69 MOOREND ROAD

MR D. FREER

DRAINAGE STRATEGY & DESIGN

26-4143-KTN-TN-01-B

15th April 2026

The Site
24 Chosen View Road
Cheltenham
GL51 9LT

DOCUMENT CONTROL

Document Status

Revision	Date	Document Author	Status
A	**13.04.2026**	**G. Jones** *(BEng IEng MICE)*	**ISSUE01**
B	**15.04.2026**	**G. Jones** *(BEng IEng MICE)*	**ISSUE01**

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National Standards, regulations and Council policy do change which could affect the validity of this Report. The methodologies adopted and the sources of information used by K-Ten Consulting Ltd in providing its services are outlined within the report. Any information provided by third parties and referred to within the report and appendices has not been checked or verified by K-Ten Consulting Ltd, unless otherwise expressly stated within this Report.

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APPENDICIES

1.0 INTRODUCTION

1.1 K-Ten Consulting Ltd (K-Ten) provide professional Flood Risk, Infrastructure and Drainage services throughout the UK.

1.2 K-Ten have been commissioned by Mr D. Freer (applicant) to prepare technical design information to discharge Planning Condition #3 relating to proposed development of surface drainage requirements on site:-

'Prior to the commencement of development, a surface water drainage scheme, which shall incorporate Sustainable Drainage System (SUDS) principles and appropriate flood risk management, shall be submitted to and approved in writing by the Local Planning Authority. The scheme shall include a programme for implementation of the works; and proposals for maintenance and management. The development shall not be carried out unless in accordance with the approved surface water drainage scheme.

Reason: To ensure flood risk management and sustainable drainage of the development, having regard to adopted policy INF2 of the Joint Core Strategy (2017). Approval is required upfront because the design of the drainage is an integral part of the development and its acceptability.'

1.3 The project consists of the replacement of existing dwelling comprising demolition of existing dwelling and erection of 1 no. new self-build dwelling and associated works, at 69 Moorend Rd, Cheltenham GL53 0HT. Refer to the Architect's site plan in **Appendix A**.

1.4 This technical note will summarise the below ground drainage requirements on site in accordance with Cheltenham Borough Council water management guidelines and national standards.

2.0 EXISTING SITE LEVELS

Site Location

2.1 The site is within the residential grounds of 69 Moorend Rd, off Leckhampton Road, 2km south of Cheltenham town centre. An existing driveway that leads from the highway to the existing dwelling and garage.

2.2 The approximate site co-ordinates are E 394489, N 220220 and National Grid SO946201, with the nearest post code GL53 0HT.

Existing Hydrology

2.3 There are no watercourses in the vicinity of the proposed development. The nearest watercourse is approximately 500m west of the site. According to the EA river maps, the closest river is the River Severn located 12.0km west of the site.

2.4 In accordance with the latest updated EA flood maps the site is within Flood Zone 1 classified as land having a less than 1 in 1,000 year annual probability of fluvial flooding. Refer to **Appendix C**.

2.5 Online soil maps indicate the site to be *underlain by sand and gravel with freely slightly acid loamy soils, over rock.*

Topography

2.6 A topographical survey has been carried out January 2025 by Element Survey & Compliance and can be viewed in the background of the drainage strategy plan in **Appendix B**

Existing Drainage

2.7 Severn Trent sewer asset records show a 525mm Ø combined water sewer within Moorend Road east to west. It also shows a storm water sewer west at the Moorend / Grove / Moorend Road junction. Refer to **Appendix D**.

2.8 A drainage CCTV survey was carried out by Cloacina Service Ltd 31st March 2026. The survey confirms that the storm and foul drainage from the existing property is combined and discharges into the Severn Trent combined sewer in the Highway. **Refer to Appendix I.**

Infiltration test and ground conditions

2.9 A ground investigation and percolation testing exercise was undertaken on 31st March 2026 at the rear gardens to assess the site's suitability for infiltration-based surface water disposal. Refer to Appendix E GI report form Cloacina Services Ltd. **Refer to Appendix E.**

2.10 One percolation test pit was excavated at the south-west gardens.

2.11 The pit measured 1.0 m x 0.4 m x 1.4 m and was filled with water to a depth of 1.0m. Three sequential tests were completed in each pit.

Ground conditions: predominantly sand & gravel
Drain-down times (75%–25%): 34 minutes, 44 minutes, and 62 minutes.
Performance: Good percolation.

2.12 The investigation identified sandy and gravelly strata with no evidence of perched or shallow groundwater, indicating favourable infiltration characteristics suitable for soakaways or other infiltration-based SuDS, subject to detailed design.

Infiltration test calculations have been undertaken — refer to **Appendix E** for full details. The slowest percolation rates recorded **2.8×10^{-5} m/s (0.100 m/hr).**

2.13 The ground investigation and percolation testing confirmed that the site has favourable infiltration characteristics. The underlying sand and gravel strata provide suitable permeability for the use of soakaways or infiltration-based SuDS features to manage surface water runoff.

2.14 No groundwater was encountered during the testing, further supporting the feasibility of infiltration techniques, subject to detailed design verification and final soakaway sizing during the next stage of design.

3.0 PROPOSED SURFACE WATER DRAINAGE STRATEGY

3.1 A surface water strategy is proposed to manage and reduce the flood risk and surface water run-off from the development, with consideration to SuDS.

3.2 The SuDS hierarchy dictates that surface water run off should be managed as high up the following list as practically possible:

a) into the ground (via infiltration) and re-use, or then;

b) to a surface water body, or then;

c) to a surface water sewer, highway drain or another drainage system, or then;

d) to a combined sewer.

3.3 The underlying ground strata are considered to be suitable for infiltration, permitting the use of traditional soakaways to manage surface water runoff from roof areas.

3.4 Surface water from the proposed roof catchment will discharge via rainwater downpipes to a below-ground drainage system. The flat roof incorporates green roof build-up to reduce runoff rates and provide initial attenuation. Runoff from the roof will discharge to a cellular storage tank soakaway located within the proposed rear garden, positioned a minimum of 5m from any structural foundations.

3.5 The proposed driveway and parking areas will be constructed using permeable paving. A Type 3 open-graded sub-base will be provided to allow surface water to infiltrate, with temporary storage and filtration occurring within the sub-base prior to controlled discharge into the underlying ground. This approach provides effective source control in accordance with SuDS best practice and supports attenuation, water quality treatment, and groundwater recharge.

3.6 The external patio area will be designed to drain towards a French drain, allowing surface water to infiltrate into the surrounding ground.

3.7 The proposed total building roof and hardstanding (impermeable) areas are shown below:

Reference	**System type**	**Catchment Area (m^2)**	**Attenuation volume requirements (m^3)**	**Percolation rate used (m/s)**
SA.01	Cellular storage tank soakaway	160	6.75	2.8×10^{-5}
PP.01	Permeable paving	60	5.4	2.8×10^{-5}

3.8 On site attenuation shall be provided to cater for all storm events up to and including the 100yr plus a 40% allowance for climate change.

3.9 Infiltration rates have been determined on closest test pit results. The permeable paving extends across both test pit locations and so attenuation requirements have been based on the slower rate of 2.8×10^{-5} m/s (0.100 m/hr).

3.10 Silt trap chamber shall be placed upstream of the attenuation.

3.11 Refer to **Appendix B** for Drainage layout plan.

3.12 Cellular storage attenuation has been designed and simulated with *Causeway Flow* design software with the following design criteria:

- Rainfall – FEH22
- Design Event – up to and including 100 year plus 40% climate change
- Storm Duration (simulation) – 15 min to 10080 min
- CV Winter and Summer – 1.0
- Factor of Safety – 2.0. This is based on CIRIA C753 (The SuDS Manual) suggested factor of safety for use in hydraulic design of infiltration systems - where the size of area drained is less than 1000m^2 and the consequence of failure is minor damage to external areas or inconvenience – i.e. parking area and access road
- Void ratio – 95% (cellular)
- Catchment – 160m^2

3.13 Permeable paving attenuation has been designed and simulated with *Causeway Flow* design software with the following design criteria:

- Rainfall – FEH22
- Design Event – up to and including 100 year plus 40% climate change
- Storm Duration (simulation) – 15 min to 10080 min
- CV Winter and Summer – 1.0
- Factor of Safety – 2.0. This is based on CIRIA Report C752 Table 25.2 (suggested factor of safety for use in hydraulic design of infiltration systems - where the consequence of failure is minor damage to external areas or inconvenience – i.e. parking area and access road
- Void ratio – 30%
- Catchment – 60m^2

3.14 Refer to **Appendix F** for Drainage calculation report and simulation outputs.

3.15 The attenuation will cater for all storm events up to and including the 1 in 100 year plus a 40% allowance for climate change.

Attenuation capacity: -

a) SA.01 Cellular storage dimensions will be 4.5m^2 x 1.5m deep cellular with 6.75m^3 water volume.
b) PP.01 permeable paving to have 60m^2 of 300mm type 3 sub-base with 30% voids with attenuation storage 5.4m^3 water volume.

3.16 A Water butt will be installed at the rear of the property, fed by a rainwater pipe. The water butt will have an overflow into the below ground drainage system. The use of this SuDS feature is a simple and eco-friendly way to conserve water for gardening, reducing reliance on mains water.

3.17 All drainage will be constructed in accordance with Building Regulations part H.

3.18 It is inevitable that as a result of extreme rainfall the capacities of sewers, covered watercourses and other drainage systems will be exceeded on occasion. Periods of exceedance occur when the rate of surface runoff exceeds the drainage system inlet capacity, when the pipe system becomes overloaded, or when the outfall becomes restricted due to flood levels in the receiving water. Underground conveyance cannot economically or sustainably be built large enough for the most extreme events and, as a result, there will be occasions when surface water runoff will exceed the design capacity of drains. When drainage exceedance capacity is exceeded the excess water (exceedance flow) is conveyed above ground, and will travel along streets and paths, between and through buildings and across open space. Indiscriminate flooding of property can occur when this flow of water is not controlled." (CIRIA C753).

3.19 Exceedance flows will be designed to ensure finished levels fall away from the buildings to ensure excessive amount of surface water flow away from the building. Overland flow routes move away from the buildings to the northern boundary and flow into the highway as the existing arrangement.

3.20 Refer to Exceedance plans in **Appendix H**.

4.0 SURFACE WATER QUALITY

4.1 Water quality has been assessed in accordance with The SuDS Manual (CIRIA C753) which states the design of surface water should consider minimising contaminants within surface water runoff discharged from the site.

4.2 The level of treatment required is dependent on the proposed land use according to the pollution hazard indices (refer to SuDS Manual table 26.2).

4.3 To ensure that adequate treatment is provided the SuDS mitigation indices for the development must be equal or exceed, the pollution hazard indices shown within SuDS Manual table 26.2.

4.4 Refer to below Water Quality Indices Table, as per C753 SuDS Manual, confirming compliance with mitigation indices against Pollution Hazard indices.

	Pollution Hazard Level	Total susp solids	Metals	HyroCarbons
Land Use: **Individual property driveways, residential car parks, low traffic roads (Table 26.2)**	Low	0.5	0.4	0.4
Land Use: Other **Roofs (Table 26.2)**	Low	0.2	0.2	0.05
Total:		0.7	0.6	0.45
SuDS Component 1: **Green Roof**		0.2	0.2	0.1
SuDS Component 2: **Permeable Paving**		0.7	0.6	0.1
SuDS Component 3: **Cellular Storage soakaway**		0.4	0.4	0.5
Total:		1.3	1.2	0.7
TOTAL SUDS MITIGATION > POLLUTION HAZARD INDICES		**Yes**	**Yes**	**Yes**

Water Quality Indices (C753 The SuDS Manual)

4.5 It is also good practice that gullies, linear drainage channels and chambers have suitable silt traps/catchpits to reduce sediments within the drainage system.

5.0 MAINTENANCE AND MANAGEMENT

5.1 Maintenance of SuDS features is required in order to ensure that the surface water drainage system operates effectively, and the risk of flooding of the site and surrounding areas is reduced.

5.2 A maintenance schedule should be undertaken to ensure that the drainage system remains fully operational for the design lifetime. The below table summarises a maintenance plan for the drainage systems and components within the development.

5.3 The SuDS Manual (CIRIA C753) and specific product suppliers guidelines should also be referred to for further information on maintenance and frequency.

5.4 All on site drainage will be maintained and managed by the property owner.

Drainage Component	Required Action	Typical Frequency
General pipework, manholes, chambers, silt traps and headwalls	Stabilise adjacent areas	As required
	Remove weeds and vegetation	As required
	Clear/Jet any poor performing structures	As required
	Inspect all drainage features for poor operation	3 monthly, 48 hours after large storms in first six months
	Monitor inspection chambers and silt traps. Inspect silt accumulation and determine silt clearance frequencies	Annually
Private Drains	Inspection	CCTV survey every 5-10 years.
	Regular Maintenance	Jet clean system fully every 5-10 years. (Recommend prior to CCTV drainage survey)
	Remedial / Occasional Maintenance	Carry out remedial works as identified in CCTV survey.
Catchpits	Inspection	Quarterly
	Regular maintenance	Remove silt and debris as necessary to prevent build up.
Overflows and flood routes	Overflows. Jet pipes leading from overflow structures annually and check by running water through the overflow. Check free flow at next SUDS feature – inlet to basin or chamber.	Annually
	Remove any accumulated grass cuttings or other debris on top of grass weirs or stone filled baskets overflows.	Monthly

Drainage Component	Required Action	Typical Frequency
	Flood Routes. Make visual inspection. Check route is not blocked by new fences, walls, soil or other rubbish. Remove as necessary.	Monthly
	Overflows. If overflow is not clear then dismantle structure and reassemble to design detail.	As required
Cellular Attenuation	Inspect for sediment and debris in pre treatment components	Annually
	Trimming roots that may cause blockages	Annually
	Remove sediment and debris from pre treatment components	As required
	Check attenuation to ensure emptying is occurring (no standing water)	Annually
Permeable Paving	Surface visual inspection for ponding, damaged blocks and build up of silt/detritus	Annually or after major storm events
	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
	Remove litter, weeds and debris	Monthly
	Vacuum sweeping and brush replacement of approved jointing material	Annually
	Replace geotextile and bedding layer	Every 30 years

6.0 CONCLUSION

6.1 The proposed surface water drainage strategy has been developed in accordance with national and local planning policy, incorporating Sustainable Drainage Systems (SuDS) principles.

6.2 Site-specific infiltration testing has confirmed that the underlying ground conditions are suitable for infiltration-based drainage. Surface water runoff from the development will be managed on-site via a combination of green roof, permeable paving, French drains, and a cellular storage soakaway.

6.3 All surface water will discharge to ground via infiltration, with no requirement for off-site discharge to a surface water or combined sewer.

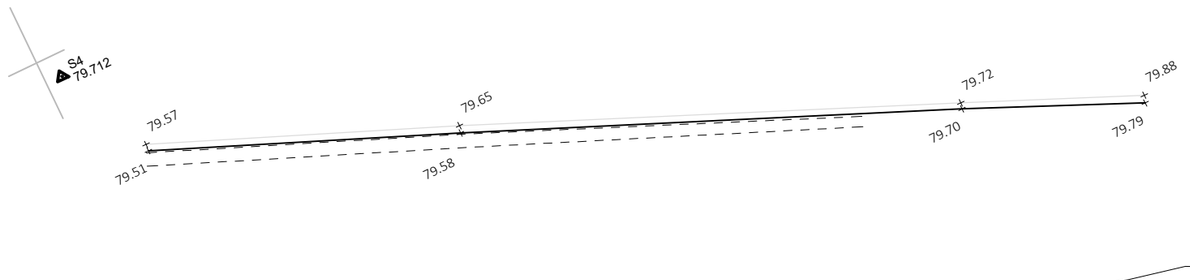
6.4 The proposed drainage system has been designed to accommodate all storm events up to and including the 1 in 100 year event, with a 40% allowance for climate change, ensuring that there is no increase in flood risk on or off the site.

6.5 Water quality treatment is provided through a treatment train incorporating source control SuDS features, ensuring that mitigation indices meet or exceed pollution hazard indices in accordance with CIRIA C753.

6.6 Subject to detailed design and construction in accordance with this strategy, the proposed drainage scheme is considered to be sustainable, robust, and suitable for approval.

APPENDIX A

ARCHITECTURAL LAYOUT



NEW DWELLING - Proposed Site Plan

REV	DATE	DESCRIPTION	INT

A.CLARKE DESIGN
ARCHITECTURAL DESIGN SERVICES

A. Clarke Design Ltd
Stanley Barn Farm, Stanley Pontlarge
Cheltenham, Glos, GL54 5HD
01242-620064
adam@aclarkedesign.co.uk
www.aclarkedesign.co.uk

69 Moorend Road
Cheltenham
Gloucestershire

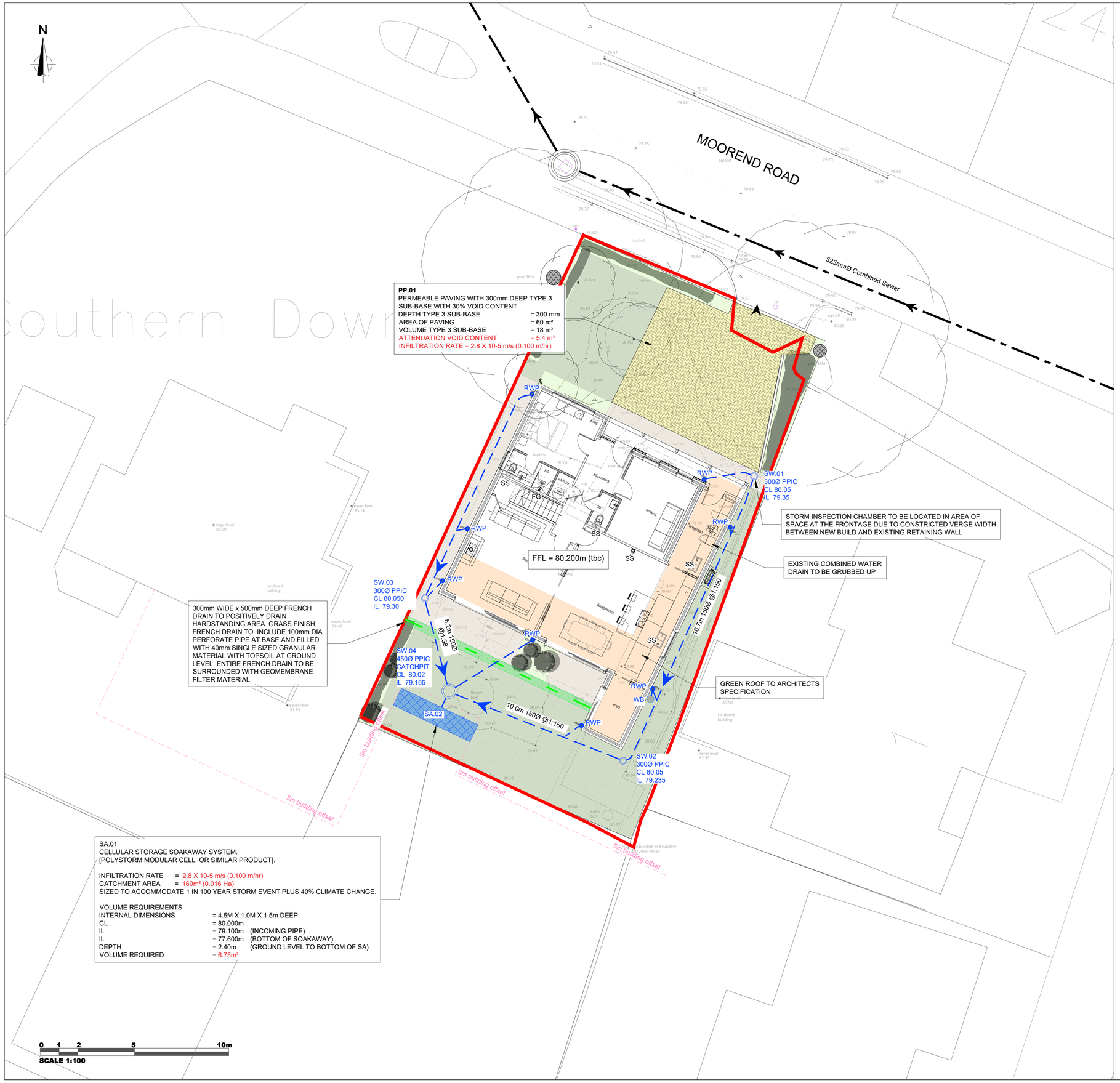
PROPOSED REPLACEMENT DWELLING

PROPOSED SITE PLAN

Scale 1:100@A2	TENDER
Date FEB 2026	
Drawn AC	1919-100B

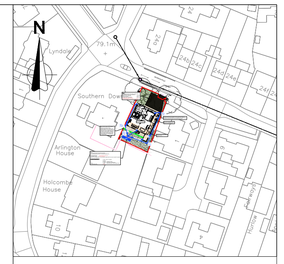
APPENDIX B

DRAINAGE LAYOUT



KEY

- EXISTING PUBLIC COMBINED SEWER
- PROPOSED PRIVATE STORM DRAIN
- PRIVATE STORM WATER 300Ø/ 450Ø / 600Ø PPIC NOTE CATCHPIT WHERE REFERENCED TO HAVE MIN. 300MM SUMP
- RWP — RAIN WATER PIPE
- WB — RAIN WATER DOWN PIPE AND WATER BUTT WITH OVERFLOW TO BELOW GROUND STORM NETWORK TO ARCHITECT SPECIFICATION
- PERMEABLE PAVING DRIVEWAY CONSTRUCTION TO BS 7533-13 4.2.3 SYSTEM A FULL INFILTRATION. TO CONTAIN MINIMUM 300MM TYPE 3 SUB-BASE WITH 30% VOID CONTENT TO UTILISE STORM WATER ATTENUATION. SURFACE FINISH TO BE CONFIRMED BY ARCHITECT
- CELLULAR STORAGE
- FRENCH DRAIN
- GREEN ROOF



Notes:

1. This drawing is to be read in conjunction with relevant Architects, Engineers and specialist manufacturers drawings, reports and specifications.
2. All levels are shown in metres above Ordnance Datum (m AOD) unless otherwise shown.
3. Any ambiguities or discrepancies within this drawing and any other information given elsewhere must be reported to K-Ten for clarification before pricing / works commence.
4. Do not scale from this drawing for construction purposes.
5. It is recommended that all sewers and drains be laid starting from the downstream connection to the existing sewer/drain and working upstream to the new development.
5. All private drainage to comply with current Building Regulations, BS EN-752 Drain and Sewer systems outside Buildings and other relevant British Standards and Codes of Practices.
6. Connections to existing sewers in accordance with the Local Water Authority guidelines & approval.
7. Connections to existing river or watercourse in accordance with the Local Authority and E.A guidelines & approval.
8. Sewers and drains of different diameters should be laid soffit to soffit unless shown otherwise in the drawing. Outfall chamber outgoing pipe where a vortex control device is fitted to be installed at lowest incoming invert level.
9. All access chambers covers and frames to be installed to BS EN 124.
10. Drainage Pipe work routes under building footprint will require Co-ordination with foundations.
11. Cover levels shown on this drawing refer to approximate surface levels. It is the contractors responsibility to ensure that access covers and frames are set at the final surface levels.
12. Where possible the contractor is to orientate manhole biscuits and covers to locate them parallel to kerbs and paving.
13. The Contractor should comply with hs(g) 47 "Avoiding Danger from Underground Services" when excavating around existing services.
14. It is the contractors responsibility to determine the location and depth of all existing services, mains and cables prior to construction.
15. The pipe diameters cover and invert levels of any existing manholes are to be verified on site prior to the commencement of the works.
16. All external non-perforated drainage within trafficked areas with less than 1.2m cover to have concrete protection. All external non-perforated drainage within landscaped areas with cover less than 0.6m to have concrete protection. All drainage with greater cover than the minimum required to have type S bed and surround.
11. Foul drainage pipe connection to public sewer to be plastic twin-walled/ribbed pipe constructed to Water Industry Standard (WIS)-4-35-01.
15. All drainage in highway to be installed in accordance with Sewers Sector Guidance.
16. All access chambers covers and frames to be installed to BS EN 124.
17. All drainage to be installed in accordance with Civil Engineering Specification for the Water industry 7th Edition.
18. Prior to commencing the works the contractor is to confirm details of the existing drainage system as noted on the drawing.
19. This drawing is for information only for planning submission. This is not to be used for construction purposes.
20. Drainage outfall connections and strategy to be agreed with the relevant authorities.
21. Gutters to have down-pipe leaf guards and rainwater down-pipes to have rodding access
22. All existing invert levels shown are indicative and to be checked by the contractor prior to starting works.
23. Drainage strategy to be approved by Cheltenham Borough Council.

Rev	Date	Details	Drawn
B	15.10.26	FOUL OMITTED	10.04.26
A	13.10.26	PRELIMINARY ISSUE	10.04.26

K-Ten Consulting

CLIENT: D. FREER

PROJECT: 69 MOOREND ROAD, CHELTENHAM

TITLE: DRAINAGE LAYOUT

SCALE @ A1:	DATE:	STATUS:	
1:100	10.04.26	INFORMATION	
JOB NO:		**DRAWING NO:**	**REVISION:**
26-4143		C001	B

APPENDIX C

ENVIRONMENT AGENCY FLOOD MAP

Flood map for planning

Your reference	Location (easting/northing)	Created
69 Moorend Road, Cheltenh	**394497/220224**	**10 April 2026 19:17**

Your selected location is in flood zone 1, an area with a low probability of flooding.

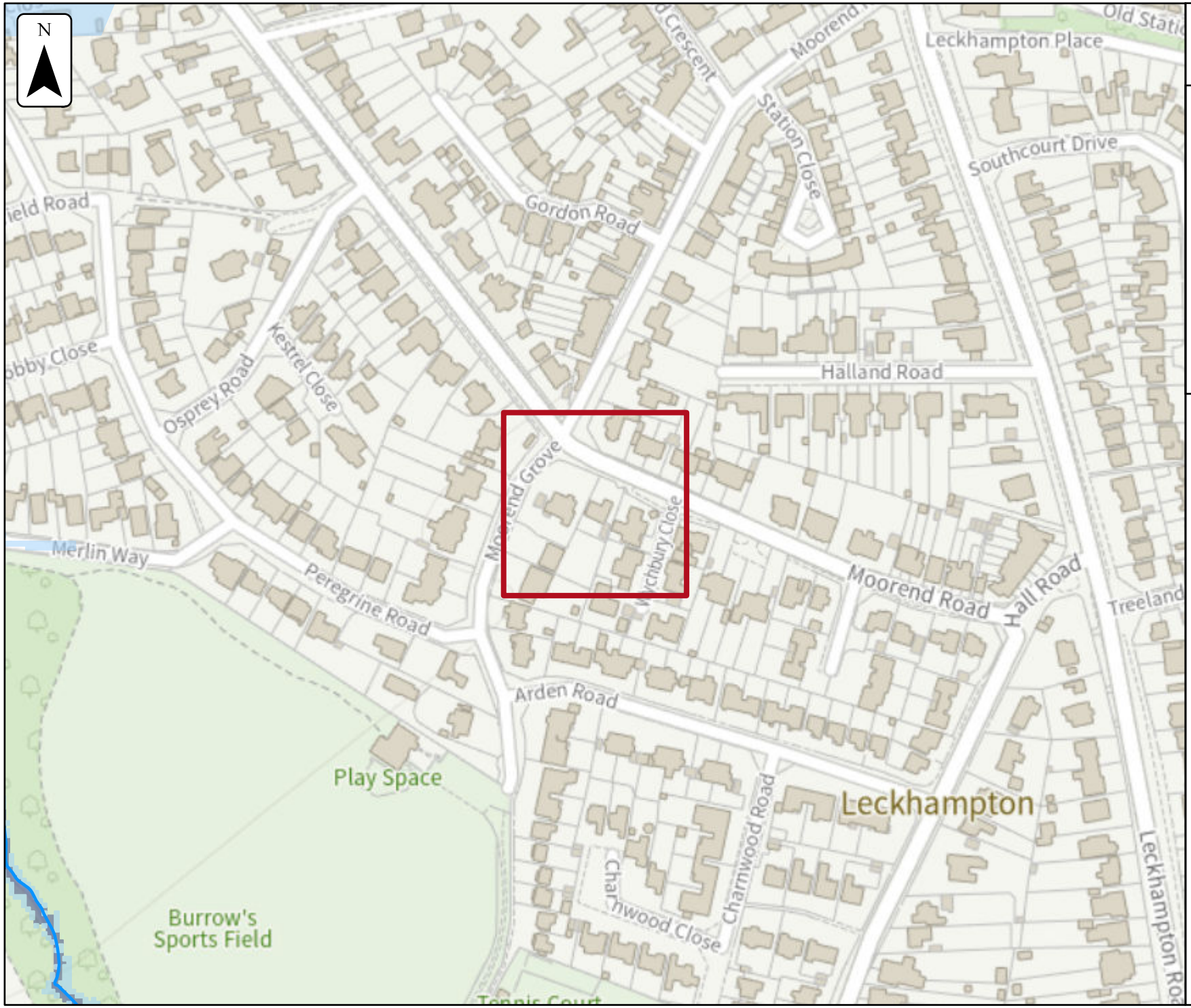
You will need to do a flood risk assessment if your site is **any of the following**:

- bigger than 1 hectare (ha)
- in an area with critical drainage problems as notified by the Environment Agency
- identified as being at increased flood risk in future by the local authority's strategic flood risk assessment
- at risk from other sources of flooding (such as surface water or reservoirs) and its development would increase the vulnerability of its use (such as constructing an office on an undeveloped site or converting a shop to a dwelling)

Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.



Environment Agency

Flood map for planning

Your reference
69 Moorend Road, Cheltenh

Location (easting/northing)
394497/220224

Scale
1:2,500

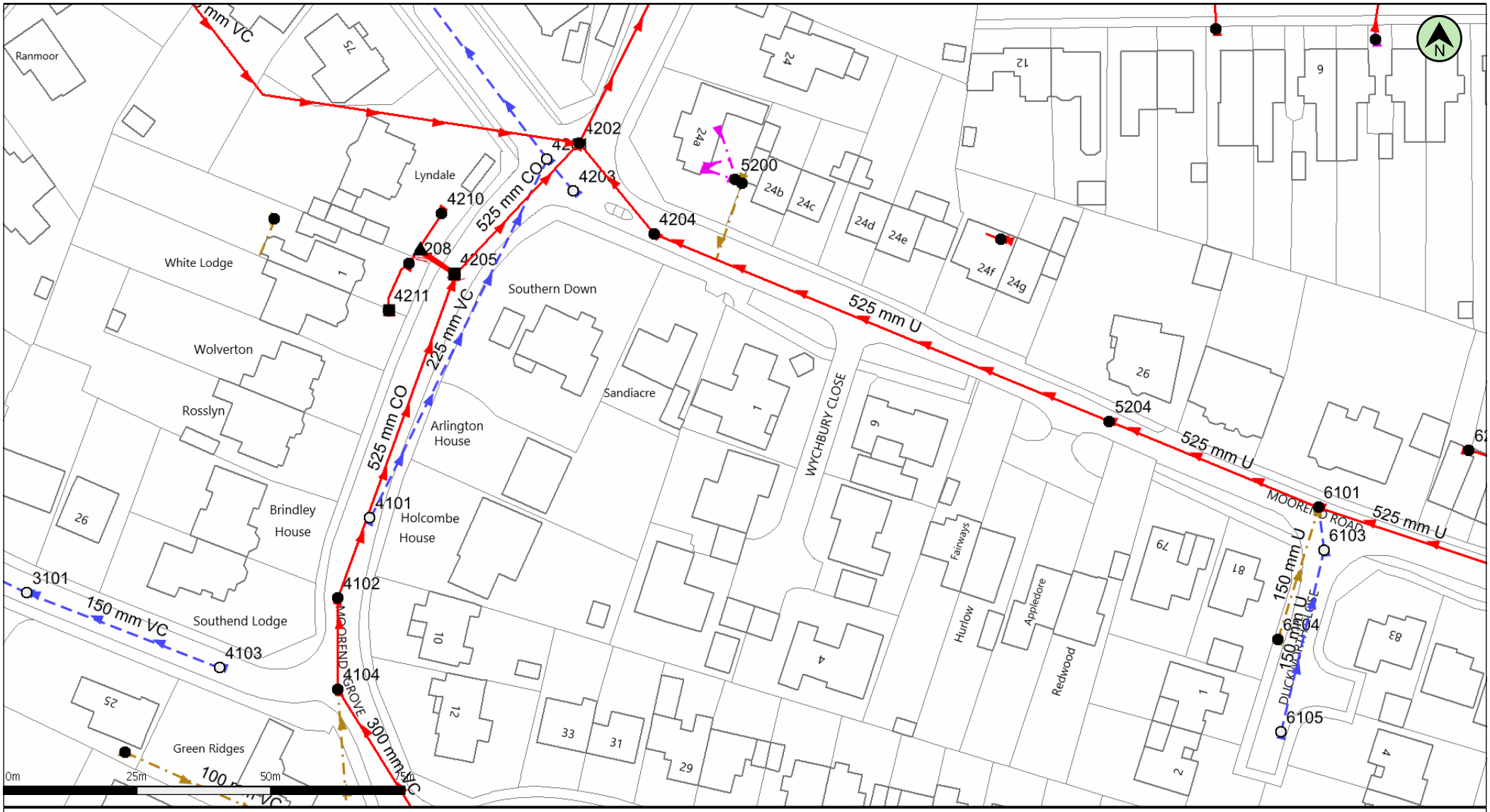
Created
10 Apr 2026 19:18

- Selected area
- Flood zone 3
- Flood zone 2
- Flood zone 1
- Flood defence
- Main river
- Water storage area

0 20 40 60 m

APPENDIX D

SEWER MAP



(c) Crown copyright and database rights 2026 Ordnance Survey AC0000808122 | Date: 27/03/26 | Scale: 1:1000 | Map Centre: 394515,220212 | Data updated: 14/03/26 | Our Ref: 2073995 - 1 | Wastewater Plan A4 Powered by digdat

1. Do not scale off this Map. 2. This plan and any information supplied with it is furnished as a general guide, is only valid at the date of issue and no warranty as to its correctness is given or implied. In particular this plan and any information shown on it must not be relied upon in the event of any development or works (including but not limited to excavations) in the vicinity of SEVERN TRENT WATER assets or for the purposes of determining the suitability of a point of connection to the sewerage or distribution systems. 3. On 1 October 2011 most private sewers and private lateral drains in Severn Trent Water's sewerage area, which were connected to a public sewer as at 1 July 2011, transferred to the ownership of Severn Trent Water and became public sewers and public lateral drains. A further transfer takes place on 1 October 2012. Private pumping stations, which form part of these sewers or lateral drains, will transfer to ownership of Severn Trent Water on or before 1 October 2016. Severn Trent Water does not possess complete records of these assets. These assets may not be displayed on the map. 4. Reproduction by permission of Ordnance Survey on behalf of HMSO. 5. Document users other than SEVERN TRENT WATER business users are advised that this document is provided for reference purpose only and is subject to copyright, therefore, no further copies should be made from it.

- Public Foul Gravity/Lateral Drain
- Public Combined Gravity/Lateral Drain
- Public Surface Water Gravity/Lateral Drain
- Pressure Foul
- Pressure Combined
- Pressure Surface Water
- Highway Drain
- Overflow Pipe
- Disposal Pipe
- Culverted Water Course
- Pumping Station
- Fitting
- Manhole Foul
- Manhole Surface
- Abandoned Pipe
- Chamber

Section 104 sewers are shown in green

Private sewers are shown in magenta

info@k-ten.co.uk

26-4143

SEVERN TRENT

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
	C			
	C			
	C			
4102	C	79.47	77.17	2.3
4104	C	79.52	77.29	2.23
4202	C	79.4	76.28	3.12
4204	C	79.71	76.89	2.82
4205	C	79.27	76.57	2.7
4208	C	79.33	77	2.33
4210	C	79.24	77.07	2.17
4211	C	79.59	77.18	2.41
5204	C	81.4	78.78	2.62
6101	C	82.22	79.59	2.63
6203	C	-	0	0
	F			
	F			
	F			
5200	F	-	0	0
6104	F	82.55	80.57	1.98
3101	S	77.72	76.45	1.27
4101	S	79.48	78.02	1.46
4103	S	78.93	77.6	1.33
4201	S	79.32	77.64	1.68
4203	S	79.45	77.78	1.67
6103	S	82.25	80.49	1.76
6105	S	82.75	81.13	1.62

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

APPENDIX E

GROUND INVESTIGATIONS & INFILTRATION TEST RESULTS

CLOACINA
SERVICES LTD

Customer Name: Mr David Freer

Site Address: 69 Moorend Road, Cheltenham

Date: 31st March 2026

Description: Percolation Testing / CCTV Drain Investigation

CLOACINA SERVICES LTD

Katie Maber Tel: 07904 918481

Director Email: cloacina.services@outlook.com

Percolation Test 1

Percolation Test Location: Lawn area at what3words: ///locked.magma.funded

Percolation Test Pit Size: 1m x 0.4m x 1.4m deep

Water Level: Filled to 1m

Test Results:

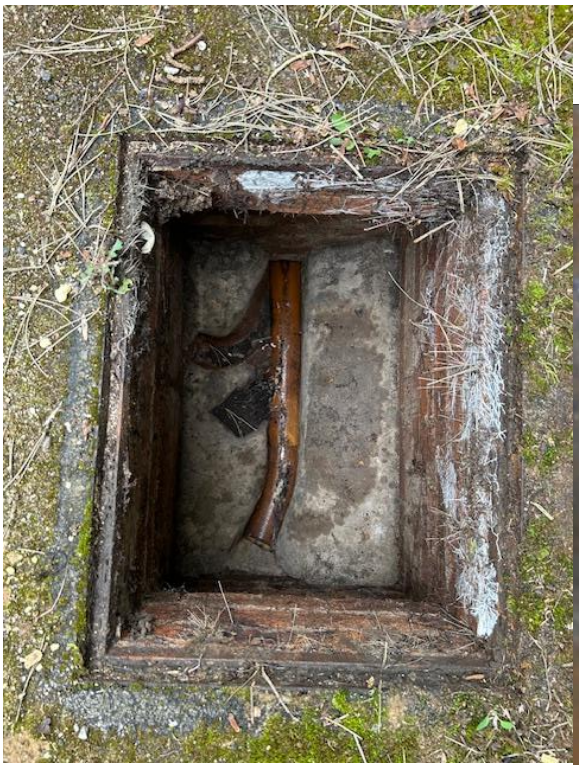
Test Pit 1	Time	Water Level (cm)
Test No: 1	09:48	100
Filled to 1m	09:58	55
	10:08	36
	10:22	25
75%-25%	Test 1 Time	34mins 38 seconds
Test No: 2	10:30	75
Filled to 75cm	10:40	64
	10:50	55
	11:00	49
	11:10	31
	11:14	25
75%-25%	Test 2 Time	44mins 15seconds
Test No: 3	11:25	75
Filled to 75cm	11:35	59
	11:45	44
	11:55	37
	12:05	31
	12:15	28
	12:27	25
75%-25%	Test 2 Time	1 hour 2 minutes

Conclusion: The excavation was carried out on the edge of the lawn towards the rear of the garden. The ground was excavated down to the required depth and filled with water. The excavated ground was made up of 250mm of sandy topsoil, 800mm of darker sandy material and the rest of the excavation was lighter sand. This ground make up made for good results in the percolation times. The weather at the time of the testing was dry. See photos below.

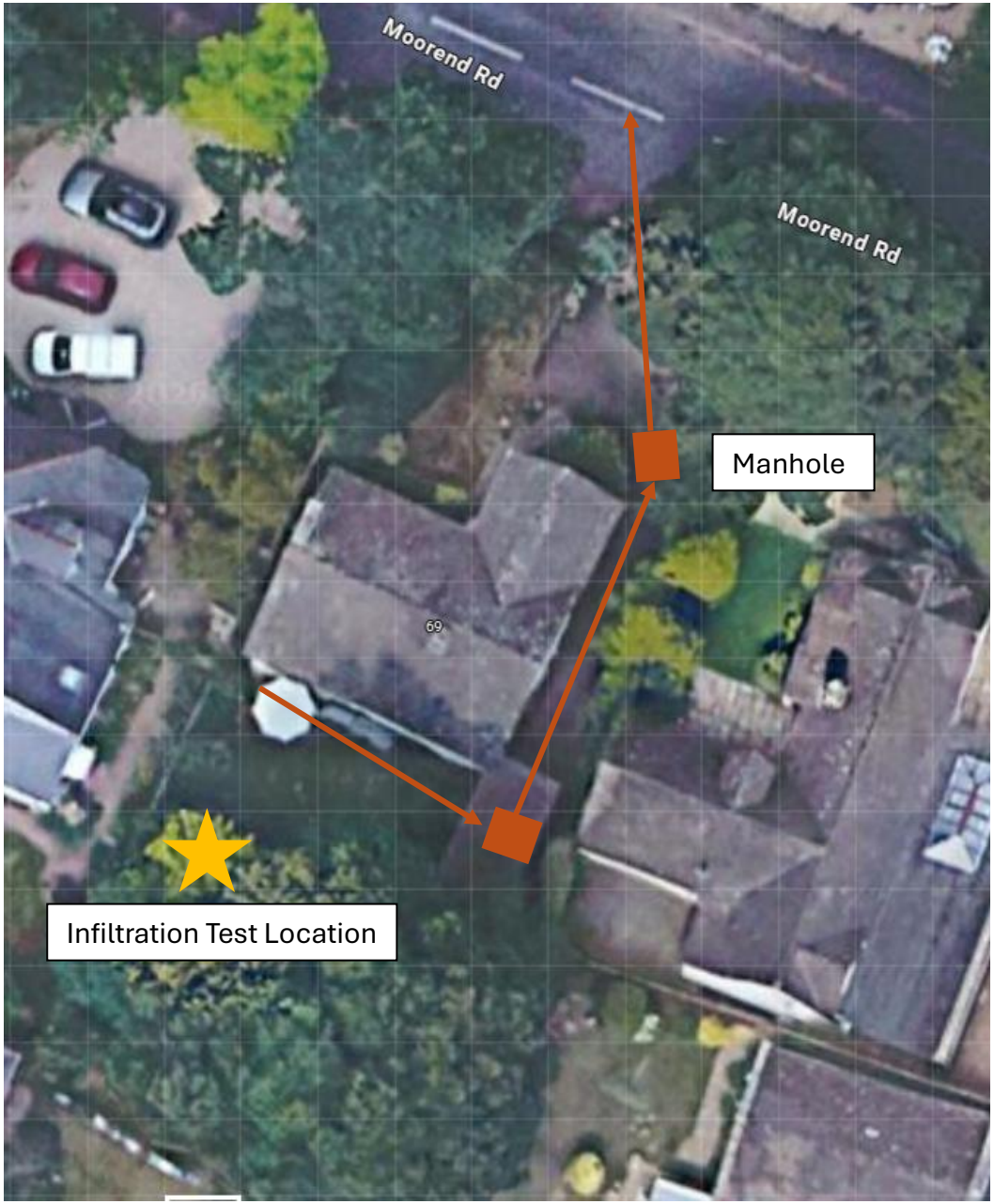
Percolation Test Photos

Drainage Investigation

We CCTV surveyed the down stream combined drain connection from the manhole in the driveway. The line is a 100mm VC pipe at 1.16m deep to invert. It runs down the driveway and drops into the combined main in the road. The drainage is picking up the foul and storm water on site from the existing property. The run, down stream has some minor root ingress which could be jetted to remove, but other than that, the line is in good condition. The up stream line picks up the drainage at the side of the property and goes to a manhole in the garage where it bends and runs to the rear of the property. This picks up the kitchen drain at the rear and the rear down pipe. We would recommend having the line jetted and root cut, post demolition and after the manhole has been moved to its new location. A liner could be installed to prevent the ingress of roots in the future. See photos below:



Location Plan



Infiltration Test Results

in accordance with BRE Digest 365

Project Name	69 Moorend Road, Cheltenham
Project Number	26-4143 69
Test Date	31.03.2026
Test Pit	01-Jan-00

Pit Dimensions:

Length =	1.000	m
Width =	0.400	m
Depth =	1.400	m

Test Number: 01

Distance from ground to top of water =				0.400	m
Total drop below water level at end of test =				0.750	m
75% of effective depth below datum =	0.188	m	Time, t_{75} =	0	mins
50% of effective depth below datum =	0.375	m			
25% of effective depth below datum =	0.563	m	Time, t_{25} =	34	mins
V_{p75-25} = 0.150 m3			t_{p75-25} =	34	mins
A_{p50} = 1.450 m2					
Soil infiltration rate, f =				**5.0E-05**	m/sec
Soil infiltration rate, f =				**0.180**	m/hr

Test Number: 02

Distance from ground to top of water =				0.400	m
Total drop below water level at end of test =				0.750	m
75% of effective depth below datum =	0.188	m	Time, t_{75} =	0	mins
50% of effective depth below datum =	0.375	m			
25% of effective depth below datum =	0.563	m	Time, t_{25} =	0	mins
V_{p75-25} = 0.150 m3			t_{p75-25} =	44	mins
A_{p50} = 1.450 m2					
Soil infiltration rate, f =				**3.9E-05**	m/sec
Soil infiltration rate, f =				**0.141**	m/hr

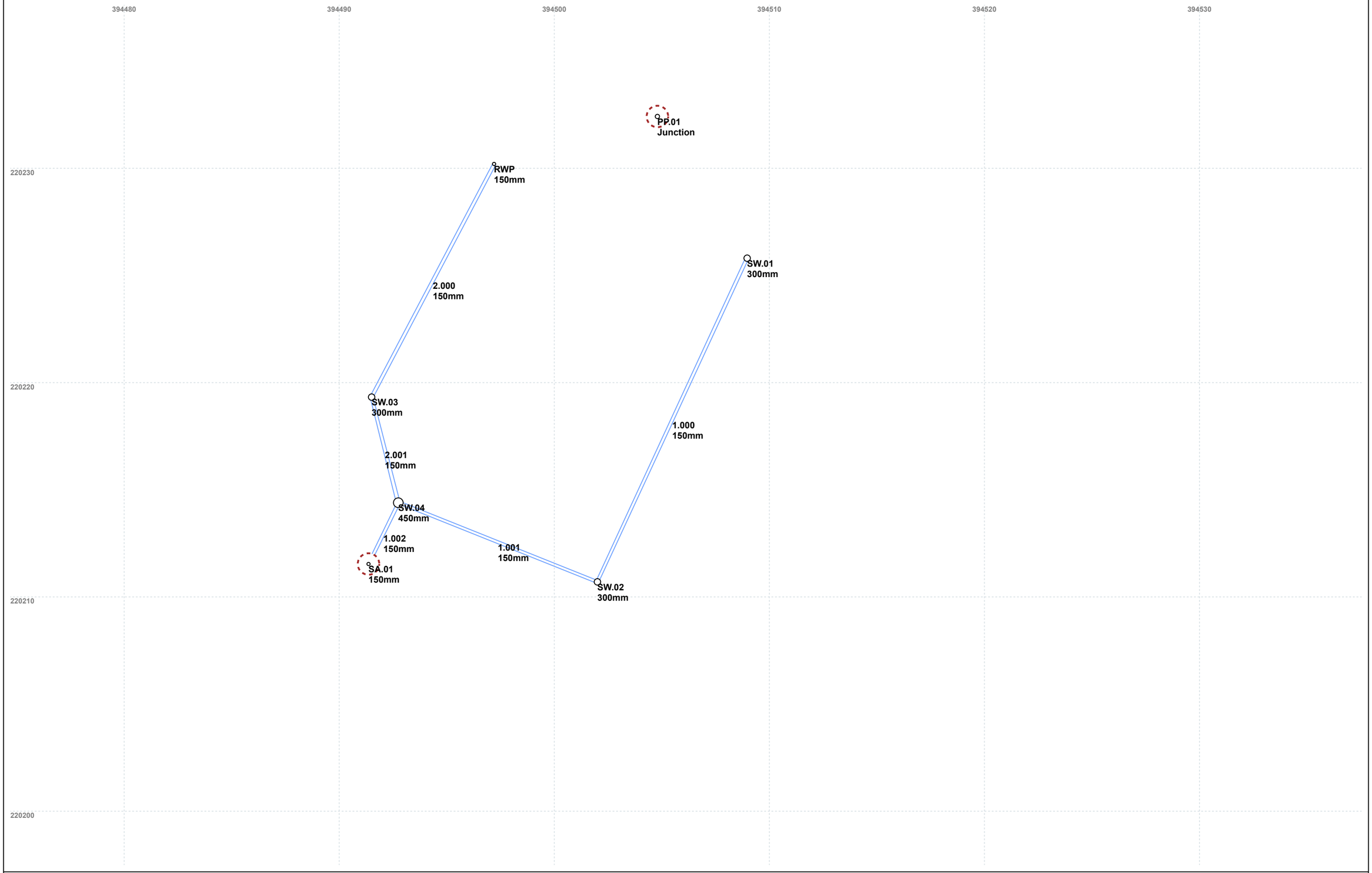
Test Number: 03

Distance from ground to top of water =				0.400	m
Total drop below water level at end of test =				0.750	m
75% of effective depth below datum =	0.188	m	Time, t_{75} =	0	mins
50% of effective depth below datum =	0.375	m			
25% of effective depth below datum =	0.563	m	Time, t_{25} =	0	mins
V_{p75-25} = 0.150 m3			t_{p75-25} =	62	mins
A_{p50} = 1.450 m2					
Soil infiltration rate, f =				**2.8E-05**	m/sec
Soil infiltration rate, f =				**0.100**	m/hr

Average Soil Infiltration rate f =	**3.9E-05**	**m/sec**
	0.140	**m/hr**
Slowest Soil Infiltration rate f =	**2.8E-05**	**m/sec**
	0.100	**m/hr**

APPENDIX F

STORM WATER CALCULATIONS



Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	4.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	100.0		

Nodes

	Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
✓	SW.01	0.004	4.00	80.050	300	394508.968	220225.805	0.700
✓	SW.02	0.004	4.00	80.050	300	394502.006	220210.701	0.815
✓	RWP	0.004	4.00	80.050	150	394497.200	220230.203	0.650
✓	SW.03	0.004	4.00	80.050	300	394491.507	220219.323	0.750
✓	SW.04	0.000		80.020	450	394492.747	220214.395	0.855
✓	SA.01	0.000		80.000	150	394491.362	220211.536	0.900
	PP.01	0.006	4.00	80.000		394504.795	220232.418	0.600

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	SW.01	SW.02	16.631	0.600	79.350	79.235	0.115	144.6	150	4.33	51.6
1.001	SW.02	SW.04	9.969	0.600	79.235	79.165	0.070	142.4	150	4.53	51.6
2.000	RWP	SW.03	12.279	0.600	79.400	79.300	0.100	122.8	150	4.23	51.6
2.001	SW.03	SW.04	5.082	0.600	79.300	79.165	0.135	37.6	150	4.28	51.6
1.002	SW.04	SA.01	3.177	0.600	79.165	79.100	0.065	48.9	150	4.57	51.6

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.833	14.7	0.7	0.550	0.665	0.004	0.0	23	0.436
1.001	0.840	14.8	1.5	0.665	0.705	0.008	0.0	32	0.536
2.000	0.905	16.0	0.7	0.500	0.600	0.004	0.0	22	0.459
2.001	1.645	29.1	1.5	0.600	0.705	0.008	0.0	23	0.867
1.002	1.442	25.5	3.0	0.705	0.750	0.016	0.0	35	0.973

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	16.631	144.6	150	Circular_Default Sewer Type	80.050	79.350	0.550	80.050	79.235	0.665
1.001	9.969	142.4	150	Circular_Default Sewer Type	80.050	79.235	0.665	80.020	79.165	0.705
2.000	12.279	122.8	150	Circular_Default Sewer Type	80.050	79.400	0.500	80.050	79.300	0.600
2.001	5.082	37.6	150	Circular_Default Sewer Type	80.050	79.300	0.600	80.020	79.165	0.705

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	SW.01	300	Manhole	Adoptable	SW.02	300	Manhole	Adoptable
1.001	SW.02	300	Manhole	Adoptable	SW.04	450	Manhole	Adoptable
2.000	RWP	150	Manhole	Adoptable	SW.03	300	Manhole	Adoptable
2.001	SW.03	300	Manhole	Adoptable	SW.04	450	Manhole	Adoptable

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.002	3.177	48.9	150	Circular_Default Sewer Type	80.020	79.165	0.705	80.000	79.100	0.750

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.002	SW.04	450	Manhole	Adoptable	SA.01	150	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
SW.01	394508.968	220225.805	80.050	0.700	300		0	1.000	79.350	150
SW.02	394502.006	220210.701	80.050	0.815	300		1	1.000	79.235	150
							0	1.001	79.235	150
RWP	394497.200	220230.203	80.050	0.650	150		0	2.000	79.400	150
SW.03	394491.507	220219.323	80.050	0.750	300		1	2.000	79.300	150
							0	2.001	79.300	150
SW.04	394492.747	220214.395	80.020	0.855	450		1	2.001	79.165	150
							2	1.001	79.165	150
							0	1.002	79.165	150
SA.01	394491.362	220211.536	80.000	0.900	150		1	1.002	79.100	150
PP.01	394504.795	220232.418	80.000	0.600						

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)	
Rainfall Events	Singular	Skip Steady State	✓	Check Discharge Rate(s)	✓
Summer CV	1.000	Drain Down Time (mins)	2160	Check Discharge Volume	✓
Winter CV	1.000	Additional Storage (m³/ha)	20.0	100 year 360 minute (m³)	

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	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
100	0	0	0
100	40	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.95
Greenfield Method	IH124	Growth Factor 100 year	2.48
Positively Drained Area (ha)		Betterment (%)	0
SAAR (mm)		QBar	
Soil Index	1	Q 1 year (l/s)	
SPR	0.10	Q 30 year (l/s)	
Region	1	Q 100 year (l/s)	
Growth Factor 1 year	0.85		

Pre-development Discharge Volume

Site Makeup	Greenfield	Return Period (years)	100
Greenfield Method	FSR/FEH	Climate Change (%)	0
Positively Drained Area (ha)		Storm Duration (mins)	360
Soil Index	1	Betterment (%)	0
SPR	0.10	PR	
CWI		Runoff Volume (m^3)	

Node SA.01 Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.10000	Invert Level (m)	77.600	Depth (m)	
Side Inf Coefficient (m/hr)	0.10000	Time to half empty (mins)	366	Inf Depth (m)	1.000
Safety Factor	2.0	Pit Width (m)	4.500	Number Required	1
Porosity	1.00	Pit Length (m)	1.000		

Node PP.01 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.10000	Invert Level (m)	79.400	Slope (1:X)	750.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	180	Depth (m)	0.300
Safety Factor	2.0	Width (m)	8.000	Inf Depth (m)	
Porosity	1.00	Length (m)	7.500		

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year 15 minute summer	104.606	29.600
2 year 15 minute winter	73.408	29.600
2 year 30 minute summer	68.560	19.400
2 year 30 minute winter	48.112	19.400
2 year 60 minute summer	46.352	12.250
2 year 60 minute winter	30.795	12.250
2 year 120 minute summer	31.178	8.239
2 year 120 minute winter	20.714	8.239
2 year 180 minute summer	24.912	6.411
2 year 180 minute winter	16.194	6.411

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year 240 minute summer	20.158	5.327
2 year 240 minute winter	13.392	5.327
2 year 360 minute summer	15.795	4.065
2 year 360 minute winter	10.267	4.065
2 year 480 minute summer	12.614	3.334
2 year 480 minute winter	8.380	3.334
2 year 600 minute summer	10.416	2.849
2 year 600 minute winter	7.117	2.849
2 year 720 minute summer	9.333	2.501
2 year 720 minute winter	6.273	2.501
2 year 960 minute summer	7.710	2.030
2 year 960 minute winter	5.107	2.030
2 year 1440 minute summer	5.624	1.507
2 year 1440 minute winter	3.780	1.507
2 year 2160 minute summer	4.048	1.119
2 year 2160 minute winter	2.789	1.119
2 year 2880 minute summer	3.393	0.909
2 year 2880 minute winter	2.280	0.909
2 year 4320 minute summer	2.630	0.688
2 year 4320 minute winter	1.732	0.688
2 year 5760 minute summer	2.229	0.571
2 year 5760 minute winter	1.443	0.571
2 year 7200 minute summer	1.954	0.499
2 year 7200 minute winter	1.261	0.499
2 year 8640 minute summer	1.763	0.450
2 year 8640 minute winter	1.138	0.450
2 year 10080 minute summer	1.624	0.414
2 year 10080 minute winter	1.048	0.414
10 year 15 minute summer	203.556	57.599
10 year 15 minute winter	142.846	57.599
10 year 30 minute summer	133.934	37.899
10 year 30 minute winter	93.989	37.899
10 year 60 minute summer	90.702	23.970
10 year 60 minute winter	60.260	23.970
10 year 120 minute summer	55.812	14.750
10 year 120 minute winter	37.080	14.750
10 year 180 minute summer	42.965	11.056
10 year 180 minute winter	27.929	11.056
10 year 240 minute summer	34.074	9.005
10 year 240 minute winter	22.638	9.005
10 year 360 minute summer	26.211	6.745
10 year 360 minute winter	17.038	6.745
10 year 480 minute summer	20.795	5.496
10 year 480 minute winter	13.816	5.496
10 year 600 minute summer	17.132	4.686
10 year 600 minute winter	11.706	4.686
10 year 720 minute summer	15.344	4.112
10 year 720 minute winter	10.312	4.112
10 year 960 minute summer	12.695	3.343
10 year 960 minute winter	8.410	3.343
10 year 1440 minute summer	9.242	2.477
10 year 1440 minute winter	6.211	2.477

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
10 year 2160 minute summer	6.592	1.822
10 year 2160 minute winter	4.542	1.822
10 year 2880 minute summer	5.462	1.464
10 year 2880 minute winter	3.671	1.464
10 year 4320 minute summer	4.108	1.074
10 year 4320 minute winter	2.705	1.074
10 year 5760 minute summer	3.392	0.868
10 year 5760 minute winter	2.195	0.868
10 year 7200 minute summer	2.920	0.745
10 year 7200 minute winter	1.885	0.745
10 year 8640 minute summer	2.597	0.662
10 year 8640 minute winter	1.676	0.662
10 year 10080 minute summer	2.367	0.604
10 year 10080 minute winter	1.528	0.604
30 year 15 minute summer	266.243	75.338
30 year 15 minute winter	186.837	75.338
30 year 30 minute summer	177.548	50.240
30 year 30 minute winter	124.595	50.240
30 year 60 minute summer	121.056	31.992
30 year 60 minute winter	80.427	31.992
30 year 120 minute summer	72.771	19.231
30 year 120 minute winter	48.347	19.231
30 year 180 minute summer	55.572	14.300
30 year 180 minute winter	36.123	14.300
30 year 240 minute summer	43.951	11.615
30 year 240 minute winter	29.200	11.615
30 year 360 minute summer	33.861	8.714
30 year 360 minute winter	22.010	8.714
30 year 480 minute summer	26.954	7.123
30 year 480 minute winter	17.907	7.123
30 year 600 minute summer	22.268	6.091
30 year 600 minute winter	15.215	6.091
30 year 720 minute summer	19.987	5.357
30 year 720 minute winter	13.432	5.357
30 year 960 minute summer	16.567	4.363
30 year 960 minute winter	10.974	4.363
30 year 1440 minute summer	12.065	3.234
30 year 1440 minute winter	8.109	3.234
30 year 2160 minute summer	8.522	2.355
30 year 2160 minute winter	5.872	2.355
30 year 2880 minute summer	6.979	1.870
30 year 2880 minute winter	4.690	1.870
30 year 4320 minute summer	5.132	1.342
30 year 4320 minute winter	3.380	1.342
30 year 5760 minute summer	4.163	1.066
30 year 5760 minute winter	2.694	1.066
30 year 7200 minute summer	3.539	0.903
30 year 7200 minute winter	2.284	0.903
30 year 8640 minute summer	3.117	0.795
30 year 8640 minute winter	2.012	0.795
30 year 10080 minute summer	2.821	0.720
30 year 10080 minute winter	1.821	0.720

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year 15 minute summer	339.828	96.160
100 year 15 minute winter	238.476	96.160
100 year 30 minute summer	228.224	64.579
100 year 30 minute winter	160.157	64.579
100 year 60 minute summer	157.187	41.540
100 year 60 minute winter	104.431	41.540
100 year 120 minute summer	93.200	24.630
100 year 120 minute winter	61.920	24.630
100 year 180 minute summer	71.149	18.309
100 year 180 minute winter	46.249	18.309
100 year 240 minute summer	56.382	14.900
100 year 240 minute winter	37.459	14.900
100 year 360 minute summer	43.582	11.215
100 year 360 minute winter	28.330	11.215
100 year 480 minute summer	34.762	9.187
100 year 480 minute winter	23.095	9.187
100 year 600 minute summer	28.734	7.859
100 year 600 minute winter	19.633	7.859
100 year 720 minute summer	25.776	6.908
100 year 720 minute winter	17.323	6.908
100 year 960 minute summer	21.296	5.608
100 year 960 minute winter	14.107	5.608
100 year 1440 minute summer	15.372	4.120
100 year 1440 minute winter	10.331	4.120
100 year 2160 minute summer	10.750	2.971
100 year 2160 minute winter	7.407	2.971
100 year 2880 minute summer	8.723	2.338
100 year 2880 minute winter	5.862	2.338
100 year 4320 minute summer	6.299	1.647
100 year 4320 minute winter	4.148	1.647
100 year 5760 minute summer	5.035	1.289
100 year 5760 minute winter	3.259	1.289
100 year 7200 minute summer	4.229	1.079
100 year 7200 minute winter	2.729	1.079
100 year 8640 minute summer	3.688	0.941
100 year 8640 minute winter	2.380	0.941
100 year 10080 minute summer	3.313	0.845
100 year 10080 minute winter	2.138	0.845
100 year +40% CC 15 minute summer	475.759	134.623
100 year +40% CC 15 minute winter	333.866	134.623
100 year +40% CC 30 minute summer	319.513	90.411
100 year +40% CC 30 minute winter	224.220	90.411
100 year +40% CC 60 minute summer	220.062	58.156
100 year +40% CC 60 minute winter	146.204	58.156
100 year +40% CC 120 minute summer	130.480	34.482
100 year +40% CC 120 minute winter	86.688	34.482
100 year +40% CC 180 minute summer	99.608	25.633
100 year +40% CC 180 minute winter	64.748	25.633
100 year +40% CC 240 minute summer	78.935	20.860
100 year +40% CC 240 minute winter	52.443	20.860
100 year +40% CC 360 minute summer	61.015	15.701
100 year +40% CC 360 minute winter	39.661	15.701

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +40% CC 480 minute summer	48.667	12.861
100 year +40% CC 480 minute winter	32.334	12.861
100 year +40% CC 600 minute summer	40.227	11.003
100 year +40% CC 600 minute winter	27.486	11.003
100 year +40% CC 720 minute summer	36.087	9.672
100 year +40% CC 720 minute winter	24.253	9.672
100 year +40% CC 960 minute summer	29.815	7.851
100 year +40% CC 960 minute winter	19.750	7.851
100 year +40% CC 1440 minute summer	21.521	5.768
100 year +40% CC 1440 minute winter	14.463	5.768
100 year +40% CC 2160 minute summer	15.050	4.159
100 year +40% CC 2160 minute winter	10.370	4.159
100 year +40% CC 2880 minute summer	12.212	3.273
100 year +40% CC 2880 minute winter	8.207	3.273
100 year +40% CC 4320 minute summer	8.819	2.306
100 year +40% CC 4320 minute winter	5.808	2.306
100 year +40% CC 5760 minute summer	7.049	1.804
100 year +40% CC 5760 minute winter	4.562	1.804
100 year +40% CC 7200 minute summer	5.921	1.510
100 year +40% CC 7200 minute winter	3.821	1.510
100 year +40% CC 8640 minute summer	5.164	1.317
100 year +40% CC 8640 minute winter	3.333	1.317
100 year +40% CC 10080 minute summer	4.638	1.183
100 year +40% CC 10080 minute winter	2.993	1.183

Results for 2 year Critical Storm Duration. Lowest mass balance: 96.95%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SW.01	10	79.374	0.024	0.8	0.0044	0.0000	OK
15 minute summer	SW.02	10	79.269	0.034	1.6	0.0057	0.0000	OK
15 minute summer	RWP	10	79.423	0.023	0.8	0.0032	0.0000	OK
15 minute summer	SW.03	10	79.324	0.024	1.6	0.0042	0.0000	OK
15 minute summer	SW.04	10	79.204	0.039	3.2	0.0062	0.0000	OK
600 minute winter	SA.01	390	78.170	-0.930	0.4	2.5640	0.0000	OK
120 minute summer	PP.01	78	79.412	0.012	0.5	0.4200	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	SW.01	1.000	SW.02	0.8	0.342	0.054	0.0392
15 minute summer	SW.02	1.001	SW.04	1.6	0.483	0.107	0.0329
15 minute summer	RWP	2.000	SW.03	0.8	0.456	0.050	0.0215
15 minute summer	SW.03	2.001	SW.04	1.6	0.601	0.055	0.0139
15 minute summer	SW.04	1.002	SA.01	3.2	0.924	0.125	0.0109
600 minute winter	SA.01	Infiltration		0.1			
120 minute summer	PP.01	Infiltration		0.2			

Results for 10 year Critical Storm Duration. Lowest mass balance: 96.21%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SW.01	10	79.382	0.032	1.5	0.0060	0.0000	OK
15 minute summer	SW.02	10	79.282	0.047	3.0	0.0079	0.0000	OK
15 minute summer	RWP	10	79.432	0.031	1.5	0.0044	0.0000	OK
15 minute summer	SW.03	10	79.333	0.033	3.0	0.0058	0.0000	OK
15 minute summer	SW.04	10	79.221	0.056	6.0	0.0089	0.0000	OK
180 minute winter	SA.01	172	78.598	-0.502	1.2	4.4901	0.0000	OK
60 minute summer	PP.01	42	79.419	0.019	1.4	0.8651	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	SW.01	1.000	SW.02	1.5	0.405	0.102	0.0621
15 minute summer	SW.02	1.001	SW.04	3.0	0.560	0.202	0.0534
15 minute summer	RWP	2.000	SW.03	1.5	0.546	0.094	0.0337
15 minute summer	SW.03	2.001	SW.04	3.0	0.699	0.103	0.0224
15 minute summer	SW.04	1.002	SA.01	6.0	1.083	0.235	0.0176
180 minute winter	SA.01	Infiltration		0.2			
60 minute summer	PP.01	Infiltration		0.3			

Results for 30 year Critical Storm Duration. Lowest mass balance: 96.21%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SW.01	10	79.386	0.036	1.9	0.0067	0.0000	OK
15 minute summer	SW.02	10	79.288	0.053	3.8	0.0090	0.0000	OK
15 minute summer	RWP	10	79.436	0.036	1.9	0.0050	0.0000	OK
15 minute summer	SW.03	10	79.337	0.037	3.8	0.0065	0.0000	OK
15 minute summer	SW.04	10	79.230	0.065	7.6	0.0103	0.0000	OK
480 minute winter	SA.01	368	78.876	-0.224	0.8	5.7402	0.0000	OK
60 minute summer	PP.01	43	79.424	0.024	1.9	1.1707	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	SW.01	1.000	SW.02	1.9	0.430	0.129	0.0740
15 minute summer	SW.02	1.001	SW.04	3.8	0.591	0.256	0.0641
15 minute summer	RWP	2.000	SW.03	1.9	0.580	0.119	0.0402
15 minute summer	SW.03	2.001	SW.04	3.8	0.730	0.131	0.0270
15 minute summer	SW.04	1.002	SA.01	7.6	1.147	0.298	0.0210
480 minute winter	SA.01	Infiltration		0.2			
60 minute summer	PP.01	Infiltration		0.4			

Results for 100 year Critical Storm Duration. Lowest mass balance: 95.69%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SW.01	10	79.392	0.042	2.5	0.0077	0.0000	OK
15 minute summer	SW.02	10	79.298	0.063	5.0	0.0106	0.0000	OK
15 minute summer	RWP	10	79.441	0.041	2.5	0.0058	0.0000	OK
15 minute summer	SW.03	10	79.344	0.044	5.0	0.0077	0.0000	OK
720 minute winter	SW.04	540	79.276	0.111	0.8	0.0176	0.0000	OK
720 minute winter	SA.01	555	79.275	0.175	1.2	7.5415	0.0000	OK
60 minute summer	PP.01	43	79.431	0.031	2.4	1.5716	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	SW.01	1.000	SW.02	2.5	0.460	0.170	0.0910
15 minute summer	SW.02	1.001	SW.04	5.0	0.626	0.337	0.0796
15 minute summer	RWP	2.000	SW.03	2.5	0.615	0.156	0.0499
15 minute summer	SW.03	2.001	SW.04	5.0	0.769	0.172	0.0337
720 minute winter	SW.04	1.002	SA.01	1.2	0.635	0.046	0.0502
720 minute winter	SA.01	Infiltration		0.2			
60 minute summer	PP.01	Infiltration		0.5			

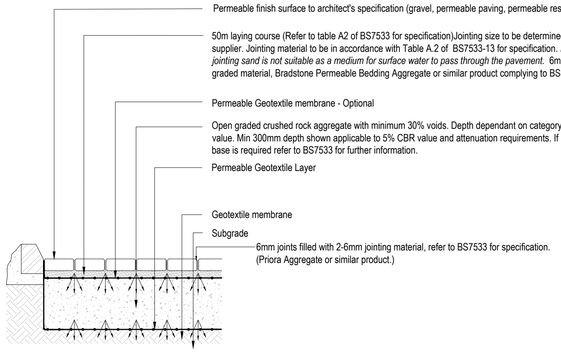
Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 95.49%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
600 minute winter	SW.01	555	79.850	0.500	0.3	0.0924	0.0000	FLOOD RISK
600 minute winter	SW.02	555	79.850	0.615	0.6	0.1039	0.0000	FLOOD RISK
600 minute winter	RWP	555	79.850	0.450	0.3	0.0634	0.0000	FLOOD RISK
600 minute winter	SW.03	555	79.850	0.550	0.6	0.0973	0.0000	FLOOD RISK
600 minute winter	SW.04	555	79.850	0.685	1.2	0.1089	0.0000	FLOOD RISK
600 minute winter	SA.01	555	79.850	0.750	1.4	10.1369	0.0000	OK
60 minute summer	PP.01	43	79.442	0.042	3.4	2.2541	0.0000	OK

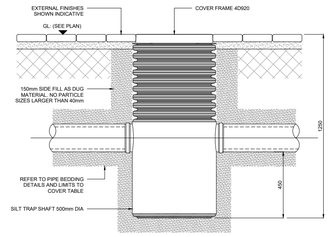
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
600 minute winter	SW.01	1.000	SW.02	0.3	0.258	0.020	0.2928
600 minute winter	SW.02	1.001	SW.04	0.6	0.375	0.040	0.1755
600 minute winter	RWP	2.000	SW.03	0.3	0.341	0.019	0.2162
600 minute winter	SW.03	2.001	SW.04	0.6	0.458	0.021	0.0895
600 minute winter	SW.04	1.002	SA.01	1.4	0.713	0.056	0.0559
600 minute winter	SA.01	Infiltration		0.2			
60 minute summer	PP.01	Infiltration		0.7			

APPENDIX G

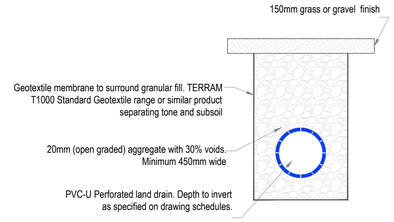
DRAINAGE DETAILS



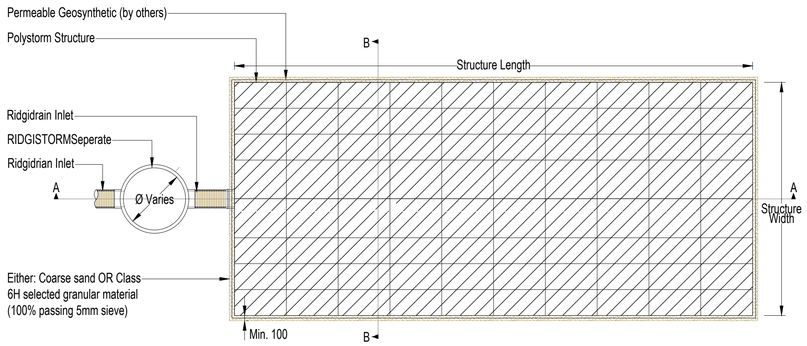
PERMEABLE BLOCK PAVING DETAIL
(SYSTEM A - TOTAL INFILTRATION BS7533-13)



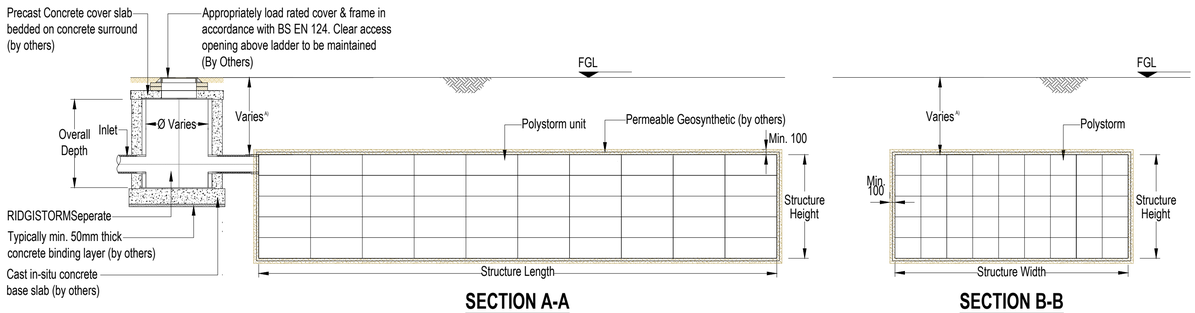
TYPICAL SILT TRAP DETAIL



PROPOSED FILTER DRAIN DETAIL*
Depth to invert as specified on drawing



TYPICAL SOAKAWAY TANK PLAN
(Scale 1:75)



SECTION A-A
Scale (1:75)

SECTION B-B
Scale (1:75)

Notes:

1. This drawing is to be read in conjunction with relevant Architects, Engineers and specialist manufacturers drawings, reports and specifications.
2. All levels are shown in metres above Ordnance Datum (m AOD) unless otherwise shown.
3. Any ambiguities or discrepancies within this drawing and any other information given elsewhere must be reported to K-Ten for clarification before pricing / works commence.
4. Do not scale from this drawing for construction purposes.
5. It is recommended that all sewers and drains be laid starting from the downstream connection to the existing sewer/drain and working upstream to the new development.
5. All private drainage to comply with current Building Regulations, BS EN-752 Drain and Sewer systems outside Buildings and other relevant British Standards and Codes of Practices.
6. Connections to existing sewers in accordance with the Local Water Authority guidelines & approval.
7. Connections to existing river or watercourse in accordance with the Local Authority and E.A guidelines & approval.
8. Sewers and drains of different diameters should be laid soffit to soffit unless shown otherwise in the drawing. Outfall chamber outgoing pipe where a vortex control device is fitted to be installed at lowest incoming invert level.
9. All access chambers covers and frames to be installed to BS EN 124.
10. Drainage Pipe work routes under building footprint will require Co-ordination with foundations.
11. Cover levels shown on this drawing refer to approximate surface levels. It is the contractors responsibility to ensure that access covers and frames are set at the final surface levels.
12. Where possible the contractor is to orientate manhole biscuits and covers to locate them parallel to kerbs and paving.
13. The Contractor should comply with hs(g) 47 "Avoiding Danger from Underground Services" when excavating around existing services.
14. It is the contractors responsibility to determine the location and depth of all existing services, mains and cables prior to construction.
15. The pipe diameters cover and invert levels of any existing manholes are to be verified on site prior to the commencement of the works.
16. All external non-perforated drainage within trafficked areas with less than 1.2m cover to have concrete protection. All external non-perforated drainage within landscaped areas with cover less than 0.6m to have concrete protection. All drainage with greater cover than the minimum required to have type S bed and surround.
11. Foul drainage pipe connection to public sewer to be plastic twin-walled/ribbed pipe constructed to Water Industry Standard (WIS)-4-35-01.
15. All drainage in highway to be installed in accordance with Sewers Sector Guidance.
16. All access chambers covers and frames to be installed to BS EN 124.
17. All drainage to be installed in accordance with Civil Engineering Specification for the Water industry 7th Edition.
18. Prior to commencing the works the contractor is to confirm details of the existing drainage system as noted on the drawing.
19. This drawing is for information only for planning submission. This is not to be used for construction purposes.
20. Drainage outfall connections and strategy to be agreed with the relevant authorities.
21. Gutters to have down-pipe leaf guards and rainwater down-pipes to have rodding access
22. All existing invert levels shown are indicative and to be checked by the contractor prior to starting works.
23. Drainage strategy to be approved by Cheltenham Borough Council.

Rev	Date	Details	Drawn
A	13.10.26	PRELIMINARY ISSUE	10.04.26

K-Ten Consulting

CLIENT:
D. FREER

PROJECT:
69 MOOREND ROAD,
CHELTENHAM

TITLE:
DRAINAGE DETAILS

SCALE @ A1:	DATE:	STATUS:	
1:100	10.04.26	INFORMATION	
JOB NO:		**DRAWING NO:**	**REVISION:**
26-4143		C005	A

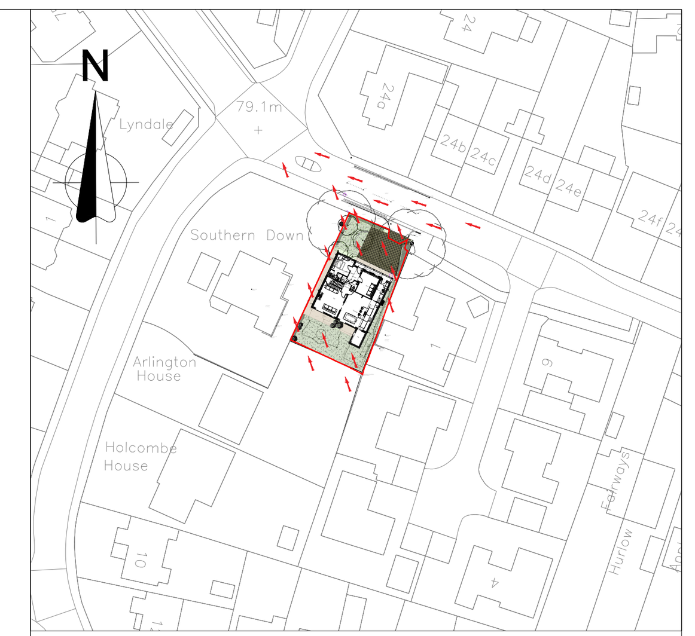
APPENDIX H

EXCEEDANCE ROUTES

0 1 2 5 10m
SCALE 1:100

KEY

SURFACE WATER FLOW EXCEEDANCE ROUTE



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TITLE:
EXCEEDANCE ROUTES

SCALE @ A1:	DATE:	STATUS:
1:100	10.04.26	INFORMATION

JOB NO:	DRAWING NO:	REVISION:
26-4143	C010	A