LT470 – Carnaig Substation

Drainage Impact Assessment

Prepared for

J Murphy & Sons Ltd

Scottish & Southern Electricity Networks (SSEN)

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Appendix

1. Introduction

J Murphy & Sons (Murphy) has commissioned Tony Gee and Partners LLP (TG) to produce a Drainage Impact Assessment Report to inform the design and planning application for the proposed development 400kV Carnaig Substation.

The proposed location for the 400kV substation is adjacent to the existing Loch Buidhe substation, north of Bonar Bridge. The new substation will enable the connection of a proposed new 400kV line between Banniskirk Substation and Beauly Substation.

1.1. Site Location

The proposed Carnaig Substation is centred around grid reference: E: 265256 N: 897907 to the south-east of Lairgs just off Lochbuie Road, approximately 0.6km south from Loch Buidhe. The loch represents the lowest point within the nearby area from where the land increases in elevation surrounding the loch. Clashban is the closest settlement to the site which is located approximately 1.2km to the southwest.

The proposed site is located approximately 100m south of the existing substation adjacent to Lochbuie Road. Access to the site is proposed from the south west off Lochbuie Road.

Figure 1: Proposed Site Location

1.2. Background and Aims

This report outlines the proposed drainage strategy to manage surface water runoff and foul water disposal resulting from the proposed development. The report will propose an indicative site area and red line boundary for the Planning Application Notice. The impact of the proposed development on the water environment has been considered.

The aim of the strategy is to develop drainage solutions for the proposed development that comply with current guidance and best management practice. Capacity requirements, discharge, and appropriate sustainable urban drainage systems (SuDS) for the surface water drainage are identified within this report.

This report has been prepared in accordance with “Water Assessment and Drainage Assessment Guide” (SEPA, 2016), The Highlands Council “Flood Risk and Drainage Impact Assessment Supplementary Guidance” (THC, 2016), the CIRIA SuDS Manual (CIRIA, 2015) and Sewers for Scotland 4th Edition (Scottish Water, 2018).

1.3. Consultation and data source

The following sources have been used in the compilation of this Drainage Assessment:

- Scottish Environment Protection Agency Flood Risk Mapping
- Scottish Water Sewer Record Plans
- CIRIA SuDS Manual C753
- Sewers for Scotland (4th Edition)
- SSEN Specification SP-NET-CIV-502 Rev 1.01
- DMRB CD 521 & CD 522
- The Highland Council Interim Supplementary Guidance: ‘Flood Risk and Drainage Impact Assessment’

1.4. Storm and Flood Risk Terminology

Storm events and flood risks will be expressed by the term Annual Exceedance Probability (AEP). AEP will be expressed by the chance of occurrence (1:100, 1:200 etc.)

Where storm or flood events have a climate change factor included the event will be noted as “+CC” for when Climate Change factor has been included i.e., 1:100+CC.

2. Existing Site Description

2.1. Description of site

The proposed substation is bounded by the existing substation to the north and Loch Buie Road to the west. The land within the proposed substation extents is predominantly woodland, with the main underfoot material being peat. To the north-east there is an area of felled trees, the remaining area to the east and south contains further woodland.

2.2. Topography

Using OS height data to identify the levels and gradients within the Carnaig site (OS Maps, 2024). It was found that the lowest point within the site area is in the north-west corner which lies at approximately 210m AOD. The high point was identified at the south-east of the proposed site which lies at approximately 235m AOD. The height difference throughout the site is approximately 25m with an average slope of 1 in 21.2 (4.72%).

The wider topography surrounding the substation is shown in Figure 2 below using Scotland Topographical Maps (Scotland Topographical, 2024). The proposed substation platform level approximately 220m AOD and topography slopes south-east to north-west.

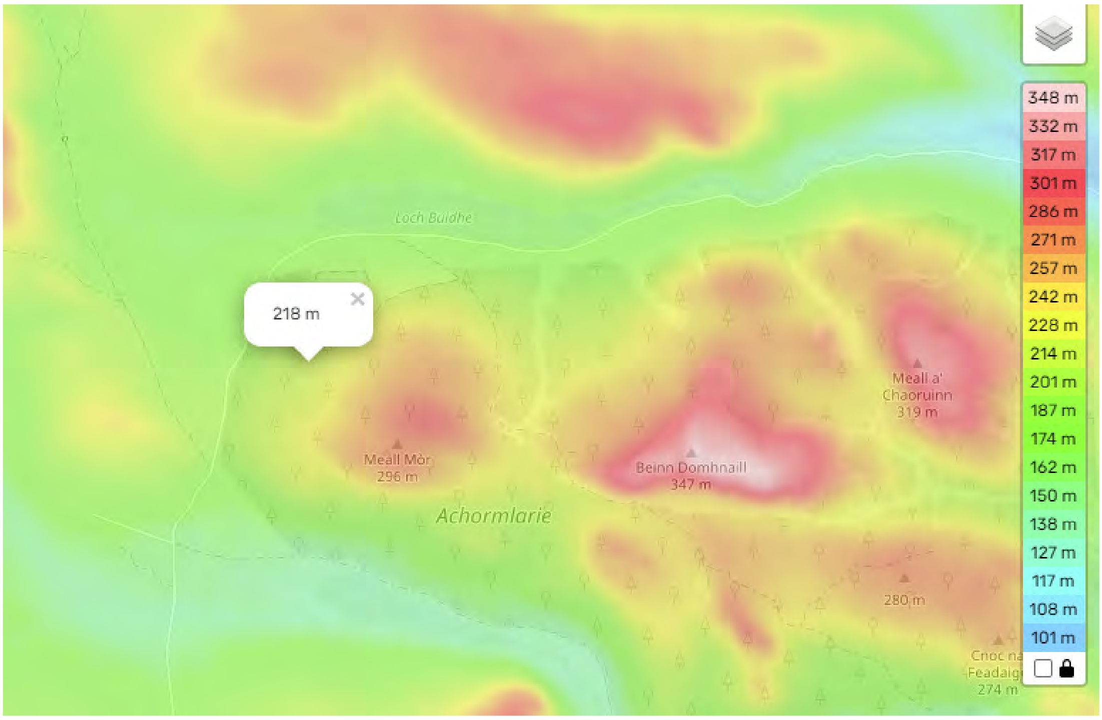

Figure 2: Topographical map (Topographical-map)

2.3. Ground Conditions

2.3.1. Geological and Hydrogeological Features

The geological conditions of the proposed Carnaig site were identified utilising the British Geological Society (BGS, 2024) Spatial Resources online geological mapping system. This indicated that the site had superficial deposits that were recorded as Peat Formation, and bedrock deposits were recorded as Altnaharra Psammite Formation.

2.3.2. Ground Investigation

SSEN appointed IGNE (IGNE, 2024) in 2023 to undertake a ground investigation (GI) for the proposed Carnaig substation location. The ground investigation included cable percussion boreholes, sonic boreholes, trial pits, soakaway pits and peat probing. The plan of the GI works is shown in Figure 3.

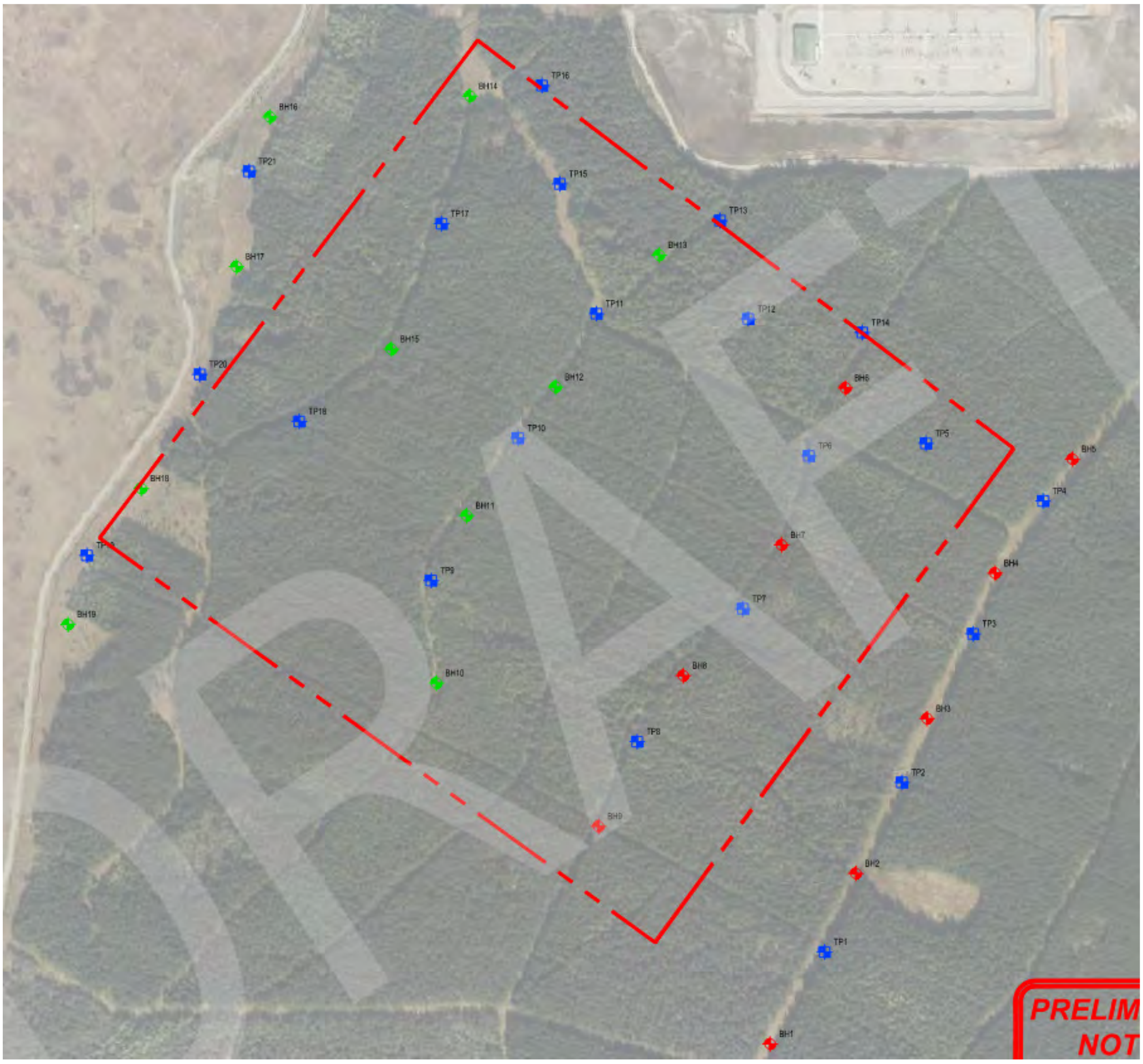

Figure 3: Ground Investigation locations

The factual report received from IGNE has been reviewed and the ground profile have been investigated. Table 1 shows an indicative the ground profile represents the majority of the proposed project area, the ground profile shown in the table is from BH11. It must be noted that the thickness of each stratum and the depth to bedrock varies throughout the project area. Generally, across the site the depth of peat is between 0.3m below ground level (bgl)

(BH15) to 2.4m bgl (BH14) and the depth to bedrock is between 0.7m blg (BH15) to 7.65m bgl (BH11).

Table 1: Ground Profile

Depth to base of strata (m)	Thickness (m)	Description
1.9m	1.9m	Peat – Dark brown spongy pseudo-fibrours peat with routlets
2.5m	0.6m	Gravel – Greyish brown very sandy silty fine to course gravel subangular and subrounded of various lithologies including granite and psammite with traces of peat. Sand is fine to course.
6.0m	3.5m	Sand – Grey gravelly silty fine to coarse sand. Gravel is subangular and subrounded of various lithologies including granite and psammite fine to course.
7.65m	1.65m	Gravel – Brownish grey very sandy very silty fine to course gravel. Subangular and subrounded of various lithologies including granite and psammite with cobbles. Sand is fine to course.
8.1m	0.45m	Possible bedrock

The groundwater level has been recorded throughout the ground investigation works and continues to be recorded at the time of writing this report. The water level measurements taken from the ground level is found to be varied throughout the site. Table 2 below shows the highest depth to water recorded across the water monitoring stations from 14th November 2023 to 10th January 2024.

Table 2: Depth to water (groundwater)

Borehole	Date recorded	Depth to Water (m)	Depth (mOD)
BH02	14/11/2023	1.71	234.80
BH03	11/12/2023	Dry	N/A
BH04	11/12/2023	0.23	235.37
BH06	10/01/2024	2.00	217.88
BH07	09/01/2024	3.23	219.77
BH09	11/12/2023	0.11	221.62
BH11	09/01/2024	2.99	209.18
BH13	20/11/2023	0.41	206.65

Borehole	Date recorded	Depth to Water (m)	Depth (mOD)
BH15	13/11/2023	0.47	200.76
BH16	10/01/2024	2.06	183.97
BH18	11/12/2023	0.06	193.41

The groundwater is found to be highest around the west corner adjacent to the road where it was recorded at being 0.06m bgl (BH18). However, this borehole is remote of the proposed platform location and associated drainage network and may not be representative what the groundwater at the location of the platform. The groundwater was at its lowest towards the east of the site where it was recorded at being 3.23m bgl (BH07).

2.3.3. Historic Land Use

Table 3 below provides a summary of the historic of the site, taken from historic Ordnance Survey maps (Maps, Ordnance Survey, 2024).

Table 3: Historic Land Use

Date	On Site Features	Off Site Features
1874	The site is shown as being undeveloped, comprising rough pasture. A stream is shown to be present in the northern part of the site, draining in a northerly direction.	The surrounding areas comprise rough pasture. A track is present approx. 50 m to the west, with an approx. south-west / north-east orientation, with a surface watercourse (Alltan Dubh) situated beyond. Loch Buidhe is present approx. 600 m to the north.
1907	No significant changes.	A small gravel pit is indicated to be present approx. 250 m to the south-west, and 3 no. other small gravel pits approx. 600 – 700 m to the south-west.
1968 / 1969	The site is recorded as a coniferous plantation and numerous tracks traverse the site. 2 no. streams are now shown on the site in the northern area, that meet close to the northern boundary before draining to the north. On the Provisional map dated 1968-1969, the site is recorded to comprise heath and rough grassland	The surrounding area (for where maps are available) is recorded as a coniferous plantation. On the Provisional map dated 1968-1969, the surrounding areas are recorded to comprise heath and rough grassland. A small feature, potentially a gravel pit or a quarry, is indicated to be present approx. 150 m to the west of the site. The gravel pits to the south-west are no longer recorded.
2001	The site appears to comprise woodland and tracks, similar to the	The surrounding area appears to comprise

Date	On Site Features	Off Site Features
	plan dated 1969.	woodland, similar to the 1969 plan.
2010	No significant changes	No significant changes
2023	No significant changes	A large development, believed to be an electricity substation with associated access roads. is shown approx. 300 m to the north of the site.

2.4. Existing Hydrological Features

2.4.1. Waterbodies

The 'Loch Buidhe', 'Loch an Lagain' and 'Loch Laro' are waterbodies that could be classified as lochs and are located nearby the proposed substation. Loch Buidhe is located 0.57km to the north, 'Loch an Lagain' is located 1.1km to the south and 'Loch Laro' is further afield at 3.7km north-west from the proposed site. 'Loch Buidhe' and 'Loch an Lagain' are sited at 162m AOD and 137m AOD respectively which are lower than the proposed substation platform which is at 220m AOD (Scotland Topographical, 2024).

2.4.2. Surface Water Network

The proposed substation platform is located on the north-west of Meall Mor hill, with the entire catchment area falling north-west. The OS map shown in Figure 4 below shows the contour lines and some of the existing stream which convey the water from the catchment. Generally, it can be observed that a large proportion of the proposed substation catchment is conveyed by 'Alltan Dubh' stream, which is to the north-west of Lochbuie Road. The 'Alltan Dubh' catchment connects into the wider 'Allt Garbh-airigh' watercourse before entering into 'Loch Buidhe'. A smaller proportion of the proposed substation catchment, south of the existing substation, is conveyed by the existing substation drainage ditch. This watercourse is conveyed north towards 'Allt Garbh-airigh' further downstream of where the 'Alltan Dubh' connects.

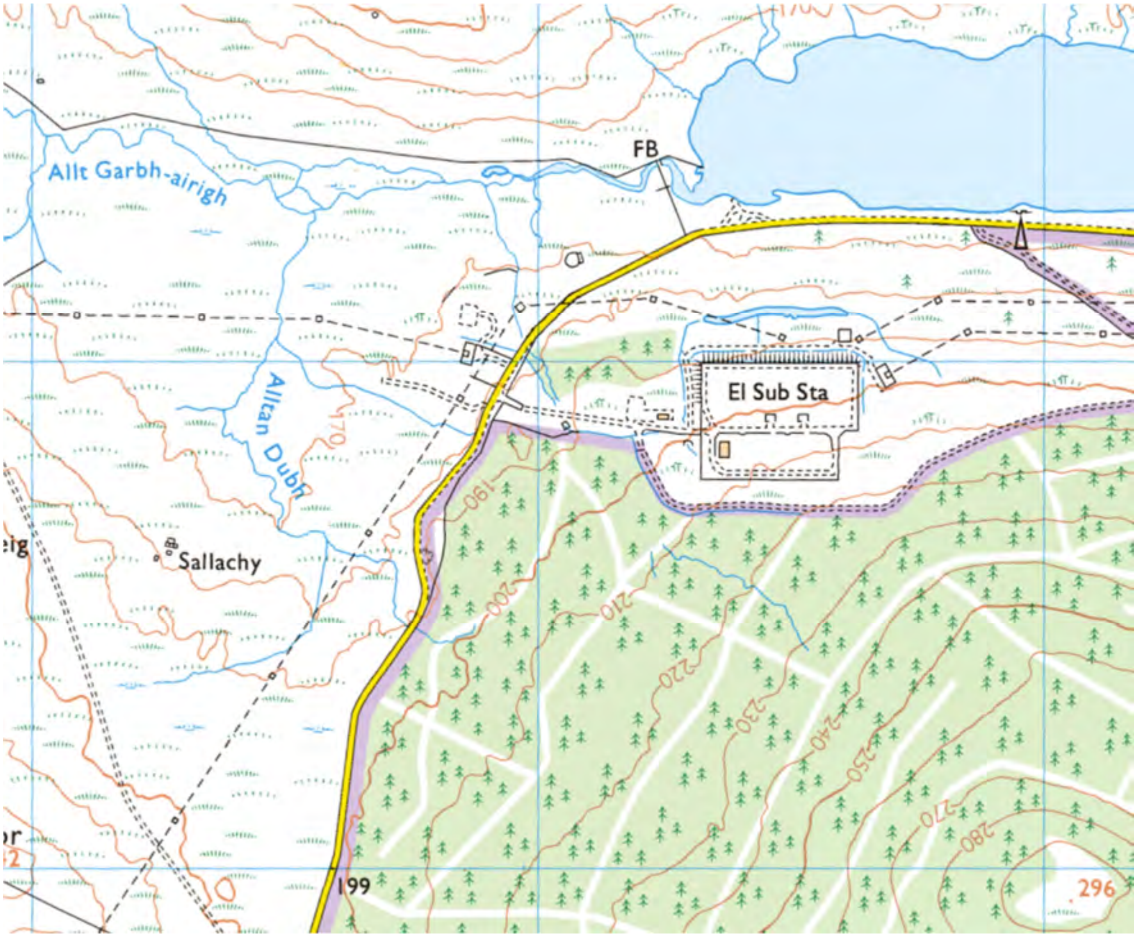

Figure 4: Wider Watercourse Network

A walkover to observe and record the surface water network draining the site was undertaken by Tony Gee and Murphy's Group on the 30th January 2024. The walkover survey identified key hydraulic structures and catchment features, which allowed for further understanding of the surface water network. The identified catchments and the surface water network is described in the subsequent paragraphs from upstream to downstream. Photos with reference is made to, are included under Appendix A 'Surface Water Network Records' to conserve page space.

The proposed platform development drains naturally into three catchments. The unnamed tributary (approx. 82%) and the existing substation drainage ditch (approx. 18%).

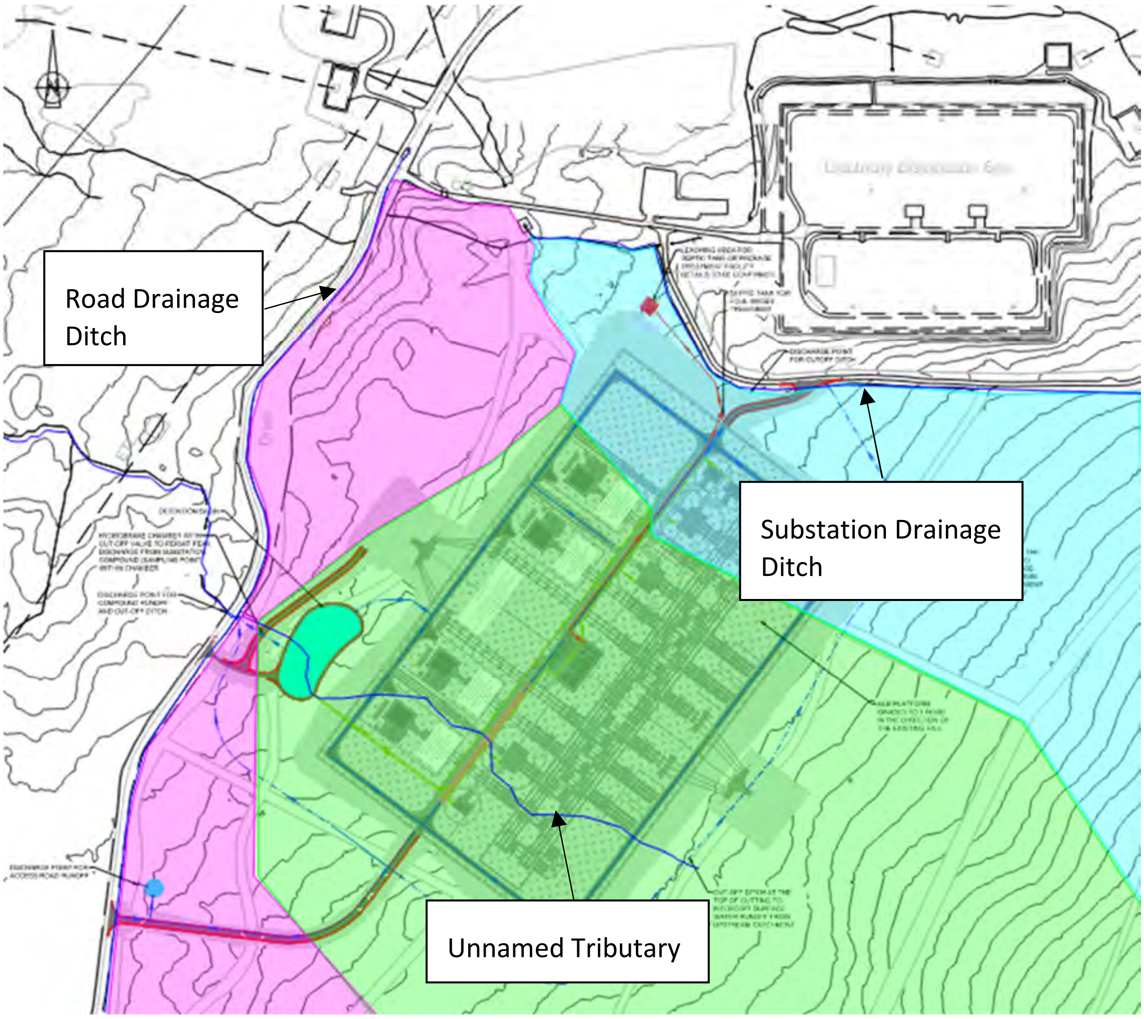

Figure 5: Location Plan showing the Surface Water Network and the Contributing Catchments

Unknown Tributary

The 'unknown tributary' flows from Meall Mor Hill, south-east of the proposed substation and flows north-west through the woodland following the natural contours. The tributary is a natural feature shown in Photo 1.1. The most upstream point the stream was observed within the woodland, east of the platform extents, where the stream was approximately 300mm wide and had a gentle flow of water. The stream would weave through the woodland heading north-west towards Lochbuie Road, at this point the stream was culverted through a 450mm pipe under Lochbuie Road, shown in Photo 1.7. Once discharged from the culvert, which is shown in Photo 1.9, the stream continued north-west towards 'Alltan Duhbh' watercourse. Access to this land was not permitted so the watercourse could not be surveyed, however, multiple watercourses corvine within the 'Alltan Dubh' catchment so this watercourse would have an increased flow.

Road Drainage Ditch

The 'road drainage ditch' runs parallel to Lochbuie Road on the east side, the purpose of the ditch is to cut off the runoff from Meall Mor hill catchment and divert the water towards a culvert under Lochbuie Road. At the location of the substation, the ditch flows from south to north along the road, a photo of the ditch can be seen in Photo 3.1 & 3.2. The ditch is culverted under the existing substation access road, shown in photo 3.5 & 3.6, and continues to flow north. The drainage ditch is then culverted under Lochbuie road through a 450mm pipe, which is shown in Photo 3.7. Once discharged from the culvert, the watercourse in conveyed by a stream towards the 'Alltan Dubh' catchment, which is shown in Photo 3.8.

Existing Substation Ditch

The 'existing substation ditch' runs parallel to the existing substation access track to the south of the existing substation. The ditch, on the south side of the track, cuts off the runoff from Meall Mor hill catchment and diverts the water towards the culvert which passes under the substation access road. The drainage ditch is a channel approximately 1m wide and the same deep, a photo of the ditch is shown in Photo 2.1. The ditch flows from east to west along the access track before connecting into the existing substation access road drainage ditch, a photo of the two ditches connecting is shown in Photo 2.13 & 2.14. The substation access road drainage ditch is culverted under the access track and where the ditches connect, the road drainage discharges from a culvert. The combined ditch is conveyed west and is culverted under the substation access road, shown in Photo 2.15. The runoff is conveyed north-west under where is conveyed under Lochbuie Road, shown in Photo 2.17. Once discharged from the culvert, the watercourse in conveyed by a stream towards the 'Alltan Dubh' catchment, which is shown in Photo 3.8. Once discharged from the culvert, the watercourse in conveyed by a stream towards the 'Alltan Dubh' catchment, which is shown in Photo 2.18.

2.4.3. Watercourse Survey

A watercourse survey was completed by CainTech on 12/03/2024 which captures the watercourses described above. The survey finding can be seen in Appendix B.

2.5. Existing Drainage Arrangement

No Scottish Water services were found in the search area of interest.

The proposed development site is currently drained naturally to the Alltan Dubh catchment north-west of the proposed development. This has been confirmed from the site walkover while took place on 30/01/2024. Details in section 2.4.

3. Reference Sources

3.1. SEPA

SEPA flooding maps (SEPA, 2024) have been used to identify the flooding potential for pluvial, fluvial and coastal sources, shown in Figure 6 below. The maps have identified that surface water flooding is prominent with the site extends. The information shown in Figure 6 contains public sector information licensed under the Open Government Licence v3.0. It must be noted that there are limitations with the accuracy of the SEPA flooding maps as it does not account for existing flooding protection.

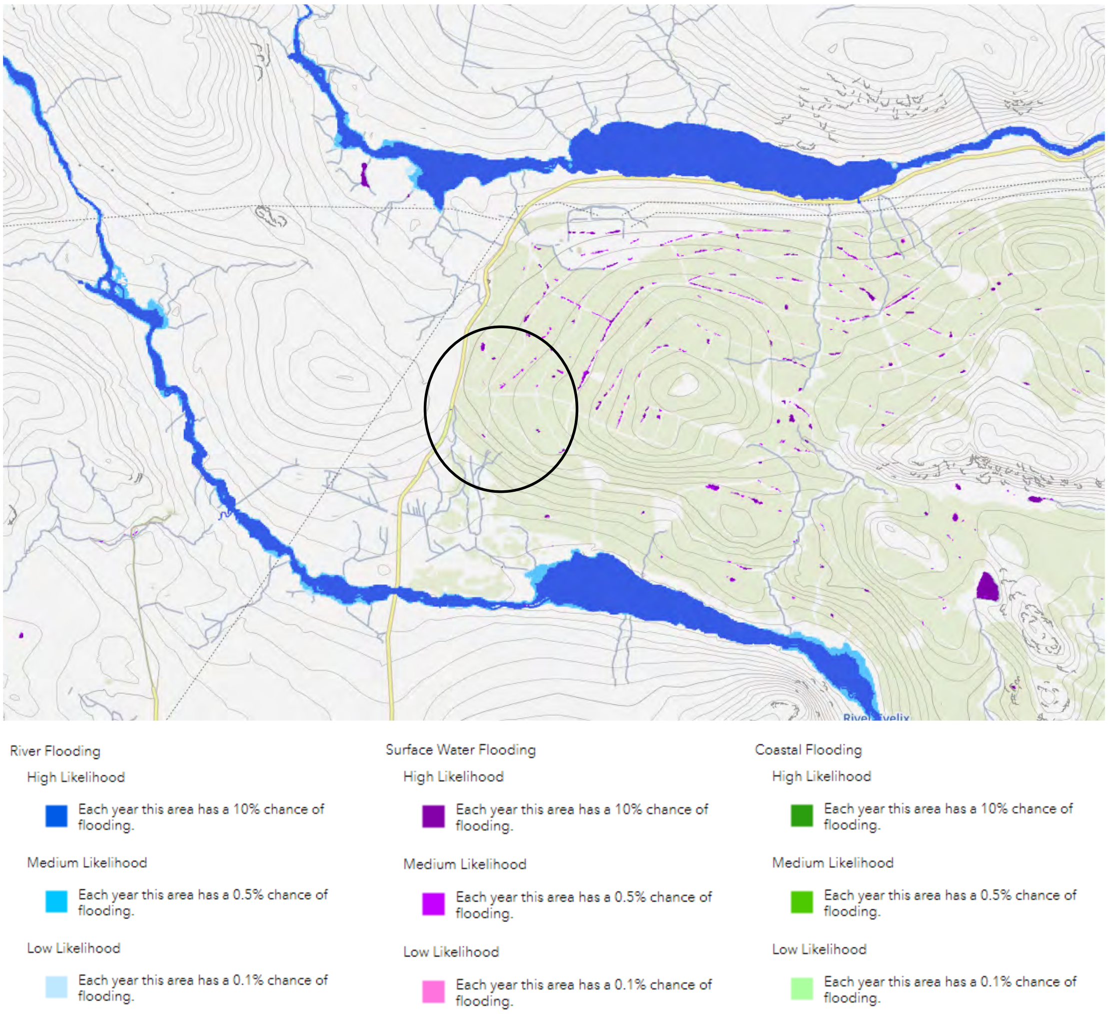

Figure 6: SEPA Flooding Maps for River, Surface water and Coastal

3.2. Site walkover

A walkover to observe and record the surface water network draining the site was undertaken by Tony Gee and Murphy's Group on the 30th January 2024. The walkover survey identified key hydraulic structures and surface water flows, which allowed for further understanding of the flooding potential for pluvial, fluvial and coastal sources.

The walkover identified the existing hydrological features which are described in Section 2.4 of this report. The flooding risks within the proposed site are captured in the Flooding Risk Statement report produced alongside this report. Document reference CAAI4-JMS-DRAI-XX-RPT-C-0003 P02.

4. Proposed Development

4.1. Description

The proposed development comprises permeable platforms which will house the AC components and designed to the requirements outlined in Drainage Specification SP-NET-CIV-502 and Earthworks Specifications SP-NET-CIV-501. The proposed development is shown on drawing CAAI4-JMS-DRAI-XX-LAY-C-0110.

The proposed permanent substation development includes 0.191km^2 (19.1ha) and will consist of free draining stone with a nominal finished platform level as stated on drawing CAAI4-JMS-DRAI-XX-LAY-C-0110 which will accommodate the substation. The platform make-up is reproduced from SSEN specification SP-NET-CIV-501 and shown in Figure 7.

Access will be provided via a permanent bound access track off the existing substation access track to the north of the proposed platform. The proposed road will allow permanent access to the substation platform.

The substation will consist of a 15-bay solution including double busbar arrangement with two bus couplers and one bus section. This is proposed to be broken down as follows:

- 1 No. 400kV Busbar Sections
- 2 No. 400kV Busbar Couplers
- 2 No. 400kV Beauly Substation Feeders
- 2 No. 400kV Spittal Substation Feeders
- 2 No. 400kV 1200MVA Transformer Bays
- 2 No. 275kV 1200MVA Transformer Bays
- 2 No. 400kV 480MVA Transformer Bays
- 2 No. 132kV 480MVA Transformer Bays
- 2 No. Synchronous Compensators

The requirements for the platform make-up taken from SP-NET-CIV-501 are described here: Layer 1 is to be single sized durable aggregate used for the surfacing material out of the area of the concrete and asphalt bound aggregate surfaces. This layer is required to mitigate step and touch electrical earthing potentials and shall be a minimum of 75mm thick with 20mm single-sized washed aggregate. Layer 2 is to be 200mm type 3 granular material as defined in Series 800 of the SHW. This layer is to be free draining. Layer 3 is to be minimum of 725mm well graded selected granular material. Class 6F2 as defined in Series 600 of the SHW is pre-approved by the employer for this layer. This layer is also to be free draining.

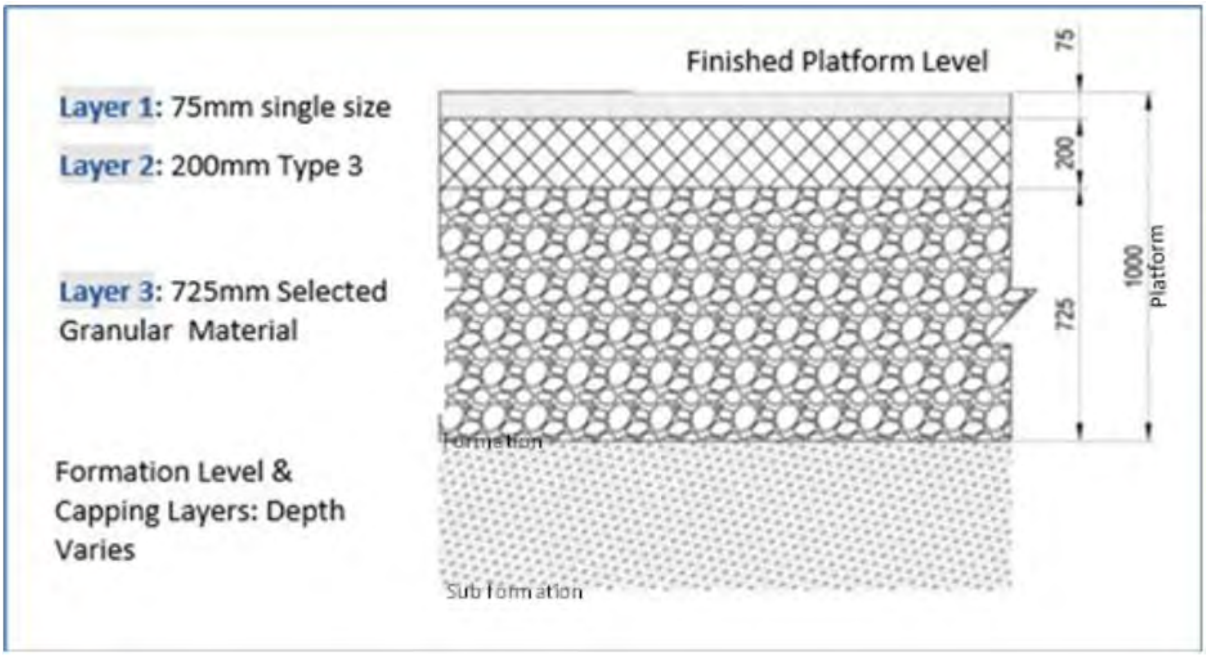

Figure 7: Substation platform make-up

5. Surface Water Drainage Strategy

5.1. Sustainable (urban) Drainage System

The drainage design will incorporate SuDs, as recommended by the SuDs Manual (CIRIA Report C753).

CIRIA C753 SuDS Manual identifies a hierarchy for managing surface water, commonly known as the management train as outlined below:-

- Prevention – The use of good site design and housekeeping to prevent run-off and pollution (e.g. minimise hardstanding areas.)
- Source Control – Control of run-off at or very near to its source (e.g. rainwater harvesting)
- Site Control – Control of run off from several sub-catchments to a centralised SuDS system.
- Regional Control – Management of run-off from several sites (typically in a wet land or retention pond.)

The implementation of SuDS measures within a development as opposed to conventional drainage systems provides several benefits including the following:-

- Reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream.
- Reducing the volumes and frequency of water flowing directly into watercourses or sewers from developed sites.
- Improving water quality over conventional surface water sewers by removing pollutants from diffuse pollutant sources.
- Improving amenity through the provision of public open spaces and wildlife habitat; replicating natural drainage patters, including the recharge of groundwater so baseflows are maintained.

5.2. Proposed Discharge Method

In line with the recommendations of the SuDS manual, the hierarchy of preferred drainage discharge methods set out below has been considered: -

Table 4: Hierarchy of Surface Water Drainage Option

Discharge method	Preferred option	Rationale
Reuse on site	N	It is anticipated that only 8 people will be on site at any one time and visits will be occasional rather than full time. Therefore, the demand is not great enough for form part of the drainage design.

Discharge method	Preferred option	Rationale
Infiltration to ground	Y	Table 1 identified that there is sandy gravels at a depth of 1.9m bgl to 8.1m bgl, which could allow for potential infiltration of rainwater runoff, this will be review once receipt of the Factual report.
Discharge to surface waters	Y	At least one watercourse has been identified from the desk study to take the discharge from the site.
Discharge to Sewer	N	Discharge to the nearest watercourse is the preferred option.

To control the discharge rate to the watercourse, attenuation will be incorporated into the drainage design. In accordance with 6.2.6 of the SSEN Drainage Specification SP-NET-CIV-502.

Table 5: Hierarchy of the Attenuation Methods

Attenuation Type	Preferred option	Rationale
Swales	Y	Swales will be located close to the source of the runoff from the platforms and will link the substation drainage system to the detention basins.
Attenuation Basins	Y	Detention basins will be incorporated into the drainage design to provide the majority of the attenuation volume.
Soakaways	Y	It is likely that the ground conditions below the platform formation would be suitable for a soakaway system. Therefore, this discharge method is recommended.
Ponds	N	Swales and detention basins are the desirable option.
Underground storage pipes and tanks, including cellular systems	N	Swales and detention basins are the desirable option.

5.3. Proposed Surface Water Drainage Strategy

It is proposed to capture and attenuate the runoff from the hardstanding surfaces and let the water permeate through the remaining surfaces, including the free draining fill making up the substation platform. An attenuation basin will attenuate and provide treatment to the runoff from the hardstanding surfaces within the platform before discharging into the existing watercourse. The discharge will be limited to the greenfield runoff rate from only the catchment feeding into the chosen watercourses.

Free Draining Surface

The subbase layer beneath the platform will be graded at 1 in 500, which is shallower than the existing gradient, so it won't increase offsite flood risk. The subbase will be graded south-east to north-west as such that the runoff catchments will be as existing topography and flow paths. The runoff from the formation level (capping layer) will be free to drain as existing off the proposed infrastructure and will dissipate into existing overland flows as existing.

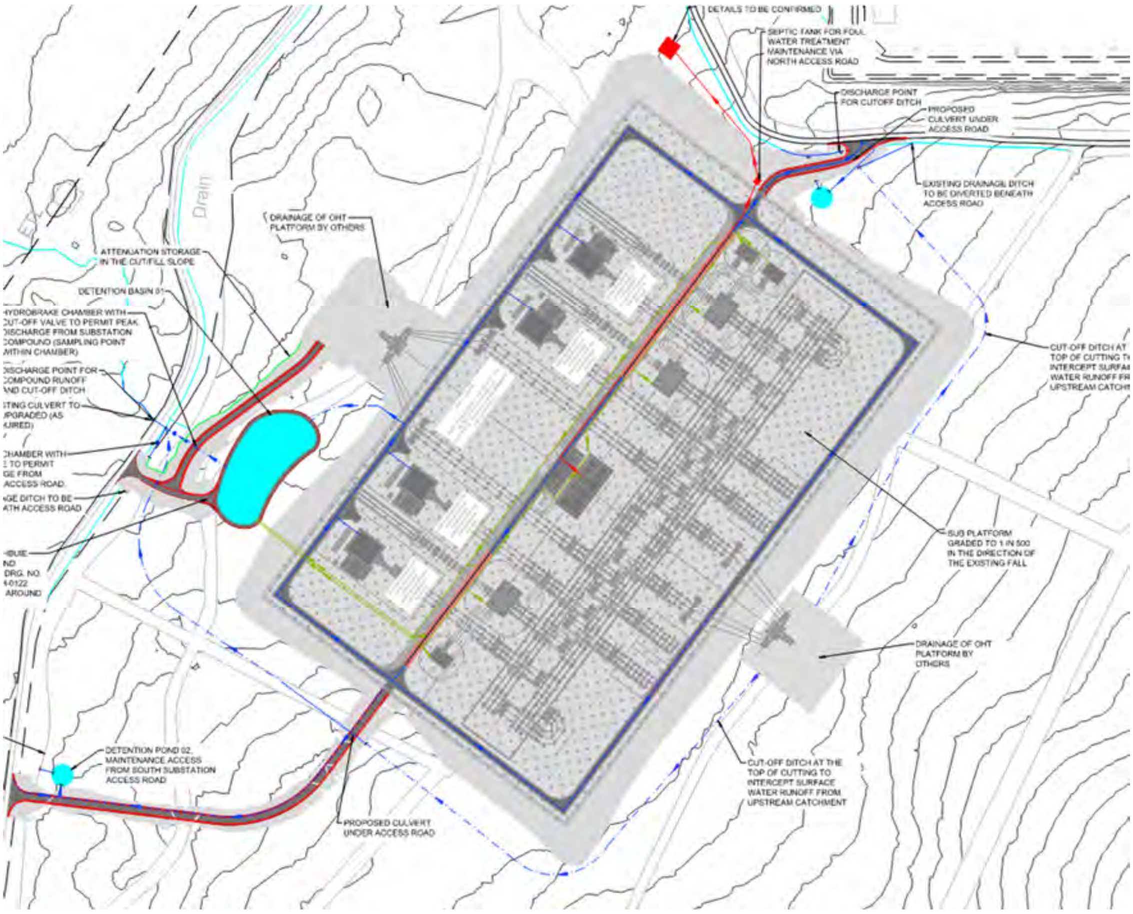

Figure 8: Location plan showing permanent drainage strategy.

Hardstanding surfaces

The drainage strategy incorporates the use of either road gullies or combined kerb drains to capture the runoff from the hardstanding road surfaces and guttering systems to capture runoff from the building roofs. It is proposed carrier pipes will convey the runoff to the swale where the runoff will receive its first level of treatment. The swale is proposed to convey the water from the substation platform to the attenuation basin at the north-west of the site.

The detailed design of the swales and the detention basins will be in accordance with The CIRIA SuDs Manual C537 (CIRIA, 2015). The detention basins have been sized to show the approximate dimensions to achieve the desired storage, shown below.

<u>Detention Basin 01 – Platform Drainage System</u>

- Depth: 1m
- Slope: 1 in 4
- Top of bank area: 3150m^2 (0.315 ha)
- Volume: 2725m^3

<u>Detention Basin 02 – South Access Road</u>

- Depth: 1m
- Slope: 1 in 4
- Top of bank area: 196m^2 (0.0196 ha)
- Volume: 111m^3

<u>Detention Basin 03 – North Access Road</u>

- Depth: 1m
- Slope: 1 in 4
- Top of bank area: 80m^2 (0.008 ha)
- Volume: 42m^3

The proposed SuDs Strategy is shown in Figure 8 which incorporates the surface water management elements as described in Table 6.

Table 6: Surface Water Management Strategy SuDS Option Summary

SuDS Management Train Element	Application	SuDS Features to be used
Source Control	For the interception of surface water run off at source from surfaced roads, foundations and buildings. Provides the required surface water attenuation / storage and first level of treatment.	Gullies or Combined Kerb Drains and Carrier Pipes / Filer Drains
Conveyance	To provide a first level of treatment and convey surface water runoff from Source Control measures to Site Control	Swales

SuDS Management Train Element	Application	SuDS Features to be used
Site Control	To provide attenuation storage in order to restrict the peak discharge rate to the permissible rate, in addition to providing a second level of treatment.	Detention Basins
Surface Water Flows	For the interception and diversion of surface water flows	Cut-off Ditch

5.4. Design return events and Climate Change

The drainage system will be designed to attenuate surface water generated during rainfall events with a return period of up to 1 in 200 year rainfall including a 42% uplift to account for climate change.

A further analysis will be undertaken for the 1 in 1000 year event to verify the extents of any surface water flooding.

5.5. Greenfield Runoff Flow

In line with THC's guidelines for development (THC, 2016), it is anticipated that the allowable discharge for the site would match that of the existing 1-in-2-year greenfield runoff rate. As per FEH method (FEH Web Service, 2024), the existing 1-in-2-year greenfield runoff rate is stated in section 5.3 for the entire area catchment within the platform. This will ensure the catchment area for the surface water is discharge into the network similar to existing arrangement to avoid increasing peak flows to watercourses and the risk of downstream flooding.

5.6. Attenuation

The outline network and the attenuation systems have been designed in accordance with Sewers for Scotland (Scottish Water, 2018). The network has been designed to provide attenuation for impermeable areas ensuring no flooding up to and including the 200 year event + 42% Climate Change to satisfy SEPA and Scottish Water criteria.

In accordance with the "Water Assessment and Drainage Assessment Guide" (SEPA, 2016), the network design calculations allow for events up to the 200-year storm event plus 42% allowance for Climate Change with potential exceedance to be accommodated within the application boundaries and without detriment to properties. A further check has been carried out to consider a 1 in 1000-year event +42% to consider the impact on the surrounding area.

5.7. Water Quality Treatment

5.7.1. Surface Water

CIRIA C753 The SUDS Manual (CIRIA, 2015) outlines guidance for designing SUDS to achieve the appropriate level of water treatment.

The post development surface water runoff generated from the impermeable areas of the site are considered to have a 'high' pollution Hazard Level as set out within Table 7 below: -

Table 7: Pollution Hazard Indices for Land Use Classification

Land Use	Pollution Hazard Level	Pollution Hazard Indices		
		Total Suspended Solids (TSS)	Metals	Hydrocarbons
Industrial Roofs (Medium potential do metal leaching)	Low	0.3	0.2	0.05
Low trafficked Access Roads	Low	0.5	0.4	0.4
Site where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured	High	0.8	0.8	0.9

The transformer bund area will be captured in a separate system, the runoff from the transformer bund will flow through an oil full retention separator before being discharged into the main drainage system. The water being discharged into the main substation drainage network from the oil retention separator will be free from oil contaminates. The oily water network will have a manhole and sampling point before entering the main drainage system where the water can be tested.

The hardstanding refuelling area will be captured in a separate network, which will pass through an oil full retention separator before being discharged into the detention basin. The oily water network will have a manhole and sampling point before entering the main drainage system where the water can be tested.

The Simple Index Approach Tool has been used for the development of the water quality treatment strategy for the development. The Simple Index Approach Tool checks that the proposed SUDS will provide the required level of treatment for the relevant pollution source.

The Simple Index Approach Tool accounts for where two or more SUDS features are used to exceed the pollution hazard indices and applies the following formula.

Total SUDS mitigation index = mitigation index 1 + 0.5 (mitigation index 2)

Table 8: SuDS Mitigation Indices

SuDS Component	Mitigation Indices		
	TSS	Metals	Hydrocarbons
Swale	0.5	0.6	0.6
Attenuation Basins	0.5	0.5	0.6
Total SUDS mitigation Index Achieved	0.75	0.85	0.9
Acceptable	Y	Y	Y

Table 8 shows the Simple Index Approach pollution hazard index is satisfied through a combination of filter drains/swales and detention basins.

A full retention oil separator will be incorporated into the compound drainage system to prevent the risk of oil discharging the system and contaminating surrounding ecosystem.

5.7.2. Foul Water

There are no existing public sewers in the vicinity of the proposed site therefore a connection to the existing sewer network was not a feasible option; in accordance with the relevant guidance (SEPA, 2022) (SSEN, 2020), an on-site treatment and discharge option will be designed for the development.

As highlighted within Section 4, the substation control building will include the provision of a toilet and basin. The usage is anticipated to be very low <15.ep. The foul water drainage system will be designed to suitably treat all foul water to SEPA regulations WAT-RM-03 (SEPA, 2022) prior to discharge. There are no existing public sewers in the vicinity of the proposed development, therefore a connection to the existing sewer network was not a feasible option, in accordance with relevant guidance, it is proposed an on-site treatment and discharge option will be designed for the development.

To calculate the population equivalent (p.e) for non-domestic sewage effluent, the BOD load should be multiplied by the number of people using the system and divided by 60 (SEPA, 2022). It is assumed at this stage that there would be 5No. operations engineers and 3No. maintenance crew at any one time. Considering this, the calculation for the p.e for this sewage system is shown below:

$$Population\ Equilalent\ (p.e) = \frac{BOD\ load\ \left(\frac{g}{day}\right) x\ no.people\ using\ system}{60} = \frac{25\ x\ 8}{60} = 3.33$$

Since the p.e of the proposed development is less than 50, a private wastewater treatment plant and/or septic tank should be designed, constructed, and installed in accordance with BS EN 12566 – 'Small wastewater treatment system up to 50 PT'. Part 1 of BS EN 12566 specifies the requirements for prefabricated septic tank units, where discharge of the effluent is to a drainage field which then infiltrates into the ground. It is recommended that a septic tank is the preferred option for treatment foul water drainage. The septic tank will require space for the leaching area where the drainage will discharge into the ground.

It is anticipated that the foul water will be treated by a septic tank prior to discharge. A single source of foul water from the proposed development control room building. Figure 9 shows the proposed septic tank for the foul water system, as well as the pipework between the devices. The septic tank will treat the effluent to the sufficient level, as per BS EN 12566-1, before being discharged to the ground. The detailed design will be subject to agreement with SEPA and authorised in accordance with the Controlled Activity Regulations (CAR).

Septic tanks should be designed, constructed, and installed in accordance with Part 4 or Part 6 of BS EN 12566. Such designs shall include a chamber downstream of the plant, for inspection, sampling in accordance with SEPA guidance.

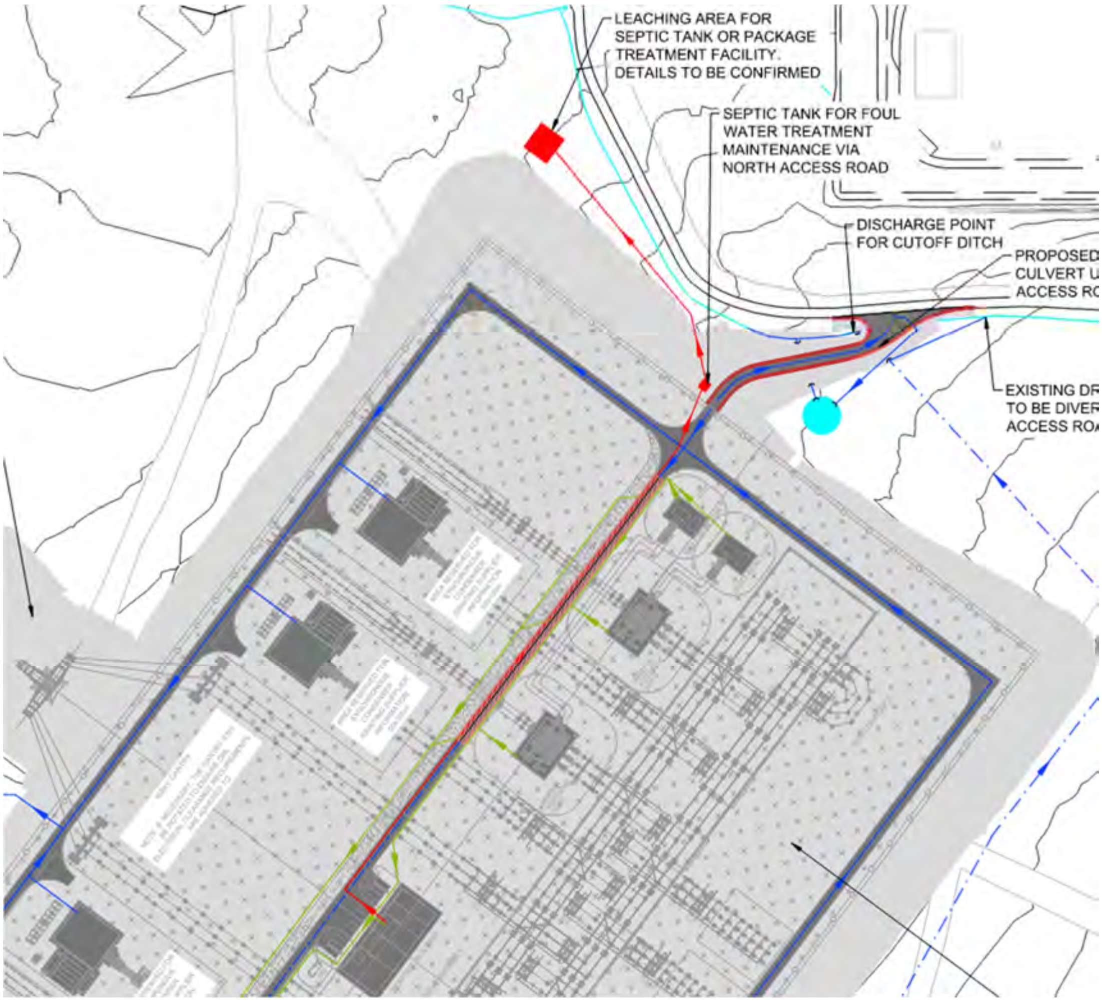

Figure 9: Foul Water Treatment System

5.7.3. Oil Filled Equipment

As highlighted in Section 4, oil-filled equipment such as transformer shall be installed in a watertight secondary containment system, which as a minimum will comprise of an above ground bund to retain the oil. The bund design is reproduced from SSEN Specification for Substation Bunds SP-NET-CIV-509 and shown in Figure 10.

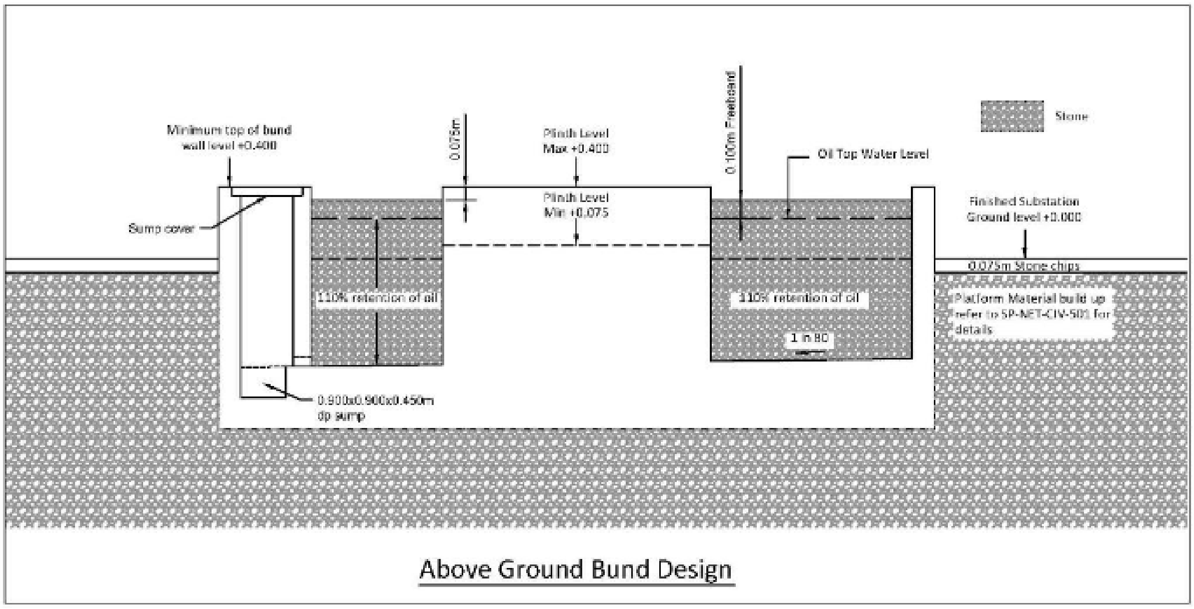

Figure 10: Above ground bund design for oil filled equipment.

The bund water control unit (BWCU) shall be discharged to the surface water drainage system via an approved above ground oily water mitigation system. The oily water drainage system will be suitable designed and discharged into the first level of treatment area as per SP-NET-CIV-502 Figure 6.1, also shown in Figure 11 below. The oily water will have the same treatment facility as the surface water system and is accounted for in the attenuation area.

Sampling points shall be incorporated at the downstream ends of the attenuation ponds prior to their discharge to the receiving watercourses, to test the quality of the surface water runoff from the site is sufficient for it to be safely discharged to the environment.

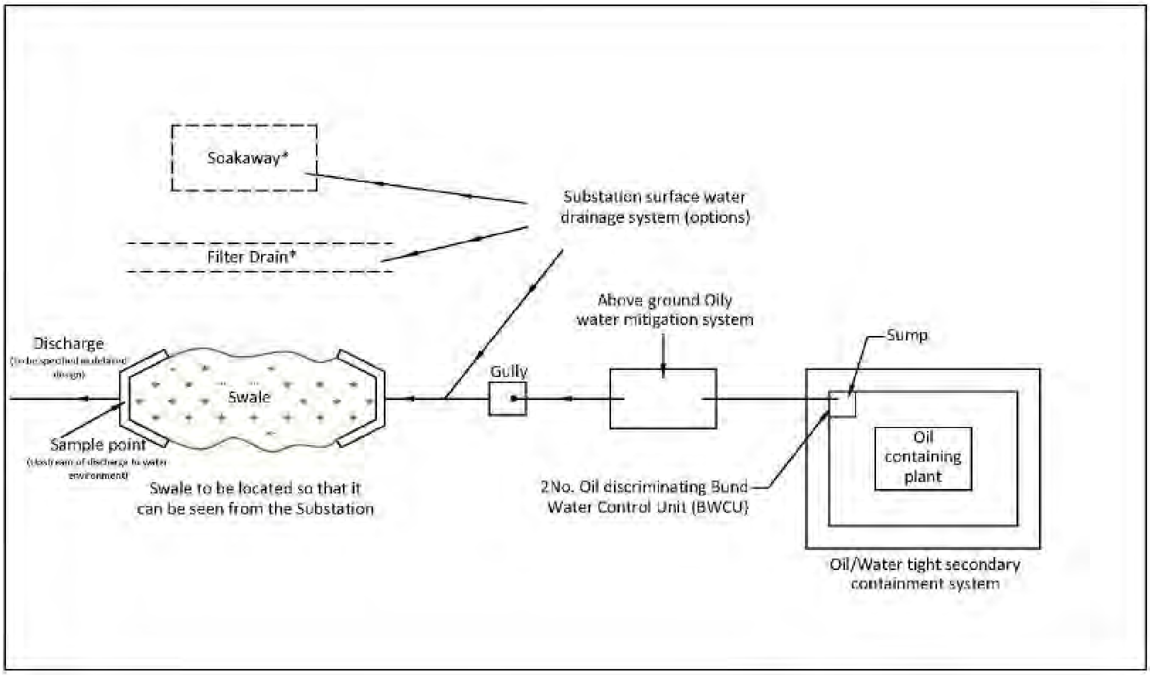

Figure 11: Surface water and oily water drainage system.

6. Operation and Maintenance

All surface water drainage and pollution control features associated with the development will remain as private assets and will be maintained by SSEN. The following section outlines the recommended maintenance requirements for the various aspects of the drainage system for the development. An operation and maintenance plan should be developed by SSEN for the site once operational.

6.1. Filter Drains

A recommended operation and maintenance plan for filter drains is summarised in Table 9 below: -

Table 9 Filter Drain Operation and Maintenance Requirements

Maintenance Schedule	Required Action	Suggested minimum frequency
Routine Maintenance	Inspect filter drain surface, inlet / outlet pipework and flow control systems for blockage, standing water or damage	Biannually (or as required)
	Inspect pre-treatment systems, inlets, pipework and chambers for silt accumulation and undertake silt removal as required	Biannually (or as required)
	Remove sediment from pre-treatment devices	Annually
	Remove litter, including leaf build up and debris from filter drain surface, access chambers and pre-treatment devices.	Annually
Occasional Maintenance	Remove or control tree roots that are encroaching the filter drainage network. Recommended methods to be utilised as NJUG, 2007 or BS3998:2010.	As required
	At locations with high pollutant load, remove surface geotextile and replace, and wash or replace overlying filter media.	5 yearly or as required

6.2. Swale

A recommended operation and maintenance plan for the swale is summarised in Table 10 below: -

Table 10: Swale Operation and Maintenance Requirements

Maintenance Schedule	Required Action	Suggested minimum frequency
Routine Maintenance	Remove litter, debris and trash	Annually
	Inspect inlets, outlets and overflows for blockages and clear as required.	Biannually (or as required)
	Remove sediment from inlets, outlets and bed	Annually
	Cut grass – to retain grass height within specified design range	Monthly during growing season (or as required)
Occasional Maintenance	Reseed any areas of poor vegetation growth	As required
	Repair erosion or other damage by re-seeding or re-turfing.	As required.

6.3. Detention Basins

A recommended operation and maintenance plan for the detention basins is summarised in Table 11 below: -

Table 11: Detention Basin Operation and Maintenance Requirements

Maintenance Schedule	Required Action	Suggested minimum frequency
Routine Maintenance	Remove litter, debris and trash	Biannually (or as required)
	Inspect inlets, outlets and overflows for blockages and clear as required.	Biannually (or as required)
	Inspect inlets and facility surface for silt accumulation.	Biannually (or as required)
	Inspect banksides, structures. Pipework etc for evidence of physical damage	Biannually (or as required)
	Remove sediment from inlets,	Annually

	outlets and bed	
	Check mechanical devices e.g. penstocks	Biannually (or as required)
	Remove sediment from inlets, outlets and borebays	Every 1 to 5 years (or as required)
	Cut the meadow grass	Biannually (or as required)
Occasional Maintenance	Remove sediment from inlets, outlets forebays and main basin when required	Every 5 years (or as required)

6.4. Septic Tank

A recommended operation and maintenance plan for the septic tank is summarised in Table 12 below: -

Table 12: Septic Tank Operational and Maintenance Requirements

Maintenance Schedule	Required Action	Suggested minimum frequency
Occasional Maintenance	Pump and clean septic tank	Annually
	Inspection of tank and leaching field	Annually

6.5. Full Retention Separator

A recommended operation and maintenance plan for the full retention separator is summarised in Table 13 below: -

Table 13: Full Retention Separator Operational and Maintenance Requirements

Maintenance Schedule	Required Action	Suggested minimum frequency
Occasional Maintenance	Inspected	Bi-annually (or as required)
	Checking and cleaning the coalescer assembly	Annually or following major incident
	Alarm probes where fitted, should be removed and cleaned	Annually or following major incident

7. Construction Stage Water Management

Construction stage water management proposals will be developed separately in a Pollution Prevention Plan and agreed with SEPA as part of the CAR Construction License submission and agreement.

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Appendix A - Surface water Network Records

Appendix A: Surface water Network Records

Unnamed Tributary- Upstream to Downstream

 Photo 1.1: East looking along stream	 Photo 1.2: West looking along stream
 Photo 1.3: East looking along stream	 Photo 1.4 West looking along stream
 Photo 1.5: East looking along stream	 Photo 1.6: West looking along stream


Photo 1.7: 450mm culvert under road


Photo 1.8: Culvert outflow (west facing)


Photo 1.9: West looking downstream of culvert

Existing Substation Drainage Ditch- Upstream to Downstream

 Photo 2.1: East looking along ditch	 Photo 2.2: West looking along ditch
 Photo 2.3: East looking along ditch	 Photo 2.4: West looking along ditch
 Photo 2.6: Ditch culverted under track (east)	 Photo 2.7: Ditch culverted under track (west)

 Photo 2.8: East looking along ditch	 Photo 2.9: West looking along ditch
 Photo 2.10: East looking along ditch	 Photo 2.11: West looking along ditch
 Photo 2.12: Substation surface water culverted under access track	 Photo 2.13: Substation surface water drainage enters ditch

Photo 2.14: West looking along ditch

Photo 2.15: 1000mm culvert under substation access road

Photo 2.15: 1000mm culvert outflow

Photo 2.16: North looking after culvert

Photo 2.17: Culverted under

Photo 2.18: West looking along stream

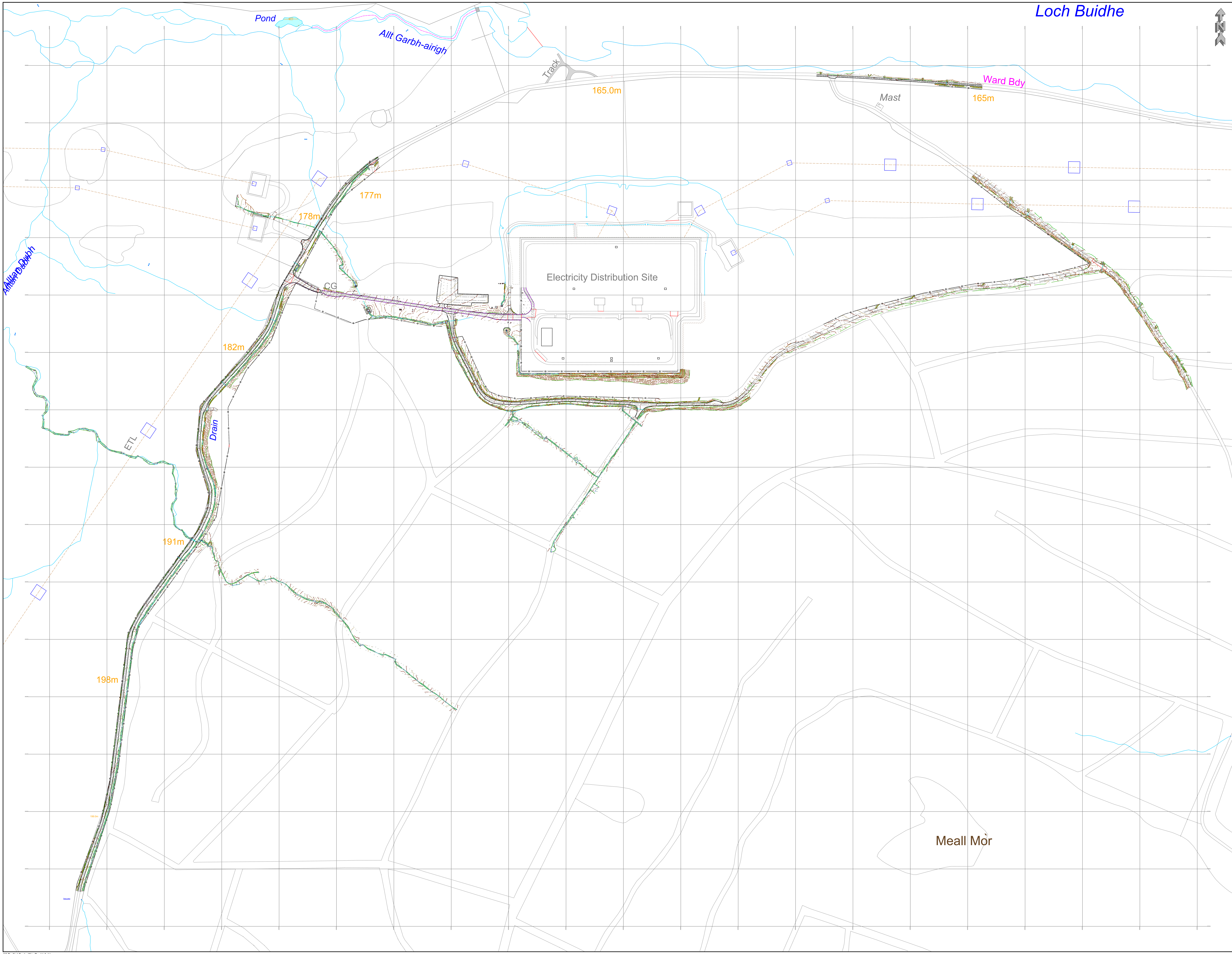
Road Drainage Ditch

 Photo 3.1: South looking along ditch	 Photo 3.2: North looking along ditch
 Photo 3.3: South looking along ditch	 Photo 3.4: North looking along ditch
 Photo 3.5: 225mm culvert under substation access road	 Photo 3.6: culvert outflow

Photo 3.7: 450mm culvert under Lochbuie Road

Photo 3.8: West looking along stream

Appendix B - Watercourse Survey



Site Layout:

Topographical Survey at
Loch Buidhe Substation,
Bonar Bridge

LAND & BUILDING SURVEYING
SETTING OUT ENGINEERS
CIVIL ENGINEERING DESIGN
LASER SCANNING SERVICES

HYDROGRAPHIC SURVEYING
VOLUMETRIC SURVEYING
DIMENSIONAL CONTROL SURVEYING
AUTOCAD DRAUGHTING SERVICES

TORE OFFICE
FOINAVEN
TORE
MUIR OF ORD
ROSS SHIRE
IV6 7SD
Tel: 01463 811400

INVERNESS OFFICE
SUITE A2
ETIVE HOUSE
BEECHWOOD BUSINESS
PARK, INVERNESS
IV2 3BW
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Drawn By:	Checked By:	Surveyed By	Surveyed Date:
MAL	GCN	JS/ZC	12.03.2024

Drawing Status:

- [ ] FOR APPROVAL
- [x] FOR ISSUE
- [ ] FOR DISCUSSION
- [ ] DRAFT STATUS

Drawing Date: 22.03.2024

Drawing Scale: 1 : 2000 @ A0

Drawing No: CTCH-J5680-001

- Levels are in metres and are to Ordnance Datum.
- Co-ordinates are to National Grid. (GPS Network)

Our Job Ref: J5680

Rev:

A0 Do Not Scale (If in Doubt Ask)