 275kV SWITCHGEAR AND SHUNT REACTOR REPLACEMENT

Location: WISHAW SUBSTATION

Drg. Title: DRAINAGE LAYOUT

Date of First Issue: 17/04/2017

Prepared | Reviewed | Approved

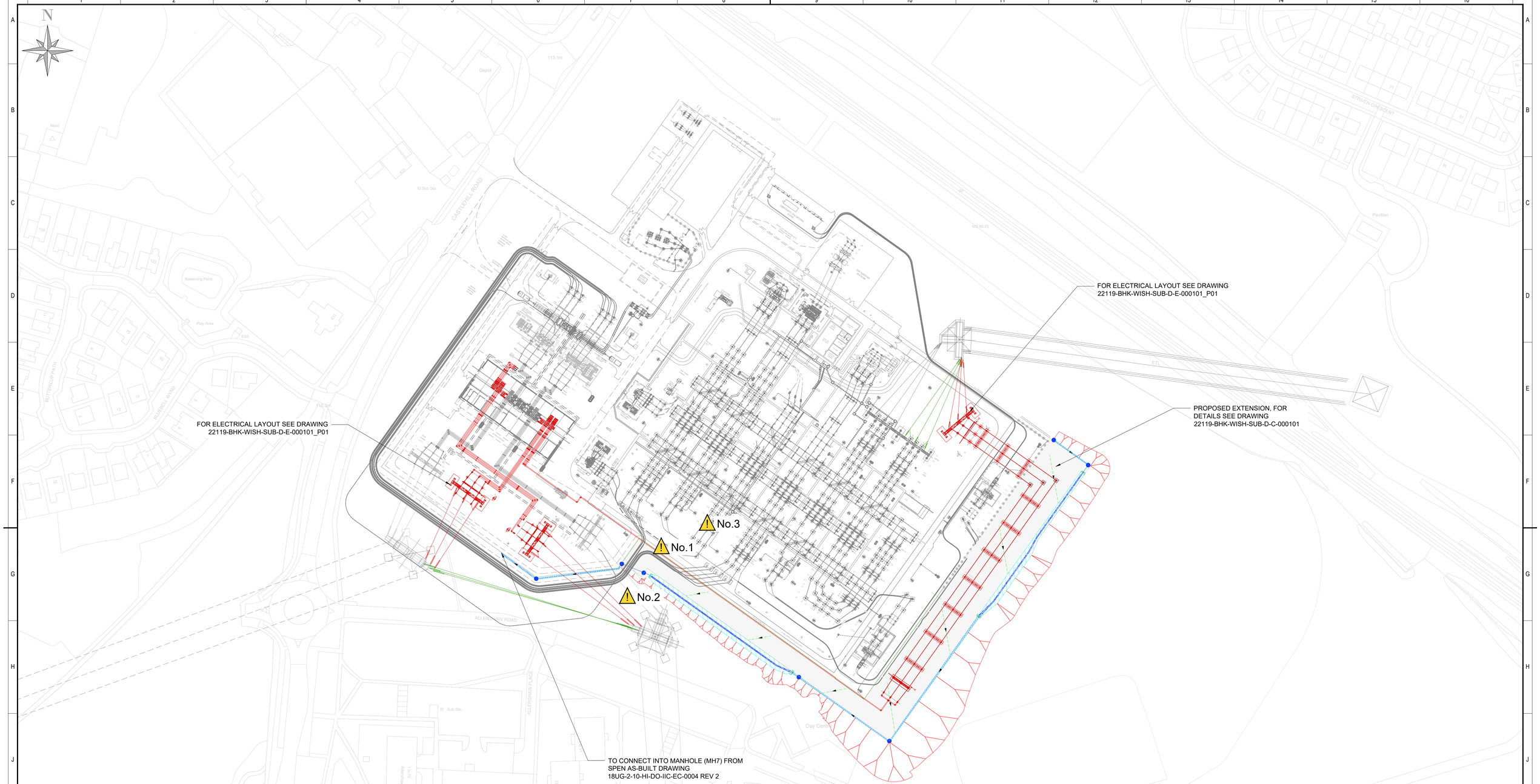
Drg. No.: 1ATD-2-10HG-DA-ADICOREC-2270

Sheet: 01 Rev: 3 Next: - Contractor's Drg. No.: -

Scale: 1:300 Size: A0

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Appendix D – Proposed Drainage Layout



KEY:

- PROPOSED SURFACE WATER PIPE AND CHAMBER
- PROPOSED HEADWALL INLET / OUTLET
- PROPOSED SWALE
- EARTHWORKS (CUT) FROM SITE BOUNDARY TO EXISTING GROUND LEVEL. INDICATIVE ONLY - EXTENT AND MAXIMUM ALLOWABLE GRADIENT TO BE CONFIRMED.
- EARTHWORKS (FILL) FROM SITE BOUNDARY TO EXISTING GROUND LEVEL. INDICATIVE ONLY - EXTENT AND MAXIMUM ALLOWABLE GRADIENT TO BE CONFIRMED.
- PROPOSED FILTER DRAIN AND CHAMBER
- PROPOSED TYPE B MATERIAL
- PROPOSED SEMI PERFORATED PIPE
- PROPOSED PERFORATED PIPE

NOTES:

1. DO NOT SCALE FROM THIS DRAWING.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
3. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ARCHITECTURAL AND ENGINEERING DETAILS, DRAWINGS AND SPECIFICATIONS.
4. DETAILS AND POSITIONS OF ALL EXISTING SERVICES TO BE CONFIRMED PRIOR TO THE COMMENCEMENT OF WORKS ON SITE.
5. DRAWING TO BE PRINTED IN COLOUR.
6. SUBSTATION COMPOUND TO BE TYPE 3 SELF DRAINING MATERIAL. DRAINAGE DESIGN IS SUBJECT TO INFILTRATION TEST RESULTS FROM THE GROUND INVESTIGATION.

Health & Safety
CDM regulations 2015

Significant risks associated with this drawing are identified below and, where applicable, at specific locations on the drawing.
Refer to the CDM Regulation 9 Risk Register for full details.

1. LOCATE UNDERGROUND SERVICES AND INTRODUCE A SAFE REMOVAL PROCEDURE (HSG47)
2. WORKING CLOSE TO OVERHEAD LINES (HSE GUIDANCE NOTE GS6)
3. FORMING PLATFORM IN PROXIMITY TO LIVE CABLES, POTENTIALLY REQUIRING PROTECTION DURING AND AFTER CONSTRUCTION

Rev.	Date	Drawn	Reviewed	Approved	Reason / Description of changes.
P02	10/09/2025	CM	CC	RH	LAND DRAIN REMOVED, SWALE, FILTER DRAIN AND CDM NOTE 3 ADDED
P01	25/08/2025	CM	CC	RH	FIRST ISSUE

SP Energy Networks | MORGAN SINDALL INFRASTRUCTURE | Baker Hicks

Drg. Title: WISHAW SUBSTATION
PROPOSED DRAINAGE LAYOUT

Location: WISHAW SUBSTATION

Project: DWNO - DENNY TO WISHAW NETWORK OPTIMISATION

Drg. No.: 22119-BHK-WISH-SUB-D-C-000201

Rev.: P02

Status Code:	Description:	SPEN Ref. No. :	Scale:	Sheet:	Next:	Size:
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Appendix E – Greenfield Runoff Calculations

Greenfield runoff rate estimation tool

www.uksuds.com | Greenfield runoff rate estimation tool (https://www.uksuds.com/)

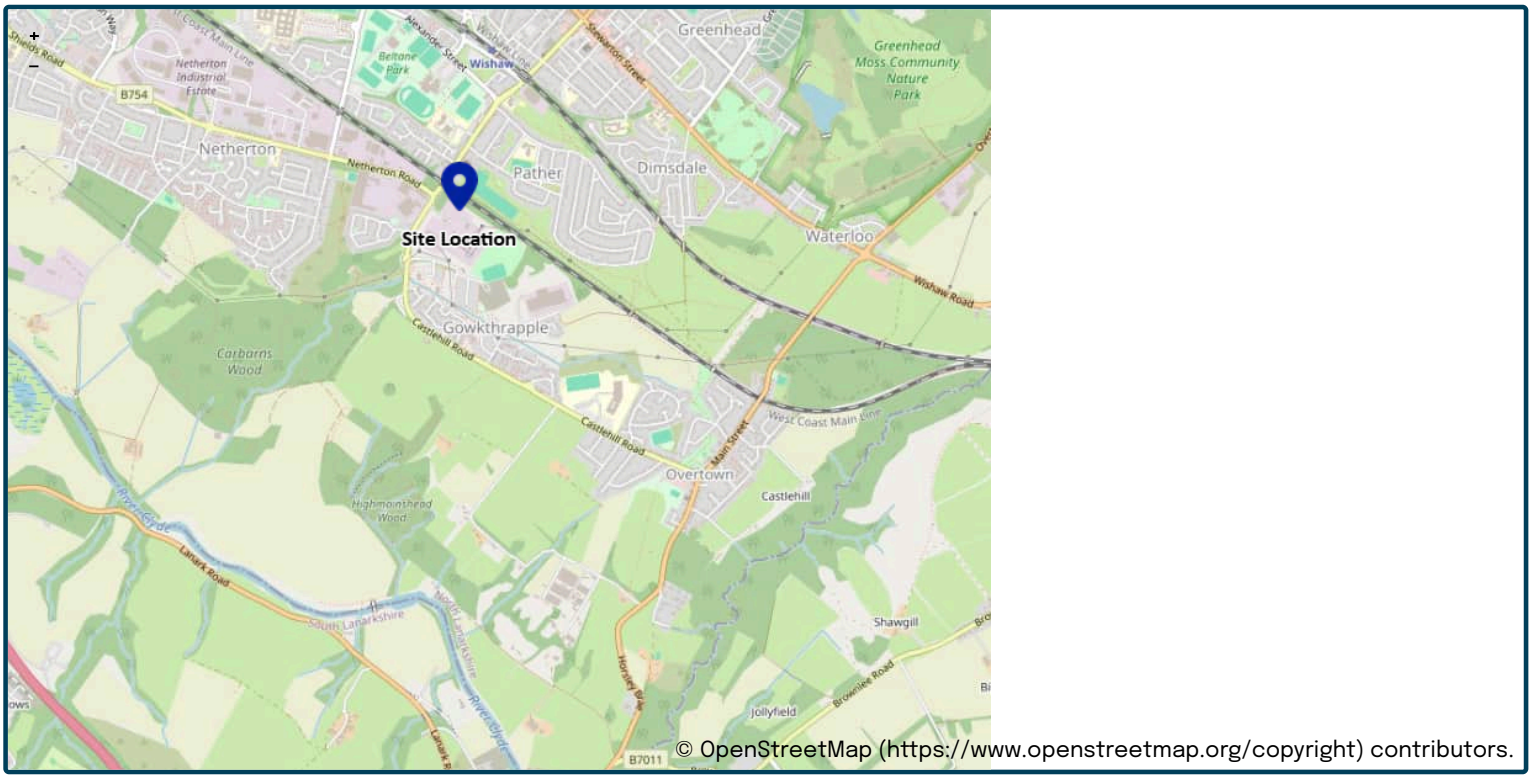
This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance “Rainfall runoff management for developments”, SC030219 (2013), the SuDS Manual C753 (CIRIA, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Project details

Date	14/01/2026
Calculated by	
Reference	
Model version	2.2.2

Location

Site name	Wishaw Substation
Site location	Wishaw



Site easting (British National Grid)	279080
Site northing (British National Grid)	654029

Site details

Total site area (ha)	1 ha

The hydrology data map service could not be accessed. We apologise for the inconvenience. Please try again later.

Greenfield runoff

Method

Method	IH124

IH124

	My value	Map value	
SAAR (mm)	1098		mm
How should SPR be derived?	Estimate using BFI		
BFIHOST	0.344		
SPR	0.491		
QBar (IH124) (l/s)	9		l/s

Growth curve factors

	My value	Map value
Hydrological region	2	
1 year growth factor	0.87	
2 year growth factor	0.91	
10 year growth factor	1.42	
30 year growth factor	1.95	
100 year growth factor	2.63	
200 year growth factor	2.99	

Results

Method	IH124	
Flow rate 1 year (l/s)	7.8	l/s
Flow rate 2 year (l/s)	8.2	l/s
Flow rate 10 years (l/s)	12.8	l/s
Flow rate 30 years (l/s)	17.5	l/s
Flow rate 100 years (l/s)	23.6	l/s
Flow rate 200 years (l/s)	26.9	l/s

Please note runoff estimation is subject to significant uncertainty. Results are therefore normally reported to only 1 decimal place. Where 2 decimal places are provided, this does not indicate accuracy to this level, it has been adopted to prevent 'zero' figures from being reported. Outputs less than 0.01 l/s are reported as 0.01 l/s.

Disclaimer

This report was produced using the Greenfield runoff rate estimation tool (2.2.2) developed by HR Wallingford and available at uksuds.com (https://www.uksuds.com/). The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at uksuds.com/terms-conditions (https://www.uksuds.com/terms-conditions). The outputs from this tool have been used to estimate Greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, Centre for Ecology and Hydrology, Wallingford Hydrosolutions or any other organisation for the use of these data in the design or operational characteristics of any drainage scheme.

The hydrology data map service could not be accessed. We apologise for the inconvenience.
Please try again later.

Appendix F – InfoDrainage Results

Project:	Date: 11/11/2025		
	Designed by: [redacted]	Checked by:	Approved By:
Report Details: Type: Inflows Storm Phase: Phase	Company Address:		



Earthworks

Type : Catchment Area

Area (ha)	0.58

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	0.600
Winter Volumetric Runoff	0.600
Time of Concentration (mins)	5
Percentage Impervious (%)	100



Substation Extension

Type : Catchment Area

Area (ha)	0.60

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	1.000
Winter Volumetric Runoff	1.000
Time of Concentration (mins)	5
Percentage Impervious (%)	100

Project:	Date: 11/11/2025		
	Designed by: [redacted]	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Storm Phase: Phase	Company Address:		



Tank

Type : Tank

Dimensions

Exceedance Level (m)	0.000
Depth (m)	1.000
Base Level (m)	-1.000
Freeboard (mm)	0
Initial Depth (m)	0.000
Porosity (%)	100
Average Slope (1:X)	0.00
Total Volume (m³)	540.000

Depth (m)	Area (m²)	Volume (m³)
0.000	540.00	0.000
1.000	540.00	540.000

Inlets

Inlet

Inlet Type	Point Inflow
Incoming Item(s)	Earthworks Substation Extension
Bypass Destination	(None)
Capacity Type	No Restriction

Advanced

Perimeter	Circular
Length (m)	35.395

Project:	Date: 11/11/2025		
	Designed by: [redacted]	Checked by:	Approved By:
Report Details: Type: Inflow Summary Storm Phase: Phase	Company Address:		

Inflow Label	Connected To	Flow (L/s)	Runoff Method	Area (ha)	Percentage Impervious (%)	Urban Creep (%)	Adjusted Percentage Impervious (%)	Area Analysed (ha)
Earthworks	Tank		Time of Concentration	0.58	100	0	100	0.58
Substation Extension	Tank		Time of Concentration	0.60	100	0	100	0.60
TOTAL		**0.0**		**1.18**				**1.18**

Project:	Date: 11/11/2025		
	Designed by: [redacted]	Checked by:	Approved By:
Report Title: Rainfall Analysis Criteria	Company Address:		

Runoff Type	Dynamic
Output Interval (mins)	5
Time Step	Default
Urban Creep	Apply Global Value
Urban Creep Global Value (%)	0
Junction Flood Risk Margin (mm)	300
Perform No Discharge Analysis	☐

Project:	Date: 11/11/2025		
	Designed by: [redacted]	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Summary Storm Phase: Phase	Company Address:		

Summary Results for Tank

Storm Event	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Percentage Available (%)	Status
FEH: 200 years: +41 %: 15 mins: Summer	307.037	0.000	43.141	OK
FEH: 200 years: +41 %: 15 mins: Winter	306.743	0.000	43.196	OK
FEH: 200 years: +41 %: 30 mins: Summer	409.832	0.000	24.105	OK
FEH: 200 years: +41 %: 30 mins: Winter	409.400	0.000	24.185	OK
FEH: 200 years: +41 %: 60 mins: Summer	502.968	0.000	6.858	OK
FEH: 200 years: +41 %: 60 mins: Winter	503.214	0.000	6.812	OK
FEH: 200 years: +41 %: 120 mins: Summer	516.688	0.000	4.317	OK
FEH: 200 years: +41 %: 120 mins: Winter	518.726	0.000	3.940	OK
FEH: 200 years: +41 %: 180 mins: Summer	507.685	0.000	5.984	OK
FEH: 200 years: +41 %: 180 mins: Winter	505.327	0.000	6.421	OK
FEH: 200 years: +41 %: 240 mins: Summer	497.293	0.000	7.909	OK
FEH: 200 years: +41 %: 240 mins: Winter	491.779	0.000	8.930	OK
FEH: 200 years: +41 %: 360 mins: Summer	475.263	0.000	11.988	OK
FEH: 200 years: +41 %: 360 mins: Winter	459.803	0.000	14.851	OK

FEH: 200 years: +41 %: 480 mins: Summer	452.022	0.000	16.292	OK
FEH: 200 years: +41 %: 480 mins: Winter	425.693	0.000	21.168	OK
FEH: 200 years: +41 %: 600 mins: Summer	429.482	0.000	20.466	OK
FEH: 200 years: +41 %: 600 mins: Winter	391.808	0.000	27.443	OK
FEH: 200 years: +41 %: 720 mins: Summer	407.763	0.000	24.488	OK
FEH: 200 years: +41 %: 720 mins: Winter	358.780	0.000	33.559	OK
FEH: 200 years: +41 %: 960 mins: Summer	368.073	0.000	31.838	OK
FEH: 200 years: +41 %: 960 mins: Winter	288.999	0.000	46.482	OK
FEH: 200 years: +41 %: 1440 mins: Summer	293.849	0.000	45.583	OK
FEH: 200 years: +41 %: 1440 mins: Winter	176.402	0.000	67.333	OK
FEH: 200 years: +41 %: 2160 mins: Summer	189.702	0.000	64.870	OK
FEH: 200 years: +41 %: 2160 mins: Winter	135.119	0.000	74.978	OK
FEH: 200 years: +41 %: 2880 mins: Summer	160.127	0.000	70.347	OK
FEH: 200 years: +41 %: 2880 mins: Winter	113.730	0.000	78.939	OK
FEH: 200 years: +41 %: 4320 mins: Summer	127.101	0.000	76.463	OK
FEH: 200 years: +41 %: 4320 mins: Winter	92.998	0.000	82.778	OK
FEH: 200 years: +41 %: 5760 mins: Summer	109.955	0.000	79.638	OK

FEH: 200 years: +41 %: 5760 mins: Winter	82.377	0.000	84.745	OK
FEH: 200 years: +41 %: 7200 mins: Summer	99.201	0.000	81.629	OK
FEH: 200 years: +41 %: 7200 mins: Winter	74.912	0.000	86.127	OK
FEH: 200 years: +41 %: 8640 mins: Summer	91.986	0.000	82.966	OK
FEH: 200 years: +41 %: 8640 mins: Winter	69.898	0.000	87.056	OK
FEH: 200 years: +41 %: 10080 mins: Summer	86.656	0.000	83.953	OK
FEH: 200 years: +41 %: 10080 mins: Winter	66.136	0.000	87.753	OK
FEH: 100 years: +41 %: 15 mins: Summer	267.734	0.000	50.420	OK
FEH: 100 years: +41 %: 15 mins: Winter	267.411	0.000	50.479	OK
FEH: 100 years: +41 %: 30 mins: Summer	355.969	0.000	34.080	OK
FEH: 100 years: +41 %: 30 mins: Winter	355.523	0.000	34.162	OK
FEH: 100 years: +41 %: 60 mins: Summer	436.351	0.000	19.194	OK
FEH: 100 years: +41 %: 60 mins: Winter	436.675	0.000	19.134	OK
FEH: 100 years: +41 %: 120 mins: Summer	448.513	0.000	16.942	OK
FEH: 100 years: +41 %: 120 mins: Winter	449.577	0.000	16.745	OK
FEH: 100 years: +41 %: 180 mins: Summer	441.114	0.000	18.312	OK
FEH: 100 years: +41 %: 180 mins: Winter	437.317	0.000	19.015	OK

FEH: 100 years: +41 %: 240 mins: Summer	431.659	0.000	20.063	OK
FEH: 100 years: +41 %: 240 mins: Winter	424.047	0.000	21.473	OK
FEH: 100 years: +41 %: 360 mins: Summer	410.087	0.000	24.058	OK
FEH: 100 years: +41 %: 360 mins: Winter	391.974	0.000	27.412	OK
FEH: 100 years: +41 %: 480 mins: Summer	387.978	0.000	28.152	OK
FEH: 100 years: +41 %: 480 mins: Winter	358.322	0.000	33.644	OK
FEH: 100 years: +41 %: 600 mins: Summer	366.556	0.000	32.119	OK
FEH: 100 years: +41 %: 600 mins: Winter	324.001	0.000	40.000	OK
FEH: 100 years: +41 %: 720 mins: Summer	345.802	0.000	35.963	OK
FEH: 100 years: +41 %: 720 mins: Winter	286.436	0.000	46.956	OK
FEH: 100 years: +41 %: 960 mins: Summer	305.577	0.000	43.412	OK
FEH: 100 years: +41 %: 960 mins: Winter	201.802	0.000	62.629	OK
FEH: 100 years: +41 %: 1440 mins: Summer	209.704	0.000	61.166	OK
FEH: 100 years: +41 %: 1440 mins: Winter	154.634	0.000	71.364	OK
FEH: 100 years: +41 %: 2160 mins: Summer	166.292	0.000	69.205	OK
FEH: 100 years: +41 %: 2160 mins: Winter	120.875	0.000	77.616	OK
FEH: 100 years: +41 %: 2880 mins: Summer	142.570	0.000	73.598	OK

FEH: 100 years: +41 %: 2880 mins: Winter	103.731	0.000	80.791	OK
FEH: 100 years: +41 %: 4320 mins: Summer	115.539	0.000	78.604	OK
FEH: 100 years: +41 %: 4320 mins: Winter	86.608	0.000	83.961	OK
FEH: 100 years: +41 %: 5760 mins: Summer	101.360	0.000	81.230	OK
FEH: 100 years: +41 %: 5760 mins: Winter	76.703	0.000	85.796	OK
FEH: 100 years: +41 %: 7200 mins: Summer	92.414	0.000	82.886	OK
FEH: 100 years: +41 %: 7200 mins: Winter	70.421	0.000	86.959	OK
FEH: 100 years: +41 %: 8640 mins: Summer	86.112	0.000	84.053	OK
FEH: 100 years: +41 %: 8640 mins: Winter	65.891	0.000	87.798	OK
FEH: 100 years: +41 %: 10080 mins: Summer	81.161	0.000	84.970	OK
FEH: 100 years: +41 %: 10080 mins: Winter	62.393	0.000	88.446	OK
FEH: 30 years: +41 %: 15 mins: Summer	204.542	0.000	62.122	OK
FEH: 30 years: +41 %: 15 mins: Winter	204.488	0.000	62.132	OK
FEH: 30 years: +41 %: 30 mins: Summer	269.997	0.000	50.001	OK
FEH: 30 years: +41 %: 30 mins: Winter	269.459	0.000	50.100	OK
FEH: 30 years: +41 %: 60 mins: Summer	329.254	0.000	39.027	OK
FEH: 30 years: +41 %: 60 mins: Winter	328.654	0.000	39.138	OK

FEH: 30 years: +41 %: 120 mins: Summer	342.796	0.000	36.519	OK
FEH: 30 years: +41 %: 120 mins: Winter	340.955	0.000	36.860	OK
FEH: 30 years: +41 %: 180 mins: Summer	338.899	0.000	37.241	OK
FEH: 30 years: +41 %: 180 mins: Winter	331.996	0.000	38.519	OK
FEH: 30 years: +41 %: 240 mins: Summer	331.369	0.000	38.635	OK
FEH: 30 years: +41 %: 240 mins: Winter	319.280	0.000	40.874	OK
FEH: 30 years: +41 %: 360 mins: Summer	311.744	0.000	42.270	OK
FEH: 30 years: +41 %: 360 mins: Winter	285.647	0.000	47.102	OK
FEH: 30 years: +41 %: 480 mins: Summer	289.892	0.000	46.316	OK
FEH: 30 years: +41 %: 480 mins: Winter	236.993	0.000	56.112	OK
FEH: 30 years: +41 %: 600 mins: Summer	264.556	0.000	51.008	OK
FEH: 30 years: +41 %: 600 mins: Winter	203.345	0.000	62.344	OK
FEH: 30 years: +41 %: 720 mins: Summer	232.046	0.000	57.029	OK
FEH: 30 years: +41 %: 720 mins: Winter	183.420	0.000	66.033	OK
FEH: 30 years: +41 %: 960 mins: Summer	197.591	0.000	63.409	OK
FEH: 30 years: +41 %: 960 mins: Winter	156.668	0.000	70.987	OK
FEH: 30 years: +41 %: 1440 mins: Summer	162.927	0.000	69.828	OK

FEH: 30 years: +41 %: 1440 mins: Winter	124.521	0.000	76.941	OK
FEH: 30 years: +41 %: 2160 mins: Summer	134.020	0.000	75.181	OK
FEH: 30 years: +41 %: 2160 mins: Winter	101.353	0.000	81.231	OK
FEH: 30 years: +41 %: 2880 mins: Summer	117.103	0.000	78.314	OK
FEH: 30 years: +41 %: 2880 mins: Winter	89.463	0.000	83.433	OK
FEH: 30 years: +41 %: 4320 mins: Summer	98.530	0.000	81.754	OK
FEH: 30 years: +41 %: 4320 mins: Winter	75.599	0.000	86.000	OK
FEH: 30 years: +41 %: 5760 mins: Summer	88.316	0.000	83.645	OK
FEH: 30 years: +41 %: 5760 mins: Winter	67.951	0.000	87.416	OK
FEH: 30 years: +41 %: 7200 mins: Summer	81.154	0.000	84.972	OK
FEH: 30 years: +41 %: 7200 mins: Winter	62.740	0.000	88.382	OK
FEH: 30 years: +41 %: 8640 mins: Summer	75.748	0.000	85.973	OK
FEH: 30 years: +41 %: 8640 mins: Winter	58.927	0.000	89.088	OK
FEH: 30 years: +41 %: 10080 mins: Summer	71.867	0.000	86.691	OK
FEH: 30 years: +41 %: 10080 mins: Winter	55.970	0.000	89.635	OK

Denny to Wishaw Network Upgrade

Cumbernauld Substation Flood Risk Assessment

SPEN

Project number: 60602788

08 December 2025

Delivering a better world

Quality information

Prepared by	Checked by	Verified by	Approved by
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Revision	Revision date	Details	Authorized	Name	Position

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4.1 Introduction

4.1.1 Context

AECOM has been commissioned by Scottish Power Energy Networks (SPEN) to undertake a Level 3 Flood Risk Assessment (FRA) and develop a Surface Water Management Strategy (SWMS) for the Cumbernauld Substation Upgrade, which is part of the Denny to Wishaw Network Upgrade project.

The FRA, conducted in line with CIRIA C624 guidance on Development and Flood Risk[1], details the flood risk concerns associated with this upgrade, including the flood risk baseline, policy context, and any implications for the proposed works with regard to flood risk. The FRA and SWMS have been used to develop a coordinated drainage solution, although the proposed drainage scheme may be subject to change in the detailed design phase. In particular, the SWMS outlines the intended strategy for managing surface water at the site, with reference to national and local policy and guidance from the CIRIA C753 SuDS Manual[2].

The terms “Proposed Development” and “Site” will be herein used to refer to the proposed extension to the Cumbernauld Substation and associated works, and the site of those works respectively.

4.1.2 Site Overview

The existing Cumbernauld Substation is located approximately 1.3km east of Cumbernauld at National Grid Reference NS 77444 74399. The proposed site is located to the south of Forest Road and comprises primarily of grassland and woodland. The surrounding land use includes the Palacerigg Country Park to the south, a construction site to the east, Cumbernauld Academy to the northwest, an industrial estate to the west, and residential estates to the northeast and northwest.

The site boundary makes up an area of approximately 6.67 ha with the temporary and permanent works occupying an area of 5.8ha. There is one paved access track to the existing Cumbernauld substation via Forest Road, to the north of the site. A track which bounds the east and west of the site can be accessed from the northeast corner of the site. The existing substation comprises of a gravel compound, a control building, and various elements of transmission infrastructure.

Plate 4- 1 shows the site and its environment. Three main water features are located in proximity to the site: Red Burn, Glencryan Burn, and Fannyside Lochs. The Red Burn runs parallel to the northwestern extent of the site at a distance of 90m, flowing northeast. The Glencryan Burn, contributed by Fannyside Lochs situated 2.2km southeast of the site, flows through a deep valley which bounds the western extent of the site and discharges through a culvert under Forest Road to the Red Burn in the northwest.

A complex of small watercourses and ditches run westwards and northwards through the woodlands and grasslands uphill of the site, some of which outlet directly to the Glencryan Burn.

[1] C624: Development and Flood Risk (2004). Construction Industry Research and Information Association..
[2] C753: The SuDS Manual (2015). Construction Industry Research and Information Association.

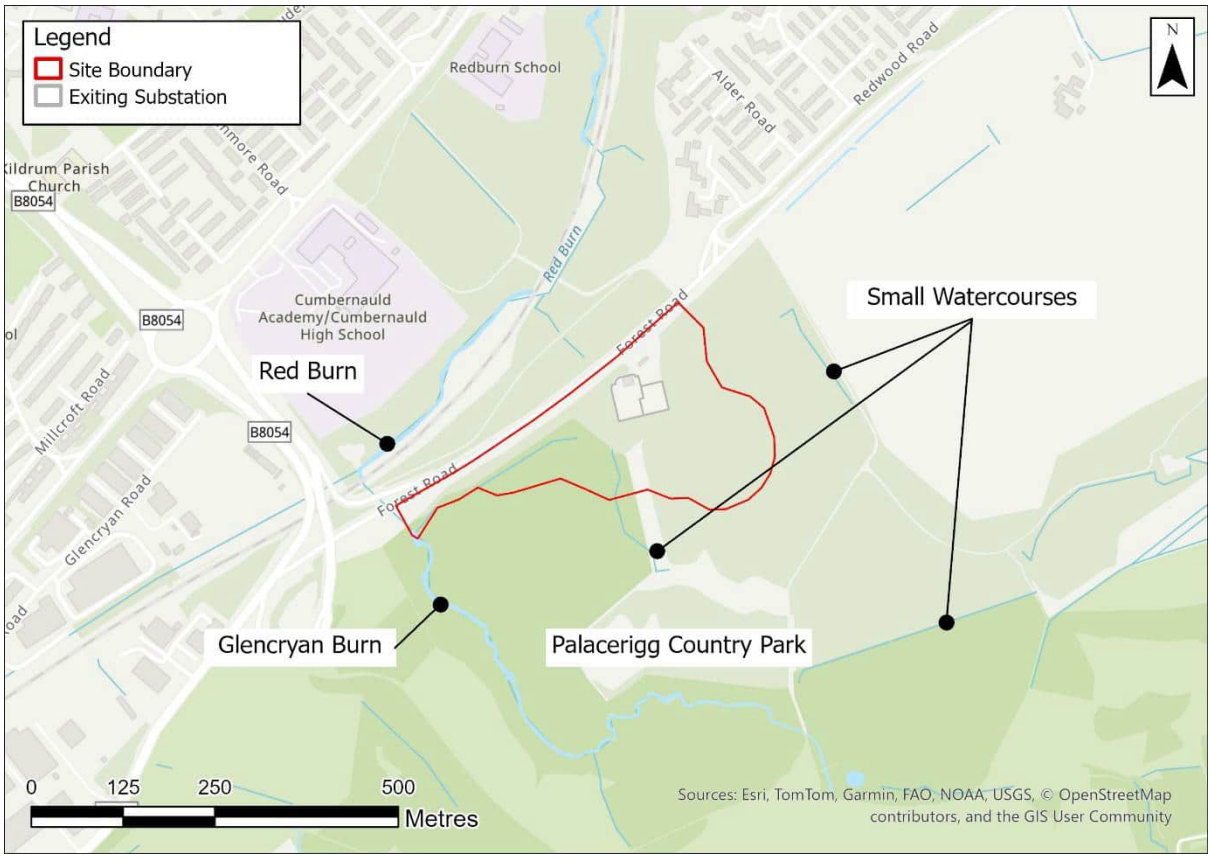


Plate 4- 1 Site Overview

4.1.3 Site Topography

Topography of the site has been assessed based on Phase 5 Scottish Government LiDAR Digital Terrain Model (DTM) with 0.5m resolution[3]. Site topography following the LiDAR data set is shown in Plate 4- 2.

The existing substation is set into the surrounding landscape with a platform elevation of approximately 118.0m Above Ordnance Datum (AOD), with groundworks which slope down to that level from the west, south, and east. The site is located on a hillside with a generally northwesterly aspect, sloping from a high of 176.3mAOD at NS 79685 74421 down to deep valleys holding the Glencryan Burn to the west and the Red Burn to the north. The highest point on site is at 142.6mAOD. The westernmost part of the site follows down Forest Road to a low point in the Glencryan burn 98.9mAOD. A significant embankment separates the site from the road.

[3] Scottish Government (2021). Dataset. *LiDAR for Scotland Phase V DTM*. Available at: https://remotesensingdata.gov.scot/data#/list

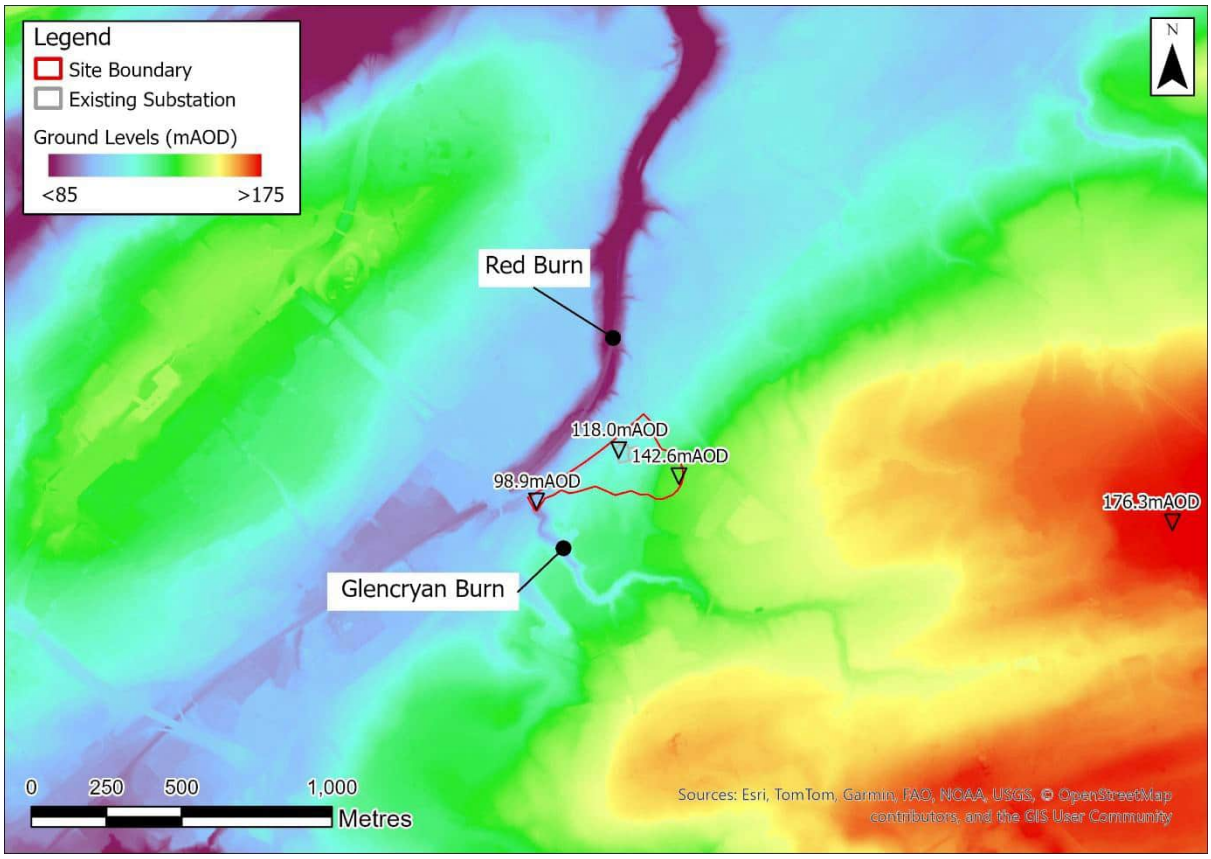


Plate 4- 2 Site topography

4.1.4 Geology

Geology mapping provided by British Geological Survey (BGS)[4] indicates superficial deposits of till in the south and east of the site. Some regions of Alluvium are noted to the west of the site. These deposits comprise of clay, silt, sand, and gravel. The local bedrock geology is made up of Upper Limestone Formation, containing grey limestone overlain by grey to black mudstones, calcareous mudstones, siltstones, paler sandstones, seatrocks, and coal.

The above information is supported by BGS borehole records[5], where a number of boreholes was located within the vicinity of the existing substation. A borehole record located 20m east of the substation (NS77SE193/1) returned a topsoil of sandy clay, with sandstone found from 6m Below Ground Level (BGL). A combination of siltstone, mudstone, limestone, and coal were found between 14 and 15 m BGL. Drilling was concluded at 23 m, before bedrock was struck.

Another borehole record which detailed a cluster of boreholes was located 10 m north of the substation (NS77SE5965/B1-B8) and returned similar results. However, these boreholes recorded a firm sandstone between 2 and 5 m BGL. Groundwater was also found in some, between the levels of 2 and 5 m BGL.

No site-specific ground investigation information has been provided at the time of conducting this study.

4.1.5 Historical Mapping

A desk-based historical assessment of the site was carried out before the site walkover to establish watercourses in the vicinity, direction of flows, discharge locations, and previous land use. The National Library Scotland Map finder[6] was used to access local historical maps which detailed these features.

An Ordnance Survey map published in 1967 before construction of the existing substation shows the most significant features near the site, the Red Burn, the Glencryan Burn, and the Forest Road, in the present arrangement. A cropped excerpt from this map is presented in Plate 4-3. This map indicates that the region south of the site, which is currently grassland, was previously used as a refuse tip.

It also shows that an unnamed small watercourse, herein referred to as the “central watercourse”, was previously aligned to run northeast into a culvert under Forest Road. In present day, this watercourse flows westward instead, before reaching the existing substation. This suggests that the watercourse may have been realigned as part of the original construction works of the substation, although this has not been confirmed. Two other watercourses are indicated to the west of the site, which are also shown in present mapping. These flow westward into Glencryan Burn and may have been used to convey the re-aligned “central watercourse”.

[4] BGS (no date) ‘Geology Viewer’. Available at: https://geologyviewer.bgs.ac.uk/?_ga=2.214158167.1385564789.1724058925-51426505.1724058925 [Accessed: 10th June 2025].

[5] BGS (no date) ‘Onshore Borehole Records’. Available at: https://mapapps2.bgs.ac.uk/geoindex/home.html?layer=BGSBoreholes&_ga=2.161074301.1501471838.1724055874-492392138.1724055874 (Accessed: 10th June 2025).

[6] National Library of Scotland. Map images. Available at: Map Finder - with Marker Pin - Map Images - National Library of Scotland (nls.uk) [Accessed at 1/10/24]

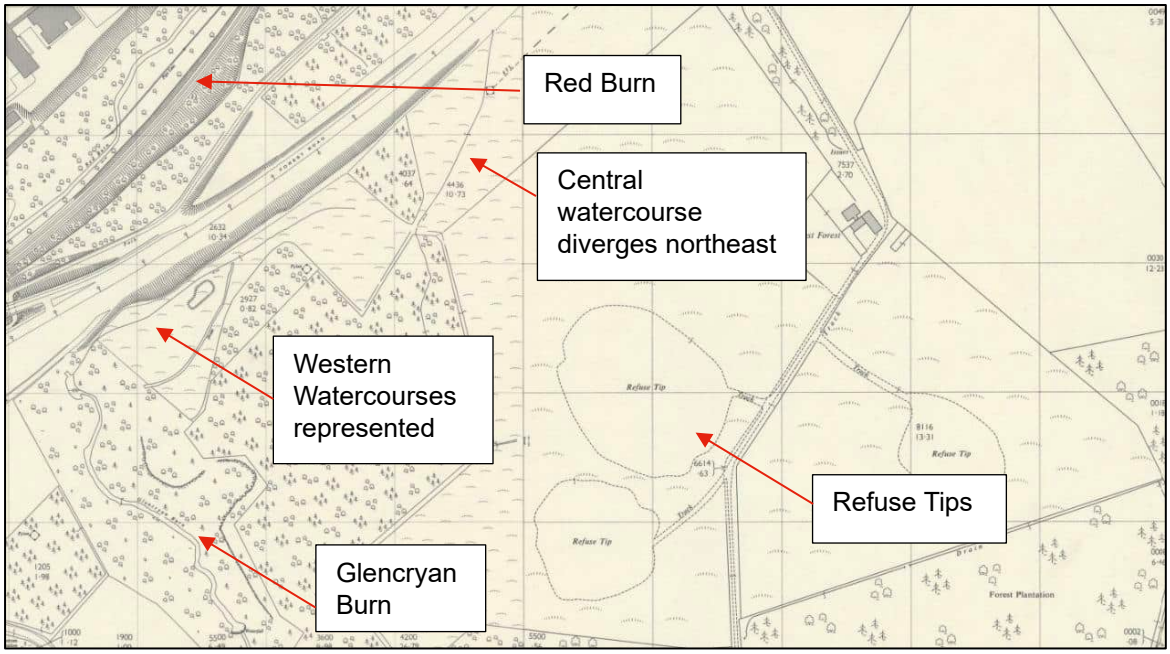


Plate 4-3 Ordnance survey map of surrounding area from 1967.

4.1.6 Site Walkover

A site walkover was conducted by AECOM on the 30th July 2025 to establish general topography, flood routes, and other hydraulic features near the site. The existing Substation site could not be accessed at the time, therefore, the walkover was limited to the Palacerigg Country Park and the surrounding grassland. The weather was dry and warm and the flows in all watercourses were low. The vegetation across the landscape was dense, which further restricted access to features which were not directly accessible by footpaths. Several photographs as taken on the site walkover are presented in Appendix A**.** The areas visited and notable features discussed in this section are identified in Plate 4-4. The site walkover focused on identifying hydraulic features uphill of the site which may impact the surface water flows towards the site.

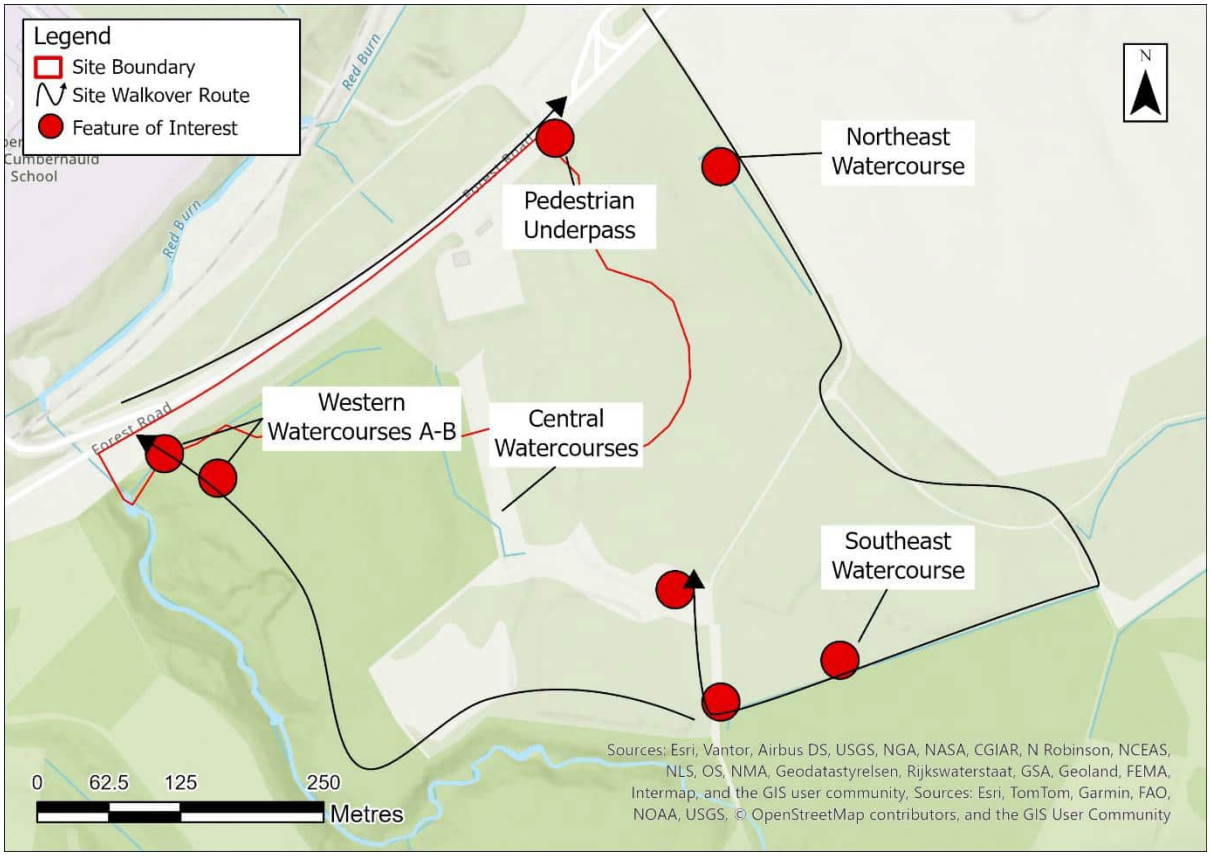


Plate 4-4 Summary of site walkover

4.1.7 Topographic Survey

Following the site walkover described above, it was determined that a topographic survey of the site was required to improve representation of flow paths surrounding the proposed development. Malcolm Hughes Chartered Land Surveyors (MHCLS) was commissioned to undertake a survey of the watercourses uphill of the site. Plate 4-5 illustrates the findings of this survey, which was completed on October 20-22, 2025.

It was identified that the southeastern watercourse, despite being well defined with depths typically greater than 0.5m, it had several blockages or other features which could obstruct flow and cause overtopping flow to continue westward towards the central watercourse.

The central watercourse, as indicated previously, was found to be intermittent and not as well defined, with channel depths typically between 0.3m and 0.5m. To the south of the site, it was found that the primary channel turns westwards, but there is evidence of historic overflow from this junction as several shallow and informal ditches run from this point northwards to the site of the existing substation.

In total, this survey indicated a possible flow path which may affect the site, with flow overtopping the southeastern watercourse and the central watercourse in turn, eventually affecting the site.

Several culverts (henceforth referred to as culverts A, B, and C) were identified along these watercourses and were included in the survey. The complete findings of the survey are provided in Appendix B.

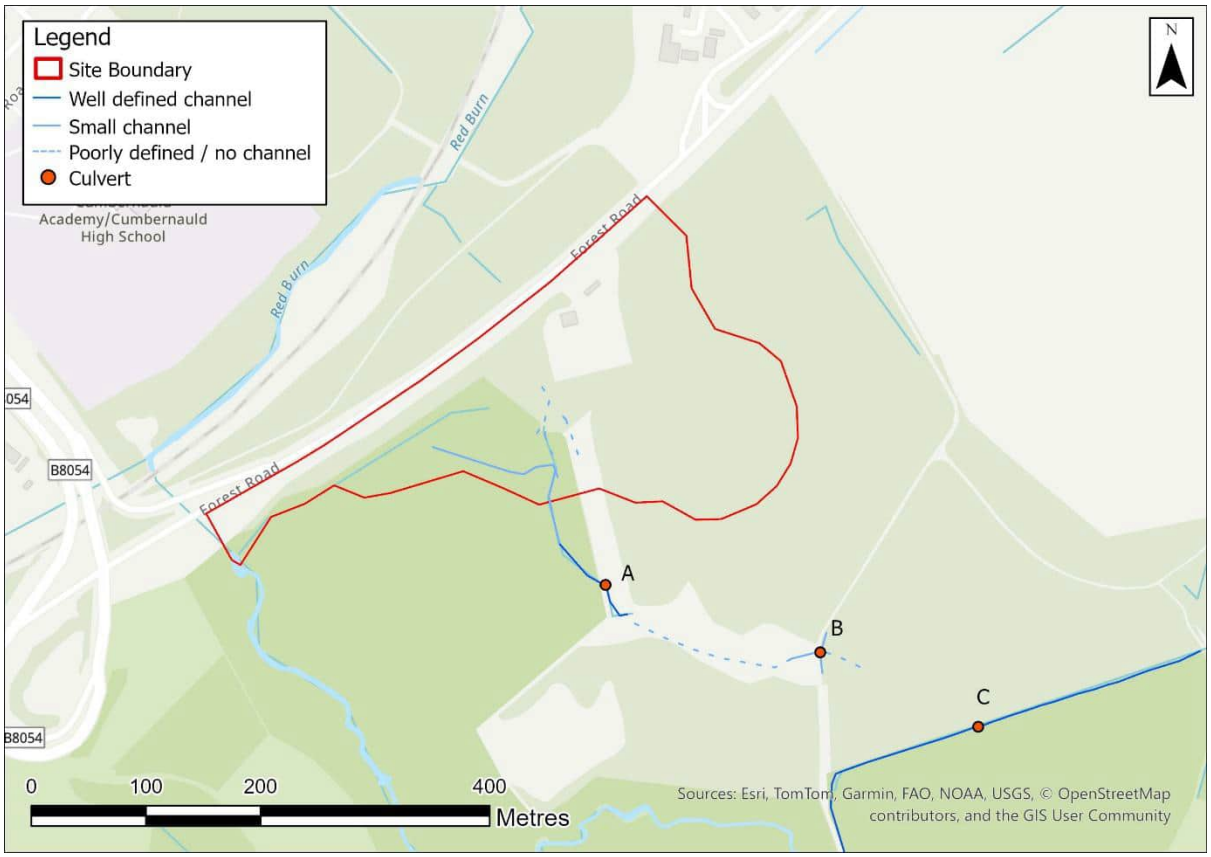


Plate 4-5 Findings of the Topographic Survey

4.1.8 Proposed Development

The proposed development consists of an extension of the existing substation compound to the south. The new platform is proposed to tie into the existing platform at a level of approximately 118.0mAOD with a slight southwards slope across the site.

Creation of this platform will involve excavation of the surrounding hillside to bring the ground to the required level. The extents of this excavation are not determined yet, as detailed design is required to confirm the appropriate bank slope. For this flood risk assessment, a slope of approximately 1:3 has been assumed.

The development will include the installation of various elements of electrical plant, access roads and parking, footpaths, and a new control building. The existing control building is proposed to be demolished following completion of construction. An overview of the proposed layout is shown in Plate 4-6 and a drawing of the proposed layout as provided by SPEN is included in Appendix C.

Site surface water management works are also proposed, consisting of grubbing-up of existing drainage, installation of new filter drains to serve the proposed extension, installation of two new SuDS ponds to the east and west of the site, and a cut-off trench and embankment above the excavation slope to intercept flows from the hillside to the south of the site and direct them towards Glencryan Burn.

Further discussion of the proposed drainage is provided in Section 4.5.

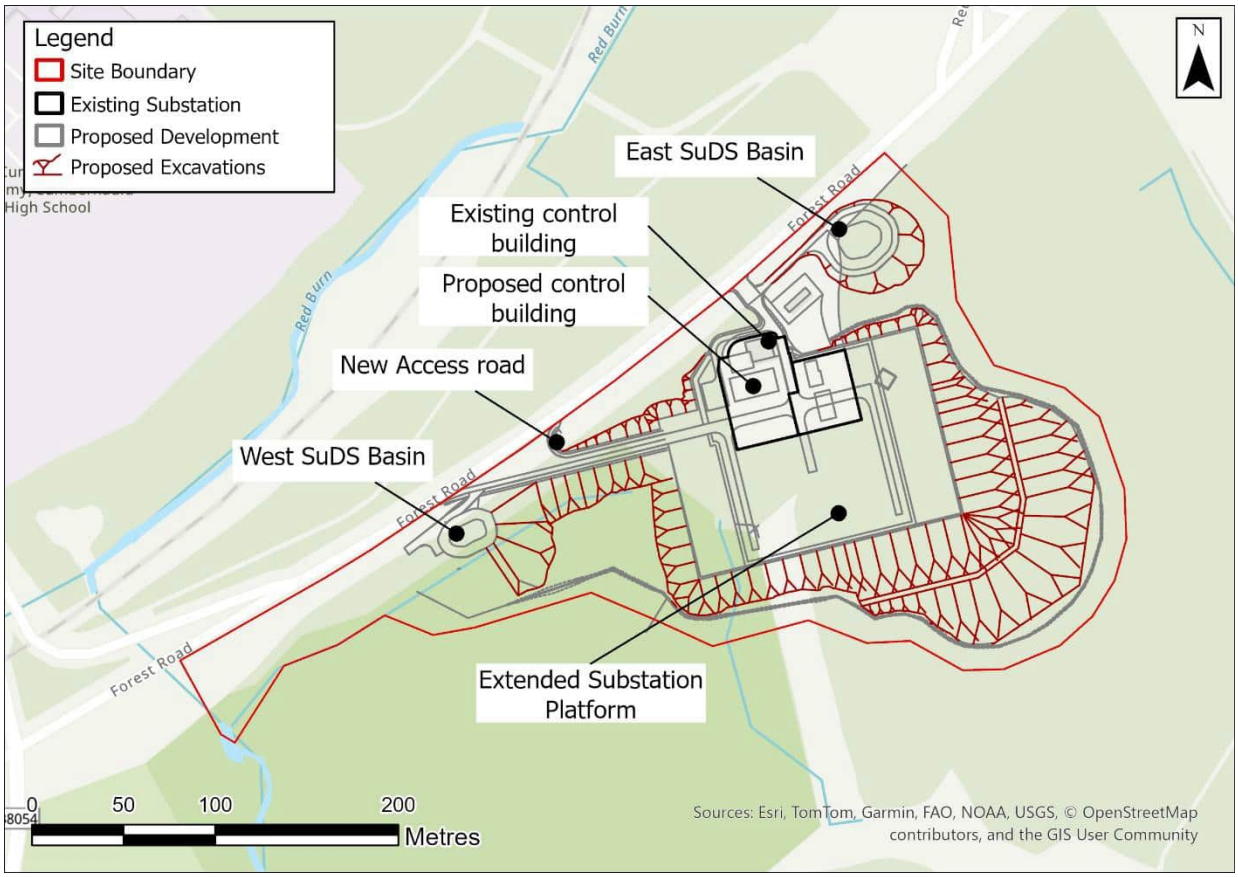


Plate 4-6 Layout of Proposed Development

4.2 Planning Policy

This report has been developed in accordance with the relevant national and local policies discussed below. While all the key policy frameworks covering the site have been referenced to produce this report, the following sections will highlight the most critical policy details which have bearing on the proposed development.

4.2.1 National Planning Policy

Policy 22 of the *National Planning Framework 4* (NPF4)[7] sets out the government's planning polices for flood risk in Scotland. This is supplemented by SEPA's *Land Use Vulnerability Guidance*[8] which categorises land uses and developments by their vulnerability to inform where exceptions to this policy may be applicable. Based on this guidance, the proposed development is categorised as 'essential infrastructure'.

Relevant sections of Policy 22 include:

[7] Scottish Government (2023). *National Planning Framework 4*. Available at: https://www.gov.scot/binaries/content/documents/govscot/publications/strategy-plan/2023/02/national-planning-framework-4/documents/national-planning-framework-4-revised-draft/national-planning-framework-4-revised-draft/govscot%3Adocument/national-planning-framework-4.pdf

[8] SEPA (2024). *Flood Risk and Land Use Vulnerability Guidance.* Available at: https://www.sepa.org.uk/environment/land/planning/guidance-and-advice-notes/

a) Development proposals at risk of flooding or in a flood risk area will only be supported if they are for:

i) essential infrastructure where the location is required for operational reasons;

ii) water compatible uses;

iii) redevelopment of an existing building or site for an equal or less vulnerable use; or.

iv) redevelopment of previously used sites in built up areas where the Local Development Plan (LDP) has identified a need to bring these into positive use and where proposals demonstrate that long term safety and resilience can be secured in accordance with relevant SEPA advice.

In such cases, it will be demonstrated by the applicant that:

- *all risks of flooding are understood and addressed;*
- *there is no reduction in floodplain capacity, increased risk for others, or a need for future flood protection schemes;*
- *the development remains safe and operational during floods;*
- *flood resistant and resilient materials and construction methods are used; and*
- *future adaptations can be made to accommodate the effects of climate change.*

c) Development proposals will:

i) not increase the risk of surface water flooding to others, or itself be at risk.

ii) manage all rain and surface water through sustainable urban drainage systems (SUDS), which should form part of and integrate with proposed and existing blue-green infrastructure. All proposals should presume no surface water connection to the combined sewer;

iii) seek to minimise the area of impermeable surface.

In this context, NPF4 defines “at risk of flooding” as “land or built form with an annual probability of being flooded of greater than 0.5% which must include an appropriate allowance for future climate change”. This will be used as the benchmark for flood risk assessment in this report.

4.2.2 Local Planning Policy

The proposed development lies within the administrative area of the North Lanarkshire Council, which provides guidance for prospective developments in several policies regarding flood risk and drainage. This report has thus paid due consideration to the following relevant guidance documents:

- North Lanarkshire Council Development Plan 2 (LDP2)[9]
- Supplementary Planning Guidance (SPG) 09: Flooding and Drainage[10]
- Forth Estuary Local Plan District’s Local Flood Risk Management Plan Cycle 2[11]

[9] North Lanarkshire Council Local Development Plan (2022).North Lanarkshire Council. https://www.northlanarkshire.gov.uk/sites/default/files/2022-11/North%20Lanarkshire%20Local%20Development%20Plan.pdf

[10] North Lanarkshire Council (2010). *SPG 09: Flooding and Drainage.* Available at: https://www.northlanarkshire.gov.uk/sites/default/files/2020-09/09%20Flooding%20and%20Drainage.pdf

[11] Falkirk Council (2023). *Local Flood Risk Management Plan, Cycle 2, 2022-2028.* Available at: https://fcwebsites.blob.core.windows.net/www/media/2d14fbbb-2b7e-4c75-89e8-75187206357d/03%20Forth%20Estuary%20Local%20Flood%20Risk%20Management%20Plan%20Cycle%202%20-%202022-

Specific advice on planning issues relating to flood and drainage management is provided in the SPG09. Section D.7 states that Flood risk assessments are required for all developments that fall within a medium to high flood risk extent according to SEPA flood maps, and drainage assessments are required for large residential developments, developments which affect conservation areas, and redevelopments which propose 1,000m^2 or more additional hardstanding. Sites with a proposed hardstanding footprint less than 1,000m^2 may not require a full drainage assessment, but should still include a demonstration of the best surface water drainage option.

4.3 Flood Risk Assessment

This section will report on the findings of a qualitative flood risk analysis desk study which aimed to assess the potential impact of flood risk sources on the proposed development. The following structure will be used:

- A brief description of the types of flood risk considered
- A review of the data-sources used to assess flood risk on site
- An analysis of each of the above flood risk types as they pertain to the site of the proposed development
- A summary of the flood risk assessed from each source and recommended mitigations.

The findings of this assessment are summarised in the SPEA FRA checklist in Appendix D, in line with SEPA technical guidance[12].

4.3.1 Potential Sources of Flood Risk

Flood risk on a site may be either caused or exacerbated by a range of hazards. Each of these hazards may carry a significant flood risk alone or may interact with other hazards to produce an overall significant flood risk. Where appropriate, estimates of the impact of climate change on the severity and extent of these hazards will also be considered. The following common flood hazards will be assessed regarding their individual contribution to flood risk and, where appropriate, their likelihood of increasing flood risk posed by other hazards:

a) **Coastal Flooding:** Extreme sea levels and wave heights can cause inundation and flooding on developments on or sufficiently near the coast.

b) **Fluvial (River) Flooding:** Extreme flood events in rivers and other large watercourses can cause rapid and significant inundation of surrounding areas

c) **Pluvial (Surface Water) Flooding:** High volume rainfall events which exceed the infiltration and storage capacity of the local soil cause flows to develop over land, potentially damaging property.

d) **Infrastructure Failure:** Water conveyance, storage, or flow control infrastructure can fail, either causing a flood risk in itself, or exacerbating the scale or extent of other flood hazards.

e) **Sewer Flooding:** The failure of sewerage can result in surface flooding.

2028.pdf%23:~:text=The%20Plan%20identifies%20where%20the%20risk%20of%20flooding,and%20will%20be%20delivered%20between%202022%20and%202028.

[12] SEPA (2022). *Technical Flood Risk Guidance for Stakeholders.* Available at ss-nfr-p-002-technical-flood-risk-guidance-for-stakeholders.pdf

f) **Groundwater Flooding:** Variations in the local water table and groundwater level can impact the storage capacity of the soil or subterranean storage infrastructure. While groundwater alone does not generally pose significant risk, it may exacerbate the risk posed by other flood hazards.

Consideration will also be given to the future impacts of climate change where appropriate.

4.3.2 Data Sources

The assessment of the above-described flood hazards has been informed by a range of sources. SEPA develops and maintains flood risk datasets pertaining to Coastal, Fluvial (River) and Pluvial (Surface Water) flooding, with additional consideration of the impact of climate change. The relevant sections of this report have drawn on the data provided in the SEPA Flood Map Version 3.0[13]. SEPA also maintains a database relating to groundwater hazards[14].

In assessing the risks of infrastructure failure, the SEPA Reservoirs map[15] has been used, which identifies areas at risk of flooding from uncontrolled release of stored water.

To maintain congruity with SEPA Flood Risk Assessment methods, this report will maintain the following terminology for levels of flood risk:

- **High Risk:** Areas which are subject to flooding in the characteristic 10% Annual Exceedance Probability (AEP) rainfall event. These areas have a 10% chance of flooding each year based on past rainfall data.
- **Medium Risk:** Areas which are subject to flooding in the characteristic 0.5% AEP (1:200 year) rainfall event. These areas have a 0.5% chance of flooding each year based on past rainfall data.
- **Low Risk:** Areas which are subject to flooding in the characteristic 0.1% AEP (1:1000 year) rainfall event. These areas have a 0.1% chance of flooding each year based on past rainfall data.

As current climate change models predict that the frequency and intensity of extreme rainfall events will increase in the future, a further risk category will be used when discussing flood hazards which would be impacted by rainfall uplift caused by climate change:

- **Medium Risk with Climate Change:** Areas which are subject to flooding in the characteristic 0.5% AEP (1:200 year) rainfall event. These areas have a 0.5% chance of flooding each year based on rainfall uplift estimates for the year 2080.

[13] SEPA (2025). Dataset. *SEPA Flood Map Version 3.0*. Available at: https://map.sepa.org.uk/floodmaps
[14] SEPA (2025). Dataset. *SEPA Groundwater Map.* Available at: https://map.sepa.org.uk/floodmap/map.htm
[15] SEPA (2022). Dataset. *SEPA Reservoirs Map.* Available at: https://map.sepa.org.uk/reservoirsfloodmap/Map.htm

4.3.3 Historic Flooding

There is no public record of historic flooding for this site, and SPEN is not aware of any historic flooding on site.

4.3.4 Coastal Flooding

As the site is located inland and at high elevation, the risk of flooding from coastal sources is deemed **negligible**.

4.3.5 Fluvial Flooding

Flooding caused by watercourses of any size is considered Fluvial in nature. Watercourses with large catchments (herein referred to as 'Major Watercourses') are best represented using the SEPA River Flood Map, while watercourses with smaller catchments (herein referred to as 'Minor Watercourses') are best represented in the SEPA Surface Water Flood Map. This assessment will consider both sources as indicators of fluvial flood risk.

4.3.5.1 Major Watercourses:

The flood extents of the Red Burn, which runs northeast to the north of the site, are shown in in Plate 4-7. These flood extents reach significantly lower levels than the existing and proposed substation platforms, therefore, they do not pose any risk to the proposed development.

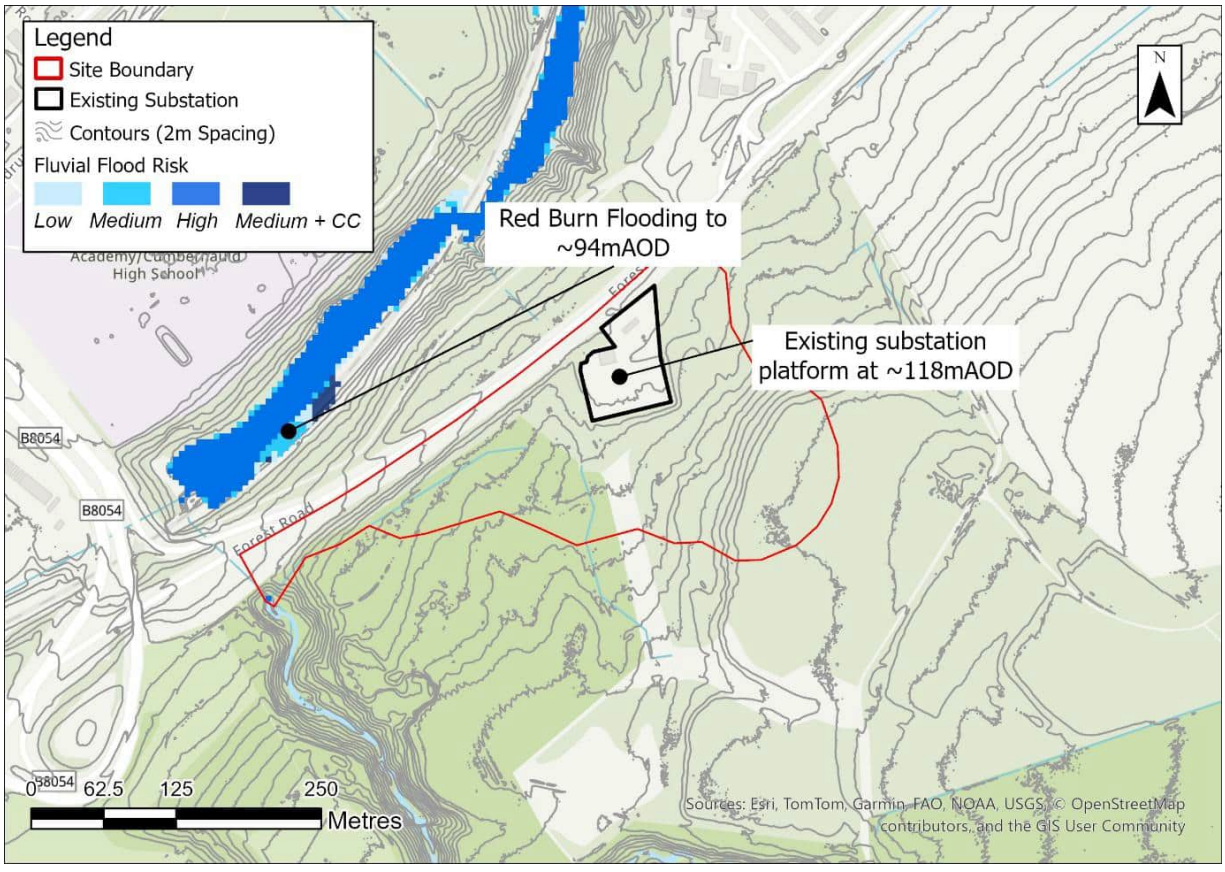


Plate 4-7 SEPA fluvial flood risk. Includes data from SEPA Flood Maps v3.0 © Scottish Environment Protection Agency (SEPA) 2025; this SEPA product is licensed under the Open Government Licence v3.0

4.3.5.2 Minor Watercourses:

The flood extents of the small watercourses are shown in Plate 4-8. The Glencryan Burn, which runs northwards through the woodlands to the south and west of the site, is at a much lower level than the proposed development, so it will not affect it. A small portion of the site boundary is within the high risk flood extents of the burn, but it is not proposed for active development.

Aside from the Glencryan Burn, a concentrated flow path entering the site from the south is shown in the flood maps. The site walkover and survey identified this as a possible flood mechanism, triggered by overtopping in the Central Watercourse where it bends westward towards Glencryan Burn. As this source arises from overflow from a channel, it will be treated as small watercourse flood risk. Based on the SEPA flood maps, this poses **moderate** flood risk to the site of the proposed development.

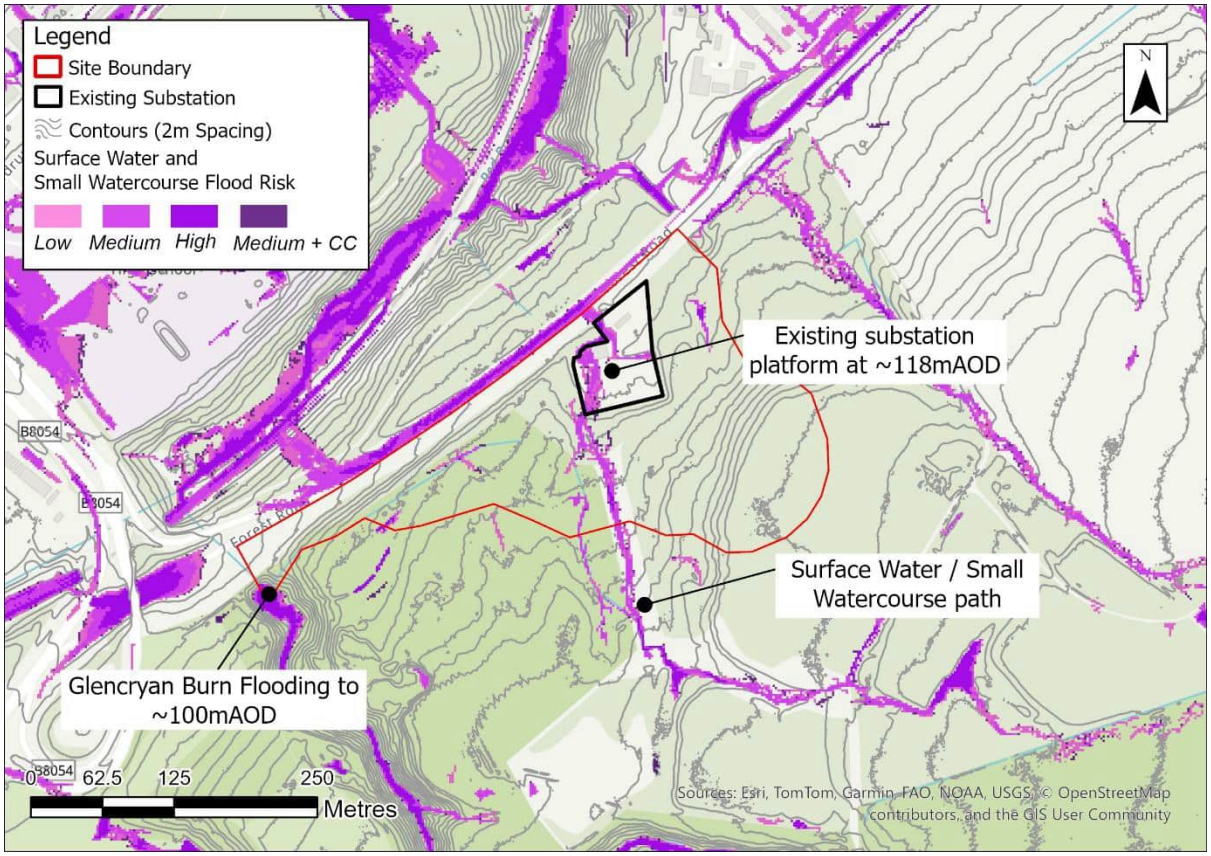


Plate 4-8 SEPA surface water and small watercourse flood risk. Includes data from SEPA Flood Maps v3.0 © Scottish Environment Protection Agency (SEPA) 2025; this SEPA product is licensed under the Open Government Licence v3.0.

4.3.6 Surface Water Flooding

Review of the SEPA Flood Maps revealed that there is minor surface water flood risk on the site, likely associated with overland flows into the excavated platform of the site, arising from the woodlands to the south of the site. **Error! Reference source not found.** shows the surface water flood risk surrounding the site, where there is low to medium flood risk indicated in the north-east of the existing substation platform. This flooding is distinct from the previously described small watercourse flood risk entering the site from the south-west. This accumulation, combined with the flood risk posed by the small watercourse, constitutes **moderate** flood risk on site.

4.3.7 Infrastructure Failure

The risk of flooding posed by reservoir failure, canal failure, and mains water failure has been assessed.

Reservoir Failure: SEPA provides flood mapping to show areas which may be inundated with water in the unlikely event of a reservoir failure[16]. This mapping shows that the site is not at risk of flooding in the event of failure.

Canal Failure: The nearest canal is the Firth and Clyde, which runs approximately 4km to the north of the site at a much lower elevation of approximately 48mAOD. Thus, there is **no risk** to the site posed be canal failure.

Mains Water Failure: A utility survey conducted by Sigma Surveys and supplied by SPEN found mains water running alongside Forest Road, however, any failure and surcharging of this portion of the water distribution network would flow down Forest Road, not impacting the site.

Considering the assessment of risk posed by the above sources, the total flood risk from infrastructure failure is considered **negligible.**

4.3.8 Sewer Surcharge

The utility survey did not identify any major wastewater or surface water sewers nearby to the site which would impact the proposed development. Thus, the flood risk posed by sewer failure is deemed **negligible**.

4.3.9 Groundwater Flooding

Groundwater is usually a contributing factor to flooding rather than the primary source in Scotland. It is difficult to predict groundwater effects, however, low-lying areas with permeable bedrock are considered to be most at risk. As identified in Section 4.1.4, there are no geological factors which would indicate particularly vulnerability to groundwater flooding. SEPA Groundwater flood maps identify some regions of Cumbernauld to the south of the site as having possible groundwater impacts, but due to the hillside nature of the site, it is unlikely that groundwater would accumulate and cause any significant impacts on site. Thus, groundwater flood risk is considered **negligible**.

4.3.10 Initial FRA Summary and Conclusions

The analysis above has indicated that there are no coastal, major watercourse, groundwater, or infrastructure sources which pose risk to the site of the proposed development. There is, however, indication that an overland flow may form to the south of the site, accumulate in a small watercourse, and cause flooding on site in high rainfall events. This flooding appears to arise from a combination of small watercourse flooding and overland surface water flow entering the site along its southern border.

In order to further assess the nature and magnitude of the possible flood risk, hydraulic analysis of the sites surface water catchment has been undertaken. Due to the complex nature of the catchment, which is comprised of several disjoint ditches, culverts, and overland flow paths, a single hydraulic model has been used to assess this flood risk. The following sections will detail the methodology employed to assess the local hydrology and construct a hydraulic model for detailed assessment of flood risk.

4.4 Flood Risk Modelling

4.4.1 Modelling Approach

The surface water impacting the site was modelled using a 2D direct rainfall model, using survey data to improve the representation of any ditches or small topographic features which may affect surface

[16] Scottish Environment Protection Agency (2022) 'Reservoirs Maps'. Available at: Reservoirs Map [Accessed: 10th June 2025].

flows. As the site has a small and poorly defined catchment without any permanent watercourses, this approach is considered the best option.

4.4.2 Hydrological Assessment

4.4.2.1 Methodology Overview

The Flood Estimation Handbook (FEH)[17] gives guidance on methods to estimate the frequency of flood events, both based on rainfall intensity and river flows. These methods include the estimation of rarity and intensity of significant flood events. A number of methods are presented within the FEH, including the FEH statistical method and the FEH rainfall-runoff method, which has been updated in the ReFH and ReFH2 methods[18] using a larger Scottish dataset.

The rainfall-runoff method uses catchment descriptors to assess the runoff response of the catchment, producing a hyetograph (rainfall intensity vs time) for a given storm duration and return period.

The ReFH2 rainfall-runoff method has been selected, as it will allow for development of a direct rainfall model where flows are routed within the model based on topography and rainfall intensity. This is preferable in this case as the expected flood mechanism on site arises from interactions between various surface water flow paths.

4.4.2.2 Catchment Descriptors

Catchment characteristics of the site were extracted from the FEH Webservice[19] and are presented in Table 4-1. As the catchment is small and poorly defined, point data was selected instead, providing sufficient descriptors to derive rainfall estimates.

Table 4-1 Catchment descriptors for Cumbernauld substation site.

Catchment Parameter	Catchment Descriptor
NGR	NS 77475 74372
BFIHOST	0.312
BFIHOST19	0.333
PROPWET	0.58
$SAAR_{91\text{-}20}$	1320

4.4.2.3 Design Rainfall (ReFH2)

The catchment descriptors from the FEH Webservice were input to the ReFH2 software to derive design rainfall hyetographs using the FEH022 DDF model.

Following initial trial runs of the model, it was determined that the 1.0 hour summer rainfall profile gives the worst-case scenario. As the catchment is small and on a significant gradient, there is very little lag between peak rainfall and peak flooding.

[17] Flood Estimation Handbook (1999). *Wallingford: Institute of Hydrology*.

[18] ReFH2 v4.1.8985.14298 (2022). Wallingford HydroSolutions

[19] UK Centre for Ecology and Hydrology. Web Service. Available online at: https://fehweb.ceh.ac.uk/

To account for ground infiltration, the rainfall hyetograph was reduced by 45% for rural land use (such as forests, meadows, and grasslands) and by 35% for more urbanised land use (the substation compound and roads).

Following requirements from SEPA[20], the model also accounted for rainfall uplifts due to climate change. The site is located in the Forth river basin, which has recommended rainfall uplift of 39%.

Hyetographs were obtained from the ReFH2 software for the 0.5%AEP and 0.1%AEP rainfall events, both with and without uplift for climate change. The design hyetographs and modified hyetographs accounting for infiltration are presented in Table 4-2.

Table 4-2 FEH2022 Design rainfall hyetographs and modifications for infiltration

Time (hrs)	0.5%AEP +CC (mm/hr)	0.5%AEP+CC (rural) (mm/hr)	0.5%AEP+CC (urban) (mm/hr)
0	0	0	0
0.2	4.11	2.23	2.83
04	11.00	5.96	7.59
0.6	31.90	17.29	22.01
0.8	11.00	5.96	7.59
1.0	4.11	2.23	2.83
1.2	0	0	0

[20] SEPA (2025). *Climate change allowances for flood risk assessment in land use planning.*

4.4.3 Model Build

Using the hydrological assessment described above, a 2D direct-rainfall model was developed to quantify the flood risk on site. The following points are relevant to the model build.

- The model was built and run using TUFLOW 2025.1.1, with the Highly Parallelised Compute (HPC) solver with double precision.
- The model domain was determined using Scottish LiDAR Phase V data with 0.5m precision, accounting for the entire topographical region which may flow to the site.
- Ground levels in the model were derived from the same LiDAR data, which had a better coverage of the domain than the existing surveys.
- Where channels, trenches, or ditches were surveyed, this survey data has been incorporated into the model ground levels using Triangular Irregular Network (TIN) meshes.
- Rainfall was applied to the model by assigning either rural or urban land-use to each region of the model.
- Manning's roughness values were assigned to the model according to land use observed in the site visit, supplemented with data from Ordnance Survey VectorMap District[21]. The following roughness values were used to represent land use in the model as shown in Table 4-3.

Table 4-3 Roughness values for grid based on land use

Land use	Manning's n
Roads and Paving	0.02
Deciduous tree cover, moderate shrubs	0.09
Buildings	0.50
Short grass	0.03
Scattered brush, tall grass	0.05

- Culverts identified by the survey were represented in the model as 1D elements using the surveyed material, measurement, and invert levels.
- The domain was discretised with varying cell-sizes using the Quadtree package in TUFLOW. Cell-size was based on the level of detail required in each area. Large flat regions were modelled with 4m cells, with cell size decreasing to 0.5m where fine details have been stamped into the model.
- To model the flow-paths surrounding the proposed development, the levels of the platform, access roads, and preliminary earthworks design were stamped into the model ground levels. The material assignments and rainfall values were also changed to reflect the proposed development of the site.

[21] Vector Map District (2025). The Ordnance Survey. Dataset. Available at: https://www.ordnancesurvey.co.uk/products/os-vectormap-district

4.4.4 Baseline Results – 0.5% AEP + Climate Change

4.4.4.1 Flood Extents

As the flood risk model used a direct rainfall approach, only depths exceeding 100mm are included in the flood extents to distinguish between accumulated flooding and rainfall on grid.

The maximum depths on the site for the 0.5%AEP + Climate Change event (0.5%AEP + CC) are shown in Plate 4- 9. These results show flooding on site up to 0.275m depth. Flooding on site is shown to arise from accumulation of pluvial sheet flow onto the platform from the south and east and overflow from the central watercourse, which bursts its banks creating overland flow into the western border of the site. The site drains onto Forest Road through the access road to the north, where surface waters eventually flow along the road then downhill into the Red Burn to the north.

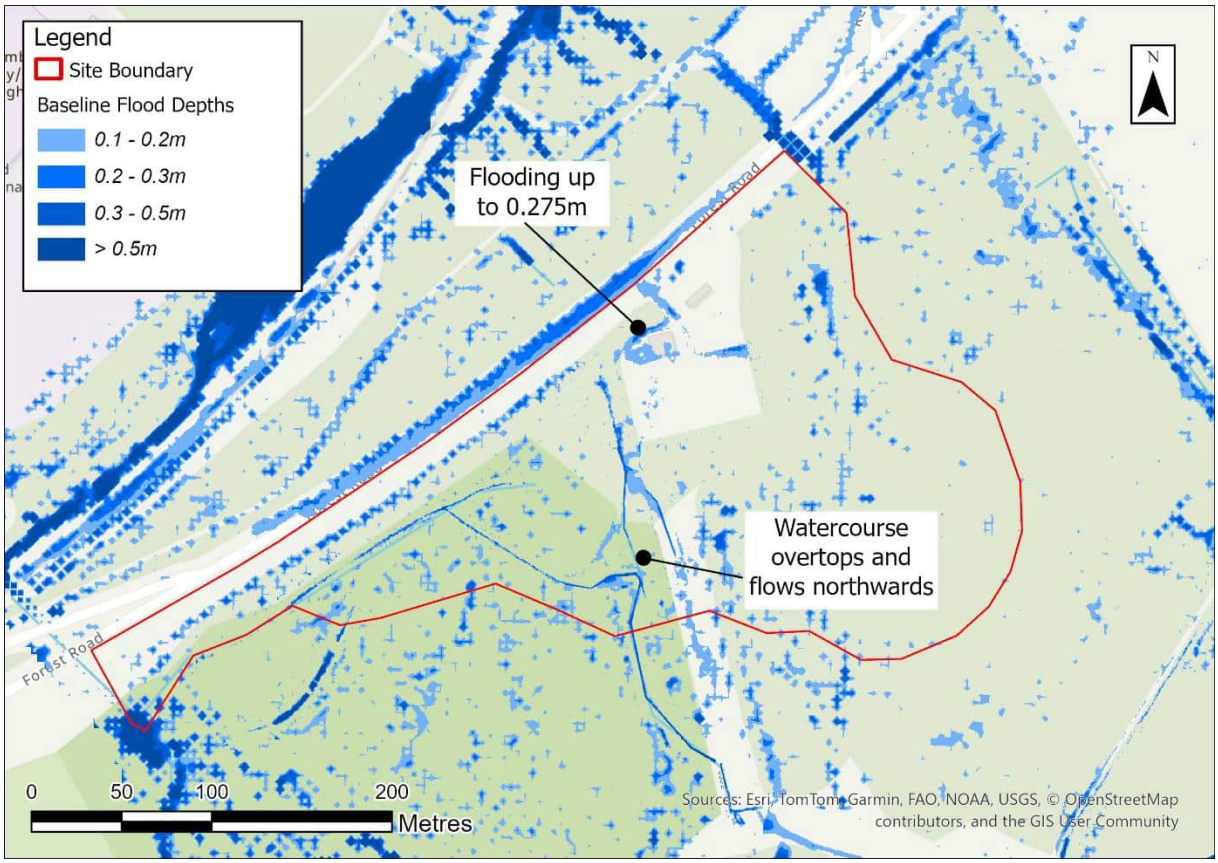


Plate 4- 9 Maximum depths on site in 0.5%AEP + Climate Change event.

4.4.4.2 Fluvial and Pluvial Flood Impacts

To determine the relative impact of pluvial and small watercourse flooding in the model, fluid fluxes into and out of the existing substation site were measured using Plot Output (PO) lines in TUFLOW. All flow into the western border and southwestern corner of the platform was considered to be fluvial in nature, and all other inflows were considered pluvial as they arise from surface water sources.

The total fluxes through the substation during the simulation are provided in Table 4-4.

Table 4-4 Summary of total flows

Source	Total Flow (m^3)	% of total
Direct rainfall	48.62	14.5
Surface Water (Pluvial)	85.86	25.6
Overflow from watercourse (Fluvial)	200.80	59.9

Plate 4-10 shows the breakdown of accumulated flow onto the site, including the outflow from the site. Comparing the total flows into site, the overflow from the small watercourse to the south and west of the site accounts for 59.9% of the total flow into site, thus the fluvial source is considered to contribute 59.9% of the flood impacts on site.

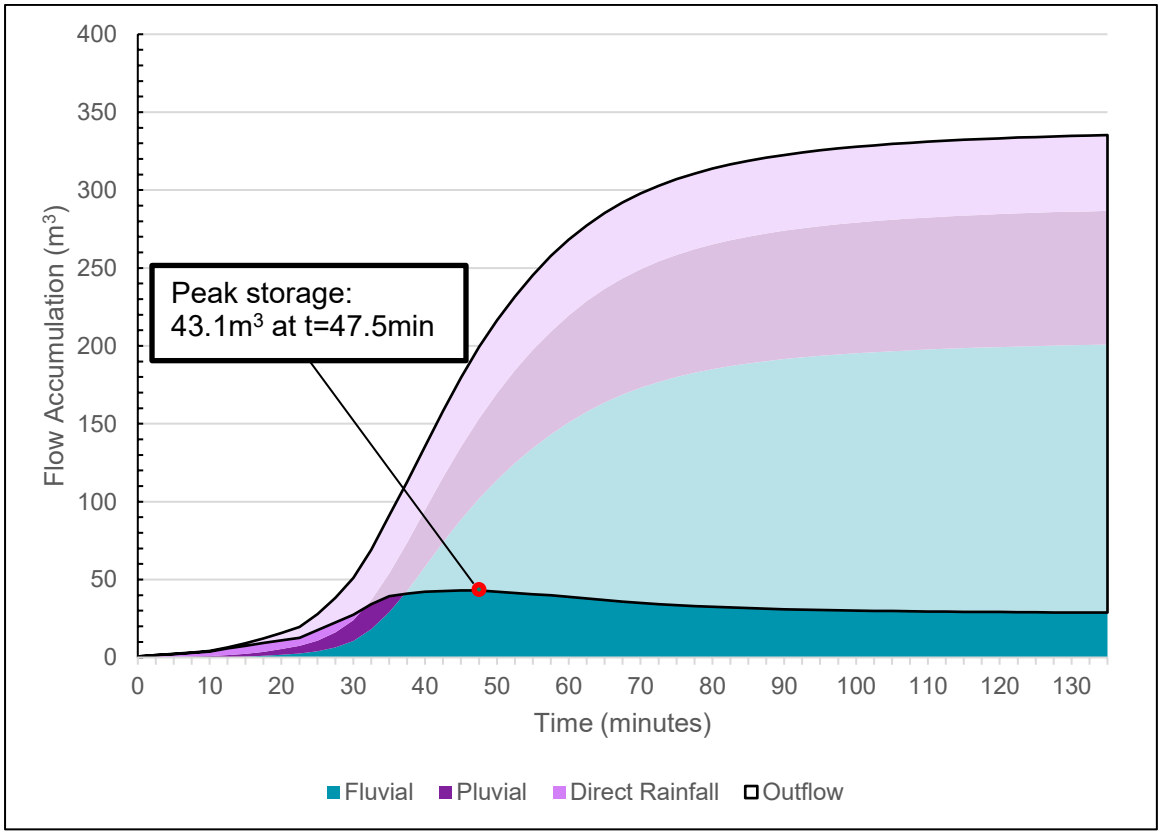


Plate 4-10 Flow accumulation on site over time.

4.4.4.3 Flood Storage

The sum of accumulated inflow and outflow at any given time represents the volume stored on site at that time. The maximum volume of flood water stored on site is 43.1m^3 at approximately t = 47.5 minutes, as shown in Plate 4-10. Thus, assuming approximately 60% of this storage is fluvial in nature, then the existing site is considered to contribute 25.8m^3 of fluvial attenuation. This is not, however, considered to be part of the functional flood plain, as the fluvial flooding on site is caused by out of bank flow. As the proposed development will require the realignment of this watercourse, equivalent storage will be required in its new arrangement.

4.4.5 Sensitivity

Further runs were conducted to assess the model's sensitivity to key parameters, including:

- An uplift of 40% to all manning's roughness coefficients within the model;
- A decrease of infiltration from 45% to 35% for rural land and from 30% to 20% for urban land;
- A halving of cell size in the direct uphill catchment area of the site, including the stamped-in channels; and
- Complete blockage of culverts A and C (not B), which was determined to be the most detrimental condition for the site as overtopping of these culverts would create more overbank flow in the watercourses upstream.

All of the above runs were conducted for the 0.5%AEP + CC Summer storm with 1.0hr duration. The maximum depth in the substation compound area for each run is summarised in Table 4-5.

Table 4-5 Summary of sensitivity runs

Scenario	Maximum flood depth in substation platform (m)
Baseline	0.275
Roughness Uplift	0.278
Decrease in Infiltration	0.309
Increase in Mesh Resolution	0.272
Blockage of Culverts	0.275

These results show that changes to the material roughness, grid resolution, and blockage of culverts all had negligible impacts on the flood conditions on site. Decreasing the assumed infiltration of the ground, equivalent to a 12.5% to 15% rainfall intensity uplift, only generated an 11.3% (0.031m) increase of maximum depth on site. Overall, these results indicate that the model is minimally sensitive to changes in key parameters.

4.4.6 Post-Development

The post-development arrangement was assessed in the 0.5% AEP + CC case. This model did not include representation of any mitigation, so as to provide data to inform the level of mitigation required.

4.4.6.1 Flood Extents

The flood extents determined by this model are shown in Plate 4- 11. These results indicate that in the absence of mitigation of fluvial and surface water flooding, the extent of flooding on site will increase. Off site, the flood extents are generally the same, showing that the development has negligible impact on flood concerns off-site.

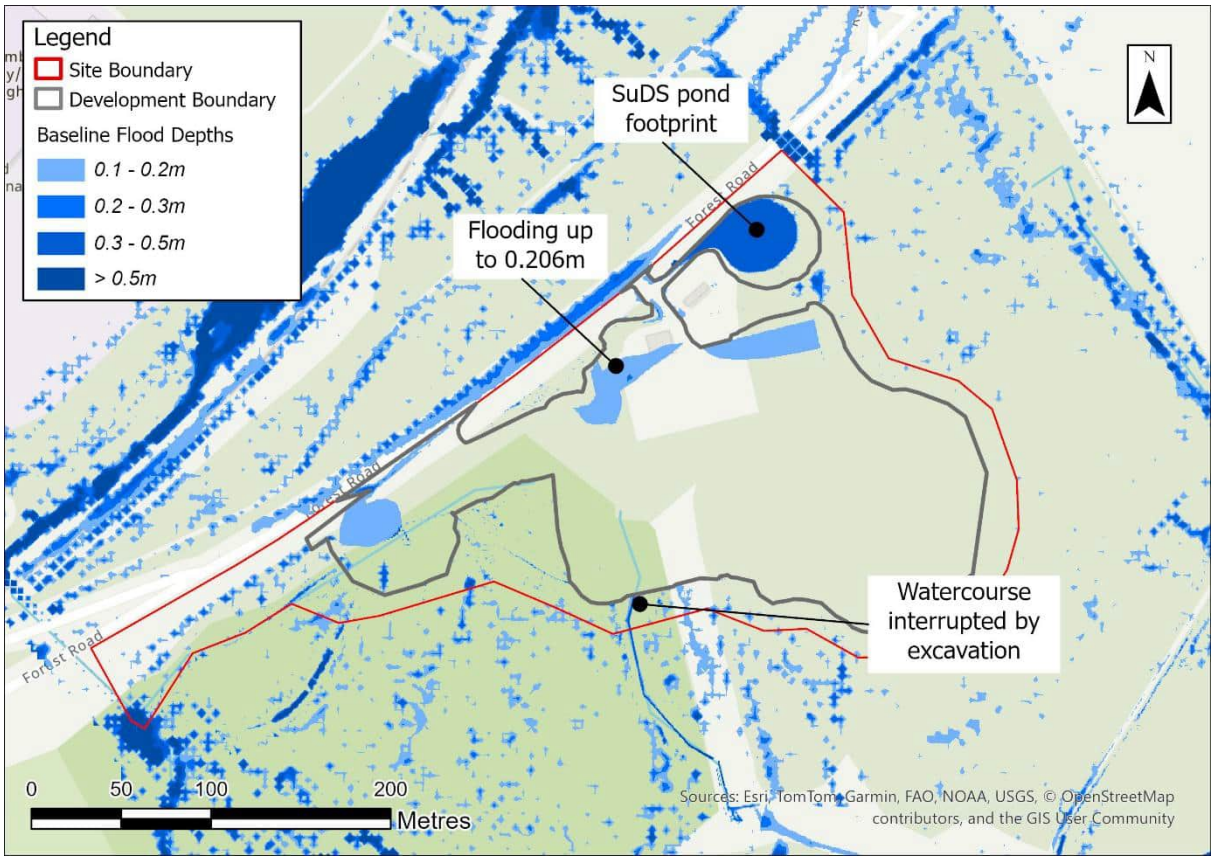


Plate 4- 11 Maximum depths on developed site in 0.5%AEP + Climate Change event

4.4.6.2 Mitigation

As the flood risk to the proposed development arises from multiple sources, mitigation measures will be recommended for each source.

4.4.6.2.1 Pluvial Flooding Mitigation

Pluvial flooding on site should be mitigated via adequate design of the surface water drainage infrastructure on site. The drainage network should be sized to manage all direct rainfall on site, as well as the additional surface water catchment which flows onto the site.

Under the proposed drainage plan for the development, the eastern portion of the site drainage network will receive surface water runoff from off-site through a cut-off trench positioned above the excavated embankments. By interrogating the model, this area has been determined to receive a total of 36.91m^3 of surface water runoff, which is equivalent to the total runoff from a 0.15 ha greenfield catchment. To mitigate the pluvial flood risk on site, the drainage strategy will have to consider this surface water catchment as well as the on-site rainfall catchment.

Further discussion of the drainage scheme proposed for the site is provided in the Surface Water Management Strategy in Section 4.5. If this strategy is followed, then the mitigation will be sufficient.

4.4.6.2.2 Fluvial Flooding Mitigation

The fluvial flood risk on site arises from out-of-bank flow from the Central Watercourse in high flow events. The proposed development would require a portion of this watercourse to be realigned through a cutoff trench so as not to flow through the substation footprint. The realignment of the watercourse provides the opportunity to improve the existing channel to support flow without overtopping the banks. The proposed arrangement of the watercourse realignment and cutoff trench is indicated in Plate 4-12.

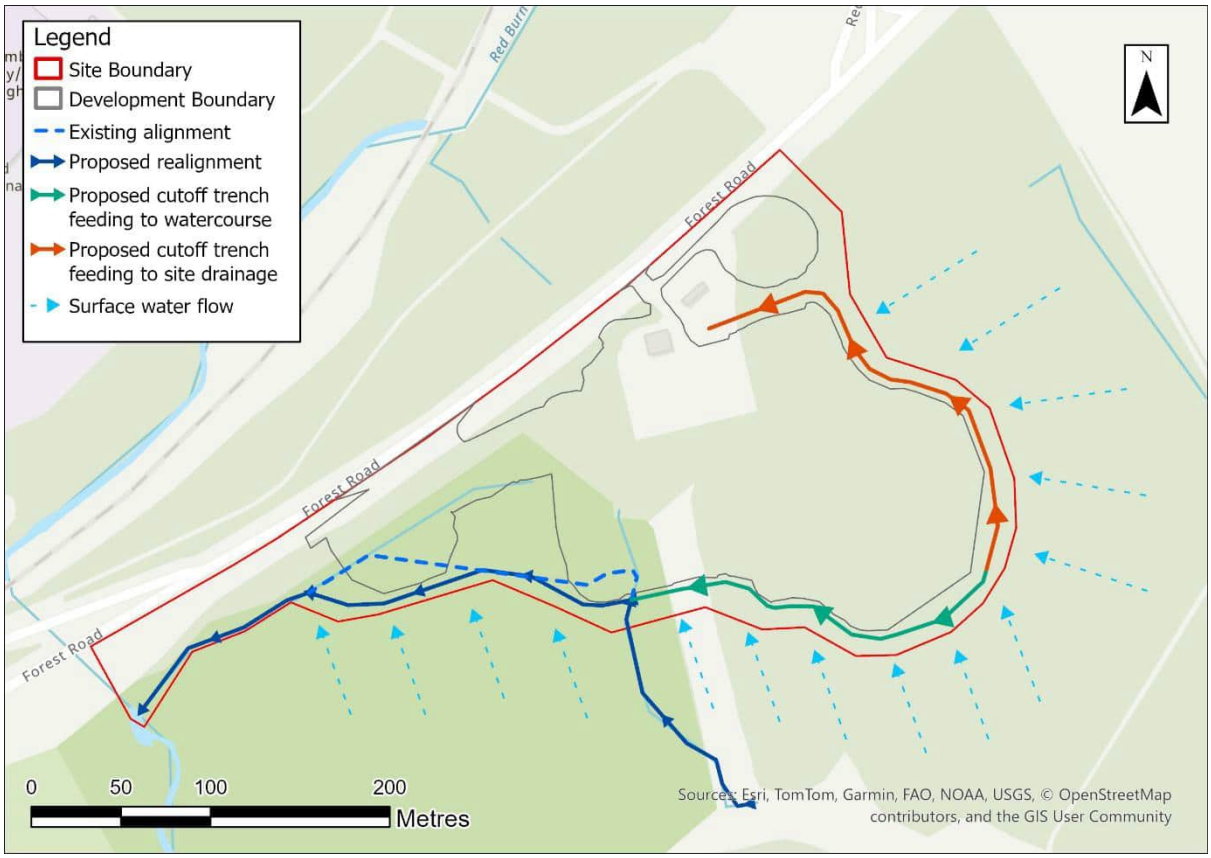


Plate 4-12 Layout of proposed watercourse realignment

The western portion of the cutoff trench and the realigned watercourse would collect surface water runoff along its southern bank. The peak flux through this boundary in the model is 1.55m^3/s, which corresponds to the sum of the base flow in the channel, plus inflow of surface water along its realigned length. This is an approximate upper bound of the flow capacity required in the channel in the 0.5%AEP+CC event.

A preliminary sizing of this channel was determined using the Manning's open channel equation by which it was determined that a trapezoidal channel section with 1:2 side slopes, 1.0m base channel width, and minimum 1:200 bed slope (S_o = *0.005)* could accommodate the required flow with a flow depth of 0.65m. The full calculations to support this conclusion can be found in Appendix E.

An additional embankment of at least 0.6m is recommended along the southern bank of this channel to provide freeboard against flows which otherwise might enter the development.

This mitigation will reduce flood risk on the substation compound as well as on Forest Road by preventing flow overtopping the channel. In normal flow conditions, this realignment would not impact flows off site at all, as the baseline flow already routes to the Glencryan Burn. In high flow conditions though, this would slightly increase flow in the Glencryan Burn, but this would not be expected to increase downstream flood risk as the Glencryan valley is deep and there are no flood risk receptors within the valley.

Additional attenuation should be provided within the realigned channel up to 25.8m^3 in the 0.5%AEP+CC flood event using a widened channel with check-dams, to compensate for flood water from this channel which would otherwise have been stored in the site footprint prior to channel realignment. In the detailed design stage, it should be verified that the proposed form of the channel provides sufficient attenuation.

4.4.7 Flood Risk Modelling Summary and Conclusions

Following the initial flood risk assessment described in Section 4.3, a 2D direct rainfall hydraulic model was developed using TUFLOW to develop a better understanding of the mechanisms of flood risk to the site. The model was built using a combination of survey and LiDAR data and it was identified that there is flood risk to the site arising from both surface water and small watercourse sources.

Assessment of the model results determined that approximately 59.9% of the flood impacts modelled on site arise from the overtopping of a small watercourse to the southwest of site, and the remaining flooding is pluvial in nature as it arises either from direct rainfall to the site or from surface water entering the site from a wider neighbour catchment.

The model was altered to reflect the proposed earthworks for the development. With this altered model, it was found that the proposed excavation would increase the flood risk to the site by increasing the size of the surface water catchment which feeds to it. The proposed earthworks would also interfere with the small watercourse to the southwest of the existing site, which is a source of flood risk. No increase in flood risk off-site was observed in the post-development model. As the proposed development constitutes essential infrastructure where the location is required for operational reasons, it can be accepted for development despite being in an area with active flood risk following NPF Policy 22a[7], as long as sufficient mitigation is provided.

Mitigation measures were proposed to address the increase in flood risk on the site. The surface water flood risk is proposed to be mitigated by the application of adequately designed surface water drainage on the site, taking into account the increase in surface water catchment arising from the development. Management of the flood risk from the small watercourse is proposed to be managed by realigning the watercourse to permit excavation of the site and improving the channel to prevent it from overtopping and impacting the site.

A preliminary sizing of this upgraded channel was offered using the Manning's open channel flow method along with the flow rate of 1.55m^3/s into the channel boundary as obtained from the post-development model. It was also noted that in-line storage should be provided in the realigned channel up to 25.8m^3 for the 0.5%AEP+CC event to compensate for storage previously provided by flooding to the site. This can be achieved using local channel widening and check dams along the channel length. Design of this extent outwits the scope of this report, so the design of the channel should be verified in the detailed design stage to provide sufficient flow capacity and sufficient attenuation.

The Surface Water Management Strategy detailed in the following section will provide high-level assessment of the level of surface water management required to mitigate pluvial flood risk to site.

4.5 Surface Water Management Strategy

4.5.1 Introduction

This Surface Water Management Strategy (SWMS) is provided to advise on the requirements for surface water management on the Cumbernauld Substation site. At the current planning stage, detailed drainage design information is not available. This SWMS will seek to provide a high-level assessment of the existing drainage on the site, the additional demands placed on it by the proposed works and assess how the proposed drainage scheme will address these demands through treatment of water quality and quantity.

4.5.2 Principles of Sustainable Drainage Systems (SuDS) Best Practice

SuDS are recommended by both national and local authorities for achieving sufficient drainage of excess surface water on site while mitigating harmful downstream effects such as pollution and flooding. SuDS achieve these goals by providing flow paths for surface water which filter out pollutants, attenuate peak flows, and provide flood storage where necessary.

The SuDS Manual[2] states the following SuDS drainage hierarchy should be utilised for new development planning proposals and requests for land drainage purposes:

1) Rainwater collection and re-use (where there is demand)
2) Infiltration to the maximum extent that is practical (where it is safe and acceptable to do so)
3) Discharge to surface waters
4) Discharge to surface water sewers
5) Discharge into combined sewer

A SuDS management approach is expressed within the SuDS Manual that allows the maximisation of SuDS uptake and benefits within planning proposals. The approach is expressed below:

- Use surface water as a resource,
- Manage rainfall at the source,
- Manage runoff on the surface of a site above ground,
- Allow for infiltration of runoff on site,
- Enhance evapotranspiration,
- Slow runoff and volume to greenfield runoff rates and volumes,
- Reduce water pollution by incorporating SuDS features to prevent pollution by enhancing water quality and control the runoff,
- Use SuDS to treat runoff in urbanised catchments/sites to prevent environmental pollution.

In accordance with the North Lanarkshire Council Supplementary Planning Guidance 09[10], this SWMS will assess the proposed drainage against SuDS best practice for the treatment of surface water (Water Quality) and the conveyance, attenuation, and storage of surface water (Water Quantity).

4.5.3 Proposed Drainage Scheme

The proposed drainage scheme is to be divided into two catchments, one serving the eastern portion and one serving the western portion. Plate 4-13 Excerpt of proposed drainage plan shows an excerpt of the proposed drainage plan, and the full plan is included in Appendix F.

In the East of the site, surface water will be collected from the contributing catchment within the substation using perforated pipes, which will flow through a network of filter drains to a SuDS attenuation basin with a footprint of approximately 850m^2. The eastern attenuation basin will also receive surface water which is intercepted by the cutoff trench to the east of the site (see Section 4.4.6.2.1). The basin will outlet at a controlled rate towards the Red Burn through existing drainage pipes beneath Forest Road. The capacity of these pipes has not yet been verified, but they will be assessed and replaced if necessary.

In the West of the site, surface water will be collected in perforated pipes and conveyed through filter drains to a SuDS attenuation basin with a footprint of approximately 600m^2. The drainage scheme for the West of the site will not receive any surface water runoff from off-site, as this is assumed to be managed by the cutoff trench as previously described. This basin will outlet at a controlled rate to the Glencryan Burn through an existing manhole on Forest Road, the condition of which will be assessed and improved if necessary prior to works commencing.

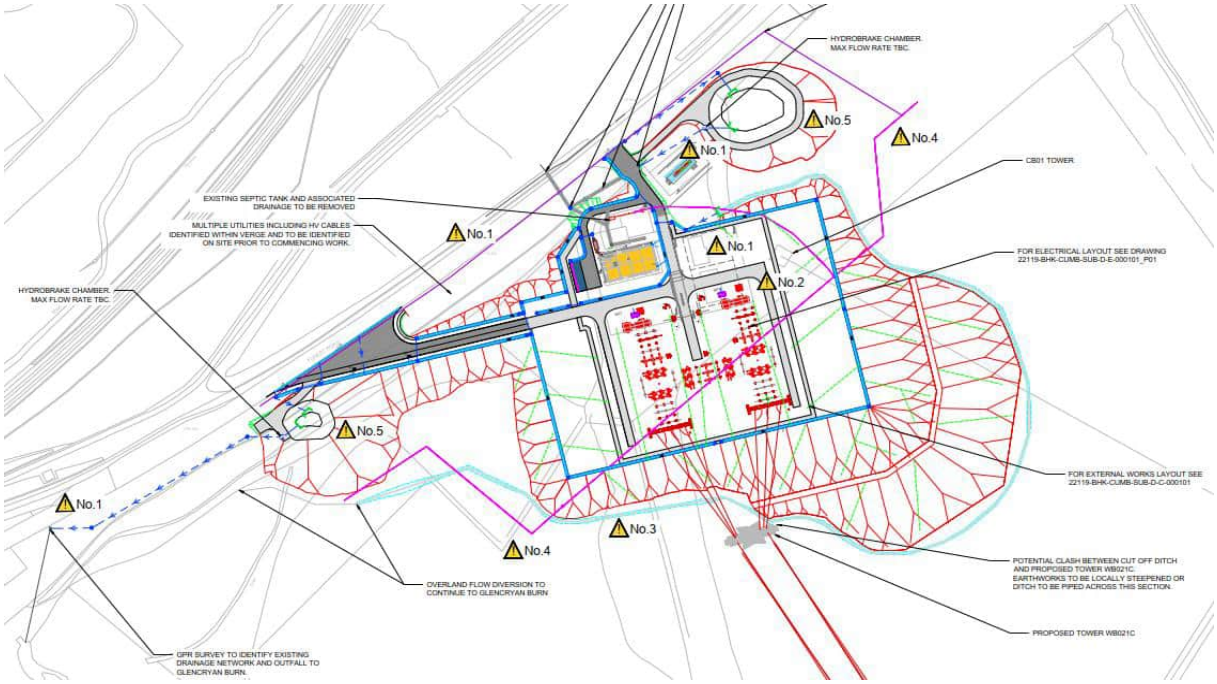


Plate 4-13 Excerpt of proposed drainage plan

4.5.4 Surface Water Impact

Each of the drainage catchments on site serves a different total area, composed of a different balance of impermeable and permeable areas. For the purpose of this SWMS, the impermeable area is considered to include paved roads and buildings, while the permeable area is considered to include the stoned substation compound, earthen banks, and any other area from which surface water may enter the drainage system.

The breakdown of impermeable and permeable areas served by each drainage catchment are outlined in Table 4-6, and a visual of the drainage catchments is shown in Plate 4-14.

Table 4-6 Breakdown of areas served by each drainage catchment

Catchment	Impermeable Area	Permeable Area (On site)	Permeable Area (Off site)	Total Area
East	0.35ha	3.13ha	0.15ha	3.63ha

West	0.15ha	0.55ha	N/a	0.70ha

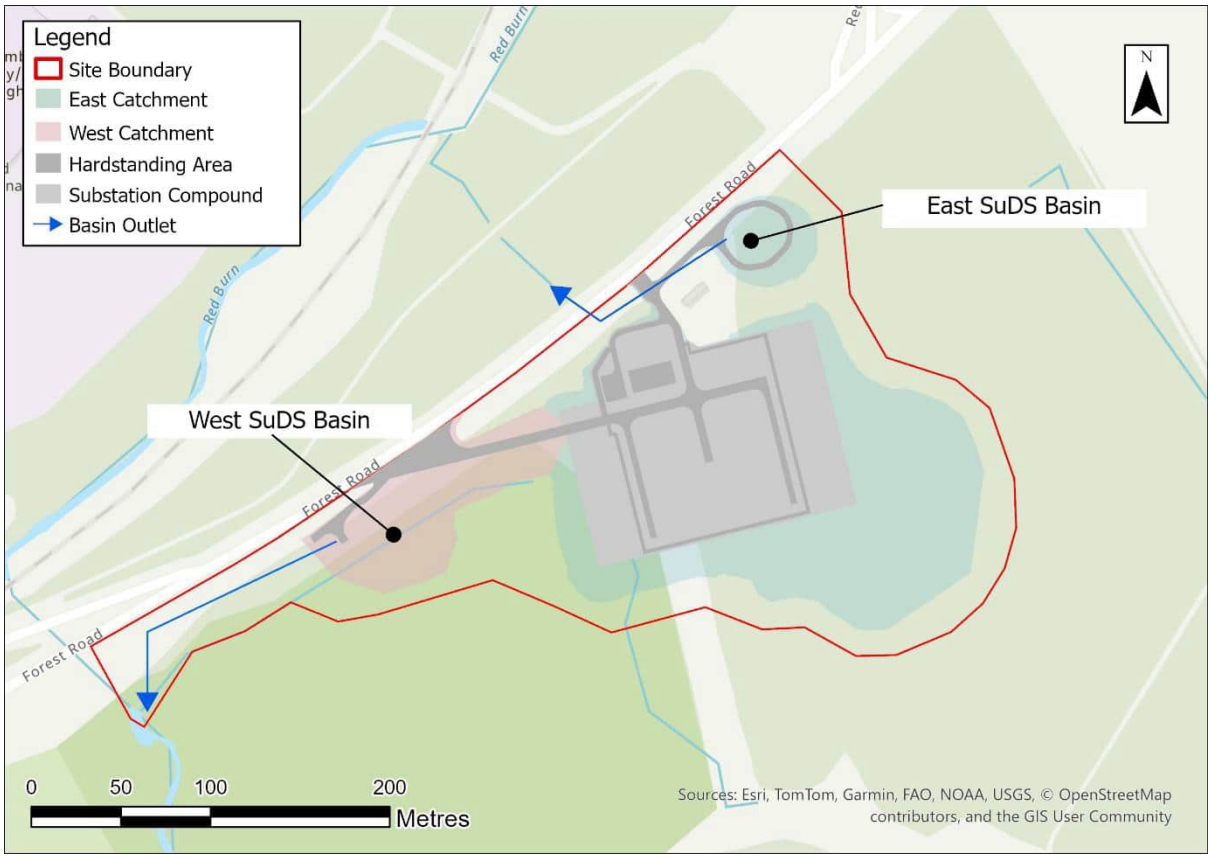


Plate 4-14 Overview of drainage catchments

4.5.5 Water Quality

The Simple Index Approach (SIA) is a method of assessing whether the SuDS features proposed for a site are adequate to treat the collected runoff for the following pollutants: Total Suspended Solids (TSS), Metals, and Hydrocarbons. Based on the proposed usage of the site, a pollution index will be assigned for each of these pollutants.

The proposed SuDS features will have a rating for each pollutant corresponding to their efficacy in treating that type of pollution. Based on the SuDS Manual, the sum of the treatment indices of the proposed SuDS must exceed the pollution index according to land usage. Where multiple SuDS features are used in series, the mitigation of each subsequent feature is factored by 0.5 to account for the reduction in treatment efficacy arising from a reduced concentration of pollutant at the inlet due to previous treatment.

The highest risk of pollution in the site arises from the access road which runs around the perimeter of the substation platform. Both the pollution risk and SuDS treatment chain are the same for the two drainage catchments on site. The traffic load on this access road is expected to be low, so the development fits the Low Hazard level for general access roads specified by Table 26.2 of the SuDS Manual. The resulting pollution hazard indices for the site and mitigation indices for the proposed SuDS are summarised in Table 4-7.

Table 4-7 Summary of Simple Index Approach for proposed SuDS

Source	Description	TSS Index	Metals Index	Hydrocarbon Index
Land Use (pollution)	Low pollution hazard access road	0.5	0.4	0.4
Proposed SuDS 1 (mitigation)	Filter Drain	0.4	0.4	0.4
Proposed SuDS 2 (mitigation)	Basin	0.5 * 0.5 = 0.25	0.5 * 0.5 = 0.25	0.5 * 0.6 = 0.3
	Check	0.65 ≥ 0.5 OK	0.65 ≥ 0.4 OK	0.7 ≥ 0.4 OK

Following the above analysis, the proposed layout of a filter drain feeding to a basin will exceed the requirements for pollution mitigation. However, it should be noted that filter drains generally require more frequent maintenance if they are used to remove coarse sediments and this should be considered when developing the maintenance plan for the proposed drainage network, as discussed further in Section 4.5.7.

4.5.6 Water Quantity

4.5.6.1 Approach

This section will provide initial calculations based on currently available data to illustrate that the proposed drainage scheme will be capable of conveying and attenuating the volume of additional surface water which will be generated by the impermeable area of the proposed scheme. This will be achieved through several steps: first by identifying the limiting outflow from the system in order to mitigate flood risk downstream of the site, then by modelling the drainage scheme to indicate approximate element sizes which would be required for sufficient attenuation. Following local council guidance, the following calculations will use the 0.5% AEP storm, with a 39% rainfall uplift for climate change as the design event following SEPA recommendations for the Clyde river basin[22].

4.5.6.2 Discharge Rate

The rate at which the proposed drainage system outlets to the Red Burn and to the Glencryan Burn is critical for estimating storage capacities required within the scheme. This rate must be controlled in order to mitigate the risk of flooding downstream of the site. Best practice is to limit this flow to the greenfield (predevelopment) runoff rate of the site.

The greenfield runoff rate was calculated using the HR Wallingford tool[23] and applying the Institute of Hydrology (IH124) method using local catchment data obtained from the FEH web service[24]. The results of this calculation are presented in Table 4-8. Full results of the calculation are presented in Appendix G.

[22] SEPA (2025). *Climate change allowances for flood risk assessment in land use planning, version 6.* Available online at: https://www.sepa.org.uk/media/jjwpxuso/climate-change-allowances-guidance_v6.pdf
[23] HR Wallingford. Webtool. Available online at: https://www.uksuds.com/tools/greenfield-runoff-rate-estimation
[24] UK Centre for Ecology and Hydrology. Web Service. Available online at: https://fehweb.ceh.ac.uk/

Table 4-8 Cumbernauld Substation Greenfield Runoff Rate

Return period (yrs)	Annual Exceedance Probability (AEP)	Greenfield Runoff Rate (l/s/ha)
1	100%	10.0
2 (Q_{BAR})	50%	10.5
30	3.33%	22.5
100	1%	30.4
200	0.5%	34.5

Appendix G.

above shows that the greenfield runoff rate of the site is 10.5L/s/ha for the 50% AEP storm. This will conservatively be taken as the controlling outlet rate. SPEN has offered preliminary controlling rates as 5l/s and 21.6l/s for the western and eastern basin respectively. Based on the catchment areas discussed previously, the outlet flows for each surface water drainage catchment are calculated in Table 4-9. This shows that the greenfield runoff rates determined in this report are greater than those offered as preliminary values by SPEN. The analysis in this report will use these more refined values to provide guidance on the required attenuation volume, although the detailed drainage design may differ.

Table 4-9 Summary of Outlet Flows for Surface Water Drainage

Drainage Catchment	Outlet location	Total Drained Area (ha)	SPEN Preliminary outlet rate (L/s)	50%AEP Greenfield Outlet Flow (L/s)
East	Red Burn	3.63	21.6	38.1
West	Glencryan Burn	0.70	5.0	7.4

4.5.6.3 Attenuation Capacity

InfoDrainage 2025.3 software, which was current at the time of modelling, was used to carry out a high-level assessment of the post-development surface water attenuation volume requirements on site. This drainage software simulated the post-development flow of the site using existing rainfall data to calculate the volume required.

The model was split into two networks, one to serve the east of the site and one to serve the west of the site. Each network was modelled with two catchments, one to represent the impermeable area with a 100% runoff coefficient, and one to represent permeable area with a 50% runoff coefficient calculated by the HR Wallingford greenfield run-off webtool[21] based on the site BFIHOST value. The sizes of these catchments correspond to the values in Table 4-6.

The storage volume for each catchment was represented using a SuDS basin with a Hydrobrake controlled outflow following **Error! Reference source not found.**. The sizing of each basin is provided in Table 4-10.

Table 4-10 Summary of basin sizing

Basin	Surface footprint	Side Slope	Depth	Storage Volume
East	1300m^2	1:4	1.5m	1426.1m^3
West	365m^2	1:4	1.5m	297.4m^3

Rainfall values on site were calculated using the FEH22 model using point descriptors obtained from the FEH Web Service. Results were obtained for the 50% AEP baseline event and the 3.33%, 1%, and 0.5% AEP events with 39% uplift for climate change. Storm durations were simulated from 15 minutes to 720 minutes, as preliminary model runs found the critical event to be of short duration.

The model found the critical event to be the 0.5% AEP (+39% rainfall) 240-minute Summer event for the East pond with 96% utilisation and the 240-minute Winter event for the West pond, with 98% utilisation. These results indicate that the proposed scheme is sufficient for handling the surface water attenuation needs of the site up to the 200 year-climate change storm. This provides a preliminary sizing recommendation for the on-site attenuation, which may change in the detailed design phase if assumptions are refined.

Results from the critical storm in each return period event are summarised in Table 4-11, and the full results are given in Appendix H.

Table 4-11 Summary of attenuation sizing

Annual Exceedance Probability	Critical Storm	East Pond Resident Volume	East Pond Utilisation	West Pond Resident Volume	West Pond Utilisation
50% AEP	240-minute, Summer	285.38m^2	20%	58.17m^2	20%
3.33% AEP + CC	180-minute, Winter	937.46m^3	66%	197.46m^3	66%
1% AEP + CC	180-minute, Winter	1197.91m^3	84%	254.45m^3	86%
0.5% AEP + CC	240-minute, Summer	1365.64m^3	96%	290.10m^3	98%

Because the outflows of each pond were controlled to the 50%AEP greenfield runoff rate for their catchments, the surface water impact off site is improved against the baseline for extreme events.

The basin sizes determined in this analysis are different from preliminary sizes indicated on the site plan in Section 4.5.3. The required attenuation in the Western pond means that this pond can be reduced in size, however the Eastern pond would need to be slightly increased in size. The available area within the site boundary would permit this change, which should be confirmed during detailed design.

The proposed site levels would place the basin crests at 115.3mAOD and 111.037mAOD for the Eastern and Western basins respectively, which would mean surcharge of these basins would not impact the substation platform at 118.0mAOD.

4.5.7 Maintenance Schedule

To ensure the continued functionality and performance of the proposed SuDS, a maintenance schedule must be produced. SPEN will be responsible for the proper maintenance of SuDS assets on site, unless they appoint a suitable factor. Each element requires inspection and maintenance, possibly through a factoring agreement for the development. Failure to properly maintain the surface water drainage can lead to increased flooding on site and pollution downstream. According to the SuDS Manual, the minimum requirements for each SuDS component are tabulated as follows:

Table 4-12 Summary of Recommended Maintenance for Filter Drains

Maintenance schedule	Required Action	Typical Frequency
Regular Maintenance	Remove litter and debris from filter drain surface, access chambers, and any pre-treatment devices	Monthly, or as required
	Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage	Monthly
	Inspect pre-treatment systems, inlets, and perforated pipework for silt accumulation and establish appropriate silt removal frequencies	Six monthly
	Remove sediment from pre-treatment devices	Six monthly, or as required
Occasional Maintenance	Remove or control tree roots where they are encroaching on the sides of the filter drain, using recommended methods (BS 3998:2010[25])	As required
	At locations with high pollution loads, remove surface geotextiles and replace, and wash or replace overlying filter medium	Five yearly, or as required
	Clear perforated pipework of blockages	As required

Table 4-13 Summary of Recommended Maintenance for SuDS Basins

Maintenance schedule	Required Action	Typical Frequency
Regular Maintenance	Remove litter and debris	Monthly, or as required
	Cut grass – public areas	Monthly (during growing season), or as required
	Cut grass – meadow grass in and around the basin	Half yearly (spring, before nesting season, and autumn)
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required

[25] BS 3998:2010 – Tree Work. (2010). British Standards Institution.

Maintenance schedule	Required Action	Typical Frequency
	Inspect inlets, outlets, and overflows for blockages and clear if required.	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Monthly (first year), then annually or as required
	Check any mechanical devices, eg penstocks	Annually
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets, outlets, and forebay	Annually (or as required)
	Manage wetland plants in outlet pool – where provided	Annually
Occasional Maintenance	Reseed areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years, or as required
	Remove sediment from inlets, outlets, forebay, and main basin when required	Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is provided)
Remedial actions	Repair erosion or other damage by reseeding or re-turfing	As required
	Realignment of rip-rap	As required
	Rehabilitation of inlets, outlets, and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required

4.5.8 Construction Phase SuDS

Prior to construction commencing, a Construction Method Statement will be drafted by the appointed contractor. This should include a section describing how surface water will be managed during construction to prevent any uncontrolled discharge into nearby watercourses, in line with SuDS Manual. This document should be issued to the relevant authorities, either SEPA or the planning authority, for approval before construction commences on site.

4.5.9 SWMS Conclusion and Recommendations

This SWMS assessed the proposed scheme for draining the new substation platform, which consists of two catchments served by peripheral filter drains and conveying to SuDS basins which discharge nearby watercourses. This scheme was deemed sufficient for treating surface water runoff for TSS, metals, and hydrocarbons following application of the Simple Index approach.

In line with best practice, the discharge rates from the SuDS basins on site are recommended to be limited to the 50%AEP greenfield runoff rate, which was calculated according to the IH124 method as 10.5l/s/ha.

The total attenuation requirement for the site was modelled using InfoDrainage 2025.1.1 software for a 0.5% AEP plus climate change (39% rainfall uplift) critical storm event. Each drainage catchment was modelled with a permeable area (50% runoff coefficient) and an impermeable area (100% runoff coefficient). These catchments were modelled to feed directly to the respective SuDS basin.

The basin sizing was iterated to achieve a solution with high utilisation. It was determined that a storage volume of 297.4m^3 was sufficient for the western catchment, and a volume of 1426.1m^3 was sufficient for the eastern catchment. These schemes achieved utilisations of 98% and 96% respectively. A maintenance schedule for each SuDS feature was recommended following CIRIA guidance.

As the site is still under planning, the proposed treatment path may be subject to change in the detailed design phase and an update to the Simple Index Approach may be required. A full drainage design is recommended to be carried out in the detailed design phase when geotechnical data is available for the site.

4.6 Summary and Conclusion

AECOM were commissioned by Scottish Power Energy Networks (SPEN) to consult on flood risk and surface water management for the proposed extension of the Cumbernauld substation as part of the Denny to Wishaw Network Upgrade project. This report has been undertaken to provide a Level 3 Flood Risk Assessment (FRA) to assess the level of flood risk on site and to prepare a Surface Water Management Strategy (SWMS) for managing surface water on site.

The new development is proposed to expand the existing Cumbernauld substation to the south by excavating into a nearby hillside. A new control building would be instated, along with various electrical equipment required for the uprating of the local overhead line.

Following a full review of the site conditions and common mechanisms for flooding, the FRA has determined that the Cumbernauld substation site is not at risk of coastal, groundwater, or infrastructure-related flooding. However, the SEPA Flood Maps indicated a possible combination of overland pluvial flows and small watercourse fluvial flows which could affect the site.

Hydraulic modelling was carried out using a 2D direct rainfall model in TUFLOW, identifying that the site is at risk of flooding from a combination of pluvial and small watercourse sources. This flood risk primarily affected the northern portion of the existing substation, with a maximum water depth of 275mm. The model was confirmed to be minimally sensitive to changes in key parameters through a suite of sensitivity tests.

A further model was developed to understand the impact of the proposed earthworks on surface water flow paths. It was determined that the proposed excavation of the hillside would increase flood risk on site, as the surface water catchment of the site would increase, and a small watercourse would be interrupted.

Mitigation to the noted flood risk was recommended, consisting of a cutoff trench to be installed above the excavation slope to the south, which would both intercept surface water which would otherwise flow into the site, and would also realign and reinforce the small watercourse to the southwest of the site. A preliminary sizing of this trench was provided based on the volume flow rate observed in the model across the boundary that the trench would serve.

With appropriate mitigation measures supplied by this cutoff trench, as well as appropriate provision of surface water drainage on site, it is deemed that the level of risk to the site is acceptable following the NPF4, as it is classified as essential infrastructure where the location is required for operational purposes. No increase in off-site flood risk was noted in the model.

This report also offers a Surface Water Management Strategy (SWMS) in support of the proposed development assessing the outline drainage design and providing recommendations for further design development. The requirements for surface water drainage are presented, as well as the principles of SuDS best practice which informed the SWMS. The proposed works include a filter drain network to service the platform extension, which would feed into a SuDS basin, discharging to the unnamed drainage ditch to the north of the site.

The proposed SuDS treatment path was assessed using the Simple Index Approach and found to be sufficient for treating surface water runoff from the proposed access roads. A high-level assessment of the storage required onsite was undertaken to ensure that the proposed scheme can provide sufficient surface water attenuation to mitigate flood risks downstream.

As the Cumbernauld site is still under planning, the proposed drainage scheme may be subject to change in the detailed design phase; update to the Simple Index Approach may be required and a full drainage design is recommended to be carried out in the detailed design phase.

Appendix A – Site walkover Photos

A.1 Western Watercourse A

The site walkover followed footpaths into Palacerigg Country Park from near the interchange between Forest Road and the B8054 to the west of the site. A small watercourse/ditch was identified at NS77169 74236, which corresponds to the expected location of the Western Watercourses. Due to lack of access, it was not possible to determine the upstream alignment of this watercourse. The channel was culverted beneath the path, with the outlet continuing towards the Glencryan Burn. This channel was dry at the time of the site walkover. This channel will be referred to as Western Watercourse A.



Plate 6-1: View of Western Watercourse A where it discharges southwest to Glencryan Burn

A.2 Western Watercourse B

Another channel, which was larger and more defined, was identified further south at NS77219 74208. This indicated that there may be two drainage ditches which both convey water westwards to Glencryan Burn from the area surrounding the site. This watercourse will be referred to as Western Watercourse B.



Plate 6-2: View of Western Watercourse B taken at NS77219 74208 facing west.

A.3 Southeastern Drain

The Southeastern Drain, which is unnamed but present on OS maps, was positively identified during the site walkover. The channel was highly vegetated but maintained a consistent cross section. It was found to originate at NS77995 74133, and was found to be culverted at NS77796 74065. The land to the north of the channel was generally tall grass, and to the south of the channel generally woodland. At its downstream end, this watercourse was found to turn abruptly to the south where it met a footpath and flowed into the Glencryan burn.



Plate 6-3: Photo of the Southeast Drain near its source, facing southwest.

A.4 Northeast Watercourse

The length of this watercourse was visited and photographed, walking southeast from an access point on Forest Road at NS77602 74618. The channel was poorly defined upstream, but degraded and eventually disappeared to near its downstream end at NS77660 74513. There did not appear to be a path through which this watercourse could flow towards site. Downhill of the end of this watercourse, a pedestrian underpass beneath Forest Road was identified, which had low flow travelling south within it indicating that it may collect some of the flow from this watercourse, transferring it towards the Red Burn.



Plate 6-4: View of Northeast Watercourse taken at NS77689 74469 facing west



Plate 6-5: View of pedestrian underpass at NS77500 74544, facing south.

A.5 Central Watercourse

An interception drain was found running alongside the main Palacerigg Country Park footpath from NS77665 74026 to NS77731 74264 and is assumed to continue along the length of the footpath. At NS77660 74129, this drain was found to be culverted beneath the footpath, flowing westward towards site and towards the Central Watercourse previously identified on OS maps. While the downstream portion of this watercourse could not be visited and identified, it is expected based on topography that it would continue towards site.

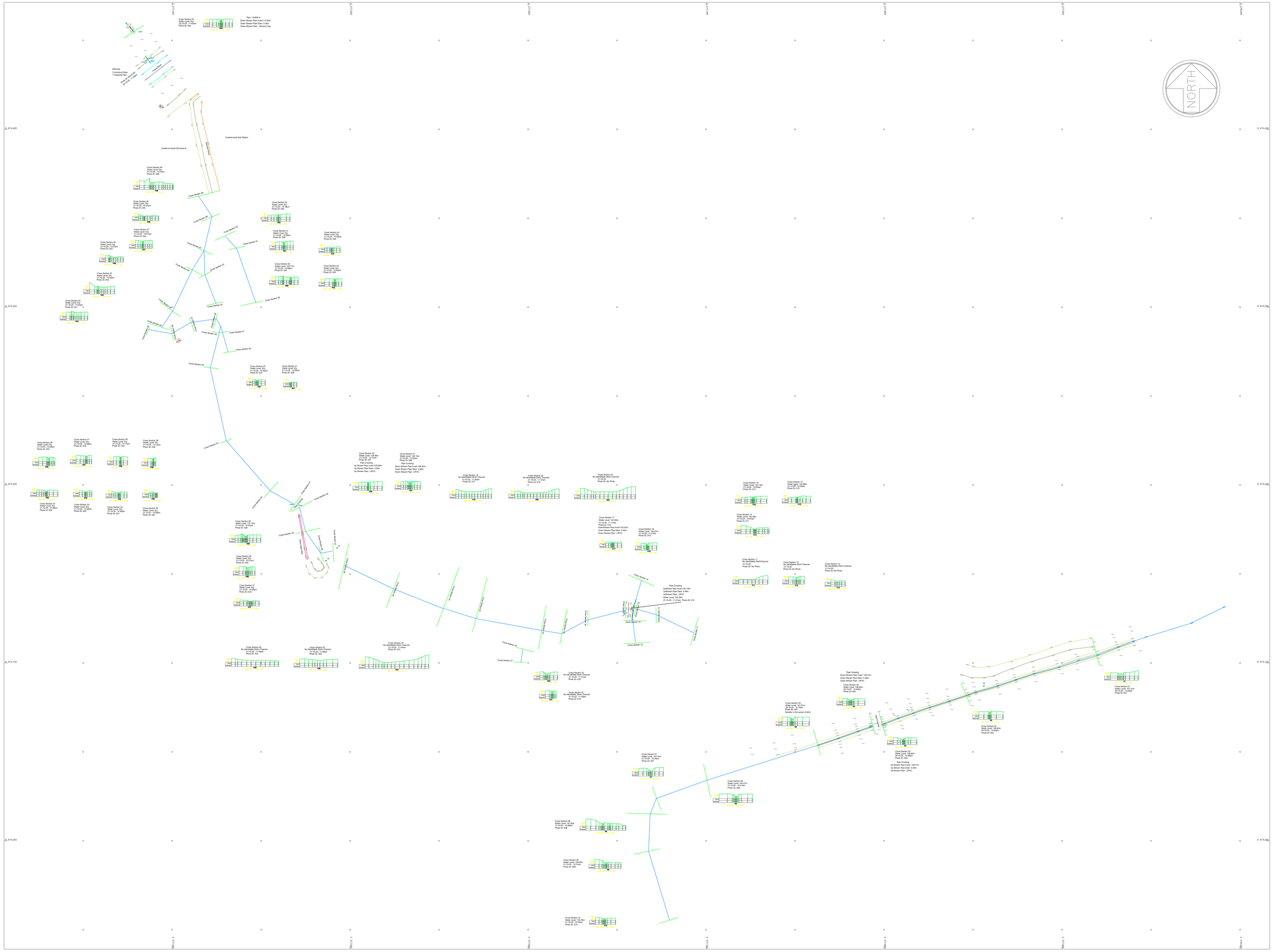


Figure 6-7: Transverse drain alongside footpath

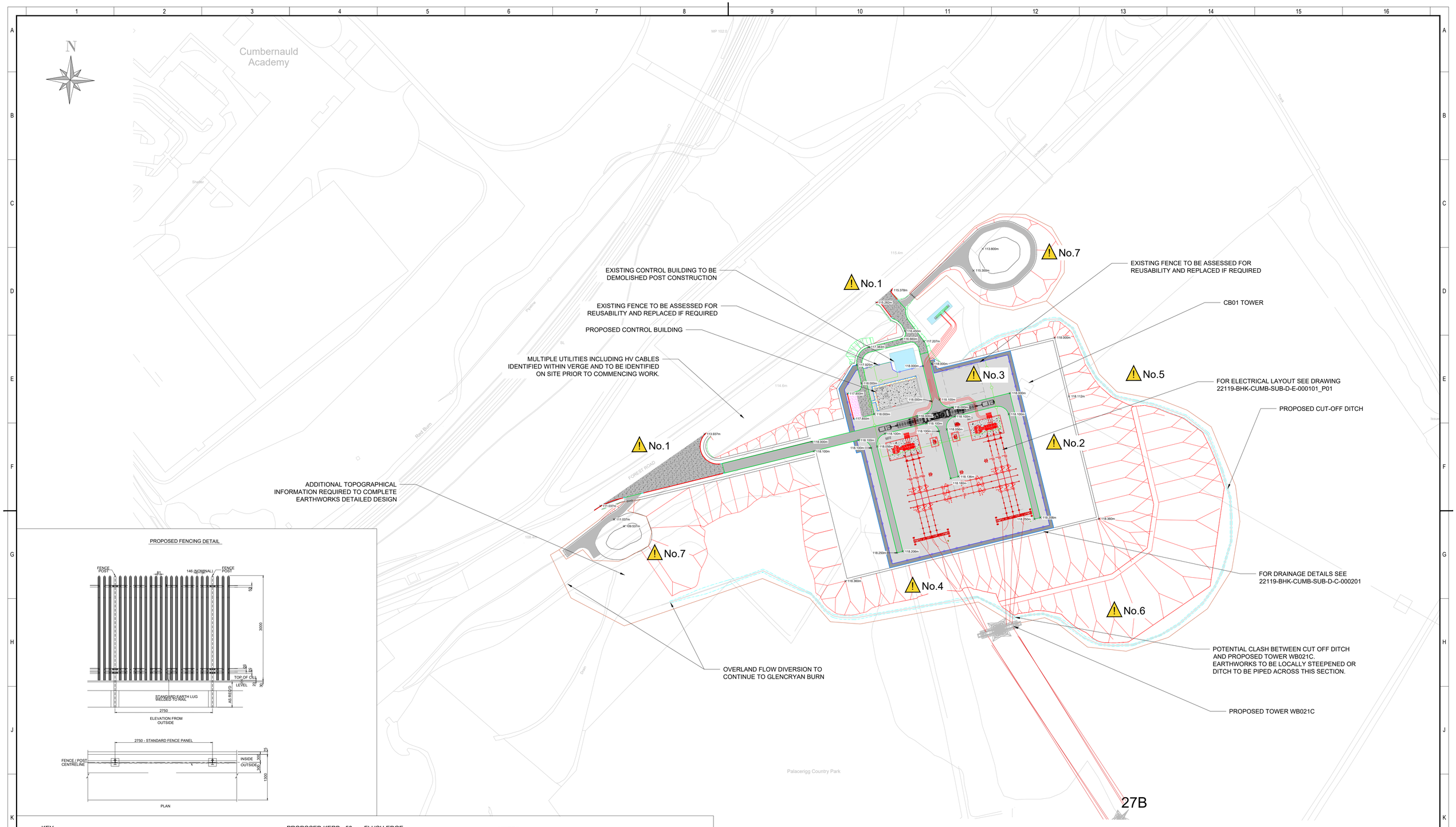


Figure 6-6b: Flow emerging from culvert of transverse drain under footpath at NS77660 74129, flowing west towards site.

Appendix B – Results of MHCLS Topographic Survey


E 677,600
E 677,700
E 677,800
E 677,900
E 678,000
N 674,400
N 674,300
N 674,200
N 674,100
N 674,000
Manhole
3 Incoming Pipes
1 Outgoing Pipe
Water Level: 142.
21-10-25 - 11:43am
Photo ID: 1
Inlet
Outlet
Access Track
Cumbernauld Sub Station
Unable to locate Structure 8
Cross Section 53
Water Level: Dry
21-10-25 - 10:55am
Photo ID: 352
Pipe - Outlet A
Down Stream Pipe Invert:112.90m
Down Stream Pipe Diam: 0.30m
Down Stream Pipe - Vitreous Clay
Cross Section 46
Water Level: Dry
21-10-25 - 11:00am
Photo ID: 346
Cross Section 48
Water Level: Dry
21-10-25 - 14:37pm
Photo ID: 349
Cross Section 47
Water Level: Dry
21-10-25 - 14:47pm
Photo ID: 348
Cross Section 49
Water Level: Dry
21-10-25 - 14:56pm
Photo ID: 347
Cross Section 45
Water Level: Dry
21-10-25 - 14:59pm
Photo ID: 345
Cross Section 44
Water Level: Dry
21-10-25 - 15:40pm
Photo ID: 344
Cross Section 52
Water Level: Dry
21-10-25 - 10:59am
Photo ID: 340
Cross Section 51
Water Level: Dry
21-10-25 - 11:05am
Photo ID: 339
Cross Section 50
Water Level: 122.07m
21-10-25 - 14:08pm
Photo ID: 337
Cross Section 43
Water Level: Dry
21-10-25 - 13:55pm
Photo ID: 343
Cross Section 42
Water Level: Dry
21-10-25 - 13:49pm
Photo ID: 342
Cross Section 41
Water Level: Dry
21-10-25 - 13:43pm
Photo ID: 338
Cross Section 42
Water Level: Dry
21-10-25 - 13:37pm
Photo ID: 337
Cross Section 38
Water Level: Dry
21-10-25 - 15:09pm
Photo ID: 333
Cross Section 37
Water Level: Dry
21-10-25 - 15:05pm
Photo ID: 334
Cross Section 35
Water Level: Dry
21-10-25 - 15:00pm
Photo ID: 336
Cross Section 32
Water Level: Dry
21-10-25 - 15:16pm
Photo ID: 329
Cross Section 33
Water Level: Dry
21-10-25 - 12:44pm
Photo ID: 330
Cross Section 34
Water Level: Dry
21-10-25 - 12:46pm
Photo ID: 331
Cross Section 35
Water Level: Dry
21-10-25 - 13:02pm
Photo ID: 332
Cross Section 30
Water Level: 125.80m
21-10-25 - 11:27am
Photo ID: 327
Up Stream Pipe Invert:125.80m
Up Stream Pipe Diam: 0.60m
Up Stream Pipe - UPVC
Cross Section 31
Water Level: 126.10m
21-10-25 - 11:31am
Photo ID: 328
Pipe Crossing
Down Stream Pipe Invert:125.32m
Down Stream Pipe Diam: 0.60m
Down Stream Pipe - UPVC
Cross Section 15
No Identifiable Ditch Channel
21-10-25 - 11:34am
Photo ID: 317
Cross Section 22
No Identifiable Ditch Channel
21-10-25 - 11:37am
Photo ID: 318
Cross Section 23
No Identifiable Ditch Channel
21-10-25
Photo ID: No Photo
Cross Section 16
Water Level: 143.16m
21-10-25 - 10:53am
Photo ID: 312
Cross Section 14
Water Level: 142.68m
21-10-25 - 10:51am
Photo ID: 311
Cross Section 17
Water Level: 142.26m
21-10-25 - 11:17am
Photo ID: 313
DownStream Pipe Invert:142.02m
DownStream Pipe Diam: 0.60m
Down Stream Pipe - UPVC
Cross Section 18
Water Level: 142.19m
21-10-25 - 11:20am
Photo ID: 314
Cross Section 11
No Identifiable Ditch Channel
21-10-25
Photo ID: No Photo
Cross Section 12
No Identifiable Ditch Channel
21-10-25
Photo ID: No Photo
Cross Section 13
No Identifiable Ditch Channel
21-10-25
Photo ID: No Photo
Cross Section 15
Water Level: 142.66m
21-10-25 - 10:47am
Photo ID: 310
Cross Section 26
Water Level: 142.42m
21-10-25 - 12:02pm
Photo ID: 326
Cross Section 28
Water Level: Dry
21-10-25 - 12:07pm
Photo ID: 325
Cross Section 27
Water Level: Dry
21-10-25 - 12:09pm
Photo ID: 324
Pipe Crossing
UpStream Pipe Invert:142.19m
UpStream Pipe Diam: 0.40m
Up Stream Pipe - UPVC
Water Level: 142.26m
21-10-25 - 11:21am Photo ID: 314
Cross Section 36
No Identifiable Ditch Channel
21-10-25 - 11:44am
Photo ID: 323
Cross Section 35
No Identifiable Ditch Channel
21-10-25 - 11:48am
Photo ID: 322
Cross Section 24
21-10-25 - 11:41am
Photo ID: 321
Cross Section 22
No Identifiable Ditch Channel
21-10-25 - 11:41am
Photo ID: 320
Cross Section 21
No Identifiable Ditch Channel
21-10-25
Photo ID: 319
Pipe Crossing
Down Stream Pipe Invert: 148.31m
Down Stream Pipe Diam: 0.46m
Down Stream Pipe - UPVC
Cross Section 55
Water Level: 148.60m
21-10-25 - 10:40am
Photo ID: 004
Cross Section 53
Water Level: 148.47m
21-10-25 - 10:15am
Photo ID: 003
Bunded. At the center of ditch
Cross Section 52
Water Level: 148.37m
21-10-25 - 10:05am
Photo ID: 002
Cross Section 54
Water Level: 148.42m
21-10-25 - 10:30am
Photo ID: 005
Pipe Crossing
Up Stream Pipe Invert: 148.31m
Up Stream Pipe Diam: 0.46m
Up Stream Pipe - UPVC
Cross Section 07
Water Level: 142.73m
21-10-25 - 10:24am
Photo ID: 307
Cross Section 08
Water Level: 140.27m
21-10-25 - 10:28am
Photo ID: 308
Cross Section 09
Water Level: 143.42m
21-10-25 - 10:18am
Photo ID: 309
Cross Section 05
Water Level: 138.94m
21-10-25 - 10:14am
Photo ID: 305
Cross Section 10
Water Level: Dry
21-10-25 - 10:35am
Photo ID: 310
Cross Section 03
Water Level: Dry
21-10-25 - 10:31am
Photo ID: 303
Cross Section 01
Water Level: Dry
21-10-25 - 10:26am
Photo ID: 301
Cross Section 02
Water Level: Dry
21-10-25 - 10:29am
Photo ID: 302
Cross Section 04
Water Level: Dry
21-10-25 - 10:33am
Photo ID: 304
Cross Section 06
Water Level: Dry
21-10-25 - 10:37am
Photo ID: 306
Cross Section 19
Water Level: 142.89m
21-10-25 - 11:23am
Photo ID: 315
Cross Section 20
Water Level: 142.77m
21-10-25 - 11:26am
Photo ID: 316
Cross Section 21
Cross Section 22
Cross Section 23
Cross Section 24
Cross Section 25
Cross Section 26
Cross Section 27
Cross Section 28
Cross Section 29
Cross Section 30
Cross Section 31
Cross Section 32
Cross Section 33
Cross Section

Appendix C – Layout of Proposed Development



PROPOSED FENCING DETAIL

KEY:

- PROPOSED ROAD - ASPHALT
- PROPOSED ROAD (AS PER SPEN SPECIFICATION SUB-03-34)
- PROPOSED FOOTPATH (AS PER SPEN SPECIFICATION SUB-03-34)
- PROPOSED FOOTPATH - ASPHALT
- PROPOSED STONE COMPOUND AREA (AS PER SPEN SPECIFICATION SUB-03-34)
- PROPOSED NEW FOUNDATIONS
- PROPOSED PERMEABLE PAVING
- PROPOSED KERB - HALF BATTER
- PROPOSED KERB - 125mm FLUSH EDGE
- PROPOSED KERB - 50mm FLUSH EDGE
- PROPOSED KERB - TRANSITION
- PROPOSED FENCE
- EARTHWORKS (CUT) FROM SITE BOUNDARY TO EXISTING GROUND LEVEL. INDICATIVE ONLY - EXTENT AND MAXIMUM ALLOWABLE GRADIENT TO BE CONFIRMED.
- EARTHWORKS (FILL) FROM SITE BOUNDARY TO EXISTING GROUND LEVEL. INDICATIVE ONLY - EXTENT AND MAXIMUM ALLOWABLE GRADIENT TO BE CONFIRMED.
- EXISTING BUILDING
- PROPOSED STOCK PROOF FENCE
- PROPOSED FIELD GATE
- × 118.000m LEVEL (mAOD)

NOTES:

1. DO NOT SCALE FROM THIS DRAWING.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
3. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ARCHITECTURAL AND ENGINEERING DETAILS, DRAWINGS AND SPECIFICATIONS.
4. DETAILS AND POSITIONS OF ALL EXISTING SERVICES TO BE CONFIRMED PRIOR TO THE COMMENCEMENT OF WORKS ON SITE.
5. DRAWING TO BE PRINTED IN COLOUR.

Health & Safety
CDM regulations 2015

Significant risks associated with this drawing are identified below and, where applicable, at specific locations on the drawing.
Refer to the CDM Regulation 9 Risk Register for full details.

1. LOCATE UNDERGROUND SERVICES AND INTRODUCE A SAFE REMOVAL PROCEDURE (HSG47)
2. WORKING CLOSE TO OVERHEAD LINES (HSE GUIDANCE NOTE GS6)
3. FORMING PLATFORM IN PROXIMITY TO LIVE CABLES, POTENTIALLY REQUIRING PROTECTION DURING AND AFTER CONSTRUCTION
4. EXISTING 33kV SPD CIRCUITS BENEATH PROPOSED EARTHWORKS REQUIRING DIVERSION
5. EXISTING HIGH PRESSURE SCOTTISH WATER MAINS REQUIRING DIVERSION
6. BADGER SETTS IDENTIFIED DURING ECOLOGICAL SURVEYS
7. RISK OF WORKING CLOSE OR ADJACENT TO WATER

Rev.	Date	Drawn	Reviewed	Approved	Reason / Description of changes.
P02	11/09/2025	CM	CC	RH	REVISED TO SUIT DRAINAGE AND ELECTRICAL LAYOUT, CDM NOTES ADDED
P01	14/08/2025	CC	LB	RH	FIRST ISSUE

SP Energy Networks | MORGAN SINDALL INFRASTRUCTURE | BakerHicks

Location: CUMBERNAULD

Project: DWNO - DENNY TO WISHAW NETWORK OPTIMISATION

Drg. Title: CUMBERNAULD SUBSTATION PROPOSED EXTERNAL WORKS

Drg. No.: 22119-BHK-CUMB-SUB-D-C-000101

Rev: P02

Status Code: S3 | Description: Suitable for Review and Comment | SPEN Ref. No.: #### | Scale: 1:1000 | Sheet: 01 | Next: | Size: A1

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Appendix D – SEPA Flood Risk Assessment Checklist

Flood Risk Assessment (FRA) Checklist

Scotland's 4th National Planning Framework has recently been published. This document is therefore being reviewed and updated to reflect the new policies. You can still find useful and relevant information here but be aware that some parts may be out of date and our responses to planning applications may not match the information set out here.

(SS-NFR-F-001 - Version 16 - Last updated 27/08/2019

This document must be attached within the front cover of any Flood Risk Assessments issued to Local Planning Authorities (LPA) in support of a development proposal which may be at risk of flooding. The document will take only a few minutes to complete and will assist SEPA in reviewing FRAs, when consulted by LPAs. This document should not be a substitute for a FRA.

Development Proposal Summary							
Site Name:		Cumbernauld Substation					
Grid Reference:	Easting:	277444	Northing:	674399			
Local Authority:		North Lanarkshire Council					
Planning Reference number (if known):							
Nature of the development:		Utility Infrastructure	If residential, state type:				
Size of the development site:		6.67 Ha					
Identified Flood Risk:	Source:	Combined	Source name:	Surface Water and small watercourse			
Land Use Planning							
Is any of the site within the functional floodplain? (refer to SPP para 255)		No	If yes, what is the net loss of storage?			m^3	
Is the site identified within the local development plan?		No	Local Development Plan Name:		Year of Publication:		
			Allocation Number / Reference:				
If yes, what is the proposed use for the site as identified in the local plan?		Select from List	If Other please specify:				
Does the local development plan and/or any pre-application advice, identify any flood risk issues with or requirements for the site.		No	If so, please specify:				
What is the proposed land use vulnerability?		Essential Infrastructure	Do the proposals represent an increase in land use vulnerability?		No		
Supporting Information							
Have clear maps / plans been provided within the FRA (including topographic and flood inundation plans)?		Yes					
Has sufficient supporting information, in line with our Technical Guidance, been provided? For example: site plans, photos, topographic information, structure information and other site specific information.		Yes					
Has a historic flood search been undertaken?		Yes	If flood records in vicinity of the site please provide details:				
Is a formal flood prevention scheme present?		No	If known, state the standard of protection offered:				
Current / historical site use:		Electrical Substation					
Is the site considered vacant or derelict?		No					
Development Requirements							
Freeboard on design water level:		0.6 m					
Is safe / dry access and egress available?		Vehicular and Pedestrian	Min access/egress level:		111.037	m AOD	
Design levels:	Ground level:	118 m AOD	Min FFL:		118	mAOD	
Mitigation							
Can development be designed to avoid all areas at risk of flooding?		No					
Is mitigation proposed?		Yes					
If yes, is compenstory storage necessary?		No					
Demonstration of compensatory storage on a "like for like" basis?		No					
Should water resistant materials and forms of construction be used?		Yes					

Flood Risk Assessment (FRA) Checklist

(SS-NFR-F-001 - Version 16 - Last updated 27/08/2019

Hydrology

Is there a requirement to consider fluvial flooding?	No				
Area of catchment:		km^2	Is a map of catchment area included in FRA?	Select from List	
Estimation method(s) used (please select all that apply):	Pooled Analysis ☐		If Pooled analysis have group details been included?	Select from List	
	Single Site Analysis ☐				
	Enhanced Single Site ☐				
	ReFH2 ☐				
	FEH RRM ☐				
	Other ☐		If other (please specify methodology used):		
Estimate of 200 year design flood flow:		m^3/s			
Qmed estimate:		m^3/s	Method:	Select from List	
Statistical Distribution Selected:	Select from List		Reasons for selection:		

Hydraulics

Hydraulic modelling method:	2D		Software used:	TuFlow	
			If other please specify:		
Number of cross sections:	N/a				
Source of data (i.e. topographic survey, LiDAR etc):	LiDAR + Survey		Date obtained / surveyed:	20/10/2025	
Modelled reach length:	N/a	m			
Any changes to default simulation parameters?			If yes please provide details:		
Model timestep:	Variable				
Model grid size:	0.5m - 4m				
Any structures within the modelled length?	Culvert		Specify, if combination:		
Maximum observed velocity:	2.5	m/s			
Brief summary of sensitivity tests, and range:					
variation on flow (%)	N/a	%	Please specify climate change scenario considered:		
variation on channel roughness (%)	40	%			
blockage of structure (range of % blocked)	0-100	%			
boundary conditions:	**Upstream**			**Downstream**	
(1) type	Direct Rainfall			Normal depth	
Specify if other			Specify if other:		
(2) does it influence water levels at the site?	Yes			No	
Has model been calibrated (gauge data / flood records)?	No				
Is the hydraulic model available to SEPA?	No				
Design flood levels: 200 year	N/a	m AOD	200 year plus climate change	117.5	m AOD
Cross section results provided?	No				
Long section results provided?	No				
Cross section ratings provided?	No				
Tabular output provided (i.e. levels, velocities)?	No				
Mass balance error:		%			

Coastal

Is there a requirement to consider coastal / tidal flooding?	No			
Estimate of 200 year design flood level:		m AOD		
Estimation method(s) used:	Select from List		If other please specify methodology used:	
Allowance for climate change (m):		m		
Allowance for wave action etc (m):		m		
Overall design flood level:		m AOD		

Comments

Any additional comments:	Surface water / small watercourse flooding modeled using direct rainfall on a 2D grid. Maximum depth 275mm observed in existing site.

Approved by: [redacted]
Organisation: AECOM
Date: 14/01/2025

Note: Further details and guidance is provided in 'Technical Flood Risk Guidance for Stakeholders' which can be accesssed here:- CLICK HERE

Appendix E – Cutoff Trench Sizing Calculation

Using the following parameters:

Parameter	Unit	Symbol	Value
Bed width	*(m)*	*b*	1.0
Side slope (1:X)	*N/a*	*z*	2
Flow depth	*(m)*	*h*	0.65
Bed Slope	*(-)*	S_o	0.005
Manning's Roughness	*(-)*	*n*	0.035

The flow area in the trapezoidal section is:

1	$\boldsymbol{A = h(b + zh)}$
2	$A = 0.65 * (1.0 + 2 * 0.65)$
3	$A = 1.495m^2$

And the hydraulic radius of a trapezoidal section:

1	$\boldsymbol{R_h = A/(b + 2h\sqrt{1 + z^2})}$
2	$R_h = \dfrac{1.495}{1.0 + 2 * 0.65\sqrt{1 + 2^2}}$
3	$R_h = 0.383m$

And by the Manning Equation:

1	$\boldsymbol{Q = \dfrac{1}{n} * A * R_h^{\frac{2}{3}} * S_o^{\frac{1}{2}}}$
2	$Q = \dfrac{1}{0.035} * 1.495 * 0.383^{2/3} * 0.005^{1/2}$
3	$Q = 1.592m^3/s$

The achieved flowrate **Q = 1.59m³/s** is greater than the required flow rate of **Q = 1.55m³/s**

Appendix F – Proposed Drainage Layout

CONDITION OF EXISTING DRAINAGE TO BE INSPECTED FOR REUSABILITY AND REPLACED IF REQUIRED. COVER LEVELS AND INVERT LEVELS TO BE AMENDED TO SUIT DETAILED DESIGN

SCOTTISH WATER HP WATER MAINS TO BE DIVERTED ALONGSIDE FOREST ROAD

HYDROBRAKE CHAMBER. MAX FLOW RATE TBC.

No.5

No.4

No.1

CB01 TOWER

EXISTING SEPTIC TANK AND ASSOCIATED DRAINAGE TO BE REMOVED

MULTIPLE UTILITIES INCLUDING HV CABLES IDENTIFIED WITHIN VERGE AND TO BE IDENTIFIED ON SITE PRIOR TO COMMENCING WORK.

No.1

No.1

No.2

FOR ELECTRICAL LAYOUT SEE DRAWING 22119-BHK-CUMB-SUB-D-E-000101_P01

HYDROBRAKE CHAMBER. MAX FLOW RATE TBC.

No.5

FOR EXTERNAL WORKS LAYOUT SEE 22119-BHK-CUMB-SUB-D-C-000101

No.1

No.3

No.4

OVERLAND FLOW DIVERSION TO CONTINUE TO GLENCRYAN BURN

POTENTIAL CLASH BETWEEN CUT OFF DITCH AND PROPOSED TOWER WB021C. EARTHWORKS TO BE LOCALLY STEEPENED OR DITCH TO BE PIPED ACROSS THIS SECTION.

PROPOSED TOWER WB021C

GPR SURVEY TO IDENTIFY EXISTING DRAINAGE NETWORK AND OUTFALL TO GLENCRYAN BURN.

27B

Palacerigg Country Park

KEY:

- EXISTING SURFACE WATER DRAINAGE
- EXISTING SURFACE WATER DRAINAGE TO BE GRUBBED UP
- EXISTING FOUL WATER DRAINAGE
- PROPOSED SURFACE WATER PIPE AND CHAMBER
- PROPOSED HYDROBRAKE CHAMBER
- PROPOSED HEADWALL INLET / OUTLET
- PROPOSED OIL SEPARATOR TBC AT DETAIL DESIGN
- PROPOSED FOUL WATER PIPE AND CHAMBER
- PROPOSED UNDERGROUND WASTE WATER TANK
- EARTHWORKS (CUT) FROM SITE BOUNDARY TO EXISTING GROUND LEVEL. INDICATIVE ONLY - EXTENT AND MAXIMUM ALLOWABLE GRADIENT TO BE CONFIRMED.
- EARTHWORKS (FILL) FROM SITE BOUNDARY TO EXISTING GROUND LEVEL. INDICATIVE ONLY - EXTENT AND MAXIMUM ALLOWABLE GRADIENT TO BE CONFIRMED.
- PROPOSED FILTER DRAIN AND CHAMBER
- PROPOSED LINEAR DRAIN
- PROPOSED POROUS PAVING WITH PERFORATED PIPE
- PROPOSED GULLY
- PROPOSED PERFORATED PIPE
- EXISTING SCOTTISH WATER MAINS AND CHAMBER
- PROPOSED SCOTTISH WATER MAINS DIVERSION
- RAINWATER PIPE WITH 100mmØ TAIL (BELOW SLAB)

NOTES:

1. DO NOT SCALE FROM THIS DRAWING.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
3. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ARCHITECTURAL AND ENGINEERING DETAILS, DRAWINGS AND SPECIFICATIONS.
4. DETAILS AND POSITIONS OF ALL EXISTING SERVICES TO BE CONFIRMED PRIOR TO THE COMMENCEMENT OF WORKS ON SITE.
5. DRAWING TO BE PRINTED IN COLOUR.
6. POSITIONS OF ABOVE GROUND RAINWATER PIPES AND INTERNAL DRAINAGE PIPES SHOWN ARE INDICATIVE. SETTING OUT TO BE CONFIRMED BY ARCHITECT / STRUCTURAL ENGINEER.
7. SUBSTATION COMPOUND TO BE TYPE 3 SELF DRAINING MATERIAL. DRAINAGE DESIGN IS SUBJECT TO INFILTRATION TEST RESULTS FROM THE GROUND INVESTIGATION.
8. DRAINAGE COVER AND INVERT LEVELS TO BE CONFIRMED AT DETAILED DESIGN STAGE.
9. FINAL SuDS BASIN SIZINGS TO BE CONFIRMED AT DETAILED DESIGN STAGE.

Health & Safety
CDM regulations 2015

Significant risks associated with this drawing are identified below and, where applicable, at specific locations on the drawing.
Refer to the CDM Regulation 9 Risk Register for full details.

1. LOCATE UNDERGROUND SERVICES AND INTRODUCE A SAFE REMOVAL PROCEDURE (HSG47)
2. WORKING CLOSE TO OVERHEAD LINES (HSE GUIDANCE NOTE GS6)
3. EXISTING 33kV SPD CIRCUITS BENEATH PROPOSED EARTHWORKS REQUIRING DIVERSION
4. EXISTING HIGH PRESSURE SCOTTISH WATER MAINS REQUIRING DIVERSION
5. RISK OF WORKING CLOSE OR ADJACENT TO WATER

Rev.	Date	Drawn	Reviewed	Approved	Reason / Description of changes.
P03	23/01/2026	CC	LB	NS	OUTFALL OF WESTERN BASIN UPDATED, BASINS RESIZED ON NEW DRAINAGE LAYOUT
P02	11/09/2025	CM	CC	RH	REVISED TO SUIT DRAINAGE AND ELECTRICAL LAYOUT, CDM NOTES ADDED
P01	14/08/2025	CC	LB	RH	FIRST ISSUE

SP Energy Networks | MORGAN SINDALL INFRASTRUCTURE | BakerHicks

Drg. Title: CUMBERNAULD SUBSTATION PROPOSED DRAINAGE LAYOUT

Location: Cumbernauld

Project: DWNO - DENNY TO WISHAW NETWORK OPTIMISATION

Drg. No.: 22119-BHK-CUMB-SUB-D-C-000201

Rev: P03

Status Code	Description	SPEN Ref. No. :	Scale:	Sheet:	Next:	Size:
S3	Suitable for Review and Comment	####	1:1000	01		A1

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Appendix G – Greenfield Runoff Rate Calculation

Greenfield runoff rate estimation tool

www.uksuds.com | Greenfield runoff rate estimation tool (https://www.uksuds.com/)

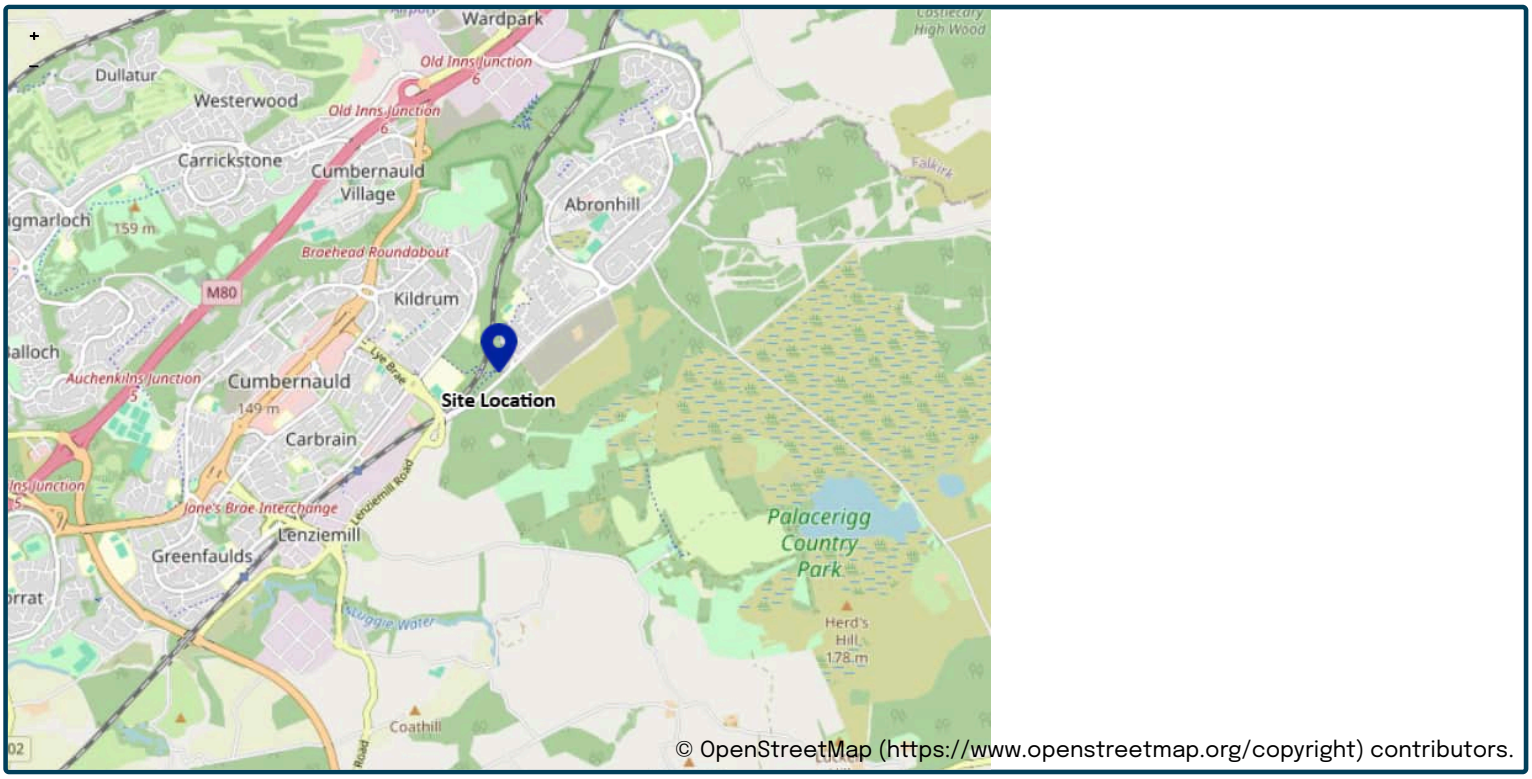
This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance “Rainfall runoff management for developments”, SC030219 (2013), the SuDS Manual C753 (CIRIA, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Project details

Date	14/01/2026
Calculated by	
Reference	
Model version	2.2.2

Location

Site name	Cumbernauld Substation
Site location	Cumbernauld



Site easting (British National Grid)	277455
Site northing (British National Grid)	674395

Site details

Total site area (ha)	1 ha

Greenfield runoff

Method

Method	IH124

IH124

	My value	Map value	
SAAR (mm)	1320		mm
How should SPR be derived?	Estimate using BFI		
BFIHOST	0.333		
SPR	0.499		
QBar (IH124) (l/s)	11.5		l/s

Growth curve factors

	My value	Map value
Hydrological region	2	
1 year growth factor	0.87	
2 year growth factor	0.91	
10 year growth factor	1.42	
30 year growth factor	1.95	
100 year growth factor	2.63	
200 year growth factor	2.99	

Results

Method	IH124	
Flow rate 1 year (l/s)	10.0	l/s
Flow rate 2 year (l/s)	10.5	l/s
Flow rate 10 years (l/s)	16.4	l/s
Flow rate 30 years (l/s)	22.5	l/s
Flow rate 100 years (l/s)	30.4	l/s
Flow rate 200 years (l/s)	34.5	l/s

Please note runoff estimation is subject to significant uncertainty. Results are therefore normally reported to only 1 decimal place. Where 2 decimal places are provided, this does not indicate accuracy to this level, it has been adopted to prevent 'zero' figures from being reported. Outputs less than 0.01 l/s are reported as 0.01 l/s.

Disclaimer

This report was produced using the Greenfield runoff rate estimation tool (2.2.2) developed by HR Wallingford and available at uksuds.com (https://www.uksuds.com/). The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at uksuds.com/terms-conditions (https://www.uksuds.com/terms-conditions). The outputs from this tool have been used to estimate Greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, Centre for Ecology and Hydrology, Wallingford Hydrosolutions or any other organisation for the use of these data in the design or operational characteristics of any drainage scheme.

Appendix H – Infodrainage Model Results

Project:	Date: 15/01/2026		
	Designed by: [redacted]	Checked by:	Approved By:
Report Details: Type: Inflows Storm Phase: Phase	Company Address:		

West Catchment Permeable Type : Catchment Area

Area (ha)	0.55

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	0.500
Winter Volumetric Runoff	0.500
Time of Concentration (mins)	5
Percentage Impervious (%)	100

East Catchment Impermeable Type : Catchment Area

Area (ha)	0.35

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	1.000
Winter Volumetric Runoff	1.000
Time of Concentration (mins)	5
Percentage Impervious (%)	100

East Catchment Permeable Type : Catchment Area

Area (ha)	3.28

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	0.500
Winter Volumetric Runoff	0.500
Time of Concentration (mins)	5
Percentage Impervious (%)	100

West Catchment Impermeable Type : Catchment Area

Area (ha)	0.15

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	1.000
Winter Volumetric Runoff	1.000
Time of Concentration (mins)	5
Percentage Impervious (%)	100

Project:	Date: 15/01/2026		
	Designed by: [redacted]	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Storm Phase: Phase	Company Address:		

West Pond Type : Pond

Dimensions

Exceedance Level (m)	0.000
Depth (m)	1.500
Base Level (m)	-1.500
Freeboard (mm)	0
Initial Depth (m)	0.000
Porosity (%)	100
Average Slope (1:X)	4.039
Total Volume (m³)	297.422

Depth (m)	Area (m²)	Volume (m³)
0.000	70.00	0.000
1.500	365.00	297.422

Inlets

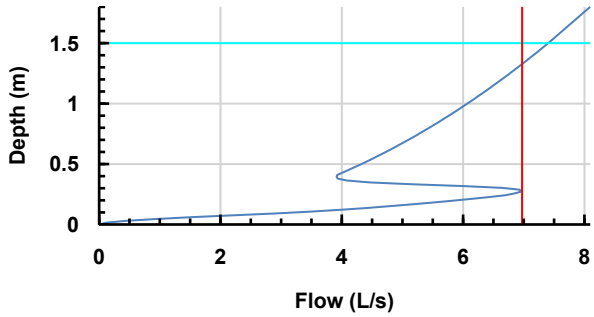
Inlet

Inlet Type	Point Inflow
Incoming Item(s)	West Catchment Permeable West Catchment Impermeable
Bypass Destination	(None)
Capacity Type	No Restriction

Outlets

Outlet

Outgoing Connection	(None)
Outlet Type	Hydro-Brake®
Invert Level (m)	-1.500
Design Depth (m)	1.500
Design Flow (L/s)	7.4
Objective	Minimise Upstream Storage Requirements
Application	Surface Water Only
Sump Available	☐
Unit Reference	CHE-0113-7400-1500-7400



Project:	Date: 15/01/2026		
	Designed by: [redacted]	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Storm Phase: Phase	Company Address:		

Advanced

Perimeter	Circular
Length (m)	34.566
Friction Scheme	Manning's n
n	0.035

East Pond Type : Pond

Dimensions

Exceedance Level (m)	0.000
Depth (m)	1.500
Base Level (m)	-1.500
Freeboard (mm)	0
Initial Depth (m)	0.000
Porosity (%)	100
Average Slope (1:X)	4.046
Total Volume (m³)	1426.070

Depth (m)	Area (m²)	Volume (m³)
0.000	640.00	0.000
1.500	1300.00	1426.070

Inlets

Inlet

Inlet Type	Point Inflow
Incoming Item(s)	East Catchment Impermeable East Catchment Permeable
Bypass Destination	(None)
Capacity Type	No Restriction

Project:	Date: 15/01/2026		
	Designed by: [redacted]	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Storm Phase: Phase	Company Address:		

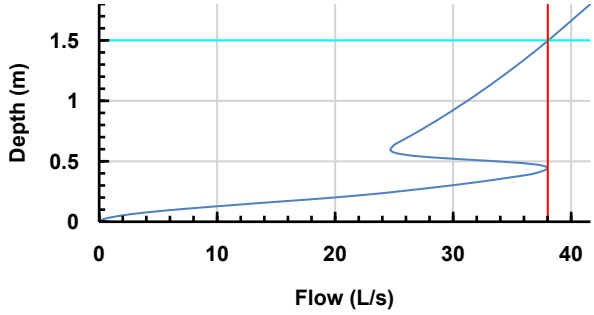
Outlets

Outlet

Outgoing Connection	(None)
Outlet Type	Hydro-Brake®

Invert Level (m)	-1.500
Design Depth (m)	1.500
Design Flow (L/s)	38.1
Objective	Minimise Upstream Storage Requirements
Application	Surface Water Only
Sump Available	☐

Unit Reference	CHE-0240-3810-1500-3810



Advanced

Perimeter	Circular
Length (m)	37.850
Friction Scheme	Manning's n
n	0.035

Project:	Date: 15/01/2026		
	Designed by: [redacted]	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Summary Storm Phase: Phase	Company Address:		

Summary Results for West Pond

Storm Event	Max. Resident Volume (m³)	Max. Outflow (L/s)	Percentage Available (%)	Status
FEH: 30 years: +39 %: 15 mins: Summer	102.399	5.4	65.571	OK
FEH: 30 years: +39 %: 15 mins: Winter	102.311	5.4	65.601	OK
FEH: 30 years: +39 %: 30 mins: Summer	139.606	6.0	53.061	OK
FEH: 30 years: +39 %: 30 mins: Winter	139.616	6.0	53.058	OK
FEH: 30 years: +39 %: 60 mins: Summer	176.673	6.7	40.598	OK
FEH: 30 years: +39 %: 60 mins: Winter	177.019	6.9	40.482	OK
FEH: 30 years: +39 %: 120 mins: Summer	191.800	6.9	35.512	OK
FEH: 30 years: +39 %: 120 mins: Winter	193.359	6.7	34.988	OK
FEH: 30 years: +39 %: 180 mins: Summer	195.117	6.9	34.397	OK
FEH: 30 years: +39 %: 180 mins: Winter	197.463	6.9	33.609	OK
FEH: 30 years: +39 %: 240 mins: Summer	193.603	7.0	34.906	OK
FEH: 30 years: +39 %: 240 mins: Winter	196.820	6.9	33.825	OK
FEH: 30 years: +39 %: 360 mins: Summer	189.464	7.0	36.298	OK
FEH: 30 years: +39 %: 360 mins: Winter	191.007	6.9	35.779	OK
FEH: 30 years: +39 %: 480 mins: Summer	185.951	6.9	37.479	OK

FEH: 30 years: +39 %: 480 mins: Winter	186.249	7.0	37.379	OK
FEH: 30 years: +39 %: 600 mins: Summer	182.888	7.0	38.509	OK
FEH: 30 years: +39 %: 600 mins: Winter	181.095	7.0	39.112	OK
FEH: 30 years: +39 %: 720 mins: Summer	180.034	7.0	39.469	OK
FEH: 30 years: +39 %: 720 mins: Winter	175.826	7.0	40.883	OK
FEH: 100 years: +39 %: 15 mins: Summer	132.097	5.9	55.586	OK
FEH: 100 years: +39 %: 15 mins: Winter	132.039	5.9	55.605	OK
FEH: 100 years: +39 %: 30 mins: Summer	182.030	6.5	38.797	OK
FEH: 100 years: +39 %: 30 mins: Winter	182.069	6.7	38.784	OK
FEH: 100 years: +39 %: 60 mins: Summer	231.238	6.9	22.253	OK
FEH: 100 years: +39 %: 60 mins: Winter	231.568	6.9	22.142	OK
FEH: 100 years: +39 %: 120 mins: Summer	247.812	7.1	16.680	OK
FEH: 100 years: +39 %: 120 mins: Winter	249.519	7.1	16.106	OK
FEH: 100 years: +39 %: 180 mins: Summer	252.169	7.1	15.215	OK
FEH: 100 years: +39 %: 180 mins: Winter	254.446	7.1	14.449	OK
FEH: 100 years: +39 %: 240 mins: Summer	251.150	7.1	15.558	OK
FEH: 100 years: +39 %: 240 mins: Winter	254.443	7.1	14.450	OK

FEH: 100 years: +39 %: 360 mins: Summer	245.289	7.0	17.528	OK
FEH: 100 years: +39 %: 360 mins: Winter	248.464	7.1	16.461	OK
FEH: 100 years: +39 %: 480 mins: Summer	241.050	7.0	18.954	OK
FEH: 100 years: +39 %: 480 mins: Winter	242.850	7.0	18.348	OK
FEH: 100 years: +39 %: 600 mins: Summer	237.778	7.0	20.054	OK
FEH: 100 years: +39 %: 600 mins: Winter	238.050	7.0	19.962	OK
FEH: 100 years: +39 %: 720 mins: Summer	235.134	7.0	20.943	OK
FEH: 100 years: +39 %: 720 mins: Winter	233.191	7.0	21.596	OK
FEH: 200 years: +39 %: 15 mins: Summer	150.170	6.1	49.509	OK
FEH: 200 years: +39 %: 15 mins: Winter	150.119	6.1	49.527	OK
FEH: 200 years: +39 %: 30 mins: Summer	207.873	6.8	30.108	OK
FEH: 200 years: +39 %: 30 mins: Winter	207.896	6.9	30.101	OK
FEH: 200 years: +39 %: 60 mins: Summer	264.225	7.2	11.161	OK
FEH: 200 years: +39 %: 60 mins: Winter	264.489	7.2	11.073	OK
FEH: 200 years: +39 %: 120 mins: Summer	281.839	7.3	5.239	OK
FEH: 200 years: +39 %: 120 mins: Winter	283.483	7.3	4.687	OK
FEH: 200 years: +39 %: 180 mins: Summer	287.146	7.3	3.455	OK

FEH: 200 years: +39 %: 180 mins: Winter	289.306	7.3	2.729	OK
FEH: 200 years: +39 %: 240 mins: Summer	286.987	7.3	3.508	OK
FEH: 200 years: +39 %: 240 mins: Winter	290.101	7.4	2.462	OK
FEH: 200 years: +39 %: 360 mins: Summer	280.859	7.3	5.569	OK
FEH: 200 years: +39 %: 360 mins: Winter	285.096	7.3	4.144	OK
FEH: 200 years: +39 %: 480 mins: Summer	276.458	7.3	7.048	OK
FEH: 200 years: +39 %: 480 mins: Winter	278.802	7.3	6.260	OK
FEH: 200 years: +39 %: 600 mins: Summer	273.199	7.2	8.144	OK
FEH: 200 years: +39 %: 600 mins: Winter	274.444	7.3	7.726	OK
FEH: 200 years: +39 %: 720 mins: Summer	270.814	7.2	8.946	OK
FEH: 200 years: +39 %: 720 mins: Winter	270.155	7.2	9.168	OK

Project:	Date: 15/01/2026		
	Designed by: [redacted]	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Summary Storm Phase: Phase	Company Address:		

Summary Results for East Pond

Storm Event	Max. Resident Volume (m³)	Max. Outflow (L/s)	Percentage Available (%)	Status
FEH: 30 years: +39 %: 15 mins: Summer	480.255	33.0	66.323	OK
FEH: 30 years: +39 %: 15 mins: Winter	479.754	33.0	66.358	OK
FEH: 30 years: +39 %: 30 mins: Summer	656.953	30.7	53.933	OK
FEH: 30 years: +39 %: 30 mins: Winter	656.402	31.4	53.971	OK
FEH: 30 years: +39 %: 60 mins: Summer	835.207	38.0	41.433	OK
FEH: 30 years: +39 %: 60 mins: Winter	834.152	37.0	41.507	OK
FEH: 30 years: +39 %: 120 mins: Summer	912.622	37.2	36.004	OK
FEH: 30 years: +39 %: 120 mins: Winter	914.881	37.7	35.846	OK
FEH: 30 years: +39 %: 180 mins: Summer	933.115	36.8	34.567	OK
FEH: 30 years: +39 %: 180 mins: Winter	937.457	37.8	34.263	OK
FEH: 30 years: +39 %: 240 mins: Summer	931.381	37.9	34.689	OK
FEH: 30 years: +39 %: 240 mins: Winter	937.053	37.9	34.291	OK
FEH: 30 years: +39 %: 360 mins: Summer	922.092	38.0	35.340	OK
FEH: 30 years: +39 %: 360 mins: Winter	917.310	38.0	35.676	OK
FEH: 30 years: +39 %: 480 mins: Summer	910.391	37.9	36.161	OK

FEH: 30 years: +39 %: 480 mins: Winter	897.389	38.0	37.073	OK
FEH: 30 years: +39 %: 600 mins: Summer	896.780	38.0	37.115	OK
FEH: 30 years: +39 %: 600 mins: Winter	872.406	38.0	38.824	OK
FEH: 30 years: +39 %: 720 mins: Summer	881.810	38.0	38.165	OK
FEH: 30 years: +39 %: 720 mins: Winter	845.198	38.0	40.732	OK
FEH: 100 years: +39 %: 15 mins: Summer	619.925	37.8	56.529	OK
FEH: 100 years: +39 %: 15 mins: Winter	619.546	37.8	56.556	OK
FEH: 100 years: +39 %: 30 mins: Summer	855.237	36.6	40.028	OK
FEH: 100 years: +39 %: 30 mins: Winter	854.734	37.1	40.064	OK
FEH: 100 years: +39 %: 60 mins: Summer	1087.318	34.5	23.754	OK
FEH: 100 years: +39 %: 60 mins: Winter	1087.129	35.4	23.768	OK
FEH: 100 years: +39 %: 120 mins: Summer	1168.148	35.6	18.086	OK
FEH: 100 years: +39 %: 120 mins: Winter	1173.184	38.0	17.733	OK
FEH: 100 years: +39 %: 180 mins: Summer	1190.966	36.8	16.486	OK
FEH: 100 years: +39 %: 180 mins: Winter	1197.910	37.0	15.999	OK
FEH: 100 years: +39 %: 240 mins: Summer	1188.348	37.4	16.670	OK
FEH: 100 years: +39 %: 240 mins: Winter	1199.066	37.8	15.918	OK

FEH: 100 years: +39 %: 360 mins: Summer	1172.837	38.0	17.757	OK
FEH: 100 years: +39 %: 360 mins: Winter	1174.042	37.9	17.673	OK
FEH: 100 years: +39 %: 480 mins: Summer	1159.874	38.0	18.666	OK
FEH: 100 years: +39 %: 480 mins: Winter	1155.356	38.0	18.983	OK
FEH: 100 years: +39 %: 600 mins: Summer	1147.217	38.0	19.554	OK
FEH: 100 years: +39 %: 600 mins: Winter	1133.165	38.0	20.539	OK
FEH: 100 years: +39 %: 720 mins: Summer	1134.234	38.0	20.464	OK
FEH: 100 years: +39 %: 720 mins: Winter	1108.579	38.0	22.263	OK
FEH: 200 years: +39 %: 15 mins: Summer	704.469	36.5	50.601	OK
FEH: 200 years: +39 %: 15 mins: Winter	704.146	36.5	50.623	OK
FEH: 200 years: +39 %: 30 mins: Summer	975.813	38.0	31.573	OK
FEH: 200 years: +39 %: 30 mins: Winter	975.153	37.9	31.620	OK
FEH: 200 years: +39 %: 60 mins: Summer	1239.585	36.2	13.077	OK
FEH: 200 years: +39 %: 60 mins: Winter	1239.715	37.5	13.068	OK
FEH: 200 years: +39 %: 120 mins: Summer	1322.859	37.6	7.237	OK
FEH: 200 years: +39 %: 120 mins: Winter	1329.139	37.1	6.797	OK
FEH: 200 years: +39 %: 180 mins: Summer	1348.598	38.0	5.433	OK

FEH: 200 years: +39 %: 180 mins: Winter	1356.698	38.0	4.865	OK
FEH: 200 years: +39 %: 240 mins: Summer	1365.639	37.5	4.238	OK
FEH: 200 years: +39 %: 240 mins: Winter	1360.094	37.6	4.626	OK
FEH: 200 years: +39 %: 360 mins: Summer	1330.346	38.0	6.712	OK
FEH: 200 years: +39 %: 360 mins: Winter	1337.698	37.8	6.197	OK
FEH: 200 years: +39 %: 480 mins: Summer	1318.016	38.0	7.577	OK
FEH: 200 years: +39 %: 480 mins: Winter	1317.764	38.0	7.595	OK
FEH: 200 years: +39 %: 600 mins: Summer	1306.885	38.0	8.358	OK
FEH: 200 years: +39 %: 600 mins: Winter	1298.263	38.0	8.962	OK
FEH: 200 years: +39 %: 720 mins: Summer	1295.825	38.0	9.133	OK
FEH: 200 years: +39 %: 720 mins: Winter	1276.205	38.0	10.509	OK