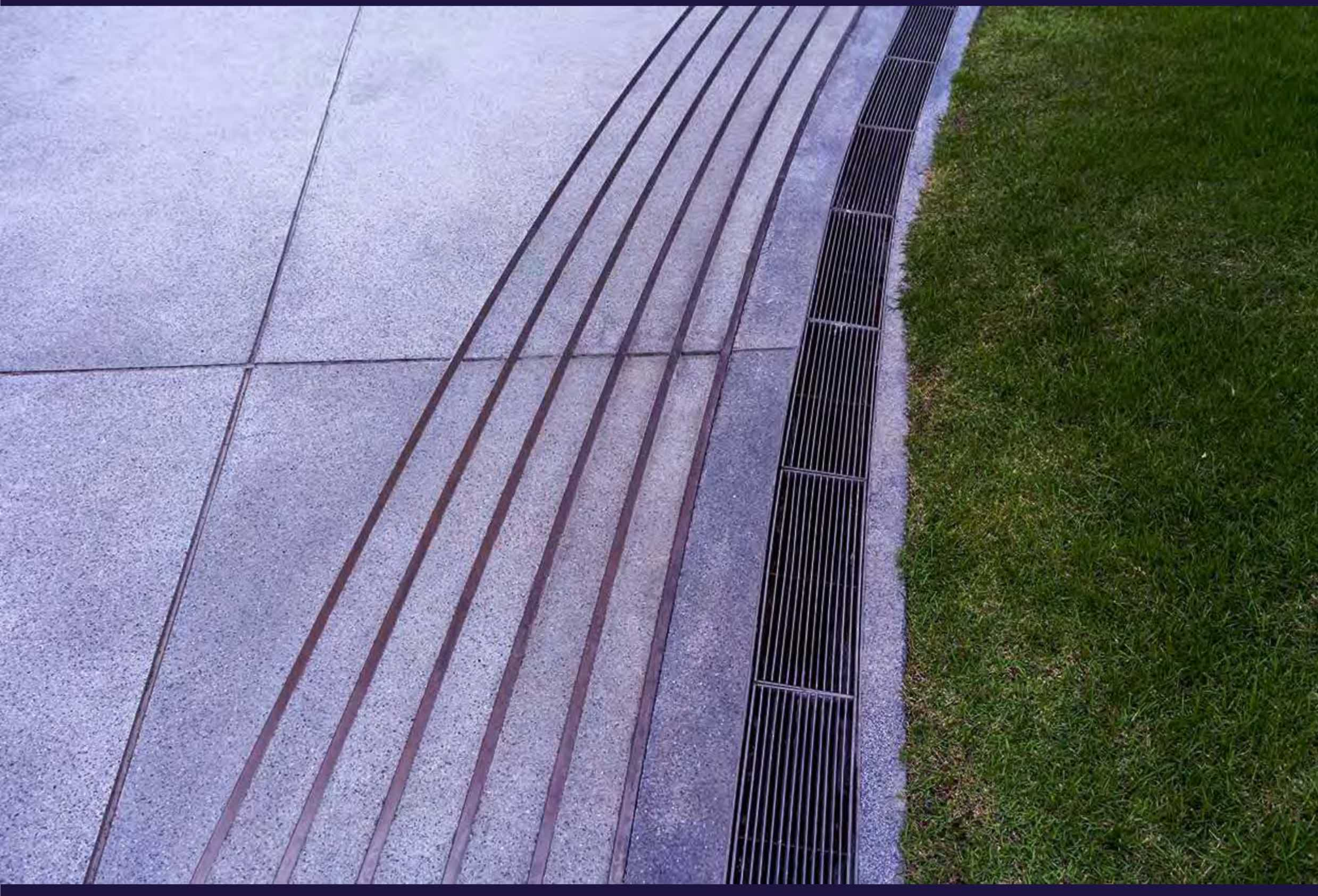
Cameron+Ross

Drainage Impact Assessment

Proposed Development at Fordoun



prepared for

FJB Contracts

191200-002 – July 2023

Document Issue Record

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-	Initial Issue	A. McKenzie	R. Gibb	July 2023
1.0	Drainage Layout (Appendix C) updated	A. McKenzie	R. Gibb	August 2023

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1. Introduction

Cameron + Ross were appointed by FJB Contracts to prepare this Drainage Impact Assessment to consider appropriate drainage proposals in accordance with the following documents.

- The SUDS Manual C753 – Guidance on the planning, design, construction and maintenance of Sustainable Drainage Systems, published by CIRIA, 2015.
- Drainage Impact Assessment – Guidance for Developers and Regulators, produced on behalf of the North East Scotland Flooding Advisory Group, 2012.
- Sewers for Scotland, Fourth Edition, October 2018, published by Scottish Water & WRc Plc.
- SuDS for Roads published by the SuDS Working Party, 2015.
- Planning Advise Note (PAN) 61 – Planning and Sustainable Urban Drainage Systems, published by the Scottish Executive, 2001.

This report will establish the suitability of the site for development and identify the drainage principles in recognition of the aforementioned documents to satisfy source control, conveyance measures, attenuation, treatment and enhanced amenity.

2. Existing Site Conditions

The site is located at National Grid reference NO 76633 73161. Access to the development is gained via a unclassified C road which is off of the A90. A site location plan is provided below for reference.

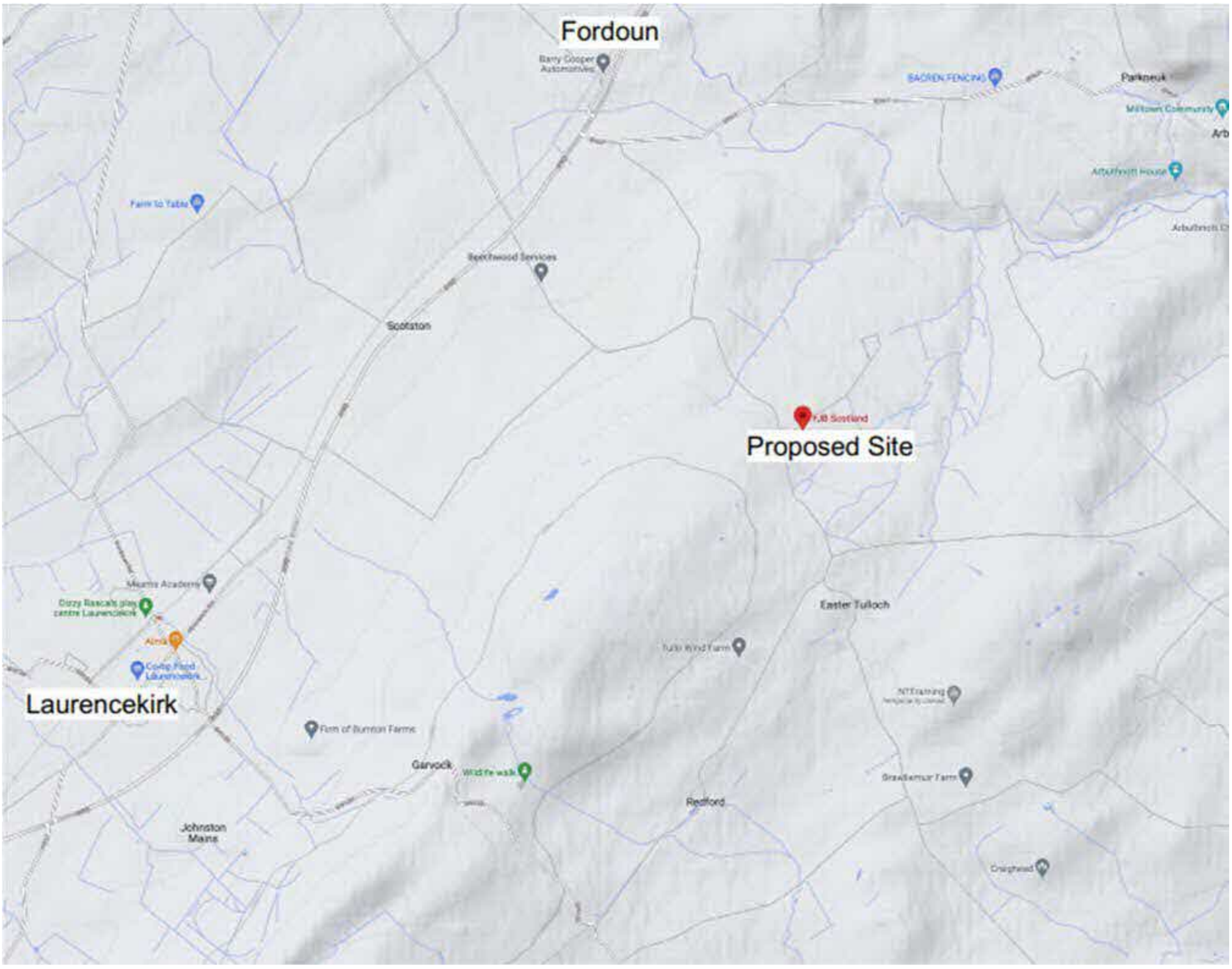

Figure 1 - Site Location Plan

The site is currently existing open ground previously used as part of the agricultural steading current on site. The site is adjacent to proposed wedding venue, workshop and office previously applied for an under construction. To the south side the development is open agricultural fields.

Based on existing topographical information, the highest level of the site is located approximately at the western boundary, which gradually slopes towards the east boundary of the site. The highest road level is predicated at 150.57m, with the lowest road level being at 148.60m which is located near to the proposed brewery.

A copy of the site Layout is provided in **Appendix A**.

3. Existing Ground Conditions

An inrusive site investigation was undertaken by S A McGregor in October 2019. It was found that ground is generally overlain by made ground comprising mixed re-worked sub-soils or cobbles with a layer of topsoil. The underlaying natural soils are described as stiff red silty sandy gravelly clays with occasionl well-rounded cobbles. The soil infiltration rates considered that it was not suitable for the construction of standard sub-surface soakaway systems and that alternative drainage system should be considered. The SUDS design will be based on discharge to watercourse/ open ditch.

4. Existing Drainage Network

There are no existing Scottish Water, foul water or surface water sewers located within or near to the development site. A copy of Scottish Water's GIS record plan is provided in **Appendix B** and an extract is provided below:

Figure 2 - Extract from Scottish Water Wastewater GIS

5. Development Proposals

The proposed development comprises the construction of 30 dwellinghouses and 2 retail units with associated infrastructure and landscaping works. An extract of the proposed site layout drawing is provided below:

Figure 3 - Extract of site layout (courtesy of Taylor Architecture)

A copy of the site layout is provided in **Appendix A.**

6. Foul Drainage Proposals

Due to there being no existing drainage infrastructure, within the development site or surrounding area of the development site. Private foul water drains from the new converted unit (Wedding Venue), office, warehous and proposed micro brewery will drain by gravity and connect into a proposed WPL HPAF mini system, which will then drain to a secondary form of treatment by the means of a partial sub-surface soakaway with highlevel overflow connecting into the surface water outfall pipe which will discharge into Wood Burn.

A copy of the proposed drainage layout is provided in **Appendix C.**

7. Surface Water Proposals

All of the SUDS devices suggested in CIRIA's publication C753 "SUDS (Sustainable Urban Drainage Systems) Design Manual" Table 1.1, were individually considered - filter strips, swales, infiltration basins, wet ponds, detention basins, filter drains, infiltration devices, pervious surfaces and green roofs.

7.1 Roof Water:

The roof water will be drained to the proposed private SUDs basin located within the the development site to the east.

7.2 Roads/ Hardstanding Areas

The road and hardstanding area will drain via road gullies (providing pre- treatment) or flow into the proposed porous parking areas conveying via a private surface water drain below ground discharging into the proposed SUDs basin. It is proposed that the entire system will remain private and maintained by the landowner.

7.3 SUDs Basin:

The proposed SUDs Basin will be designed to manage surface water flow generated by the proposed development up to and including the 1 in 200 year storm event and additional Climate Change (30%) and Urban Creep (10%) allowances will be made in the storage volume.

A copy of the proposed drainage layout is provided in **Appendix C**, and a copy of the proposed drainage calculations is provided in **Appendix D.**

7.4 Treatment Criteria Check to CIRIA SUDS Manual C753:

In accordance with CIRIA document C753 the risk posed by surface water run-off to the receiving environment is a function of the land use, the effectiveness of SuDS treatment components and the sensitivity of the receiving watercourse. Determining the hazard posed by the land use activities at a site can be established by using a simple index approach by allocating pollution hazards indices for the proposed land use as outlined in Table 7.1 below.

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Other Roofs, roads and commercial yard and delivery areas	Medium	0.7	0.6	0.7
Maximum Pollution Hazard Index	Medium	0.7	0.6	0.7

Table 7.1a - Pollution hazard indices for different land use classifications (ref Table 26.2 C753)

Where the proposed destination of the run-off is to surface water, the indices in Table 7.2 below should be used.

Proposed SUDS Component	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Detention Basin	0.5	0.5	0.6
Filter Drain	0.4	0.4	0.4
Total Mitigation Index	0.7	0.7	0.8

Table 7.2: Indicative SuDS mitigation indices for discharge to ground water
(Ref Table 26.4 C753)

To deliver adequate treatment, the selected SuDS components suggested in Table 7.2 above should have a total pollution mitigation index (for each contaminant type) that's equates or exceeds the pollution hazard index specified in Table 7.1).

Where the mitigation index of an individual component is insufficient on its own, two components (or more) can be used in series where required. A factor of 0.5 is then used to account for the reduced performance of the secondary or tertiary components associated with the already reduced inflow concentrates. As a result, the proposed SuDS components identified in Table 7.2 equals or exceeds the land use pollution hazard providing the required level of treatment for a development of this nature.

As is noted from the above table the necessary treatment of surface water can be achieved by a detention basin and a filter drain connected in series prior to discharging to the receiving watercourse.

7.5 Land Drainage:

The topographical survey has not identified any field drains within the area of green space with in site. If field drains are encountered during construction these will be re-routed around the development and into the land drainage system. However, it should be noted that through development of the site any groundwater discharge will be reduced as surface water is collected via roofs and hardstanding areas and directed into the new surface water drainage network with attenuation provided before controlled discharge to ground water.

8. Assessment of Flood Risk

8.1 Review of SEPA Flood Maps:

A review of the online SEPA Flood Maps shows that there is no fluvial, pluvial or coastal flooding risk to the proposed development site.

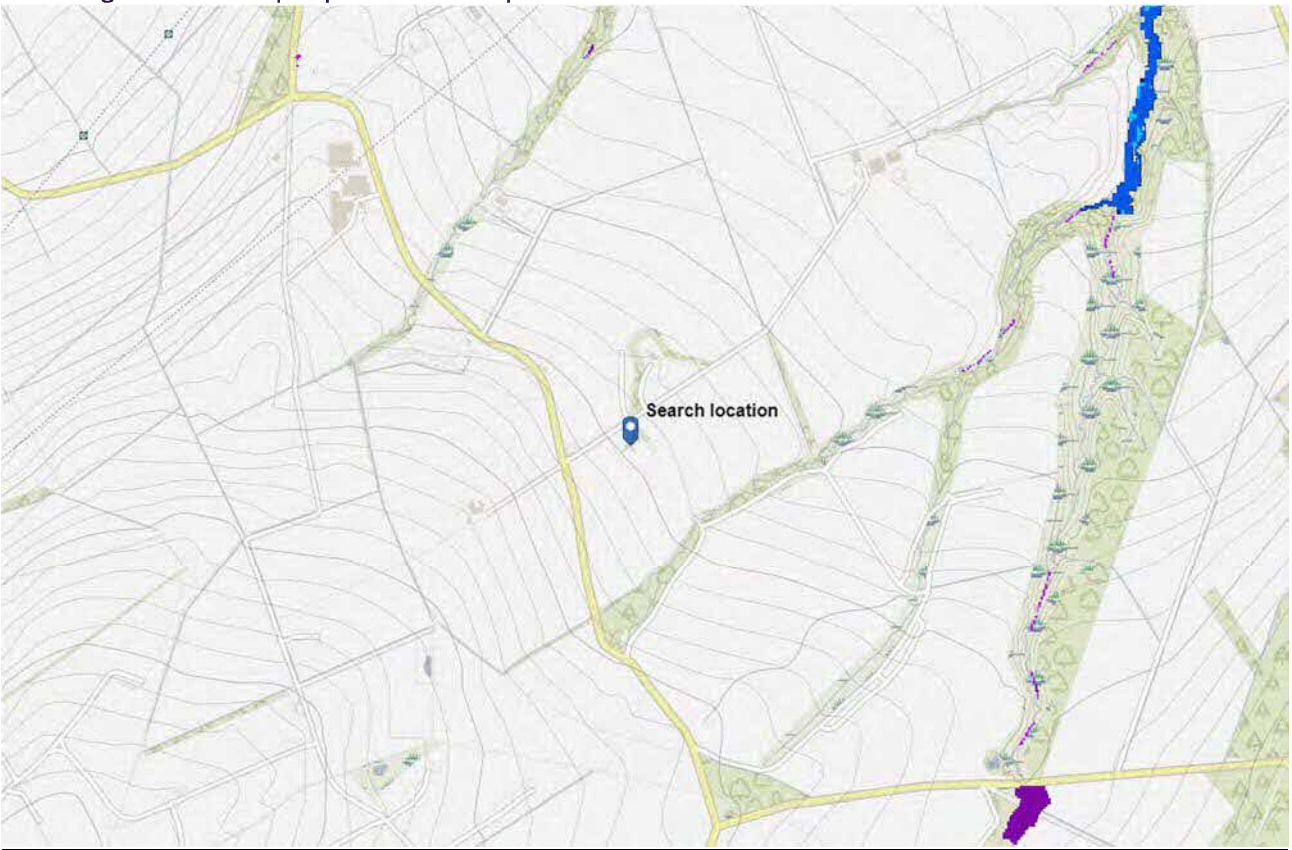

Figure 4 - Extract from SEPAs online flood map

8.2 Surface Water flood risk:

The Sustainable Drainage System (SUDS) measures discussed in the section 7 above have been designed such to incorporate attenuation of site run-offs, to as close as reasonably practical, to the attenuated post-development hard standing run-off rates which should have a neutral or better effect on the risk of flooding both on and off site.

The SUDS proposals will not heighten the risk of flooding occurring as the system has been designed such that no part of the site will flood during a 1 in 200 year storm event.

Ground levels will be such that no surface water flooding of any property on or adjacent to the site occurs, and that access for emergency vehicles will not be impeded.

8.3 Overland Flooding Risk

The proposed development site is situated on a relatively sloped area of Old Rayne, and run-off generated within site is likely. Land drainage will be engineered during the detailed design of the development to manage surface water run-off away from the proposed dwellings and redirect water during heavy rainfall events into Wood Burn.

It is noted that potential flood risk from other sources, including coastal flooding, sewer flooding and groundwater are to be low.

9. Adoption & Future Maintenance

The road and hard standing area drainage, which is the gullies and their tails along with proposed porous paving will be private and maintained by the landowner and it will be their responsibility to inspect and maintain this asset upon the fulfilment of the defects liability period. It is recommended that gullies are inspected and cleared of any silt / debris on a six monthly basis. The maintenance activities as listed in Table 20.15 Pervious Pavements.

TABLE 20.15 Operation and maintenance requirements for pervious pavements

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphospate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

TABLE 16.1 Operation and maintenance requirements for filter drains

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 devices	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 22.1 Operation and maintenance requirements for detention basins

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly
	Cut grass – for spillways and access routes	Monthly (during growing season), or as required
	Cut grass – meadow grass in and around basin	Half yearly (spring – before nesting season, and autumn)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Monthly (for first year), then annually or as required
	Check any penstocks and other mechanical devices	Annually
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets, outlet and forebay	Annually (or as required)
	Manage wetland plants in outlet pool – where provided	Annually (as set out in Chapter 23)
Occasional maintenance	Reseed areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years, or as required
	Remove sediment from inlets, outlets, forebay and main basin when required	Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is provided)
Remedial actions	Repair erosion or other damage by reseeding or re-turfing	As required
	Realignment of rip-rap	As required
	Repair/rehabilitation of inlets, outlets and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required

Figure 5- Extract of Table 20.15 from CIRIA C753 - The SuDS Manual

In addition to the above it is recommended that a suitably qualified person carries out regular visual inspections of all SUDS devices to reduce the risks of blockage.

10. Construction Phase

The measures for controlling surface water run-off will be continually reviewed in line with each stages of construction by the groundworks contractor and any influencing factors and should generally consider the following measures:

Control:

The contractor should give consideration, in the main, to surface water run-off during and after topsoil strip, as well as after re-grading of the land during site construction. Stripping of topsoil and vegetation is to be limited wherever possible and undertaken just prior to the construction in that particular area. This is to provide a means of reducing run off and to remove silts/fines from the water and aid natural absorption into the soils.

Interception:

Any existing network of field drainage that may be cut off by the development, therefore, should it prove necessary, these will be redirected and / or connected to a new perimeter land drain to intercept any ground water.

Prevention:

The installation of the drains, SUDS measures and roadways will follow the earthworks operation continually improving the overall site drainage. SUDS facilities will be installed at the outset of the sewer works and will be utilised as temporary sediment control. It is therefore essential these are reinstated or reconstructed at the end of construction works and before adoption by the local authority.

10. Conclusion

This Drainage Impact Assessment has been prepared in support of a new development proposal at Fordoun.

The existing site characteristics, topography and natural drainage patterns have been reviewed and suitable drainage proposals identified. In developing a suitable, sustainable and robust drainage scheme for the site, current best practice and relevant guidance documents have been referenced and adopted within the proposed design.

The proposed drainage scheme consists of on site gullies, porous paving, SUDs Basin and controlled discharge to Wood Burn. Foul drainage is proposed to fall by gravity to the proposed treatment plant and partial soakaway before discharging to Wood Burn. The relevant SEPA approval and license will be required to be in place prior to construction.

The drainage proposals as set out above demonstrate that the site is suitable for the proposed development and that a sustainable drainage solution can be implemented in accordance with the relevant guidance documents and publications.

END OF REPORT – 191200-002/AAM

APPENDIX A

Proposed Site Layout
(courtesy of Taylor Archiects)

APPENDIX B

Scottish Water GIS record Drawing

Sootywells
Denhead House
Drain
Davo Smithy House
Blue House
Treehead
Davo House
Woodburnden
Iss
Collects
Wind Turbine
Brownlie / Brownie
125m
110m
115m
120m
130m
135m
140m
145m
150m
155m
165m
170m
175m
180m
185m
190m
195m
205m

APPENDIX C

Drainage Layout Drawing

FIGURED DIMENSIONS ONLY TO BE USED

GENERAL NOTES:-

This drawing is to be read in conjunction with all relevant engineers and architects drawings.

Drainage - all sewers to be constructed in accordance with Scottish water's publication "Sewers for Scotland (4th edition April) a policy, design and construction guide for developers in Scotland"

Sewers laid within roads should have a minimum cover of 1.5m from final road surface to pipe soffit level. Where this cannot be achieved then ridged pipes shall be protected by a full concrete surround, similarly, flexible pipes shall be protected by a concrete slab at a depth less than 1.2m.

The contractor is responsible for checking the line and level of all existing services prior to commencement of works. Any discrepancies from design information must be reported to the site manager and site engineer in writing.

FOUL DRAINAGE

New Foul water sewer (uPVC Marley Quantum solid pipework) unless otherwise noted on drawing. To remain private and maintained by Owner(s)/ Factoring Agreement.

New Manhole with reference number. To remain private and maintained by Owner(s)/ Factoring Agreement. (FMH? DC?)

New Foul Water Partial Soakaway. To remain private and maintained by Owner(s)/ Factoring Agreement.

SURFACE DRAINAGE

New Surface water drain (uPVC Marley Quantum solid pipework) unless otherwise noted on drawing. To remain private and maintained by Owner(s)/ Factoring Agreement.

New Manhole with reference number. To remain private and maintained by Owner(s)/ Factoring Agreement. (S1)

Detention basin and maintained by Owner(s)/ Factoring Agreement.

New headwall and maintained by Owner(s)/ Factoring Agreement.

New standard road gully and footpath gully with associated gully tail.

Car Parking - Non adopted and to remain private and to be maintained by owner/ factoring agreement.

The contractor should allow for CCTV camera survey of entire drainage system upon substantial completion of works. If any remedial works are required a repeat survey should also be carried out prior to formal submission to Engineer together with as-built drawing including manhole co-ordinates, cover and invert levels and pipe gradients.

The contractor should also allow for lifting of manhole covers during vesting inspection by Scottish Water and any additional drainage survey requirements to ensure full adoption.

Issue	Revision	Initial	Date
A	Drainage routes updated to suit leased boundary of brewery.	AAM	09/08/23

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Client: Finlay Brock

Project: Wedding Venue & Workshop Fordoun

Drawing Title: Drainage Proposals

Status: PLANNING

North

Scale: 1:250 @ A1		Date: 09/07/2023	
By: SAD	Checked: AAM	Approved: AAM	

Dwg. No. 191200-002-CAM-DR-S-920

Rev. A

APPENDIX D

Drainage Calculations

Cameron+Ross

CALCULATION

Sheet No.	1 of 2
Contract No.	191200
Date	07/07/2023
Designer	AAM

Calculation **Pre & Post Development Site Run-Off Calculation**

Contract **Wedding Venue, Workshop, Office & Brewery**

Site Area, Total		15960 m^2		**1.596** ha
				0.5 km^2 (min. 0.5km)
SAAR		800 mm		From Wallingford Vol 3 Annual Rainfall Chart
Soil Type		3		
SOIL	(Soil Index)	0.40		

Flow offsite, QBAR rural = $0.00108 \times AREA^{0.89} \times SAAR^{1.17} \times SOIL^{2.17}$

= 198.88 l/sec

Therefore QBAR rural / ha = **3.98** l/sec/ha **6.3** l/sec for this site

Equivalent 1, 30, 100 and 200 year throttle rates applicable for hydrological growth curve 1 for North Scotland

1 year factor	0.85
10 year factor	1.45
30 year factor	1.90
100 year factor	2.45
200 year factor	2.80

Therefore greenfield limiting discharge rates are:

1 year factor	3.38	l/sec/ha	**5.4**	l/sec for this site
10 year factor	5.77	l/sec/ha	**9.2**	l/sec for this site
30 year factor	7.56	l/sec/ha	**12.1**	l/sec for this site
100 year factor	9.75	l/sec/ha	**15.6**	l/sec for this site
200 year factor	11.14	l/sec/ha	**17.8**	l/sec for this site

Post-development Run-off Calculation

Total Impermeable Area = 5245 m^2 **0.5** ha

Hardstanding covers 32.9 % of site

Allowable Post-development Run-off = **4.0** l/sec

Summary of Results for 2 year Return Period (+30%)

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	145.166	0.166	3.7	0.0	3.7	42.7	O K
30 min Summer	145.217	0.217	3.8	0.0	3.8	58.2	O K
60 min Summer	145.270	0.270	3.9	0.0	3.9	75.2	O K
120 min Summer	145.318	0.318	4.0	0.0	4.0	91.4	O K
180 min Summer	145.337	0.337	4.1	0.0	4.1	98.2	O K
240 min Summer	145.347	0.347	4.1	0.0	4.1	101.8	O K
360 min Summer	145.359	0.359	4.1	0.0	4.1	106.2	O K
480 min Summer	145.366	0.366	4.1	0.0	4.1	108.7	O K
600 min Summer	145.370	0.370	4.2	0.0	4.2	110.3	O K
720 min Summer	145.372	0.372	4.2	0.0	4.2	111.2	O K
960 min Summer	145.373	0.373	4.2	0.0	4.2	111.4	O K
1440 min Summer	145.364	0.364	4.1	0.0	4.1	108.2	O K
2160 min Summer	145.339	0.339	4.1	0.0	4.1	99.0	O K
2880 min Summer	145.310	0.310	4.0	0.0	4.0	88.6	O K
4320 min Summer	145.249	0.249	3.9	0.0	3.9	68.1	O K
5760 min Summer	145.190	0.190	3.7	0.0	3.7	49.9	O K
7200 min Summer	145.140	0.140	3.6	0.0	3.6	35.2	O K
8640 min Summer	145.095	0.095	3.5	0.0	3.5	23.1	O K
10080 min Summer	145.058	0.058	3.5	0.0	3.5	13.7	O K
15 min Winter	145.166	0.166	3.7	0.0	3.7	42.8	O K
30 min Winter	145.218	0.218	3.8	0.0	3.8	58.4	O K
60 min Winter	145.271	0.271	3.9	0.0	3.9	75.6	O K
120 min Winter	145.320	0.320	4.0	0.0	4.0	92.4	O K
180 min Winter	145.341	0.341	4.1	0.0	4.1	99.6	O K
240 min Winter	145.352	0.352	4.1	0.0	4.1	103.6	O K
360 min Winter	145.361	0.361	4.1	0.0	4.1	106.9	O K
480 min Winter	145.364	0.364	4.1	0.0	4.1	108.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	36.749	0.0	47.9	0.0	25
30 min Summer	25.481	0.0	66.4	0.0	38
60 min Summer	17.193	0.0	89.5	0.0	66
120 min Summer	11.391	0.0	118.6	0.0	124
180 min Summer	8.858	0.0	138.8	0.0	180
240 min Summer	7.437	0.0	155.3	0.0	218
360 min Summer	5.814	0.0	181.8	0.0	286
480 min Summer	4.869	0.0	203.0	0.0	354
600 min Summer	4.243	0.0	221.4	0.0	424
720 min Summer	3.791	0.0	237.2	0.0	494
960 min Summer	3.176	0.0	265.0	0.0	636
1440 min Summer	2.471	0.0	309.5	0.0	914
2160 min Summer	1.917	0.0	359.9	0.0	1320
2880 min Summer	1.601	0.0	401.1	0.0	1708
4320 min Summer	1.241	0.0	466.3	0.0	2468
5760 min Summer	1.034	0.0	518.2	0.0	3224
7200 min Summer	0.897	0.0	561.3	0.0	3904
8640 min Summer	0.798	0.0	599.6	0.0	4600
10080 min Summer	0.724	0.0	634.7	0.0	5344
15 min Winter	36.749	0.0	47.9	0.0	25
30 min Winter	25.481	0.0	66.3	0.0	38
60 min Winter	17.193	0.0	89.8	0.0	66
120 min Winter	11.391	0.0	118.7	0.0	122
180 min Winter	8.858	0.0	138.7	0.0	178
240 min Winter	7.437	0.0	155.4	0.0	230
360 min Winter	5.814	0.0	182.1	0.0	292
480 min Winter	4.869	0.0	203.4	0.0	370

Summary of Results for 2 year Return Period (+30%)

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
600 min Winter	145.365	0.365	4.1	0.0	4.1	108.6	O K
720 min Winter	145.364	0.364	4.1	0.0	4.1	108.0	O K
960 min Winter	145.356	0.356	4.1	0.0	4.1	105.0	O K
1440 min Winter	145.328	0.328	4.1	0.0	4.1	95.0	O K
2160 min Winter	145.276	0.276	3.9	0.0	3.9	77.1	O K
2880 min Winter	145.223	0.223	3.8	0.0	3.8	59.9	O K
4320 min Winter	145.125	0.125	3.6	0.0	3.6	31.1	O K
5760 min Winter	145.040	0.040	3.5	0.0	3.5	9.3	O K
7200 min Winter	145.000	0.000	3.3	0.0	3.3	0.0	O K
8640 min Winter	145.000	0.000	2.9	0.0	2.9	0.0	O K
10080 min Winter	145.000	0.000	2.7	0.0	2.7	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
600 min Winter	4.243	0.0	221.3	0.0	450
720 min Winter	3.791	0.0	237.4	0.0	528
960 min Winter	3.176	0.0	264.9	0.0	682
1440 min Winter	2.471	0.0	309.4	0.0	974
2160 min Winter	1.917	0.0	360.2	0.0	1392
2880 min Winter	1.601	0.0	400.9	0.0	1788
4320 min Winter	1.241	0.0	466.6	0.0	2516
5760 min Winter	1.034	0.0	518.0	0.0	3224
7200 min Winter	0.897	0.0	561.6	0.0	0
8640 min Winter	0.798	0.0	600.1	0.0	0
10080 min Winter	0.724	0.0	634.6	0.0	0

Summary of Results for 30 year Return Period (+30%)

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	145.291	0.291	4.0	0.0	4.0	82.2	O K
30 min Summer	145.379	0.379	4.2	0.1	4.2	113.8	O K
60 min Summer	145.457	0.457	4.3	3.0	7.3	144.4	O K
120 min Summer	145.508	0.508	4.5	6.1	10.5	166.0	O K
180 min Summer	145.529	0.529	4.5	6.9	11.4	175.2	O K
240 min Summer	145.543	0.543	4.5	7.3	11.8	181.4	O K
360 min Summer	145.556	0.556	4.5	7.7	12.3	187.3	O K
480 min Summer	145.559	0.559	4.6	7.8	12.3	188.5	O K
600 min Summer	145.556	0.556	4.5	7.7	12.3	187.3	O K
720 min Summer	145.552	0.552	4.5	7.6	12.1	185.3	O K
960 min Summer	145.543	0.543	4.5	7.3	11.8	181.1	O K
1440 min Summer	145.523	0.523	4.5	6.7	11.2	172.5	O K
2160 min Summer	145.500	0.500	4.4	5.6	10.0	162.5	O K
2880 min Summer	145.482	0.482	4.4	4.5	8.9	154.7	O K
4320 min Summer	145.453	0.453	4.3	2.7	7.1	142.6	O K
5760 min Summer	145.427	0.427	4.3	1.5	5.8	132.3	O K
7200 min Summer	145.401	0.401	4.2	0.5	4.7	122.2	O K
8640 min Summer	145.356	0.356	4.1	0.0	4.1	105.2	O K
10080 min Summer	145.304	0.304	4.0	0.0	4.0	86.8	O K
15 min Winter	145.291	0.291	4.0	0.0	4.0	82.3	O K
30 min Winter	145.380	0.380	4.2	0.1	4.2	114.0	O K
60 min Winter	145.458	0.458	4.3	3.1	7.4	145.0	O K
120 min Winter	145.513	0.513	4.5	6.4	10.8	168.1	O K
180 min Winter	145.534	0.534	4.5	7.0	11.5	177.1	O K
240 min Winter	145.546	0.546	4.5	7.4	11.9	182.8	O K
360 min Winter	145.555	0.555	4.5	7.7	12.2	186.8	O K
480 min Winter	145.554	0.554	4.5	7.6	12.2	186.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	67.313	0.0	87.8	0.0	26
30 min Summer	47.063	0.0	122.7	0.0	40
60 min Summer	31.302	0.0	163.3	9.7	66
120 min Summer	20.266	0.0	211.6	33.7	116
180 min Summer	15.599	0.0	244.0	50.5	144
240 min Summer	12.933	0.0	270.1	62.8	176
360 min Summer	9.907	0.0	310.2	79.6	244
480 min Summer	8.190	0.0	342.1	89.5	314
600 min Summer	7.063	0.0	368.6	94.8	382
720 min Summer	6.256	0.0	391.9	97.5	450
960 min Summer	5.165	0.0	431.2	99.2	584
1440 min Summer	3.942	0.0	493.8	98.0	842
2160 min Summer	3.006	0.0	564.5	91.1	1220
2880 min Summer	2.478	0.0	620.6	80.6	1616
4320 min Summer	1.886	0.0	708.8	55.6	2384
5760 min Summer	1.553	0.0	778.1	30.0	3176
7200 min Summer	1.335	0.0	836.1	7.8	4040
8640 min Summer	1.180	0.0	887.5	0.0	4840
10080 min Summer	1.064	0.0	932.4	0.0	5552
15 min Winter	67.313	0.0	87.8	0.0	25
30 min Winter	47.063	0.0	122.8	0.0	39
60 min Winter	31.302	0.0	163.2	9.7	66
120 min Winter	20.266	0.0	211.3	33.7	118
180 min Winter	15.599	0.0	244.3	50.3	148
240 min Winter	12.933	0.0	269.9	62.6	186
360 min Winter	9.907	0.0	310.4	79.6	262
480 min Winter	8.190	0.0	341.9	90.1	336

Summary of Results for 30 year Return Period (+30%)

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
600 min Winter	145.547	0.547	4.5	7.4	12.0	183.3	O K
720 min Winter	145.539	0.539	4.5	7.2	11.7	179.6	O K
960 min Winter	145.522	0.522	4.5	6.7	11.2	172.1	O K
1440 min Winter	145.498	0.498	4.4	5.5	9.9	161.7	O K
2160 min Winter	145.471	0.471	4.4	3.8	8.2	150.1	O K
2880 min Winter	145.448	0.448	4.3	2.5	6.8	140.9	O K
4320 min Winter	145.408	0.408	4.2	0.7	4.9	124.6	O K
5760 min Winter	145.327	0.327	4.1	0.0	4.1	94.7	O K
7200 min Winter	145.237	0.237	3.9	0.0	3.9	64.5	O K
8640 min Winter	145.158	0.158	3.7	0.0	3.7	40.4	O K
10080 min Winter	145.087	0.087	3.5	0.0	3.5	21.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
600 min Winter	7.063	0.0	368.5	96.0	408
720 min Winter	6.256	0.0	391.6	98.6	478
960 min Winter	5.165	0.0	431.3	97.9	616
1440 min Winter	3.942	0.0	493.9	91.3	884
2160 min Winter	3.006	0.0	564.7	74.4	1296
2880 min Winter	2.478	0.0	620.3	53.6	1708
4320 min Winter	1.886	0.0	708.7	12.2	2600
5760 min Winter	1.553	0.0	778.1	0.0	3464
7200 min Winter	1.335	0.0	835.9	0.0	4192
8640 min Winter	1.180	0.0	887.2	0.0	4928
10080 min Winter	1.064	0.0	932.6	0.0	5560

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	1.000
Region	Scotland and Ireland	Cv (Winter)	1.000
M5-60 (mm)	15.900	Shortest Storm (mins)	15
Ratio R	0.250	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.522

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.174	4	8	0.174	8	12	0.174

Model Details

Storage is Online Cover Level (m) 146.000

Tank or Pond Structure

Invert Level (m) 145.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	226.0	0.300	344.0	0.600	472.0	0.900	610.0
0.100	264.0	0.400	386.0	0.700	517.0	1.000	657.0
0.200	304.0	0.500	429.0	0.800	563.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0098-4000-0800-4000
Design Head (m)	0.800
Design Flow (l/s)	4.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	98
Invert Level (m)	144.500
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	4.0	Kick-Flo®	0.525	3.3
Flush-Flo™	0.238	4.0	Mean Flow over Head Range	-	3.5

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)	Depth (m)	Flow (l/s)
0.100	3.2	0.800	4.0	2.000	6.1	4.000	8.5	7.000	11.1
0.200	4.0	1.000	4.4	2.200	6.4	4.500	9.0	7.500	11.4
0.300	4.0	1.200	4.8	2.400	6.7	5.000	9.4	8.000	11.8
0.400	3.8	1.400	5.2	2.600	6.9	5.500	9.9	8.500	12.1
0.500	3.5	1.600	5.5	3.000	7.4	6.000	10.3	9.000	12.5
0.600	3.5	1.800	5.8	3.500	8.0	6.500	10.7	9.500	12.8

Orifice Overflow Control

Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 145.370

Summary of Results for 100 year Return Period (+30%)

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	145.363	0.363	4.1	0.0	4.1	107.8	O K
30 min Summer	145.467	0.467	4.4	3.6	7.9	148.6	O K
60 min Summer	145.552	0.552	4.5	7.6	12.1	185.1	O K
120 min Summer	145.613	0.613	4.7	9.2	13.8	213.8	O K
180 min Summer	145.639	0.639	4.7	9.8	14.5	226.4	O K
240 min Summer	145.655	0.655	4.7	10.1	14.9	234.3	O K
360 min Summer	145.670	0.670	4.8	10.4	15.2	241.7	O K
480 min Summer	145.673	0.673	4.8	10.5	15.3	243.1	O K
600 min Summer	145.670	0.670	4.8	10.4	15.2	241.4	O K
720 min Summer	145.663	0.663	4.8	10.3	15.0	238.0	O K
960 min Summer	145.645	0.645	4.7	9.9	14.6	229.2	O K
1440 min Summer	145.612	0.612	4.7	9.2	13.8	213.3	O K
2160 min Summer	145.571	0.571	4.6	8.1	12.7	194.1	O K
2880 min Summer	145.539	0.539	4.5	7.2	11.7	179.6	O K
4320 min Summer	145.498	0.498	4.4	5.5	9.9	161.7	O K
5760 min Summer	145.472	0.472	4.4	3.9	8.3	150.8	O K
7200 min Summer	145.451	0.451	4.3	2.6	7.0	142.0	O K
8640 min Summer	145.431	0.431	4.3	1.7	6.0	133.9	O K
10080 min Summer	145.414	0.414	4.3	0.9	5.1	127.2	O K
15 min Winter	145.363	0.363	4.1	0.0	4.1	107.9	O K
30 min Winter	145.468	0.468	4.4	3.6	8.0	148.9	O K
60 min Winter	145.554	0.554	4.5	7.6	12.2	186.3	O K
120 min Winter	145.619	0.619	4.7	9.3	14.0	216.4	O K
180 min Winter	145.642	0.642	4.7	9.8	14.6	227.9	O K
240 min Winter	145.656	0.656	4.7	10.1	14.9	234.7	O K
360 min Winter	145.664	0.664	4.8	10.3	15.1	238.8	O K
480 min Winter	145.660	0.660	4.7	10.2	15.0	236.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	87.091	0.0	113.6	0.0	26
30 min Summer	61.393	0.0	160.1	10.5	39
60 min Summer	40.710	0.0	212.3	40.1	64
120 min Summer	26.137	0.0	272.7	76.2	116
180 min Summer	19.988	0.0	312.8	99.5	144
240 min Summer	16.493	0.0	344.4	116.8	178
360 min Summer	12.540	0.0	392.6	141.4	246
480 min Summer	10.310	0.0	430.3	158.0	314
600 min Summer	8.852	0.0	461.8	169.4	384
720 min Summer	7.812	0.0	489.1	176.4	450
960 min Summer	6.413	0.0	535.6	181.2	584
1440 min Summer	4.855	0.0	608.3	179.6	842
2160 min Summer	3.670	0.0	689.9	172.7	1216
2880 min Summer	3.006	0.0	752.9	162.0	1588
4320 min Summer	2.266	0.0	851.7	133.8	2304
5760 min Summer	1.853	0.0	928.6	103.2	3064
7200 min Summer	1.585	0.0	992.9	73.3	3832
8640 min Summer	1.395	0.0	1048.3	45.8	4664
10080 min Summer	1.252	0.0	1098.0	21.4	5456
15 min Winter	87.091	0.0	113.5	0.0	26
30 min Winter	61.393	0.0	160.0	10.6	39
60 min Winter	40.710	0.0	212.1	40.0	64
120 min Winter	26.137	0.0	272.9	76.2	118
180 min Winter	19.988	0.0	312.9	99.6	148
240 min Winter	16.493	0.0	344.5	116.9	186
360 min Winter	12.540	0.0	392.6	141.6	262
480 min Winter	10.310	0.0	430.6	158.4	336

Summary of Results for 100 year Return Period (+30%)

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
600 min Winter	145.651	0.651	4.7	10.0	14.8	232.1	O K
720 min Winter	145.639	0.639	4.7	9.8	14.5	226.2	O K
960 min Winter	145.613	0.613	4.7	9.2	13.8	213.6	O K
1440 min Winter	145.566	0.566	4.6	8.0	12.5	191.8	O K
2160 min Winter	145.518	0.518	4.5	6.5	11.0	170.4	O K
2880 min Winter	145.491	0.491	4.4	5.0	9.5	158.8	O K
4320 min Winter	145.455	0.455	4.3	2.9	7.2	143.5	O K
5760 min Winter	145.425	0.425	4.3	1.5	5.7	131.5	O K
7200 min Winter	145.389	0.389	4.2	0.2	4.4	117.5	O K
8640 min Winter	145.306	0.306	4.0	0.0	4.0	87.3	O K
10080 min Winter	145.227	0.227	3.8	0.0	3.8	61.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
600 min Winter	8.852	0.0	461.8	170.3	408
720 min Winter	7.812	0.0	489.4	178.1	478
960 min Winter	6.413	0.0	535.6	183.9	616
1440 min Winter	4.855	0.0	608.1	177.1	876
2160 min Winter	3.670	0.0	689.8	160.9	1244
2880 min Winter	3.006	0.0	753.0	138.4	1624
4320 min Winter	2.266	0.0	851.8	88.1	2428
5760 min Winter	1.853	0.0	928.6	40.3	3288
7200 min Winter	1.585	0.0	992.2	3.2	4256
8640 min Winter	1.395	0.0	1048.4	0.0	5024
10080 min Winter	1.252	0.0	1097.8	0.0	5752

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	1.000
Region	Scotland and Ireland	Cv (Winter)	1.000
M5-60 (mm)	15.900	Shortest Storm (mins)	15
Ratio R	0.250	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.522

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.174	4	8	0.174	8	12	0.174

Model Details

Storage is Online Cover Level (m) 146.000

Tank or Pond Structure

Invert Level (m) 145.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	226.0	0.300	344.0	0.600	472.0	0.900	610.0
0.100	264.0	0.400	386.0	0.700	517.0	1.000	657.0
0.200	304.0	0.500	429.0	0.800	563.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0098-4000-0800-4000
Design Head (m)	0.800
Design Flow (l/s)	4.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	98
Invert Level (m)	144.500
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	4.0	Kick-Flo®	0.525	3.3
Flush-Flo™	0.238	4.0	Mean Flow over Head Range	-	3.5

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)	Depth (m)	Flow (l/s)
0.100	3.2	0.800	4.0	2.000	6.1	4.000	8.5	7.000	11.1
0.200	4.0	1.000	4.4	2.200	6.4	4.500	9.0	7.500	11.4
0.300	4.0	1.200	4.8	2.400	6.7	5.000	9.4	8.000	11.8
0.400	3.8	1.400	5.2	2.600	6.9	5.500	9.9	8.500	12.1
0.500	3.5	1.600	5.5	3.000	7.4	6.000	10.3	9.000	12.5
0.600	3.5	1.800	5.8	3.500	8.0	6.500	10.7	9.500	12.8

Orifice Overflow Control

Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 145.370

Summary of Results for 200 year Return Period (+30%)

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	145.410	0.410	4.2	0.8	5.0	125.6	O K
30 min Summer	145.523	0.523	4.5	6.7	11.2	172.2	O K
60 min Summer	145.617	0.617	4.7	9.3	13.9	215.7	O K
120 min Summer	145.686	0.686	4.8	10.8	15.6	249.5	O K
180 min Summer	145.713	0.713	4.8	11.3	16.2	263.7	Flood Risk
240 min Summer	145.730	0.730	4.9	11.6	16.5	272.6	Flood Risk
360 min Summer	145.745	0.745	4.9	11.9	16.8	280.9	Flood Risk
480 min Summer	145.748	0.748	4.9	12.0	16.9	282.3	Flood Risk
600 min Summer	145.744	0.744	4.9	11.9	16.8	280.3	Flood Risk
720 min Summer	145.737	0.737	4.9	11.7	16.6	276.3	Flood Risk
960 min Summer	145.716	0.716	4.9	11.4	16.2	265.4	Flood Risk
1440 min Summer	145.675	0.675	4.8	10.5	15.3	244.2	O K
2160 min Summer	145.624	0.624	4.7	9.4	14.1	219.0	O K
2880 min Summer	145.584	0.584	4.6	8.5	13.1	200.0	O K
4320 min Summer	145.528	0.528	4.5	6.9	11.3	174.6	O K
5760 min Summer	145.496	0.496	4.4	5.3	9.7	160.7	O K
7200 min Summer	145.474	0.474	4.4	4.0	8.4	151.3	O K
8640 min Summer	145.456	0.456	4.3	2.9	7.3	143.9	O K
10080 min Summer	145.438	0.438	4.3	2.1	6.4	136.9	O K
15 min Winter	145.410	0.410	4.2	0.8	5.0	125.7	O K
30 min Winter	145.524	0.524	4.5	6.7	11.2	172.7	O K
60 min Winter	145.620	0.620	4.7	9.3	14.0	217.0	O K
120 min Winter	145.691	0.691	4.8	10.9	15.7	252.1	O K
180 min Winter	145.715	0.715	4.9	11.3	16.2	264.8	Flood Risk
240 min Winter	145.730	0.730	4.9	11.6	16.5	272.5	Flood Risk
360 min Winter	145.738	0.738	4.9	11.8	16.7	276.8	Flood Risk
480 min Winter	145.732	0.732	4.9	11.7	16.5	273.9	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	101.014	0.0	131.6	1.1	26
30 min Summer	71.545	0.0	186.6	26.0	38
60 min Summer	47.360	0.0	247.2	63.7	66
120 min Summer	30.260	0.0	315.7	107.1	118
180 min Summer	23.055	0.0	360.9	134.6	146
240 min Summer	18.971	0.0	396.1	155.2	178
360 min Summer	14.363	0.0	449.6	184.4	248
480 min Summer	11.771	0.0	491.3	204.7	316
600 min Summer	10.080	0.0	526.0	219.4	384
720 min Summer	8.878	0.0	556.1	229.9	452
960 min Summer	7.263	0.0	606.4	239.7	586
1440 min Summer	5.473	0.0	685.7	238.6	844
2160 min Summer	4.118	0.0	773.5	230.1	1216
2880 min Summer	3.360	0.0	841.8	218.9	1588
4320 min Summer	2.519	0.0	946.8	189.6	2296
5760 min Summer	2.052	0.0	1027.9	156.5	3048
7200 min Summer	1.749	0.0	1095.4	123.3	3760
8640 min Summer	1.535	0.0	1154.2	92.2	4576
10080 min Summer	1.375	0.0	1206.2	63.5	5344
15 min Winter	101.014	0.0	131.6	1.1	26
30 min Winter	71.545	0.0	186.6	26.0	38
60 min Winter	47.360	0.0	247.1	63.7	64
120 min Winter	30.260	0.0	315.9	107.1	118
180 min Winter	23.055	0.0	361.1	134.8	150
240 min Winter	18.971	0.0	395.9	155.5	188
360 min Winter	14.363	0.0	449.8	184.9	264
480 min Winter	11.771	0.0	491.5	205.4	338

Summary of Results for 200 year Return Period (+30%)

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
600 min Winter	145.721	0.721	4.9	11.5	16.3	268.0	Flood Risk
720 min Winter	145.707	0.707	4.8	11.2	16.0	260.7	Flood Risk
960 min Winter	145.677	0.677	4.8	10.6	15.4	245.0	O K
1440 min Winter	145.619	0.619	4.7	9.3	14.0	216.3	O K
2160 min Winter	145.557	0.557	4.5	7.7	12.3	187.4	O K
2880 min Winter	145.516	0.516	4.5	6.5	10.9	169.2	O K
4320 min Winter	145.475	0.475	4.4	4.1	8.4	151.9	O K
5760 min Winter	145.447	0.447	4.3	2.4	6.8	140.5	O K
7200 min Winter	145.423	0.423	4.3	1.3	5.6	130.8	O K
8640 min Winter	145.394	0.394	4.2	0.3	4.5	119.2	O K
10080 min Winter	145.319	0.319	4.0	0.0	4.0	91.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
600 min Winter	10.080	0.0	526.1	220.3	410
720 min Winter	8.878	0.0	555.9	231.3	482
960 min Winter	7.263	0.0	606.5	243.1	618
1440 min Winter	5.473	0.0	685.7	238.7	880
2160 min Winter	4.118	0.0	774.0	221.9	1256
2880 min Winter	3.360	0.0	841.8	199.4	1612
4320 min Winter	2.519	0.0	946.9	145.5	2376
5760 min Winter	2.052	0.0	1027.9	92.1	3176
7200 min Winter	1.749	0.0	1095.5	44.0	4032
8640 min Winter	1.535	0.0	1153.8	6.1	5016
10080 min Winter	1.375	0.0	1205.7	0.0	5856

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	200	Cv (Summer)	1.000
Region	Scotland and Ireland	Cv (Winter)	1.000
M5-60 (mm)	15.900	Shortest Storm (mins)	15
Ratio R	0.250	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.522

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.174	4	8	0.174	8	12	0.174

Model Details

Storage is Online Cover Level (m) 146.000

Tank or Pond Structure

Invert Level (m) 145.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	226.0	0.300	344.0	0.600	472.0	0.900	610.0
0.100	264.0	0.400	386.0	0.700	517.0	1.000	657.0
0.200	304.0	0.500	429.0	0.800	563.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0098-4000-0800-4000
Design Head (m)	0.800
Design Flow (l/s)	4.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	98
Invert Level (m)	144.500
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	4.0	Kick-Flo®	0.525	3.3
Flush-Flo™	0.238	4.0	Mean Flow over Head Range	-	3.5

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)	Depth (m)	Flow (l/s)
0.100	3.2	0.800	4.0	2.000	6.1	4.000	8.5	7.000	11.1
0.200	4.0	1.000	4.4	2.200	6.4	4.500	9.0	7.500	11.4
0.300	4.0	1.200	4.8	2.400	6.7	5.000	9.4	8.000	11.8
0.400	3.8	1.400	5.2	2.600	6.9	5.500	9.9	8.500	12.1
0.500	3.5	1.600	5.5	3.000	7.4	6.000	10.3	9.000	12.5
0.600	3.5	1.800	5.8	3.500	8.0	6.500	10.7	9.500	12.8

Orifice Overflow Control

Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 145.370

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