McCloy Consulting

Drainage Impact Assessment

Land at Camsiscan Farm, Craigie, Kilmarnock South

M03291-01_DG01| November 2022

WATER & ENVIRONMENTAL CONSULTANTS

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DOCUMENT CONTROL

DOCUMENT FILENAME	M03291-01_DG01 Drainage Impact Assessment REV04
DOCUMENT REFERENCE	M03291-01_DG01-
TITLE	Drainage Impact Assessment
CLIENT	Scot Stablity Ltd
CLIENT CONTACT	David Kemmett (Noriker Power Ltd)
PROJECT MANAGER	Phillip Duffy
AUTHOR(S)	Iain Black, Michael Rea
BRANCH	BELFAST Mossley Mill, Lower Ground (West), Carnmoney Road North, Newtownabbey BT36 5QA T: +44 (0) 28 9084 8694 | W: www.mccloyconsulting.com

REVISION HISTORY

Rev. Ref.	Date	Prep	Chk	App	Amendments	Reason for Issue
1	15/09/2022	IB	MR	PD	Original	For Review
2	21/09/2022	IB	MR	PD	Calculations Updated	For Review
3	31/10/2022	MR	PD	PD	Minor Amendments	For Planning
4	15/11/2022	IB	PD	PD	Minor Amendments	For Planning
5	18/11/2022	IB	PD	PD	Minor Amendments	For Planning
6	18/11/2022	IB	PD	PD	Minor Amendments	For Planning

DISTRIBUTION

Recipient	Revision					
	1	2	3	4	5	6
FILE	✓	✓	✓	✓	✓	
AGENT	✓	✓	✓	✓	✓	

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MAPPING

1 INTRODUCTION

1.1 Terms of Reference

This Drainage Assessment was commissioned by Scot Stability Ltd to support a planning application for a battery storage site at lands at Camsiscan Farm, Craigie, Kilmarnock South, South Ayrshire.

The assessment will determine drainage characteristics and establish the means for safely disposing of surface water at the site.

1.2 Statement of Authority

McCloy Consulting is an independent environmental and water engineering consultancy specialising in drainage and SuDS design, drainage and hydrological assessments, river modelling and flood risk assessment. The practice has extensive experience in design and implementation of surface water management across the UK and Ireland.

This report and assessment have been prepared and reviewed by qualified professional civil engineers specialising in the fields of SuDS and drainage design and flood risk as required by South Ayrshire Council and SEPA. The key staff members involved in this project are as follows:

- Iain Black BEng (Hons) – Graduate Engineer with experience in the fields of flood risk and drainage and surface water management design.
- Michael Rea *MEng (Hons*) – Senior Project Engineer specialising in the fields of drainage design, flood modelling and SuDS and surface water management design.
- Philip Duffy *BEng (Hons) CEng MIEI* – Associate and Senior Engineer with expertise in infrastructure engineering and drainage and wastewater design, green infrastructure, and environmental improvement schemes.

1.3 Objective

The objective of this report is to demonstrate that the surface water drainage design provided meets the requirements of South Ayrshire Council and includes:

- An overview of the site context including land uses and geology.
- Confirmation of hydraulic parameters including the outgoing flow rates and stormwater storage calculations.
- An overview of the proposed drainage system; and
- Confirmation of maintenance arrangements.

1.4 Site Location and Context

The site is located South of Kilmarnock at British National Grid Reference (245093.7,632408.6) and is currently a greenfield site.

The proposals include the construction of Battery Energy Storage Systems (BESS) with HV compound to the north of the site and associated (unbound) hard standing forming tracks between the battery containers to the south.

A reservoir is proposed to the southwest of the site, water will be pumped from the attenuation ponds when required and the water contained is intended for use for cooling the batteries in the event of a fire or other emergency.

The site topography survey indicates the site slopes from west to east, with low points located on the Eastern site border. Ground levels within the site observed from 1m LiDAR data vary between 99- 118m OD.

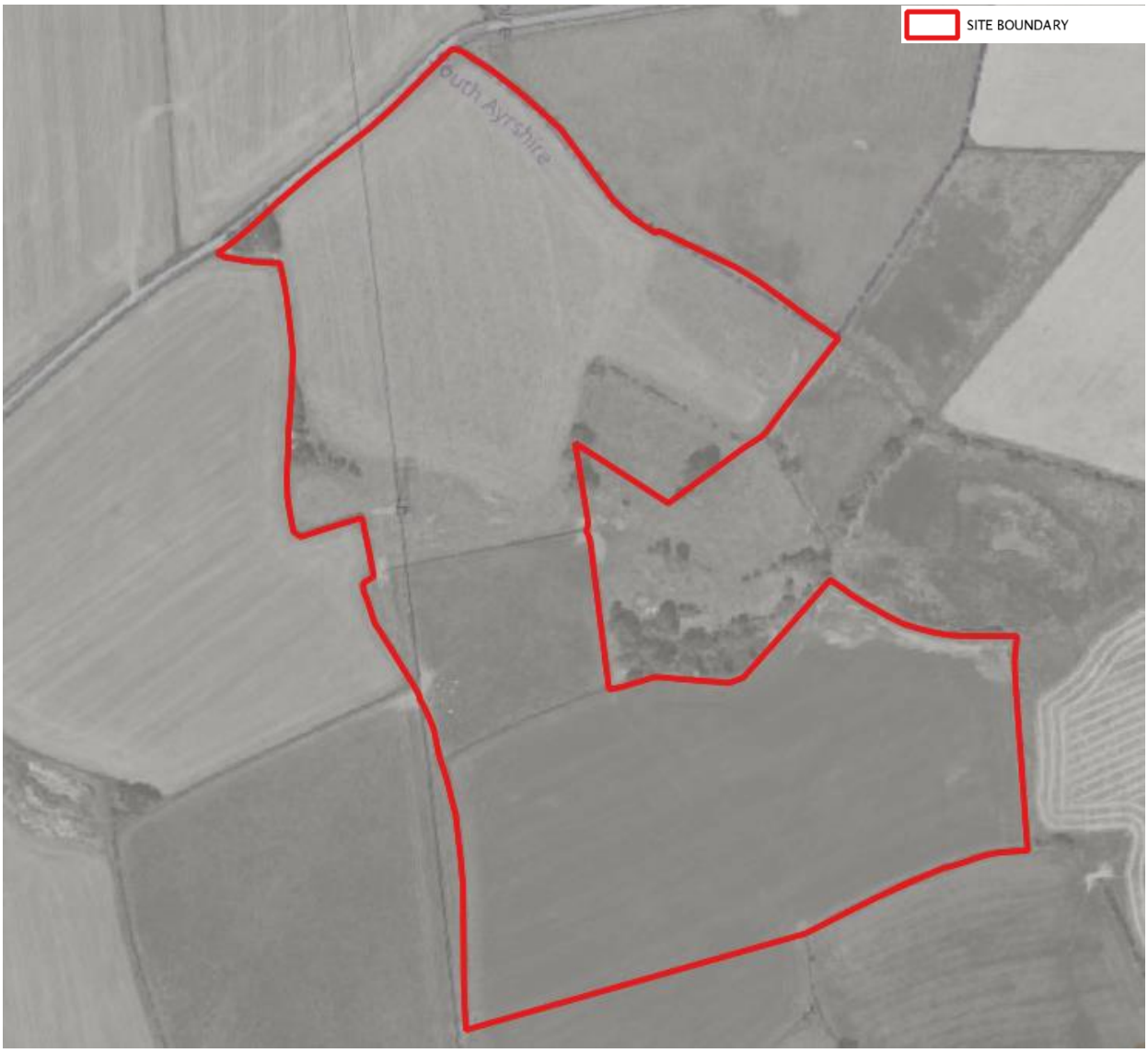


Figure 1-1 Existing Site

Figure 1-2 Proposed Site

1.5 Flood Risk and Existing Drainage Regime

Watercourses were identified from Scottish Environmental Protection Agency's (SEPA) online flood maps, OS mapping and using GIS routines on best available height data. An unnamed watercourses is located adjacent to the site which flows easterly 1.1km to the Cessnock Water, as shown in Figure 1-3.

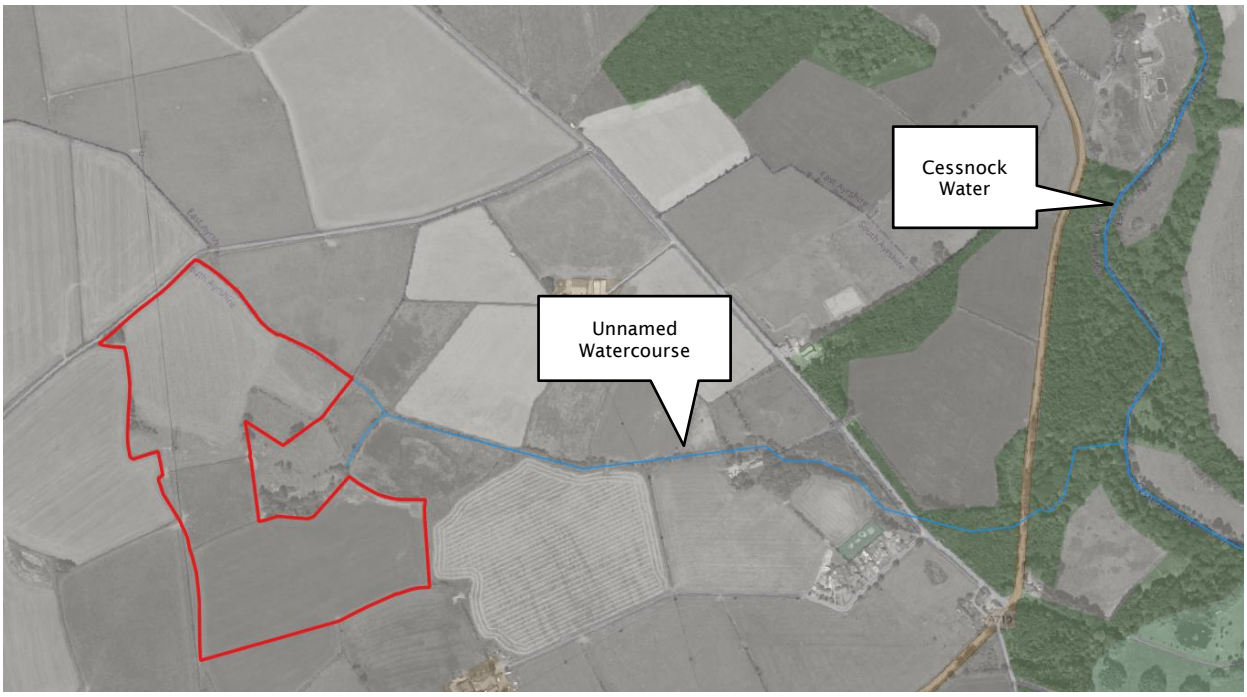


Figure 1-3 Site Hydrological Context

1.5.1 SEPA Flood Mapping

The site was reviewed against the Scottish Environmental Protection Agency's (SEPA) online flood maps[1], indicating:

- The site is unaffected by known fluvial floodplains.
- The 0.5% AEP surface water flood extent lies adjacent to the sites eastern site border. Surface water flooding shown corresponds to lower lying lands and a permanent lake, as indicated in Figure 1-4 below.

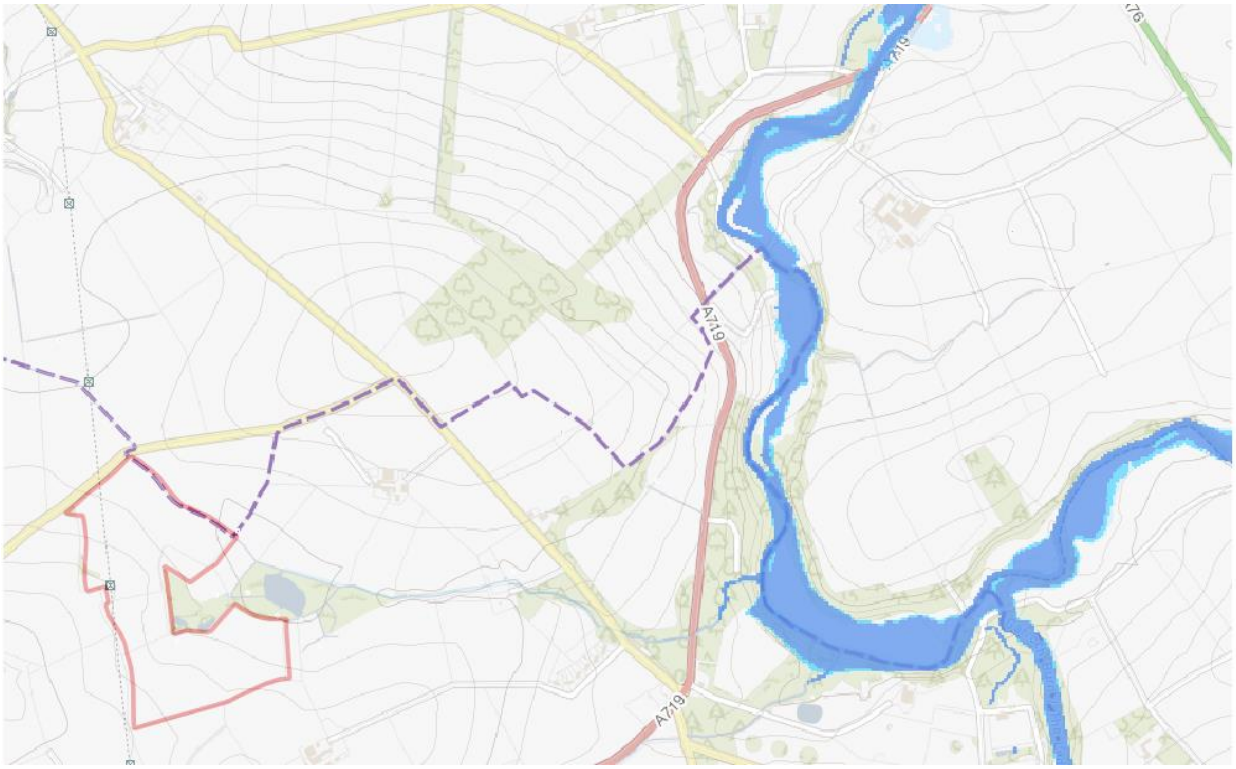


Figure 1-4 SEPA Fluvial Flood Map

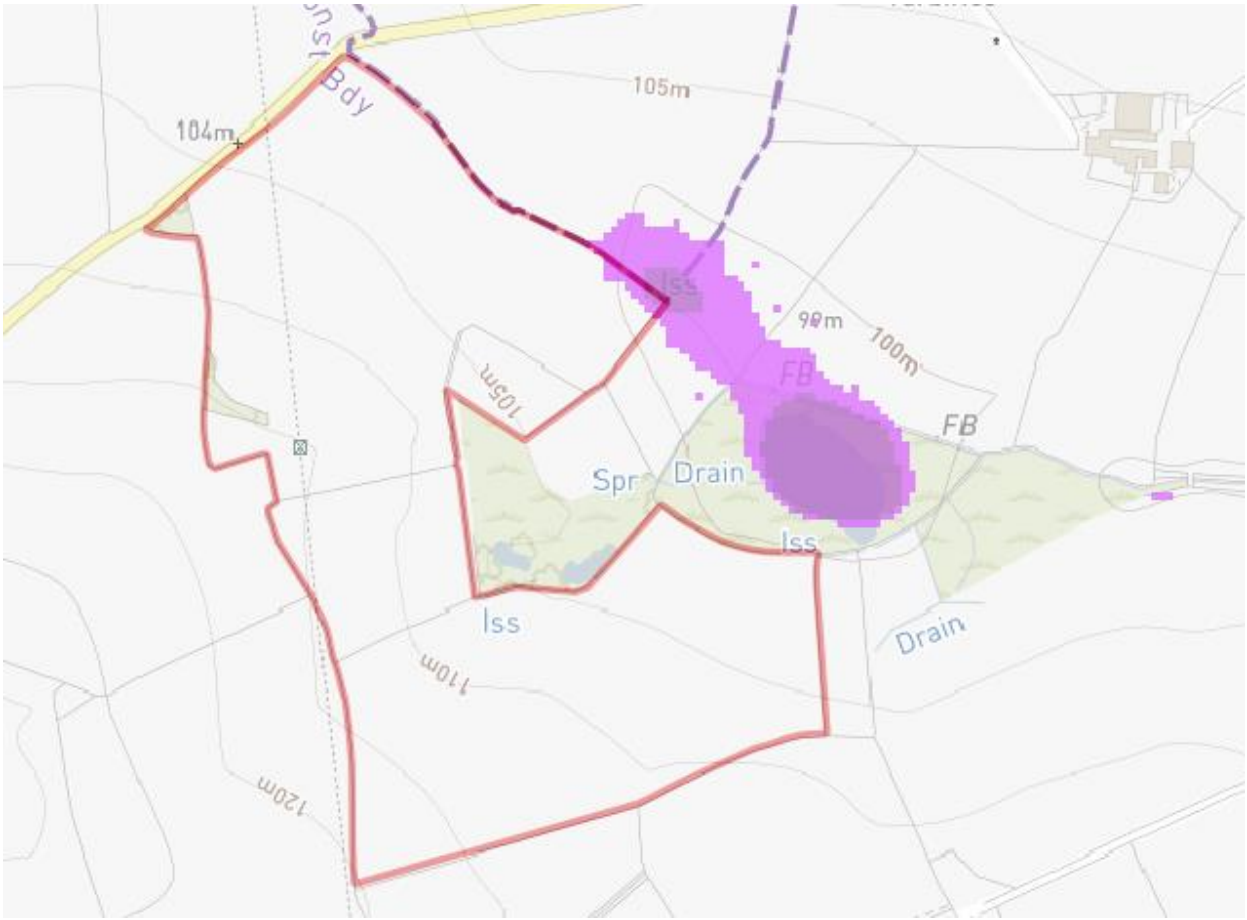


Figure 1-5 SEPA Surface Water Flood Mapping[1]

SEPA pluvial flood maps are derived from OS DTM / LiDAR files. Best available LiDAR for the area was obtained and analysed using a GIS "rolling ball" analysis and a depressions analysis to identify low lying lands. This surface water flood mapping corresponds with the results of the depression analysis; the surface water flood risk illustrated by FMNI can therefore be primarily attributed to existing levels at the site.

The depression analysis was analysed to determine the maximum level at which surface water accumulation can be anticipated is c. 99.8mOD. Depression and flow routing analysis is shown on the following figure.

Flow routing analysis confirms that site runoff in its present state would tend to the east, uncontrolled runoff from the site and downstream of the site would drain as shown in the following figure. Development should allow for managed flow paths across the site per CIRIA document C635 – Designing for exceedance in urban drainage, to include ensuring that boundary conditions allow ingress and egress of surface water at identified flow routes.

[11] Flood Maps, 2021, Scottish Environmental Protection Agency, https://www.sepa.org.uk/environment/water/flooding/flood-maps/ [Accessed 07.09.22]

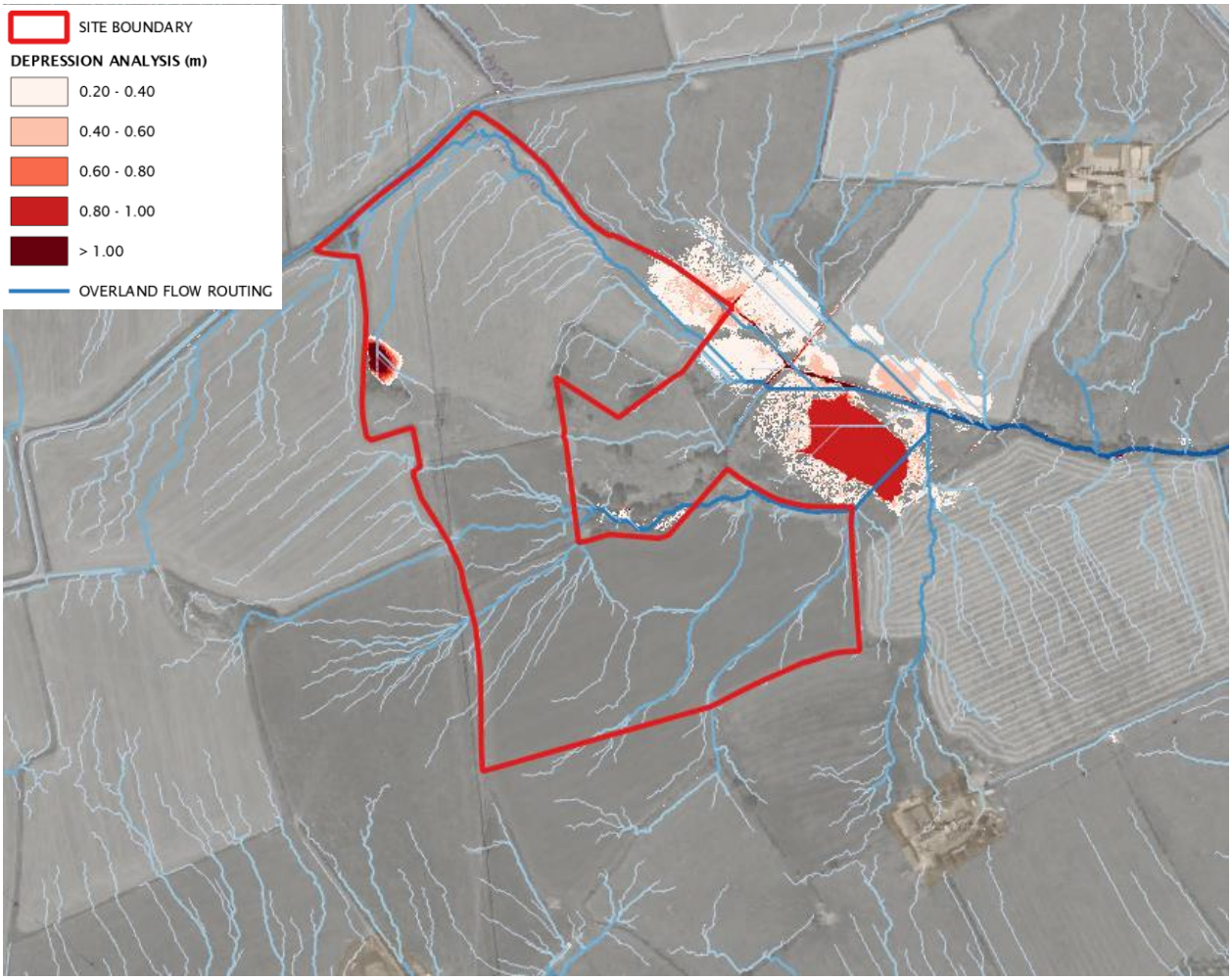


Figure 1-6 Depression Analysis and Overland Flow Paths

Due to the sites rural setting, no relevant Scottish Water sewerage / drainage infrastructure is anticipated in proximity to the site that would influence surface water flooding or cause flood risk from urban drainage failures.

1.6 Ground Conditions

A review of BGS geology data has been undertaken to inform this assessment. Underlying superficial geology based on BGS 1:50k mapping within site is indicated to be predominantly Devensian Till. An area of Alluvium comprising clay, silt, sand, and gravel is also noted to the east of the site as indicated in the following figure.

Figure 1-7 Superficial Geology

2 DESIGN STATEMENT

2.1 Design Criteria

2.1.1 Design Standard

The following criteria have been used to progress the design and are in line with Scottish Water requirements, South Ayrshire Council planning guidance, and SEPA.

- Design to demonstrate that a 1 in 200-year return period plus climate change event can be accommodated without presenting a flood risk to site.
- The 200 peak rainfall intensity allowance climate change of +41% has been adopted based on the SEPA Climate Change Allowances for Flood Risk Assessments indicated on the Land Use Planning web portal[2].
- Design assumes that all unbound hardstanding areas are 60% impermeable, to offer conservative assessment of the attenuation requirements, infiltration has been assumed as zero.
- Ordinary storm water discharged is anticipated to be disposed to the watercourse bounding the site at a flow limited to greenfield rate.
- Consideration of water quality management as part of the proposed drainage system.

In addition, it is assumed that:

- New hardstanding areas are to be attenuated to a greenfield rate, equated to 1in 2 year (QBAR) calculated as 8.13/s/ha.
- Drainage will not be eligible for adoption and will be privately maintained; therefore, Scottish Water internal design standards are not applicable.

2.2 Proposed Layout

2.2.1 Discharge Strategy

It has been established that the proposals for the site shall increase the extent of impermeable surfaces at the site which would result in an increase in runoff from the site. The current site is greenfield; all runoff presently tends to the undesignated watercourses east of the site. Hardstanding will be attenuated to greenfield rate (equated to QBAR). It is proposed to discharge surface water from the site to the watercourse to the east. Two attenuation ponds are proposed serving the northern and southern portions of the site as separate subcatchments.

A swale along hardstanding areas is proposed to collect runoff and convey flows to the attenuation pond. Flow controls on the outlet of the attenuation ponds will restrict flows to the greenfield rate of 11.8lps and 8.8lps for the northern and southern sub-catchments respectively.

A sluice gate is proposed downstream of the attenuation ponds which will cut-off runoff from the site in the event of a pollution incident or to prevent firewater runoff entering the natural site in line with COMAH guidelines.

A pump is to be located at the attenuation pond to allow the top up of water in the reservoir to the east of the site in an emergency event (in case of fire or battery overheating). The pump and sluice gates are not proposed to control day to day flows leaving the site.

[2] SEPA. (April 2022). Climate Change Allowances for Flood Risk Assessment in Land Use Planning. Available from: https://scottishepa.maps.arcgis.com/apps/webappviewer/index.html?id=2ddf84e295334f6b93bd0dbbb9ad7417. [Accessed: 1/8/2022].

Figure 2-1 Proposed Drainage Plan

2.2.2 Effect of the Development

The site is currently undeveloped greenfield. The proposed development will cause an increase in the impermeable area of the site and is likely to result in an increase to the rate and volume of runoff from the site when compared to the existing scenario if not mitigated.

An estimated of unmitigated post-development runoff for the site has been made as part of this assessment. Runoff estimates are based on plans submitted as part of the present applicating. A comparison of existing and proposed runoff rates in litres per second is given in the following table.

Table 2-1 Comparison of Unmitigated Surface Water Runoff Rates (Peak [1hr] Runoff Rates)

Return Period	Existing Site (lps)	Proposed Site (lps)	Increase (lps)
1 in 1 year (1hr)	88	134.1	46.1
1 in 30 year (1hr)	183.5	326.9	143.4
1 in 200 year (1hr)	254	453.4	199.3

2.2.3 Drainage Design

Innovyze Microdrainage software has been utilised in the design process to establish the storage requirements based on the above design criteria. Calculations are included in Appendix B.

The stormwater drainage of the hardstanding at the proposed site will comprise of sustainable drainage features (SuDS). Runoff will be directed into water catchment ponds located on the northeast and southwest border, with volumes 513m^3 and 405m^3 respectively This will be discharged at greenfield rate pro-rata based on impermeable sub-catchment area the drainage serves, equating to 11.8lps for the northern pond, and 8.8lps for the southern pond.

Runoff is restricted by a flow control, discharging downstream to an unnamed watercourse, eventually discharging to Cessnock Water.

The presently site slopes to the east, post development, uncontrolled runoff would similar drain easterly as indicated in Figure 1-6. Direct flood risk to adjacent lands will be mitigated by ensuring the control of runoff from the site up to a suitable flood protection measure as stipulated by SEPA (200yr rainfall including climate change).

The proposed drainage layout is included in Appendix C.

2.3 Water Treatment

To ensure best practice treatment of surface water within the drainage network the Simple Index Approach, as described in the CIRIA C753 SuDS Manual, has been used to provide an indication of the suitability of the system in mitigation of water quality risks to receiving waters.

The proposed development consists of battery energy storage systems and associated gravel access tracks is assessed as a low pollution hazard level per the CIRIA C753 SuDS Manual, Table 26.2. The SuDS manual indicates the following hazard indices attributed to this land use:

- Total Suspended Solids – 0.5
- Heavy Metals – 0.4
- Hydrocarbons – 0.4

The proposed drainage features include a retention pond. Per CIRIA C753, Table 26.3, the mitigation indices of a pond would exceed the respective pollution hazard indices shown above. Therefore, the proposed features are suitable for the nature of the development in terms of pollution risk mitigation.

2.4 Maintenance Requirements

Drainage assets shall be the responsibility of the site operator to maintain. The developer shall put in place drainage management procedures as part of the overall facility management.

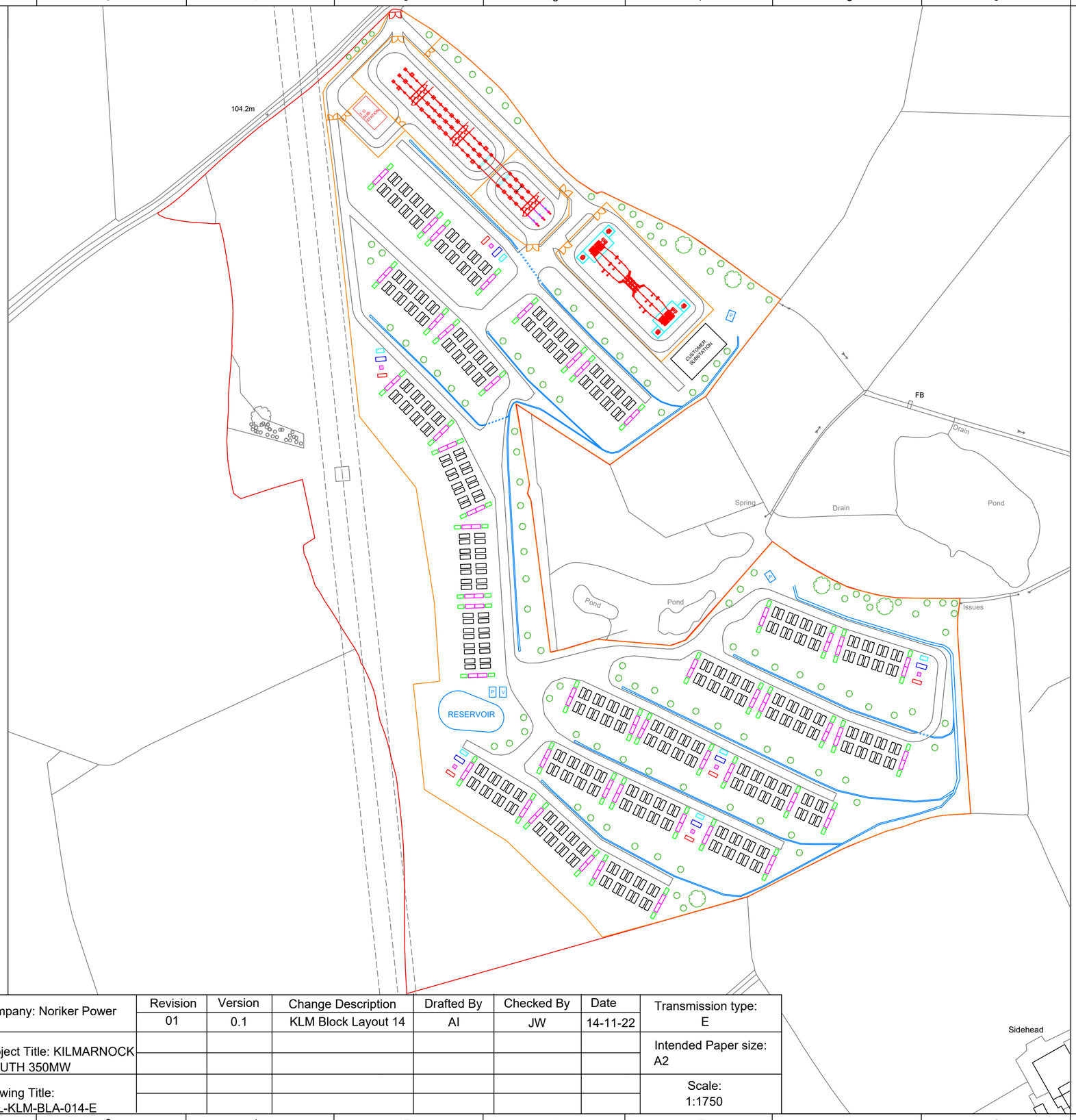
The following initial Maintenance Schedule indicates the required activities for the drainage system. Features requiring maintenance including the chambers are in accessible locations. A maintenance plan will be produced and should include:

Table 2-2 Site Drainage Maintenance Schedule

Inlets, Outlets, Pipework, Chambers and Cells		
Regular Maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly
	Remove debris and sediment from chambers and cells	Monthly for first six months, then quarterly or after significant storm
Remedial actions	Repair/rehabilitate where required	As required
Monitoring	Check all structures to ensure all is in good condition and operating as designed.	Annually
	(Flow control) check for evidence of blockage	Monthly or after significant storm.
	(Flow control) check for damage to components	Annually or after significant storm.

Appendix A

Site Layout



Legend:

- Site Boundary
- Perimeter Fences
- Overhead Lines
- Internal Road
- Water Drainage Run
- P / V — Water Pump Room / Valve Room
- Battery Container
- Inverter
- Transformer
- Back-up Generator
- T — Auxiliary Transfomer
- LV and Control Container
- Switchgear Container
- Tree To Plant
- Existing Tree

Notes:

NORIKER POWER

Company: Noriker Power	Revision	Version	Change Description	Drafted By	Checked By	Date	Transmission type: E
	01	0.1	KLM Block Layout 14	AI	JW	14-11-22	
Project Title: KILMARNOCK SOUTH 350MW							Intended Paper size: A2
Drawing Title: NPL-KLM-BLA-014-E							Scale: 1:1750

Appendix B

Calculations

Project	[Kilmarnock South, Scotland]
Ref	M03291-01
Date	16/11/2022

Purpose

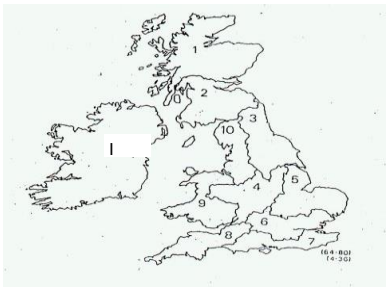
To estimate the indicative (1-hr) change in runoff rate on a site caused by the proposed development. Note that proposed / indicative runoff rates are outline only and rely on the routing equation within the Modified Rational and Wallingford methods; actual runoff rates may differ significantly dependant on the nature of the surface water drainage network proposed and should be determined using hydraulic modelling.

Existing Site	A1	A2	A3	A4	**TOTAL**	
Roof	0				0	m^2
Bitmac / Paved / Hardstanding	0				0	m^2
					0	m^2

Proposed Site	A1	A2	A3	A4	**TOTAL**	
Roof	2625				2625	m^2
Bitmac / Paved / Hardstanding	15182				15182	m^2
					17806	m^2

Site Details

Total Site Area	13.09	**Ha**	
SAAR	1092	**mm**	From FEH3
SAAR4170	1092	**mm**	From FEH3
UCWI	110	**mm**	
IOH124 region	2		from map ->
SOIL	4		From WRAP maps
SOIL	0.45		
DEEPSTOR	0.31		



Modified Rational Method (MRM):

	Existing		***Proposed***		
Length (m)	335	**m**	335	**m**	From Site Maps
Impermeable Area (ha)	0.000	**Ha**	1.781	**Ha**	
Max Height	118.0	**mAOD**	118.0	**mAOD**	From Survey
Min Height	98.9	**mAOD**	98.9	**mAOD**	From Survey
DeltaH	19.145		19.100		
Slope (%)	5.71		5.70		
Te (mins)	10.00		10.01		
ARF	0.000		0.982		

	Existing Site		Proposed Site	
PIMP	0.000	**%**	100.000	**%**
Percentage Runoff PR	0.45	**%**	82.03	**%**
Cv	0.00		0.82	
Cr	1.3		1.3	

Institute of Hydrology Report 124 (IoH 124) "Flood Estimation on Small Catchments" method

	Existing		***Proposed***	
Remaining Greenfield Area	13.09	**Ha**	11.31	**Ha**
% Greenfield	100.00	**%**	86.40	**%**

Existing Site - Peak (1-hr) Runoff Rates

Return Period	Permeable Runoff (IOH124) (lps)	Impermeable Runoff (MRM) (lps)	Total Runoff (lps)
1 in 2 year (1hr)	88.0	0.0	88.0
1 in 30 year (1hr)	183.5	0.0	183.5
1 in 100 year (1hr)	254.0	0.0	254.0

Proposed Site - Peak (1-hr) Runoff Rates

Return Period	Permeable Runoff (IOH124) (lps)	Impermeable Runoff (MRM) (lps)	Total Runoff (lps)
1 in 2 year (1hr)	76.1	58.1	134.1
1 in 30 year (1hr)	158.5	168.3	326.9
1 in 100 year (1hr)	219.5	233.9	453.4

Summary - Peak (1-hr) Runoff Rates

Return Period	Existing Site (lps)	Proposed Site (lps)	*Increase (lps)*	Increase (%)
1 in 2 year (1hr)	88.0	134.1	*46.1*	*52%*
1 in 30 year (1hr)	183.5	326.9	*143.4*	*78%*
1 in 100 year (1hr)	254.0	453.4	*199.3*	*78%*

By	Checked	Revision	Reason for Change	Date
IB	MR	4		16/11/2022

Summary of Results for 200 year Return Period (+41%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	99.122	0.322	11.8	0.0	11.8	165.2	O K
30 min Summer	99.254	0.454	11.8	0.0	11.8	233.0	O K
60 min Summer	99.398	0.598	11.8	0.0	11.8	306.7	O K
120 min Summer	99.532	0.732	11.8	0.0	11.8	375.7	O K
180 min Summer	99.598	0.798	11.8	0.0	11.8	409.6	O K
240 min Summer	99.633	0.833	11.8	0.0	11.8	427.5	O K
360 min Summer	99.662	0.862	11.8	0.0	11.8	442.4	O K
480 min Summer	99.674	0.874	11.8	0.0	11.8	448.1	O K
600 min Summer	99.676	0.876	11.8	0.0	11.8	449.3	O K
720 min Summer	99.673	0.873	11.8	0.0	11.8	447.9	O K
960 min Summer	99.658	0.858	11.8	0.0	11.8	440.0	O K
1440 min Summer	99.610	0.810	11.8	0.0	11.8	415.7	O K
2160 min Summer	99.523	0.723	11.8	0.0	11.8	371.0	O K
2880 min Summer	99.413	0.613	11.8	0.0	11.8	314.6	O K
4320 min Summer	99.231	0.431	11.8	0.0	11.8	220.9	O K
5760 min Summer	99.104	0.304	11.8	0.0	11.8	156.1	O K
7200 min Summer	99.025	0.225	11.6	0.0	11.6	115.4	O K
8640 min Summer	98.980	0.180	11.2	0.0	11.2	92.5	O K
10080 min Summer	98.961	0.161	10.6	0.0	10.6	82.8	O K
15 min Winter	99.163	0.363	11.8	0.0	11.8	186.0	O K
30 min Winter	99.312	0.512	11.8	0.0	11.8	262.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	94.445	0.0	171.2	0.0	25
30 min Summer	67.248	0.0	245.4	0.0	39
60 min Summer	45.347	0.0	335.3	0.0	68
120 min Summer	29.108	0.0	431.0	0.0	126
180 min Summer	22.260	0.0	494.6	0.0	184
240 min Summer	18.333	0.0	543.3	0.0	242
360 min Summer	13.907	0.0	618.4	0.0	322
480 min Summer	11.409	0.0	676.5	0.0	386
600 min Summer	9.777	0.0	724.7	0.0	450
720 min Summer	8.614	0.0	766.2	0.0	518
960 min Summer	7.050	0.0	836.0	0.0	658
1440 min Summer	5.311	0.0	944.2	0.0	938
2160 min Summer	4.001	0.0	1071.0	0.0	1360
2880 min Summer	3.270	0.0	1166.8	0.0	1736
4320 min Summer	2.455	0.0	1312.8	0.0	2432
5760 min Summer	2.001	0.0	1429.8	0.0	3120
7200 min Summer	1.707	0.0	1524.1	0.0	3760
8640 min Summer	1.498	0.0	1605.1	0.0	4416
10080 min Summer	1.342	0.0	1675.7	0.0	5144
15 min Winter	94.445	0.0	192.2	0.0	25
30 min Winter	67.248	0.0	275.2	0.0	39

Summary of Results for 200 year Return Period (+41%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
60 min Winter	99.477	0.677	11.8	0.0	11.8	347.3	O K
120 min Winter	99.630	0.830	11.8	0.0	11.8	425.6	O K
180 min Winter	99.708	0.908	11.8	0.0	11.8	465.7	O K
240 min Winter	99.752	0.952	11.8	0.0	11.8	488.3	O K
360 min Winter	99.791	0.991	11.8	0.0	11.8	508.5	O K
480 min Winter	99.798	0.998	11.8	0.0	11.8	511.9	O K
600 min Winter	99.799	0.999	11.8	0.0	11.8	512.7	O K
720 min Winter	99.793	0.993	11.8	0.0	11.8	509.4	O K
960 min Winter	99.766	0.966	11.8	0.0	11.8	495.3	O K
1440 min Winter	99.684	0.884	11.8	0.0	11.8	453.7	O K
2160 min Winter	99.540	0.740	11.8	0.0	11.8	379.4	O K
2880 min Winter	99.355	0.555	11.8	0.0	11.8	284.9	O K
4320 min Winter	99.098	0.298	11.8	0.0	11.8	153.1	O K
5760 min Winter	98.980	0.180	11.2	0.0	11.2	92.1	O K
7200 min Winter	98.951	0.151	9.9	0.0	9.9	77.5	O K
8640 min Winter	98.935	0.135	8.7	0.0	8.7	69.3	O K
10080 min Winter	98.924	0.124	7.8	0.0	7.8	63.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
60 min Winter	45.347	0.0	375.8	0.0	68
120 min Winter	29.108	0.0	482.9	0.0	124
180 min Winter	22.260	0.0	554.2	0.0	180
240 min Winter	18.333	0.0	608.7	0.0	236
360 min Winter	13.907	0.0	692.8	0.0	346
480 min Winter	11.409	0.0	757.9	0.0	410
600 min Winter	9.777	0.0	811.9	0.0	474
720 min Winter	8.614	0.0	858.4	0.0	552
960 min Winter	7.050	0.0	936.6	0.0	710
1440 min Winter	5.311	0.0	1057.7	0.0	1016
2160 min Winter	4.001	0.0	1199.7	0.0	1468
2880 min Winter	3.270	0.0	1307.1	0.0	1844
4320 min Winter	2.455	0.0	1470.9	0.0	2476
5760 min Winter	2.001	0.0	1601.5	0.0	3056
7200 min Winter	1.707	0.0	1707.2	0.0	3720
8640 min Winter	1.498	0.0	1798.0	0.0	4416
10080 min Winter	1.342	0.0	1877.4	0.0	5144

Model Details

Storage is Online Cover Level (m) 99.800

Tank or Pond Structure

Invert Level (m) 98.800

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	513.0	1.000	513.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0157-1180-1000-1180
Design Head (m)	1.000
Design Flow (l/s)	11.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	157
Invert Level (m)	98.800
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	11.8
Flush-Flo™	0.308	11.8
Kick-Flo®	0.683	9.9
Mean Flow over Head Range	-	10.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.6	1.200	12.9	3.000	19.9	7.000	29.9
0.200	11.4	1.400	13.8	3.500	21.4	7.500	30.9
0.300	11.8	1.600	14.7	4.000	22.8	8.000	31.9
0.400	11.7	1.800	15.6	4.500	24.1	8.500	32.8
0.500	11.4	2.000	16.4	5.000	25.4	9.000	33.7
0.600	10.9	2.200	17.1	5.500	26.6	9.500	34.6
0.800	10.6	2.400	17.9	6.000	27.7		
1.000	11.8	2.600	18.6	6.500	28.8		

Weir Overflow Control

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 99.800

Summary of Results for 200 year Return Period (+41%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	99.719	0.319	8.8	0.0	8.8	129.0	O K
30 min Summer	99.850	0.450	8.8	0.0	8.8	182.2	O K
60 min Summer	99.994	0.594	8.8	0.0	8.8	240.4	O K
120 min Summer	100.128	0.728	8.8	0.0	8.8	294.9	O K
180 min Summer	100.195	0.795	8.8	0.0	8.8	322.0	O K
240 min Summer	100.232	0.832	8.8	0.0	8.8	336.8	O K
360 min Summer	100.262	0.862	8.8	0.0	8.8	349.1	O K
480 min Summer	100.274	0.874	8.8	0.0	8.8	353.8	O K
600 min Summer	100.277	0.877	8.8	0.0	8.8	355.0	O K
720 min Summer	100.275	0.875	8.8	0.0	8.8	354.2	O K
960 min Summer	100.261	0.861	8.8	0.0	8.8	348.9	O K
1440 min Summer	100.218	0.818	8.8	0.0	8.8	331.4	O K
2160 min Summer	100.140	0.740	8.8	0.0	8.8	299.5	O K
2880 min Summer	100.041	0.641	8.8	0.0	8.8	259.6	O K
4320 min Summer	99.854	0.454	8.8	0.0	8.8	184.0	O K
5760 min Summer	99.722	0.322	8.8	0.0	8.8	130.4	O K
7200 min Summer	99.637	0.237	8.7	0.0	8.7	95.8	O K
8640 min Summer	99.584	0.184	8.4	0.0	8.4	74.5	O K
10080 min Summer	99.555	0.155	8.2	0.0	8.2	62.7	O K
15 min Winter	99.759	0.359	8.8	0.0	8.8	145.3	O K
30 min Winter	99.907	0.507	8.8	0.0	8.8	205.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	93.693	0.0	134.1	0.0	25
30 min Summer	66.726	0.0	192.0	0.0	39
60 min Summer	45.042	0.0	262.2	0.0	68
120 min Summer	28.919	0.0	337.0	0.0	126
180 min Summer	22.119	0.0	386.8	0.0	184
240 min Summer	18.220	0.0	424.9	0.0	242
360 min Summer	13.822	0.0	483.7	0.0	334
480 min Summer	11.340	0.0	529.2	0.0	394
600 min Summer	9.718	0.0	566.9	0.0	458
720 min Summer	8.562	0.0	599.4	0.0	524
960 min Summer	7.008	0.0	654.0	0.0	664
1440 min Summer	5.279	0.0	738.6	0.0	944
2160 min Summer	3.977	0.0	837.5	0.0	1364
2880 min Summer	3.250	0.0	912.5	0.0	1764
4320 min Summer	2.441	0.0	1027.0	0.0	2468
5760 min Summer	1.990	0.0	1118.2	0.0	3168
7200 min Summer	1.697	0.0	1192.1	0.0	3824
8640 min Summer	1.490	0.0	1255.5	0.0	4496
10080 min Summer	1.334	0.0	1310.8	0.0	5144
15 min Winter	93.693	0.0	150.5	0.0	25
30 min Winter	66.726	0.0	215.3	0.0	39

Summary of Results for 200 year Return Period (+41%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
60 min Winter	100.072	0.672	8.8	0.0	8.8	272.3	O K
120 min Winter	100.225	0.825	8.8	0.0	8.8	334.1	O K
180 min Winter	100.304	0.904	8.8	0.0	8.8	366.2	O K
240 min Winter	100.350	0.950	8.8	0.0	8.8	384.7	O K
360 min Winter	100.393	0.993	8.8	0.0	8.8	402.1	O K
480 min Winter	100.402	1.002	8.8	0.0	8.8	405.9	O K
600 min Winter	100.403	1.003	8.8	0.0	8.8	406.2	O K
720 min Winter	100.399	0.999	8.8	0.0	8.8	404.4	O K
960 min Winter	100.375	0.975	8.8	0.0	8.8	394.8	O K
1440 min Winter	100.301	0.901	8.8	0.0	8.8	364.8	O K
2160 min Winter	100.169	0.769	8.8	0.0	8.8	311.3	O K
2880 min Winter	99.998	0.598	8.8	0.0	8.8	242.1	O K
4320 min Winter	99.727	0.327	8.8	0.0	8.8	132.6	O K
5760 min Winter	99.590	0.190	8.5	0.0	8.5	76.8	O K
7200 min Winter	99.544	0.144	7.7	0.0	7.7	58.4	O K
8640 min Winter	99.528	0.128	6.8	0.0	6.8	51.8	O K
10080 min Winter	99.517	0.117	6.1	0.0	6.1	47.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
60 min Winter	45.042	0.0	293.8	0.0	68
120 min Winter	28.919	0.0	377.6	0.0	124
180 min Winter	22.119	0.0	433.4	0.0	180
240 min Winter	18.220	0.0	476.1	0.0	238
360 min Winter	13.822	0.0	541.9	0.0	348
480 min Winter	11.340	0.0	592.8	0.0	446
600 min Winter	9.718	0.0	635.0	0.0	480
720 min Winter	8.562	0.0	671.4	0.0	558
960 min Winter	7.008	0.0	732.6	0.0	714
1440 min Winter	5.279	0.0	827.3	0.0	1024
2160 min Winter	3.977	0.0	938.1	0.0	1476
2880 min Winter	3.250	0.0	1022.2	0.0	1876
4320 min Winter	2.441	0.0	1150.6	0.0	2548
5760 min Winter	1.990	0.0	1252.5	0.0	3120
7200 min Winter	1.697	0.0	1335.2	0.0	3744
8640 min Winter	1.490	0.0	1406.3	0.0	4416
10080 min Winter	1.334	0.0	1468.6	0.0	5144

Model Details

Storage is Online Cover Level (m) 100.600

Tank or Pond Structure

Invert Level (m) 99.400

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	405.0	1.000	405.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0137-8800-1000-8800
Design Head (m)	1.000
Design Flow (l/s)	8.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	137
Invert Level (m)	99.400
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	8.8
Flush-Flo™	0.299	8.8
Kick-Flo®	0.664	7.3
Mean Flow over Head Range	-	7.6

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.0	1.200	9.6	3.000	14.8	7.000	22.2
0.200	8.5	1.400	10.3	3.500	15.9	7.500	22.9
0.300	8.8	1.600	11.0	4.000	17.0	8.000	23.7
0.400	8.7	1.800	11.6	4.500	18.0	8.500	24.4
0.500	8.4	2.000	12.2	5.000	18.9	9.000	25.0
0.600	7.9	2.200	12.8	5.500	19.8	9.500	25.7
0.800	7.9	2.400	13.3	6.000	20.6		
1.000	8.8	2.600	13.8	6.500	21.4		

Weir Overflow Control

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 100.600

Appendix C

Drainage Layout Drawings

GENERAL

1. THIS DRAWING SHALL NOT BE USED FOR CONSTRUCTION PURPOSES.
2. THIS DRAWING SHALL BE REVIEWED IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL DRAWINGS.
3. THIS DRAWING IS NOT TO BE SCALED FROM.
4. THE CONTRACTOR IS TO LIAISE WITH ALL STATUTORY UNDERTAKERS IN REGARD TO LOCATING ALL EXISTING SERVICES WITHIN AND ADJACENT TO THE SITE OF THE WORK

LEGEND

- SITE BOUNDARY
- PROPOSED DRAINAGE PIPE
- PROPOSED DISCHARGE POINT
- PROPOSED ATTENUATION POND
- PROPOSED SWALES
- RESERVOIR
- ROOFED
- UNBOUND HARDSTANDING
- EQUIPMENT

ISSUE	DRN	APP	DATE	NOTES / DESCRIPTION
3	IB	MR	16/11/2022	FOR PLANNING
2	IB	MR	31/10/2022	FOR PLANNING
1	IB	MR	14/09/2022	FOR REVIEW

STATUS

McCloy Consulting
T: 028 9084 8694
F: 028 9084 1525
E: info@mccloyconsulting.com
W: www.mccloyconsulting.com
Mossley Mill, Lower Ground (West)
Carnmoney Road North
Newtownabbey
Co. Antrim, BT36 5QA

PROJECT

BESS
LAND AT CAMSISCAN FARM

CLIENT

SCOT STABILITY LTD

DRAWING TITLE

PROPOSED DRAINAGE LAYOUT
GENERAL ARRANGEMENT

SCALE	ORIGINAL SIZE
1:1000m	A1

DRAWN	CHECKED	DATE
IB	MR	16/11/2022

PROJECT No.	DRAWING No.	ISSUE NO.
M03291-01	DWG_100	3