336-009-RP02

Drainage Impact Assessment

Proposed BESS – Fyrish

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Contents

1 Introduction

Haydn Evans Consulting Ltd (HEC) has been commissioned by Field Fyrish Ltd (hereafter referred to as the Client) to carry out a Drainage Impact Assessment (DIA) to support a planning application for the construction and operation of a Battery Energy Storage System (BESS) of up to 200 megawatts (MW) with associated infrastructure (including cable route to substation), access and ancillary works on land 650m south of Fyrish Substation, Alness, IV17 0XH .

1.1 Limitation

This document has been prepared for the sole use of the Client. The copyright of this report is vested in HEC and the Client. HEC accepts no responsibility whatsoever to other parties to whom this report, or any part thereof, is made known. Any such other parties that rely upon the report do so at their own risk.

The DIA should be read in conjunction with the Flood Risk Assessment (FRA) which has been prepared for this site; HEC document reference 336-004-RP1.

1.2 Site Proposal

The Proposed Development would have a total development footprint of approximately 4.6 hectares (ha) across the 53.5 ha site.

Battery Energy Storage System (BESS) of up to 200 MW with associated infrastructure (including cable route to substation), access and ancillary works (including landscaping and biodiversity enhancement).

The Proposed Development principally comprises a BESS that will import and export electricity from the adjacent, existing Fyrish Substation located to the north of the development area.

It includes:

- Battery Storage Units
- AC Twin Skids which include a MV transformer and two PCS (inverter) units
- Transmission Owner Substation
- Substation building; including office, welfare and SCADA
- High voltage transformers
- Auxiliary transformers
- Underground 132 kV grid connection cable
- Site-wide supporting infrastructure including cabling, access tracks, fencing, attenuation basins, and landscaping measures.

Whilst the exact specifications are subject to detailed design, the principal components described form the basis of the planning application to allow environmental assessments and mitigation to be appropriately scoped.

2 Location & Existing Conditions

2.1 Site Location

The site is located to the south-west of Alness, on approximate Ordnance Survey (OS) grid reference 262817, 869390 (see red line boundary on Figure 1).

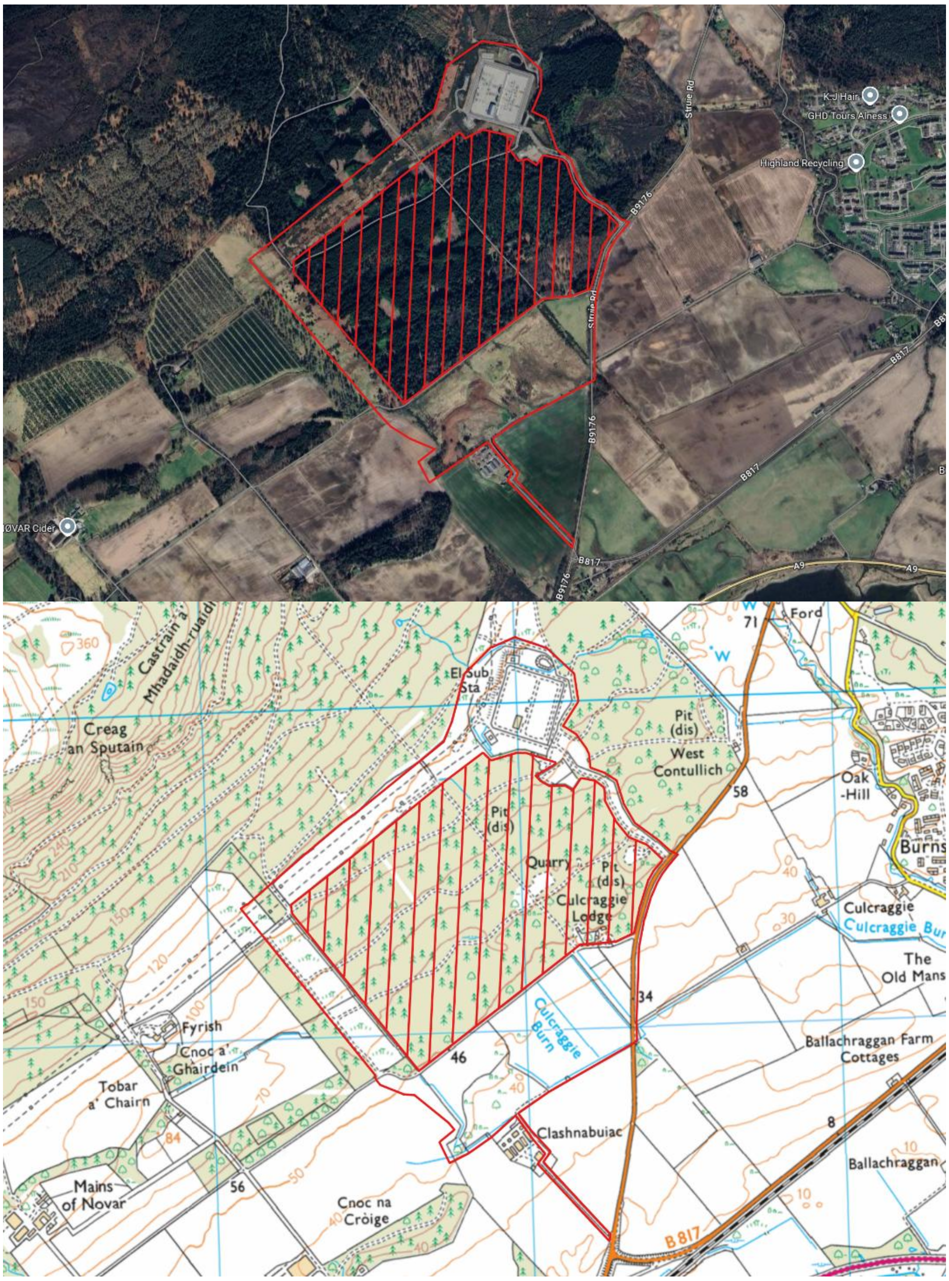

Figure 1: Site location maps

The site is predominantly surrounded by greenfield land; a single dwelling and a farm area comprising several barns are located along the southern boundary.

A new access off the B9176 is proposed as part of the development, to be used for all construction and maintenance traffic, the existing access will be maintained as an emergency access to site.

2.2 Existing Topography

A topographic survey has been produced for the site. The survey shows ground levels to generally fall from north-west, towards the south-east. Ground levels in the north-west are circa 46 metres Above Ordnance Datum (mAOD), falling to circa 29mAOD in the south-east. There are varying levels across the site as shown on the topographic survey, where there are mound features which, from the site visit and review of aerial mapping, appear to be natural.

2.3 Existing Sewer Assets

The combined utilities report does not show any Scottish Water (SW) foul or surface sewers within the vicinity of the site (see Appendix B).

2.4 Existing Potable Water Assets

The utilities search within Appendix B shows three existing water mains crossing the development site. One of which is noted to be abandoned and the other two live.

2.5 Existing Drainage Regime

There is no formal drainage system located on site therefore it is assumed the surface water runs-off would flow overland following the topography to the Culcraggie Burn or infiltrate into the underlying soils.

2.6 Ground Conditions

British Geological Survey (BGS) mapping confirms the site to have a bedrock geology of Raddery Sandstone Formation (Sandstone) (see Figure 2).

The superficial deposits for the site are shown to comprise of Glaciofluvial Deposits (Gravel, sand, and silt). The southern half of the access road is shown to have superficial deposits of Raised Marine Devensian (Gravel, sand, and silt) (see Figure 3).

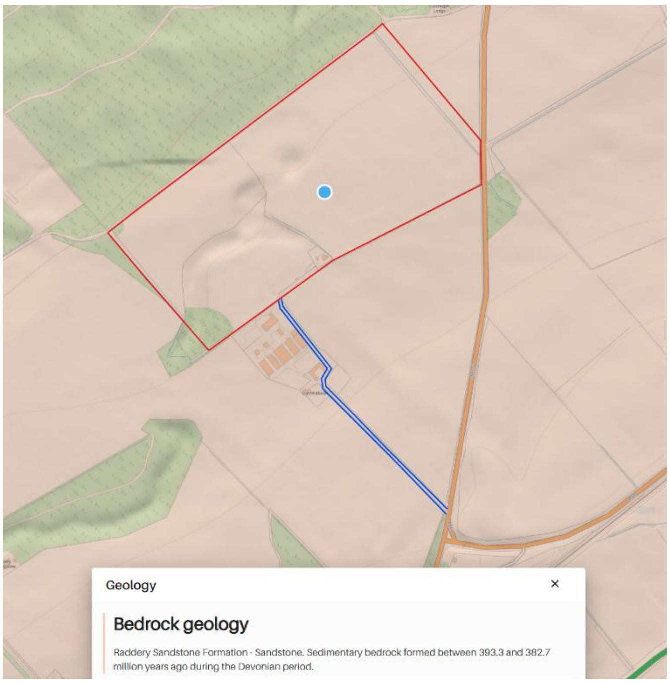

Figure 2: BGS Mapping – Bedrock geology

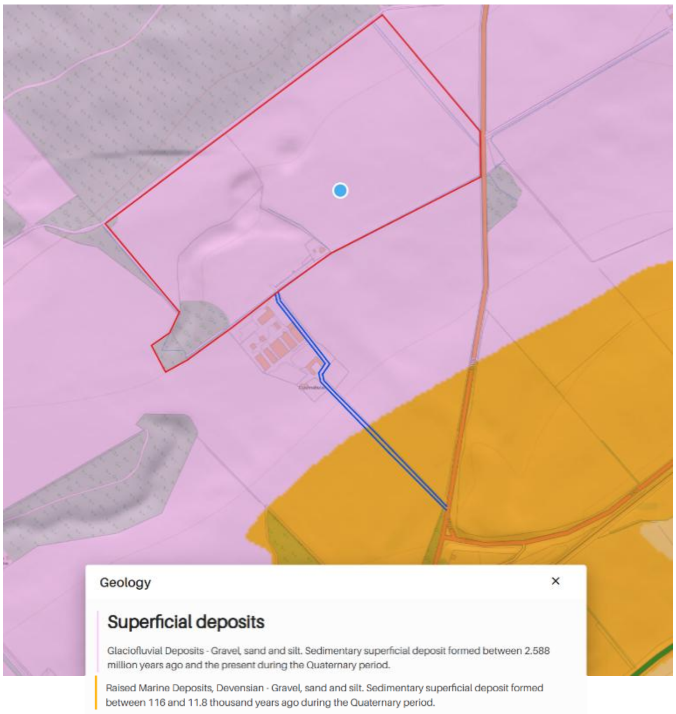

Figure 3: BGS Mapping – Superficial deposits

The Phase 2 Ground Investigation Report, prepared by Curtins on behalf of Field (Ref: 086360-CUR-XX-XX-T-GE-00001), provides a comprehensive summary of the findings from the trial pits, detailing the ground conditions observed during the investigation.

Stratum		Depth to Top m bgl (m AOD*)		Thickness Encountered (m)		Typical Description / Comments
		Min	Max	Min	Max	
Topsoil		Ground Level (45.84)	Ground Level (31.86)	0.10	0.60	Encountered at all locations except TP11 and TP29. Brown gravelly slightly clayey silty fine to coarse SAND with occasional rootlets.
Made Ground		Ground Level	Ground Level	0.50 (Note base not proven)	0.90 (Note base not proven)	TP11 and TP29 only. Topsoil and re-worked granular Glaciofluvial Deposits. Service present at 0.50m bgl in TP11 and water pipe encountered at 0.90m bgl in TP29.
Peat		0.10 (35.10)	0.10 (35.00)	0.30	0.90	Only encountered in TP04 and TP06. Black spongey pseudo-fibrous PEAT.
Glaciofluvial Deposits	Granular	0.10 (45.64)	1.00 (31.66)	0.30 (Note thickness only proven in BH02)	14.75 (Note thickness only proven in BH02)	Generally encountered as light brown / grey clayey gravelly SAND and silty SAND and GRAVEL, with rare pockets of clay and silt. The gravel component is described as being angular to subrounded of various lithologies. Cobbles and boulders of various lithologies were also noted.
	Cohesive	1.00 (41.75)	4.00 (30.63)	1.30 (Note thickness only proven in BH07)	1.80 (Note thickness only proven in BH07)	Occurs as cohesive layer / lense within granular Glaciofluvial Deposits in BH07 (1.50m thick), TP25, TP26 and TP28 only. The thickness of the clay was not proven in TP25, TP26 and TP28 but is at least 1.30m to 1.80m thick. Hard digging noted in TP26 from 2.5m bgl. Stiff to very stiff grey slightly sandy slightly gravelly CLAY.
Raddery Sandstone Formation		13.50 (26.76)	-	4.50	Base of unit not proven.	Encountered in BH02 only. Possible 'Residual Soil' between 13.50m – 14.70m bgl where soil described as reddish brown slightly gravelly SAND. Gravel is fine to medium subangular sandstone. Below this weathered and weak red sandstone was present underlain by light brownish grey CONGLOMERATE to the base of the borehole.

Figure 4: Summary of Ground Conditions

The site investigation report states that the majority of the site has a low risk of flooding from groundwater with the southern corner being at a moderate risk. This corner of the site is predominantly occupied by a peat bog. These findings are supported by observations during the site walkover where it was noted that the ground conditions where *'marshy and boggy'* allowing the assumption that groundwater is at a high level for the proposed development land.

Exploratory Hole Ref.	Depth to Groundwater (m bgl)	Depth to Groundwater (m AOD)	Notes
BH01	7.1	35.26	
BH02	2.8	37.46	
BH03	2.5	38.17	
BH04	2.4	37.73	
BH05	7.0	35.00	
BH06	5.5	36.74	
BH07	2.0	32.63	
TP01	1.6	37.33	
TP02	1.7	35.95	
TP13	1.0	36.05	
TP14	0.3	36.12	
TP17	2.5	38.37	
TP18	2.2	39.32	
TP20	1.5	40.60	
TP28	2.2	31.74	
TP31	0.3	31.61	
TP32	1.3		
TP33	1.2	32.22	Water encountered at 0.4, 0.8 and 1.2 m bgl

Figure 5 – Groundwater Strikes recorded during the Ground Investigation Works

3 Planning Policy Context

3.1 National Planning Framework 4 (NPF4 Adopted 2023)

The National Planning Framework 4 (NPF4, 2023) includes government policy for developments and meeting the challenges of climate change and flood risk. Policy 22 states that development proposals should:

- Not increase the risk of surface water flooding to others, or itself be at risk;
- 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; and
- Seek to minimise the area of impermeable surface.

3.2 Highland-wide Local Development Plan (HwLDP, Adopted 2012)

On 5 April 2012 the Highland-wide Local Development Plan was adopted by the Council and was constituted as the local development plan in law. The Plan sets out a vision statement and spatial strategy for the area, taking on board the outcomes of consultation undertaken during preparation of the plan. Policy 66 and Section 5.6 are relevant to this assessment and reads as follows:

Policy 66 Surface Water Drainage
All proposed development must be drained by Sustainable Drainage Systems (SuDS) designed in accordance with The SuDS Manual (CIRIA C697) and, where appropriate, the Sewers for Scotland Manual 2nd Edition. Planning applications should be submitted with information in accordance with Planning Advice Note 69: Planning and Building Standards Advice on Flooding paragraphs 23 and 24. Each drainage scheme design must be accompanied by particulars of proposals for ensuring long-term maintenance of the scheme.

Section 5.6 of the HwLDP states 'In line with SPP all new development need to be free from unacceptable flood risk for all flood events up to the 1 in 200 year return period (including an allowance for climate change). '

4 Surface Water Drainage

4.1 Proposed Surface Water Drainage Strategy

The surface water drainage strategy has been designed based on the requirements of CIRIA 753 (C753) dated March 2015 and the Water Assessment and Drainage Assessment Guide produced by the Sustainable Urban Drainage Scottish Working Party (SUDSWP).

The surface water drainage strategy is focused on the proposed development areas only, namely the BESS Compound. The remainder of the site area within the red line boundary will drain as existing, towards the Culcraggie Burn.

The surface water drainage strategy also considers the recommendations of the Hydrogeological Assessment Report and the potential impact on Groundwater Dependent Terrestrial Ecosystems (GWDTE).

4.1.1 SuDS Hierarchy

Surface water drainage should be managed in a way that replicates the natural drainage processes for the site as closely as possible. The proposals should follow the hierarchy outlined in C753 and should be disposed of to a receptor in the order of preference described below:

1. Into the ground;
2. To a surface water body e.g. watercourse;
3. To a surface water, highway drain, or another drainage system;
4. To a combined sewer.

4.1.2 SuDS Selection

<u>Into the Ground</u>

The Phase 2 Ground Investigation (ref: 086360-CUR-XX-XX-T-GE-00001) includes soakaway testing undertaken at the site. The results of this testing show that infiltration is not viable at the site.

Testing was undertaken in three locations, each of the tests undertaken failed to record a drop in water level over 90 minutes and the tests where therefore abandoned.

<u>To a surface water body</u>

It is proposed to discharge surface water run-off from the compound areas to a mapped water source, Culcraggie Burn, within the red line boundary.

The burn is shown (on the topographical survey and OS mapping) to flow towards the Contullich Burn located to the east and south of the Site. The proposed strategy therefore mimics the existing drainage regime for the Site.

4.2 Greenfield run-off rates

The greenfield run-off discharge rates have been calculated using the HR Wallingford IH124 method and are based on the area of the proposed compounds. The greenfield rates are summarised in Table 1 below (see Greenfield Calculations in Appendix A).

Rainfall Event	BESS Compound – 5.190 ha (l/s)
	Soil classification 3
1:1 year	14.34
Qbar	16.87
1:30 year	32.90
1:100 year	41.84
1:200 year	47.91

4.3 Surface water drainage strategy

The surface water generated by the compound is intercepted by filter drains positioned periodically across the contributing area. The filter drains collect and direct the surface water through a network of pipes to the attenuation and the outfall. The drainage system will discharge surface water at a restricted rate to the Culcraggie Burn located approximately 70 m to the south of the BESS. The burn is shown on the topographical survey and OS mapping to connect to the Contullich Burn. The surface water drainage drawings and supporting calculations are provided in Appendix A.

The discharge of surface water run-off from the BESS compound will be restricted to the Qbar greenfield rate (16.8 l/s) in line with Highland Council guidance. Discharge is controlled by a flow control device, hydrobrake or similar, which will be installed on the outfall from the attenuation basin.

Attenuation has been sized using FEH data and Causeway Flow software to accommodate the temporary run-off for rainfall events up to and including the 1:200-year event inclusive of 42% climate change. The volume of storage provided in the attenuation basin for the whole of the BESS compound in a 200-year event plus climate change is 6492 m^3 with a maximum water level of 31.499 mAOD. The proposed top of bank level for the basin is 31.800 mAOD allowing for sufficient freeboard. The basin has been designed with 1:3 side slopes.

The drainage strategy does not drain down to over half of the volume within 24 hours, therefore; addition 10-year 6 hour check was done and the basin has sufficient capacity for the required volume of surface water.

The proposed drainage will not intercept groundwater throughflows into the GWDTE. The filter drains to the northern and western boundaries of the BESS compound collect overland flows from the upstream catchment. The filter drain to the west discharges to groundwater to assist with rainfall recharge to the GWDTE. The filter drain along the northern boundary diverts run-off to the Culcraggie Burn. Any direct rainfall to the BESS compound within the GWDTE catchment is collected and diverted to the attenuation basin and does not discharge to the GWDTE due to the potential risk of contamination of the GWDTE.

4.4 Pollution Mitigation

The above proposals ensures that surface water is managed ‘at source’. All surface water from the Proposed Development area will pass through filter drains and an attenuation basin as pollution mitigation. This type of development has ‘Low’ pollution hazard level, as shown in table 26.2 of C753. The relevant land use is tabled below, with the SuDS pollution indices tabled (as per table 26.3 of C753).

Pollution Hazard indices for different land use classifications				
Land Use	**Pollution Hazard Level**	**Total suspended solids pollution index**	**Metals**	**Hydrocarbons (HC)**
Individual property driveways, residential car parks, low traffic roads (e.g. cul de sacs, home zones and general access roads) and non-residential car parking with infrequent change (e.g. schools, offices) i.e., 300 traffic movements/day	Low	0.5	0.4	0.4
Indicative SuDS mitigation indices for discharges to surface waters				
Filter Drain		0.4	0.4	0.4
Detention Basin (secondary indices halved)		0.5 (0.25)	0.5 (0.25)	0.6 (0.3)
Total		**0.65**	**0.65**	**0.7**

Table 2: SuDS Pollution Assessment

The required indices for pollutants at a low hazard level (TSS 0.5, Metals 0.4 & HC 0.4) are exceeded by the mitigation indices provided by the filter drain and detention basin (TSS 0.65, Metals 0.65 & HC 0.7). Therefore the mitigation techniques provided exceed the required levelof treatment to surface water run-off.

A penstock valve is provided, which can be manually shut off in case of a fire or pollutive incident on site, to prevent any contaminated water from entering the wider environment.

4.5 Management and Maintenance

The surface water drainage system should be maintained to ensure the system operates at its maximum capacity for the 30-year lifetime of development. A management and maintenance plan are provided in Appendix A.

4.6 Flows from off-site

The site is liable to receive off-site flows form the north-west due to the topography of the surrounding land. To mitigate against the risk of flooding due to uncontrolled water entering the site, the site will have filter drains along the north and west boundaries of the compound to intercept any overland flow. These filter drains will collect the water and divert it around the site and discharge either to groundwater or direct to the watercourse downstream of the sites flow control device.

5 Summary and Conclusion

5.1 Summary

HEC has been commissioned by the Client to carry out a Drainage Impact Assessment to support a planning application for the construction and operation of a 200 MW Battery Energy Storage System (BESS) with associated infrastructure, access and ancillary works on land at Fyrish, Alness.

Infiltration drainage is not feasible at the Site, as reported by Phase 2 Ground Investigation (ref: 086360-CUR-XX-XX-T-GE-00001) due to the impermeable soils present at the site. It is therefore proposed to discharge surface water to the Culcraggie Burn which flows to the Contullich Burn, mimicking the existing drainage regime for the Site.

Attenuation has been provided for the 1 in 200-year event inclusive of 42% climate change with a restricted discharge matching the Qbar greenfield run-off rate.

The use of filter drains, and attenuation basins provide the appropriate mitigation for the pollutants likely for this type of development.

The proposed drainage strategy takes the hydrogeology of the site into consideration and mitigates impact on the GWDTE by preventing interception of groundwater throughflows and recharging groundwater with runoff from the upstream catchment where feasible.

The surface water drainage system should be maintained to ensure the system operates at its maximum capacity for the lifetime of development in line with the management and maintenance plan provided.

Overland flow from areas to the north and west will be intercepted and diverted around the site with discharge to the groundwater/watercourse maintaining the current drainage regime of the existing site.

5.2 Conclusion

The drainage strategy complies with guidance; surface water generated by the Proposed Development can be attenuated on site in the relevant extreme event and discharged to a watercourse. The proposals for the site do not increase on or off-site flood risk and are therefore considered acceptable.

Appendix A Surface Water Drainage

Haydn Evans calculations ref: 336-009-CA1 – Greenfield Calculation

Haydn Evans drawing ref: 336-004-D002 – Surface Water Drainage Strategy – Soil Type 3

Haydn Evans calculations ref: 336-009-CA3 – SWDS Calculations – Soil Type 3

Haydn Evans document ref : 336-009-RP3 – SuDS Management & Maintenance Plan hr wallingford

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Tayler Evans
Site name:	336-009
Site location:	Fyrish

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.

Site Details

Latitude:	57.68906° N
Longitude:	4.29999° W
Reference:	2970015033
Date:	Feb 13 2025 13:00

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 5.190

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	5	3
HOST class:	N/A	N/A
SPR/SPRHOST:	0.53	0.37

Hydrological characteristics

	Default	Edited
SAAR (mm):	778	778
Hydrological region:	1	1
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	1.95	1.95
Growth curve factor 100 years:	2.48	2.48
Growth curve factor 200 years:	2.84	2.84

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

Default Edited

Q_{BAR} (l/s):	36.8	16.87
1 in 1 year (l/s):	31.28	14.34
1 in 30 years (l/s):	71.76	32.9
1 in 100 year (l/s):	91.26	41.84
1 in 200 years (l/s):	104.51	47.91

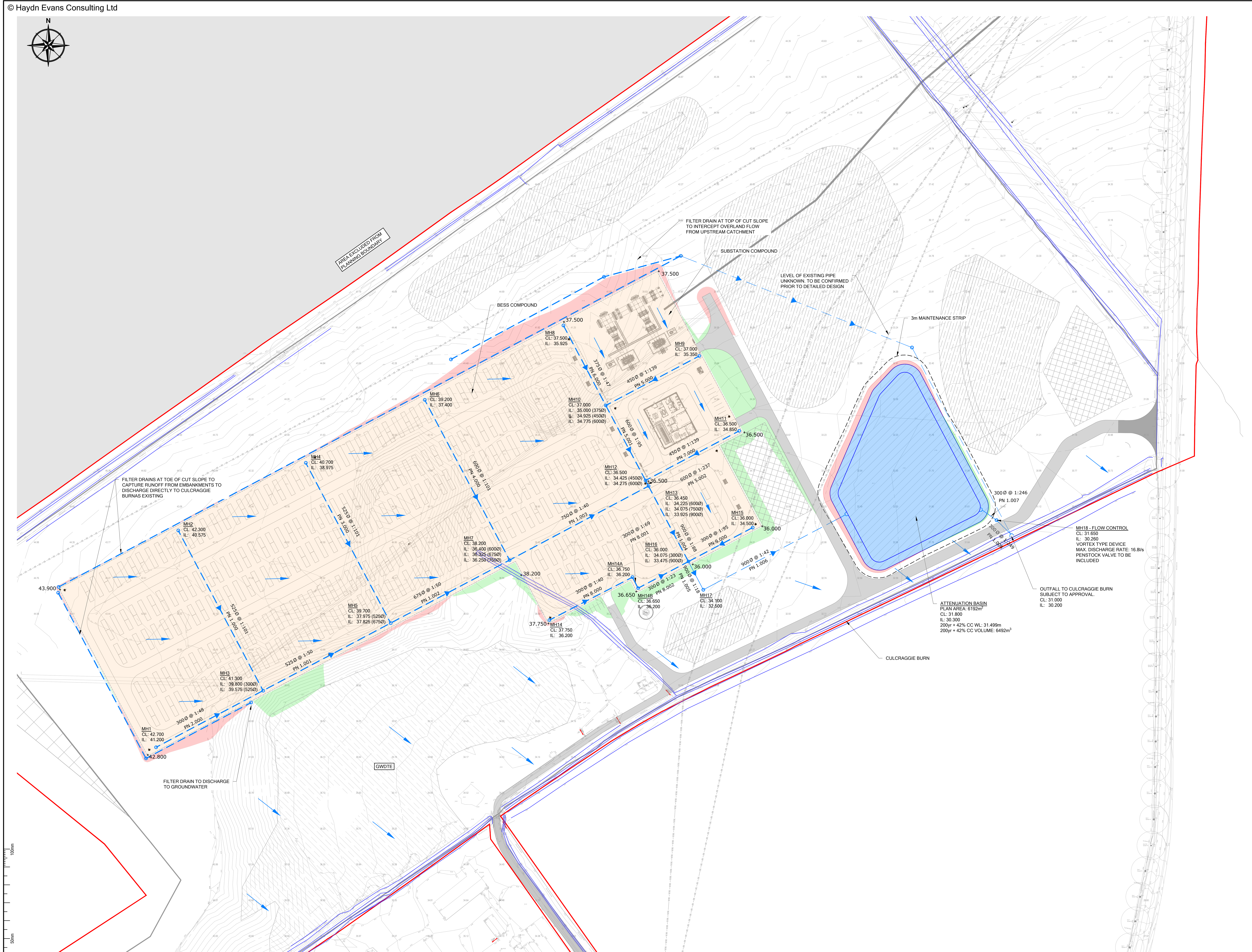

TABLE 1 - ATTENUATION BASIN

REF.	CONTRIBUTING AREA (ha)	200yr + 42% CC VOLUME (m³)	30yr + 42% CC VOLUME (m³)	HALF DRAIN TIME (MINS)	VOLUME AFTER 24h (m³)	10yr 6h VOLUME (m³)	REQUIRED VOLUME (m³)	STRUCTURE CAPACITY (m³)
BASIN	5.190	6492	4611	4140	4238	1850	6088	8302

NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ENGINEERS, ARCHITECTS AND SPECIALISTS DRAWINGS AND THE SPECIFICATION.
2. DO NOT SCALE FROM THIS DRAWING MANUALLY OR ELECTRONICALLY. WRITTEN PERMISSION MUST BE OBTAINED FROM HAYDN EVANS PRIOR TO SCALING ELECTRONICALLY OR USING THIS ELECTRONIC FILE.
3. THIS DRAINAGE STRATEGY DRAWING SHOWS HOW SURFACE WATER RUN-OFF COULD BE MANAGED ON SITE WITH A RESTRICTED OFF-SITE DISCHARGE, FOR ALL RAINFALL EVENTS UP TO AND INCLUDING THE 200 YEAR RETURN PERIOD PLUS 42% CLIMATE CHANGE EVENT TO ENSURE NO INCREASED FLOOD RISK TO OTHERS AS A RESULT OF THE PROPOSED DEVELOPMENT.

   THIS IS NOT INTENDED TO BE A DETAILED DESIGN AT THIS STAGE. PLEASE NOTE THAT THE FINAL LAYOUT MAY BE SUBJECT TO REFINEMENT TO MEET CERTAIN TECHNICAL CRITERIA.
4. SITE LAYOUT BASED ON FIELD DETAILED SITE PLAN, DRAWING REF. BTGBFYR01-005.1 REV. 08, DATED 07/02/2025 .

KEY

- PLANNING BOUNDARY
- +xx.xxx PROPOSED LEVELS
- CONTRIBUTING AREA (5.190ha)
- ACCESS ROAD
- CUT GRADING
- FILL GRADING
- PROPOSED ATTENUATION BASIN
- SURFACE WATER MANHOLE
- SURFACE WATER DRAIN
- SURFACE WATER FILTER DRAIN
- OVERLAND FLOW ROUTE
- WATER ABANDONED
- WATER EXISTING
- EXISTING WATERCOURSE

DRAWING FOR APPROVAL
NOT FOR CONSTRUCTION

Rev'n	Date	Description	Drawn	Chk'd	App'd
P04	13.02.2024	UPDATED TO LATEST LAYOUT	BP	JRC	JRC
P03	08.01.2024	UPDATED TO ACCOMMODATE CLIMATE CHANGE ALLOWANCE AND GWDTE	TE	BP	JRC
P02	05.12.2024	GROUND INVESTIGATION UNDERTAKEN CHANGING SOIL TYPE	TE	JRC	JRC
P01	01.11.2024	PRELIMINARY ISSUE	TE	BP	JRC

Status: PRELIMINARY

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Client: FIELD

Project: FYRISH

Drawing title: SURFACE WATER DRAINAGE STRATEGY

Scale	Drawn	Checked	Approved	Date
1:1000 @ A1	TE	BP	JRC	OCT 2024

Drawing no.	Revision
336-009-D002	P04

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
MH1	0.148	5.00	42.700	1200	262772.671	868779.063	1.500
MH2	0.646	5.00	42.300	1350	262785.101	868900.188	1.725
MH3	0.171	5.00	41.300	1500	262832.494	868810.689	1.725
MH4	0.682	5.00	40.700	1350	262856.335	868937.968	1.725
MH5	0.149	5.00	39.700	1500	262903.727	868848.470	1.875
MH6	0.647	5.00	39.200	1500	262922.787	868973.157	1.800
MH7	0.222	5.00	38.200	1500	262970.179	868883.658	1.950
MH8	0.276	5.00	37.500	1200	262999.637	869015.956	1.575
MH9	0.319	5.00	37.000	1500	263072.265	869005.062	1.650
MH10	0.419	5.00	37.000	1500	263020.052	868977.414	2.225
MH11	0.279	5.00	36.500	1350	263094.520	868963.191	1.650
MH12	0.000		36.500	1500	263042.247	868935.511	2.225
MH13	0.215	5.00	36.450	1500	263047.797	868925.021	2.525
MH14	0.173	5.00	37.750	1500	262988.524	868857.479	1.550
MH14A	0.000		36.750	1200	263034.929	868881.460	1.200
MH14B	0.000		36.650	1200	263038.097	868875.330	1.200
MH15	0.225	5.00	36.000	1500	263102.060	868909.167	1.500
MH16	0.000		36.000	1500	263066.215	868890.205	2.525
MH17	0.000		34.100	1800	263074.525	868874.435	1.600
Basin	0.619	5.00	31.800	1800	263230.928	868922.216	1.500
MH18	0.000		31.650	1200	263238.334	868913.293	1.390
Outfall	0.000		31.000	1200	263252.229	868907.238	0.800

Links

Name	US Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)
2.000	MH1	67.668	0.600	41.200	39.800	1.400	48.3	300	5.50
1.000	MH2	101.273	0.600	40.575	39.575	1.000	101.3	525	5.76
1.001	MH3	80.632	0.600	39.575	37.975	1.600	50.4	525	6.18
3.000	MH4	101.271	0.600	38.975	37.975	1.000	101.3	525	5.76
1.002	MH5	75.194	0.600	37.825	36.325	1.500	50.1	675	6.52
4.000	MH6	101.272	0.600	37.400	36.400	1.000	101.3	600	5.70
1.003	MH7	87.951	0.600	36.250	34.075	2.175	40.4	750	6.85
6.000	MH8	43.615	0.600	35.925	35.000	0.925	47.2	375	5.27
5.000	MH9	59.081	0.600	35.350	34.925	0.425	139.0	450	5.57

Name	US Node	DS Node	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
2.000	MH1	MH3	2.267	160.2	26.7	1.200	1.200	0.148	0.0
1.000	MH2	MH3	2.225	481.7	116.7	1.200	1.200	0.646	0.0
1.001	MH3	MH5	3.160	684.1	174.4	1.200	1.200	0.965	0.0
3.000	MH4	MH5	2.225	481.7	123.2	1.200	1.200	0.682	0.0
1.002	MH5	MH7	3.707	1326.4	324.5	1.200	1.200	1.796	0.0
4.000	MH6	MH7	2.419	684.1	116.9	1.200	1.200	0.647	0.0
1.003	MH7	MH13	4.408	1947.3	481.6	1.200	1.625	2.665	0.0
6.000	MH8	MH10	2.644	292.0	49.9	1.200	1.625	0.276	0.0
5.000	MH9	MH10	1.722	273.9	57.6	1.200	1.625	0.319	0.0

Links

Name	US Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)
5.001	MH10	47.418	0.600	34.775	34.275	0.500	94.8	600	5.89
7.000	MH11	59.149	0.600	34.850	34.425	0.425	139.2	450	5.57
5.002	MH12	3.548	0.600	34.275	34.225	0.050	71.0	600	5.91
1.004	MH13	47.651	0.600	33.925	33.475	0.450	105.9	900	7.12
9.000	MH15	40.551	0.600	34.500	34.075	0.425	95.4	300	5.42
8.000	MH14	52.235	0.600	36.200	35.550	0.650	80.4	300	5.50
8.001	MH14A	6.900	0.600	35.550	35.450	0.100	69.0	300	5.56
8.002	MH14B	31.810	0.600	35.450	34.075	1.375	23.1	300	5.72
1.005	MH16	17.826	0.600	33.475	32.500	0.975	18.3	900	7.16
1.006	MH17	91.121	0.600	32.500	30.300	2.200	41.4	900	7.47
1.007	Basin	9.824	0.600	30.300	30.260	0.040	245.6	300	7.63
1.008	MH18	14.939	0.600	30.260	30.200	0.060	249.0	300	7.88

Name	US Node	DS Node	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
5.001	MH10	MH12	2.501	707.0	183.2	1.625	1.625	1.014	0.0
7.000	MH11	MH12	1.721	273.7	50.4	1.200	1.625	0.279	0.0
5.002	MH12	MH13	2.893	818.0	233.6	1.625	1.625	1.293	0.0
1.004	MH13	MH16	3.044	1936.7	754.1	1.625	1.625	4.173	0.0
9.000	MH15	MH16	1.610	113.8	40.7	1.200	1.625	0.225	0.0
8.000	MH14	MH14A	1.755	124.1	31.3	1.250	0.900	0.173	0.0
8.001	MH14A	MH14B	1.895	133.9	31.3	0.900	0.900	0.173	0.0
8.002	MH14B	MH16	3.282	232.0	31.3	0.900	1.625	0.173	0.0
1.005	MH16	MH17	7.345	4672.6	826.0	1.625	0.700	4.571	0.0
1.006	MH17	Basin	4.875	3101.6	826.0	0.700	0.600	4.571	0.0
1.007	Basin	MH18	0.999	70.6	937.8	1.200	1.090	5.190	0.0
1.008	MH18	Outfall	0.992	70.1	937.8	1.090	0.500	5.190	0.0

Simulation Settings

Rainfall Methodology	FEH-13	Analysis Speed	Normal	Starting Level (m)	
Rainfall Events	Singular	Skip Steady State	x	Check Discharge Rate(s)	x
Summer CV	1.000	Drain Down Time (mins)	10000	Check Discharge Volume	x
Winter CV	1.000	Additional Storage (m³/ha)	20.0		

Storm Durations

60	180	360	600	960	2160	4320	7200	10080
120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
10	0	0	0
30	0	0	0
30	42	0	0
200	42	0	0

Node Basin Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	30.300	Product Number	CTL-SHE-0181-1680-1200-1680
Design Depth (m)	1.200	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	16.8	Min Node Diameter (mm)	1500

Node Basin Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	30.300
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	5520

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	4877.0	0.0	1.500	6192.0	0.0

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.81%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	MH1	33	41.258	0.058	13.2	0.1806	0.0000	OK
60 minute summer	MH2	33	40.697	0.122	57.8	1.0891	0.0000	OK
60 minute summer	MH3	34	39.701	0.126	86.3	0.4712	0.0000	OK
60 minute summer	MH4	33	39.100	0.125	61.0	1.1684	0.0000	OK
60 minute summer	MH5	34	37.984	0.159	157.5	0.5332	0.0000	OK
60 minute summer	MH6	33	37.517	0.117	57.9	1.0446	0.0000	OK
60 minute summer	MH7	34	36.427	0.177	233.4	0.7149	0.0000	OK
60 minute summer	MH8	33	35.999	0.074	24.7	0.3452	0.0000	OK
60 minute summer	MH9	33	35.448	0.098	28.6	0.5542	0.0000	OK
60 minute summer	MH10	33	34.918	0.143	90.4	0.7938	0.0000	OK
60 minute summer	MH11	33	34.942	0.092	25.0	0.4423	0.0000	OK
60 minute summer	MH12	33	34.465	0.190	115.0	0.3356	0.0000	OK
60 minute summer	MH13	34	34.211	0.286	365.7	0.9929	0.0000	OK
60 minute summer	MH14	33	36.271	0.071	15.5	0.2855	0.0000	OK
60 minute summer	MH14A	33	35.626	0.076	15.5	0.0861	0.0000	OK
60 minute summer	MH14B	34	35.503	0.053	15.4	0.0600	0.0000	OK
60 minute summer	MH15	33	34.587	0.087	20.1	0.4133	0.0000	OK
60 minute summer	MH16	34	33.661	0.186	401.3	0.3281	0.0000	OK
60 minute summer	MH17	33	32.793	0.293	401.1	0.7468	0.0000	OK
2880 minute summer	Basin	1860	30.567	0.267	50.7	1337.0970	0.0000	OK
2880 minute summer	MH18	1860	30.362	0.102	15.8	0.1150	0.0000	OK
2880 minute summer	Outfall	1860	30.295	0.095	15.8	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	MH1	2.000	13.1	1.377	0.082	0.6430	
60 minute summer	MH2	1.000	57.9	1.497	0.120	3.9159	
60 minute summer	MH3	1.001	85.1	2.184	0.124	3.1422	
60 minute summer	MH4	3.000	59.8	1.545	0.124	3.9280	
60 minute summer	MH5	1.002	158.0	2.530	0.119	4.6955	
60 minute summer	MH6	4.000	56.7	1.500	0.083	3.8389	
60 minute summer	MH7	1.003	233.3	3.023	0.120	6.7899	
60 minute summer	MH8	6.000	24.7	1.618	0.084	0.6648	
60 minute summer	MH9	5.000	28.3	1.125	0.103	1.4851	
60 minute summer	MH10	5.001	90.3	1.416	0.128	3.0366	
60 minute summer	MH11	7.000	24.7	1.082	0.090	1.3509	
60 minute summer	MH12	5.002	114.4	1.757	0.140	0.2318	
60 minute summer	MH13	1.004	366.3	2.770	0.189	6.3687	
60 minute summer	MH14	8.000	15.5	1.156	0.125	0.7014	
60 minute summer	MH14A	8.001	15.4	1.389	0.115	0.0773	
60 minute summer	MH14B	8.002	15.4	1.862	0.066	0.2630	
60 minute summer	MH15	9.000	20.0	1.211	0.176	0.6705	
60 minute summer	MH16	1.005	401.1	3.027	0.086	2.4296	
60 minute summer	MH17	1.006	405.7	4.985	0.131	8.6733	
2880 minute summer	Basin	Hydro-Brake®	15.8				
2880 minute summer	MH18	1.008	15.8	0.788	0.226	0.3005	2285.2

Results for 10 year Critical Storm Duration. Lowest mass balance: 99.81%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	MH1	33	41.295	0.095	34.1	0.2944	0.0000	OK
60 minute summer	MH2	33	40.776	0.201	148.8	1.7910	0.0000	OK
60 minute summer	MH3	33	39.784	0.209	222.6	0.7853	0.0000	OK
60 minute summer	MH4	33	39.183	0.208	157.1	1.9436	0.0000	OK
60 minute summer	MH5	34	38.091	0.266	409.9	0.8920	0.0000	OK
60 minute summer	MH6	33	37.591	0.191	149.1	1.7135	0.0000	OK
60 minute summer	MH7	33	36.536	0.286	605.3	1.1567	0.0000	OK
60 minute summer	MH8	33	36.047	0.122	63.6	0.5656	0.0000	OK
60 minute summer	MH9	33	35.512	0.162	73.5	0.9146	0.0000	OK
60 minute summer	MH10	33	35.023	0.248	233.4	1.3706	0.0000	OK
60 minute summer	MH11	33	34.999	0.149	64.3	0.7150	0.0000	OK
60 minute summer	MH12	33	34.602	0.327	297.8	0.5784	0.0000	OK
60 minute summer	MH13	34	34.414	0.489	949.0	1.6979	0.0000	OK
60 minute summer	MH14	33	36.318	0.118	39.9	0.4701	0.0000	OK
60 minute summer	MH14A	33	35.678	0.128	39.9	0.1451	0.0000	OK
60 minute summer	MH14B	33	35.536	0.086	39.9	0.0978	0.0000	OK
60 minute summer	MH15	33	34.647	0.147	51.8	0.7016	0.0000	OK
60 minute summer	MH16	34	33.816	0.341	1043.1	0.6024	0.0000	OK
60 minute summer	MH17	33	32.963	0.463	1044.9	1.1795	0.0000	OK
2880 minute summer	Basin	1980	30.747	0.447	80.2	2270.2310	0.0000	SURCHARGED
2160 minute summer	MH18	1800	30.365	0.105	16.8	0.1186	0.0000	OK
2160 minute summer	Outfall	1800	30.298	0.098	16.8	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	MH1	2.000	34.0	1.805	0.212	1.2745	
60 minute summer	MH2	1.000	149.2	1.912	0.310	7.9065	
60 minute summer	MH3	1.001	219.9	2.826	0.321	6.2881	
60 minute summer	MH4	3.000	155.9	2.005	0.324	7.8816	
60 minute summer	MH5	1.002	409.9	3.265	0.309	9.4422	
60 minute summer	MH6	4.000	148.0	1.959	0.216	7.6572	
60 minute summer	MH7	1.003	606.9	3.513	0.312	15.2789	
60 minute summer	MH8	6.000	63.6	2.103	0.218	1.3193	
60 minute summer	MH9	5.000	73.3	1.461	0.268	2.9634	
60 minute summer	MH10	5.001	233.4	1.750	0.330	6.3288	
60 minute summer	MH11	7.000	64.5	1.295	0.235	3.0637	
60 minute summer	MH12	5.002	296.7	2.243	0.363	0.4697	
60 minute summer	MH13	1.004	953.3	3.338	0.492	13.6313	
60 minute summer	MH14	8.000	39.9	1.471	0.322	1.4187	
60 minute summer	MH14A	8.001	39.9	1.763	0.298	0.1570	
60 minute summer	MH14B	8.002	39.8	2.431	0.172	0.5210	
60 minute summer	MH15	9.000	51.8	1.552	0.455	1.3524	
60 minute summer	MH16	1.005	1044.9	3.911	0.224	4.8744	
60 minute summer	MH17	1.006	1056.2	5.968	0.341	17.1398	
2880 minute summer	Basin	Hydro-Brake®	16.8				
2160 minute summer	MH18	1.008	16.8	0.801	0.239	0.3130	3345.6

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.81%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	MH1	33	41.315	0.115	48.6	0.3566	0.0000	OK
60 minute summer	MH2	33	40.821	0.246	212.3	2.1940	0.0000	OK
60 minute summer	MH3	33	39.833	0.258	317.6	0.9687	0.0000	OK
60 minute summer	MH4	33	39.231	0.256	224.1	2.3903	0.0000	OK
60 minute summer	MH5	33	38.154	0.329	586.4	1.1031	0.0000	OK
60 minute summer	MH6	33	37.633	0.233	212.6	2.0829	0.0000	OK
60 minute summer	MH7	33	36.598	0.348	866.8	1.4074	0.0000	OK
60 minute summer	MH8	33	36.073	0.148	90.7	0.6884	0.0000	OK
60 minute summer	MH9	33	35.549	0.198	104.8	1.1183	0.0000	OK
60 minute summer	MH10	33	35.089	0.314	333.0	1.7366	0.0000	OK
60 minute summer	MH11	32	35.029	0.179	91.7	0.8621	0.0000	OK
60 minute summer	MH12	33	34.688	0.413	425.1	0.7302	0.0000	OK
60 minute summer	MH13	33	34.542	0.617	1356.6	2.1398	0.0000	OK
60 minute summer	MH14	33	36.344	0.144	56.9	0.5772	0.0000	OK
60 minute summer	MH14A	33	35.708	0.158	57.0	0.1788	0.0000	OK
60 minute summer	MH14B	33	35.555	0.105	56.9	0.1186	0.0000	OK
60 minute summer	MH15	33	34.685	0.185	73.9	0.8801	0.0000	OK
60 minute summer	MH16	34	33.912	0.437	1487.7	0.7729	0.0000	OK
60 minute summer	MH17	33	33.060	0.560	1491.1	1.4262	0.0000	OK
2880 minute summer	Basin	2100	30.865	0.565	98.2	2903.4460	0.0000	SURCHARGED
960 minute summer	MH18	1515	30.365	0.105	16.8	0.1186	0.0000	OK
960 minute summer	Outfall	1515	30.298	0.098	16.8	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	MH1	2.000	48.5	1.987	0.303	1.6518	
60 minute summer	MH2	1.000	212.9	2.078	0.442	10.3779	
60 minute summer	MH3	1.001	314.4	3.088	0.460	8.2325	
60 minute summer	MH4	3.000	223.0	2.195	0.463	10.2966	
60 minute summer	MH5	1.002	585.2	3.562	0.441	12.3557	
60 minute summer	MH6	4.000	211.7	2.154	0.309	9.9535	
60 minute summer	MH7	1.003	866.5	3.579	0.445	21.4541	
60 minute summer	MH8	6.000	90.7	2.308	0.311	1.7143	
60 minute summer	MH9	5.000	104.7	1.602	0.382	3.8595	
60 minute summer	MH10	5.001	332.8	1.878	0.471	8.4435	
60 minute summer	MH11	7.000	92.2	1.301	0.337	4.5546	
60 minute summer	MH12	5.002	421.7	2.401	0.516	0.6347	
60 minute summer	MH13	1.004	1359.7	3.530	0.702	18.2926	
60 minute summer	MH14	8.000	57.0	1.601	0.459	1.8583	
60 minute summer	MH14A	8.001	56.9	1.918	0.425	0.2054	
60 minute summer	MH14B	8.002	56.8	2.672	0.245	0.6767	
60 minute summer	MH15	9.000	73.9	1.683	0.649	1.7799	
60 minute summer	MH16	1.005	1491.1	4.252	0.319	6.4088	
60 minute summer	MH17	1.006	1506.8	6.241	0.486	22.6383	
2880 minute summer	Basin	Hydro-Brake®	16.8				
960 minute summer	MH18	1.008	16.8	0.801	0.239	0.3130	3306.7

Results for 30 year +42% CC Critical Storm Duration. Lowest mass balance: 99.81%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	MH1	33	41.340	0.140	69.1	0.4358	0.0000	OK
60 minute summer	MH2	33	40.881	0.306	301.5	2.7294	0.0000	OK
60 minute summer	MH3	33	39.899	0.324	451.1	1.2156	0.0000	OK
60 minute summer	MH4	33	39.295	0.320	318.3	2.9873	0.0000	OK
60 minute summer	MH5	33	38.238	0.413	833.8	1.3870	0.0000	OK
60 minute summer	MH6	33	37.684	0.284	301.9	2.5474	0.0000	OK
60 minute summer	MH7	33	36.684	0.434	1235.7	1.7560	0.0000	OK
60 minute summer	MH8	33	36.107	0.182	128.8	0.8458	0.0000	OK
60 minute summer	MH9	33	35.595	0.245	148.9	1.3819	0.0000	OK
60 minute summer	MH10	33	35.171	0.396	473.4	2.1927	0.0000	OK
60 minute summer	MH11	33	35.064	0.214	130.2	1.0309	0.0000	OK
60 minute summer	MH12	33	34.922	0.647	602.1	1.1433	0.0000	SURCHARGED
60 minute summer	MH13	34	34.753	0.828	1927.3	2.8724	0.0000	OK
60 minute summer	MH14	33	36.380	0.180	80.7	0.7215	0.0000	OK
60 minute summer	MH14A	33	35.747	0.197	80.8	0.2226	0.0000	OK
60 minute summer	MH14B	33	35.578	0.128	80.7	0.1446	0.0000	OK
60 minute summer	MH15	33	34.744	0.244	105.0	1.1613	0.0000	OK
60 minute summer	MH16	34	34.050	0.575	2115.5	1.0159	0.0000	OK
60 minute summer	MH17	33	33.197	0.697	2119.1	1.7745	0.0000	OK
5760 minute summer	Basin	4140	31.175	0.875	89.9	4611.4180	0.0000	SURCHARGED
120 minute summer	MH18	828	30.365	0.105	16.8	0.1186	0.0000	OK
120 minute summer	Outfall	828	30.298	0.098	16.8	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	MH1	2.000	69.0	2.176	0.431	2.1465	
60 minute summer	MH2	1.000	302.3	2.235	0.628	13.6974	
60 minute summer	MH3	1.001	447.3	3.341	0.654	10.8221	
60 minute summer	MH4	3.000	317.0	2.381	0.658	13.5059	
60 minute summer	MH5	1.002	831.4	3.849	0.627	16.2568	
60 minute summer	MH6	4.000	303.7	2.319	0.444	13.3150	
60 minute summer	MH7	1.003	1233.0	3.624	0.633	29.9427	
60 minute summer	MH8	6.000	128.8	2.517	0.441	2.2325	
60 minute summer	MH9	5.000	149.1	1.710	0.544	5.2315	
60 minute summer	MH10	5.001	472.0	1.916	0.668	11.3603	
60 minute summer	MH11	7.000	130.2	1.305	0.475	6.8856	
60 minute summer	MH12	5.002	597.8	2.403	0.731	0.9655	
60 minute summer	MH13	1.004	1933.6	3.678	0.998	24.7254	
60 minute summer	MH14	8.000	80.8	1.732	0.651	2.4351	
60 minute summer	MH14A	8.001	80.7	2.076	0.603	0.2677	
60 minute summer	MH14B	8.002	80.7	2.923	0.348	0.8781	
60 minute summer	MH15	9.000	104.8	1.785	0.921	2.3810	
60 minute summer	MH16	1.005	2119.1	4.573	0.454	8.4872	
60 minute summer	MH17	1.006	2135.4	6.386	0.688	30.3382	
5760 minute summer	Basin	Hydro-Brake®	16.8				
120 minute summer	MH18	1.008	16.8	0.801	0.239	0.3130	2933.0

Results for 200 year +42% CC Critical Storm Duration. Lowest mass balance: 99.81%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	MH1	33	41.377	0.177	106.6	0.5488	0.0000	OK
60 minute summer	MH2	35	41.220	0.645	465.3	5.7561	0.0000	SURCHARGED
60 minute summer	MH3	35	40.453	0.878	698.5	3.2941	0.0000	SURCHARGED
60 minute summer	MH4	35	39.976	1.001	491.2	9.3478	0.0000	SURCHARGED
60 minute summer	MH5	35	39.084	1.259	1234.4	4.2243	0.0000	SURCHARGED
60 minute summer	MH6	35	38.219	0.819	466.0	7.3368	0.0000	SURCHARGED
60 minute summer	MH7	35	37.804	1.554	1835.3	6.2853	0.0000	SURCHARGED
60 minute summer	MH8	34	37.181	1.256	198.8	5.8239	0.0000	SURCHARGED
60 minute summer	MH9	34	37.000	1.650	229.8	9.2961	1.1517	FLOOD
60 minute summer	MH10	34	36.748	1.973	664.1	10.9164	0.0000	FLOOD RISK
60 minute summer	MH11	34	36.405	1.555	201.0	7.4857	0.0000	FLOOD RISK
60 minute summer	MH12	34	36.178	1.903	842.7	3.3631	0.0000	SURCHARGED
60 minute summer	MH13	34	35.899	1.974	2613.3	6.8494	0.0000	SURCHARGED
60 minute summer	MH14	33	36.467	0.267	124.6	1.0674	0.0000	OK
60 minute summer	MH14A	33	35.820	0.270	124.4	0.3057	0.0000	OK
60 minute summer	MH14B	34	35.611	0.161	124.2	0.1823	0.0000	OK
60 minute summer	MH15	34	35.551	1.051	162.1	5.0114	0.0000	SURCHARGED
60 minute summer	MH16	34	34.687	1.212	2879.4	2.1423	0.0000	SURCHARGED
60 minute summer	MH17	34	33.810	1.310	2883.2	3.3336	0.0000	FLOOD RISK
10080 minute summer	Basin	6840	31.499	1.199	81.5	6492.6290	0.0000	SURCHARGED
120 minute summer	MH18	2320	30.365	0.105	16.8	0.1186	0.0000	OK
60 minute summer	Outfall	1787	30.298	0.098	16.8	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	MH1	2.000	106.6	2.277	0.665	3.8408	
60 minute summer	MH2	1.000	468.7	2.368	0.973	21.8783	
60 minute summer	MH3	1.001	657.8	3.476	0.962	17.4192	
60 minute summer	MH4	3.000	469.3	2.496	0.974	21.8779	
60 minute summer	MH5	1.002	1191.9	3.874	0.899	26.8426	
60 minute summer	MH6	4.000	483.5	2.350	0.707	28.5260	
60 minute summer	MH7	1.003	1679.1	3.816	0.862	38.7091	
60 minute summer	MH8	6.000	180.2	2.446	0.617	4.8106	
60 minute summer	MH9	5.000	201.8	1.641	0.737	9.3610	
60 minute summer	MH10	5.001	658.4	2.338	0.931	13.3566	
60 minute summer	MH11	7.000	184.3	1.299	0.673	9.3718	
60 minute summer	MH12	5.002	840.4	2.984	1.027	0.9994	
60 minute summer	MH13	1.004	2617.1	4.130	1.351	30.2000	
60 minute summer	MH14	8.000	124.4	1.870	1.003	3.4753	
60 minute summer	MH14A	8.001	124.2	2.327	0.927	0.3614	
60 minute summer	MH14B	8.002	123.6	3.131	0.533	1.7333	
60 minute summer	MH15	9.000	151.2	2.148	1.329	2.8556	
60 minute summer	MH16	1.005	2883.2	4.937	0.617	11.2977	
60 minute summer	MH17	1.006	2901.3	6.365	0.935	44.7850	
10080 minute summer	Basin	Hydro-Brake®	16.8				
120 minute summer	MH18	1.008	16.8	0.801	0.239	0.3130	4343.5

200 MW BESS, Fyrish, Alness
SuDS Management & Maintenance Plan

1 Introduction

Sustainable Drainage Systems (SuDS) features are utilised to manage rainfall and use landscape features to deal with surface water. SuDS control the flow rate and volume of water leaving the development area and reduce pollution by intercepting silt and cleaning run-off from hard surfaces.

Like all aspects of drainage systems, SuDS components should be regularly inspected and maintained. This ensures efficient operation and reduces the likelihood of failure. The level of inspection and maintenance will vary depending on the type of SuDS component. Further information on maintenance can be found in The SuDS Manual (CIRIA publication C753).

The SuDS and drainage features for the Proposed Development are to be maintained by the site owner/occupant.

This Plan should be updated following any changes to the proposed drainage design at detailed design stage.

2 Managing SuDS

The SuDS features have been designed for easy maintenance and comprise:

- Regular maintenance – litter collection and checking the inlets and outlets where water enters or leaves the SuDS feature.
- Occasional tasks – removing any silt that builds up, cutting back and clearing excessive vegetation growth, inspection of outlets, manholes and flow controls.
- Remedial work – repairing damage where necessary.

3 Contact

In the event of concern over any matter to do with the SuDS, please contact the site owner/occupant.

4 SuDS Maintenance

The surface water drainage system includes filter drains, an attenuation basin, flow control, pipes and manholes.

Surface water is collected by filter drains and directed to the attenuation basin via a piped network. Surface water is then directed to filter drains to infiltrate water and also a positive outfall to a highway drain.

Table 1 below provides a breakdown of general maintenance requirements to be undertaken, appropriate to the types of SuDS and surface water drainage systems proposed at this site.

Regular Maintenance		Frequency
1	**Litter Management** Check for and pick up litter around the entire site.	Monthly
2	**Inlets and Outlets** Remove silt and debris from inlets and outlets.	Quarterly
3	**Respond to reported blockages, etc.**	As required
Occasional Maintenance		**Frequency**
4	**Inspection of Control Chamber** Inspection of chambers for silt build up and visually check pipes appear clear and free flowing. Remove silt as required. Jetting as required.	Annually
5	**Inspection of Attenuation** Check for blockages within the connecting pipes.	Quarterly and following heavy storms
Remedial Work		**Frequency**
6	**Inspect SuDS systems to check for damage or failure** Undertake remedial work as required.	Annually
7	**Silt control and removal** Wash or replace filter medium when required.	As required

Table 1: SuDS General Maintenance Requirements

Tables 2 to 3 below provides a breakdown of typical maintenance requirements appropriate to the types of SuDS proposed at this site.

Operation and Maintenance Requirements for Attenuation Basin		
Responsible for Maintenance	Site Owner/Occupier	
Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Remove litter and debris.	Monthly
	Cut grass - for spillways and access routes.	Monthly (during growing season)
	Cut grass - meadow grass in and around basins.	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 (for first year), then annually
	Check any penstocks and other mechanical devices.	Annually
	Tidy all dead growth before start of growing season.	Annually
	Remove sediment from inlets, outlets and forebay.	Annually
	Manage wetland plants in outlet pool, where provided.	Annually
Occasional maintenance	Reseed areas of poor vegetation growth	To be reviewed every 2 years
	Prune and trim any trees and remove cuttings	Every 2 years
	Remove sediment from inlets, outlets, forebay and main basins when required	Every 5 years (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
	Repair/rehabilitation of inlets, outlets and overflows.	As required
	Relevel uneven surfaces and reinstate design levels.	As required

Table 1: Site specific maintenance requirements – Attenuation Basins

Operation and Maintenance Requirements for Pipes, Manholes and Gullies		
Responsible for Maintenance	**Site Owner/Occupier**	
Maintenance Schedule	**Required Action**	**Typical Frequency**
Regular inspections	Remove cover and inspect, ensuring that water is flowing freely and that the exit route for water is unobstructed. Remove debris and silt.	Annually and after leaf fall in autumn
Remedial action	Repair physical damage if necessary.	As required
Monitoring	Inspect for evidence of poor performance. CCTV survey to investigate poor performance.	As required

Table 2: Site specific maintenance requirements – Pipes, manholes and gullies

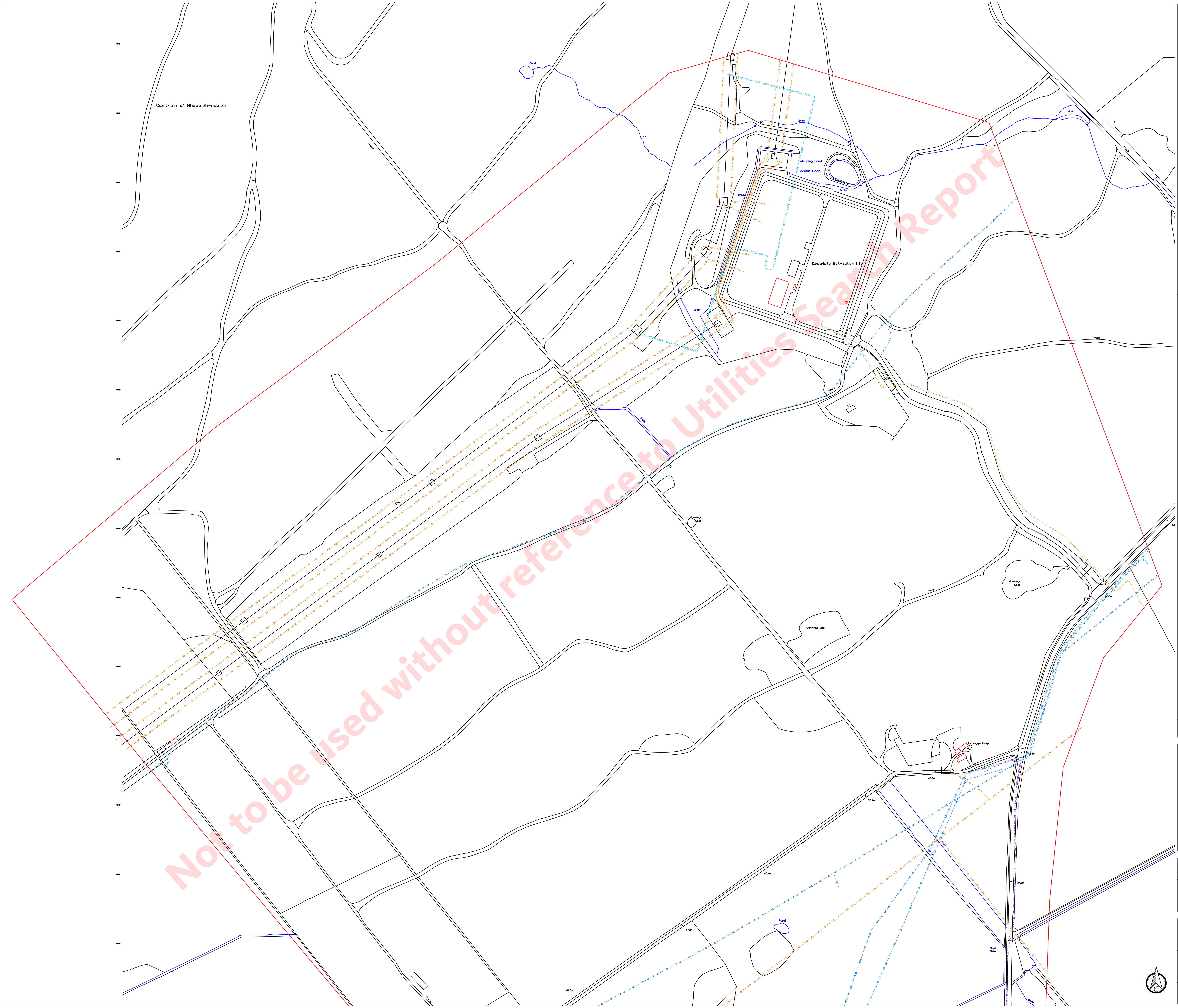
Operation and Maintenance requirements for Filter Drains		
Responsible for Maintenance	**Developer/Household**	
Maintenance Schedule	**Required Action**	**Typical Frequency**
Regular maintenance	Remove litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment 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	Six monthly, or as required
Occasional maintenance	Remove or control tree roots where they are encroaching 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 geotextile and replace, and wash or replace overlying filter medium	Five yearly, or as required
	Clear perforated pipework of blockages	As required

Table 3: Site specific maintenance requirements – Filter Drains

Appendix B Utilities Search

Underground Utilities Search Page 1 of 2 – Site ref: BTGBFYR01 – Cornerstone Projects Ltd

Underground Utilities Search Page 2 of 2 – Site ref: BTGBFYR01 – Cornerstone Projects Ltd



NOTES:

1. Do not scale from this drawing.
2. Utility connections to individual properties / buildings are often not shown on the utility plans but it should be assumed that such live utility connections exist. Connections to street lighting and other road furniture / signage may also not be shown but should be considered to exist until proven otherwise.
3. Any utility apparatus shown outside the search boundary may be incomplete.
4. The location of all underground utility plant and apparatus shown on this AutoCAD drawing (and any pdf prints of the same) is based on the original utility plans contained within the Utility Search Report (USR) which must be referred to prior to any work. This drawing is intended to be indicative only and must not be relied on to provide confirmation of the type, location, status, presence or absence of any utility apparatus. This CAD drawing should not be used in isolation but in conjunction with the USR. Further guidance notes and individual utility information not shown on this drawing will also be contained within the USR.
5. The actual type, location, status, presence or absence of all utility apparatus must be determined and confirmed on site using the procedure detailed in HSE HS(G) 47 and BSI PAS 128:2014. For example, on site surveys such as GPR and EML surveys, trial holes and hand digging should be used as appropriate.
6. The size and type of each utility is not denoted on this drawing and the line colours may not reflect the colours used on the original utility plans. Please refer to the USR for these details.
7. The utility plans this drawing is based on are only valid for three months from the date of issue of the USR unless otherwise noted in the USR.
8. If Cornerstone Projects purchased the (Ordnance Survey OS) mapping then it is licensed for one year from the date of this drawing and should be destroyed after this date. We are not liable for any errors or lack of accuracy in the OS mapping.
9. Cornerstone Projects Ltd will not accept any liability for errors, omission or inaccuracies in the information shown on this drawing.
10. Please refer to the Terms & Conditions on our website for further information regarding this drawing and the USR.

LEGEND:

- WATER — W — W — W —
- WATER ABANDONED — WA — WA —
- WATER PROPOSED — WP — WP —
- BT — BT — BT — BT —
- ELECTRICITY — E — E — E —
- ELECTRICITY OVERHEAD — OHE — OHE —
- NEOS NETWORKS — NEOS — NEOS —
- SEARCH BOUNDARY

REV:	DESCRIPTION:	BY:	DATE:

CORNERSTONE PROJECTS LTD
91 Market Street, Hoylake, Wirral, CH47 5AA
0151 632 5142
enquiries@cornerstoneprojects.co.uk
www.cornerstoneprojects.co.uk
VAT REG NO. 8514941 19
COMPANY NO. 5132353

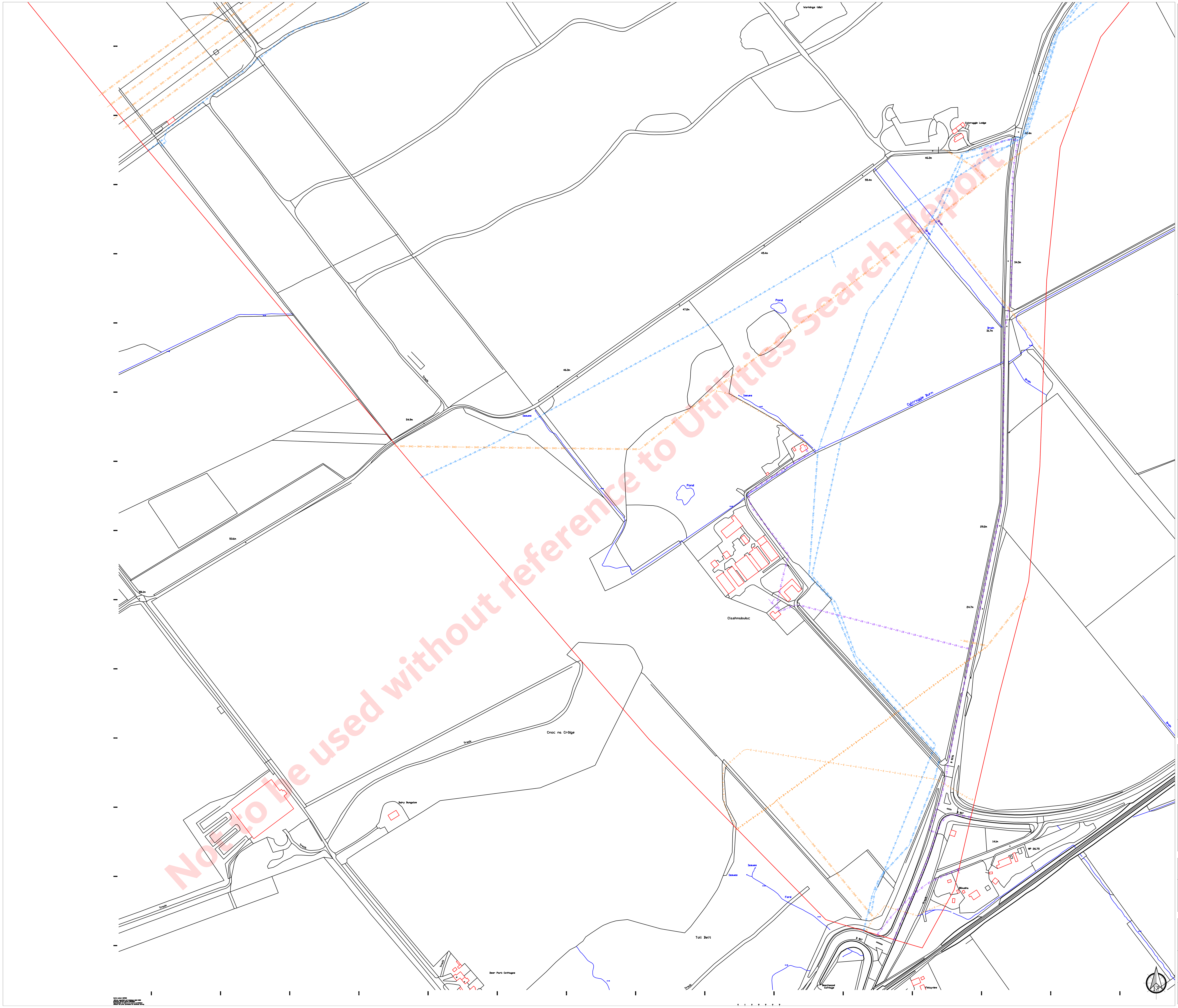
UNDERGROUND UTILITIES SEARCH

CLIENT NAME: Virmati Energy

SITE NAME: Fyrish BESS

SITE REFERENCE:	SHEET NO:
BTGBFYR01	1 OF 2

SCALE:	DATE:	DRAWN:	CHECKED:
1:2500	13/06/2024	FC	JS



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LEGEND:

WATER	W W W W
WATER ABANDONED	WA WA WA WA
WATER PROPOSED	WP WP WP WP
BT	BT BT BT BT
ELECTRICITY	E E E E
ELECTRICITY OVERHEAD	OHE OHE
NEOS NETWORKS	NEOS NEOS NEOS NEOS
SEARCH BOUNDARY	

REV:	DESCRIPTION:	BY:	DATE:

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UNDERGROUND UTILITIES SEARCH

CLIENT NAME: Virmati Energy

SITE NAME: Fyrish BESS

SITE REFERENCE:	SHEET NO:
BTGBFYR01	2 OF 2

SCALE:	DATE:	DRAWN:	CHECKED:
1:2500	13/06/2024	FC	JS

HAYDN
EVANS