CYDER MILL BARN

SURFACE WATER DRAINAGE STRATEGY

Gatier Planning Consultants

Report Ref:
MDC-PR001-RP001
ISSUE 01 – June 2022

Document Control Sheet

Project name: CYDER MILL BARN

Project ref: MDC-PR001

Report Title Surface Water Drainage Strategy

Doc. ref: MDC-PR001-RP001

Date: 9th June 2022

	Name	Position	Signature	Date
Prepared by:	Mark Dyer	Senior Civil Engineer		June 2022
Approved by:	Tafari Lewis	Associate		June 2022

Revision	Date	Description	Prepared	Approved
Issue 1	09/06/2022	First Issue	MTD	TL

PAGE LEFT INTENTIONALLY BLANK

CONTENTS

PAGE NO.

FIGURES

APPENDICES

1. INTRODUCTION

1.1. All forms of flooding and their impact on the natural and built environment are material planning considerations. The revised National Planning Policy Framework (NPPF) sets out the Government's objectives for the planning system, and how planning should facilitate and promote sustainable patterns of development, avoiding flood risk and accommodating the impacts of climate change. Government policy with respect to development in flood risk areas is contained within the revised NPPF and the supporting Planning Practice Guidance (PPG).

1.2. This Surface Water Drainage Strategy has been completed in accordance with the revised NPPF and the PPG to review all sources of flood risk both to and from the proposed development. The report also considers the most appropriate drainage options including the implementation of Sustainable Drainage Systems (SuDS) in line with national policy.

Objectives & Scope

1.3. This report will review the information provided to support the planning application in relation to drainage.

1.4. The objective of this report is:

- Determine existing drainage and site conditions
- Establish foul and surface water runoff for the proposed development site.
- Detail a suitable drainage strategy for the management and maintenance of the surface water generated from the proposed development
- Provide sufficient information to support a proposed planning application of the development proposals

1.5. The scope of this drainage strategy is to provide sufficient information to support a proposed planning application of the development proposals

Limitations

1.6. The general limitations of this report are that:

- This Report is intended for the sole use of the Client in accordance with the Agreement under which our services were performed. No other warranty, expressed or implied, is made as to the professional advice included in this Report or any other services provided. This Report is confidential and may not be disclosed by the Client nor relied upon by any other party without the prior and express written agreement of MD Consulting.
- A number of data sources have been used in compiling this report. Whilst MD Consulting believe them to be trustworthy; it is unable to guarantee the accuracy of the information that has been provided by others.
- This report is based on information available at the time of preparation. There is potential for further information to become available, which may create a need to modify conclusions drawn in this report.
- The conclusions and recommendations contained in this Report are based upon information provided by others and upon the assumption that all relevant information has

been provided by those parties from whom it has been requested and that such information is accurate.

The Development Proposals

1.7. The development proposals comprise the conversion of an existing Grade II barn and detached garage to form a new residential dwelling. Refer to Blue Square Drafting drawing 00905A-10 Revision A entitled 'Proposed Site Location Plan' included in **Appendix A**.

1.8. The site is a brownfield site.

2. EXISTING SITE

Site Location

2.1. The proposed development is located at Cyder Mill Barn, Cols Pool Lane, Badgeworth, Gloucestershire, GL51 4UP. The Ordnance Survey National Grid Reference for the site is SO 90454 19486 (approximate centre). The total site covers approximately 0.091 ha and is located red in **Figure 1**.

Figure 1 : Site Location Plan

Image courtesy of © 2022 Microsoft – Bing Maps

2.2. The site is accessed from Cold Pool Lane from the south est. The site is bound by Cyder Mill cottage to the south eastern boundary and residential estates to the remaining boundaries. The north eastern boundary is adjacent to an access track leading to open fields to the north. Refer to **Figure 2**.

Figure 2: Red line boundary

Image courtesy of © 2022 Google Maps

Topography

2.3. Refer to A. D Horner drawing 06.183-01 in **Appendix B** for a topographical survey of the site. This topographical survey was obtained from a historic planning application and was undertaken in March 2006. A number of changes could have occurred to the site since the survey and as such it is to be viewed as informative only.

2.4. The site is shown to be predominantly flat with a general fall to the north east of the site. The existing barn has various FFL's ranging from 45.45 to 45.24

Hydrology

2.5. The nearest Environment Agency defined main river is Ham Brook which is located approximately 150m to the north of the site.

2.6. There are no watercourses or ditches within the site or its immediate vicinity.

Geology

2.7. The published geological information available through the British Geological Society (BGS) online records indicates that the site is underlain by bedrock of the Charmouth Mudstone Formation - Mudstone. The site is not overlain by superficial deposits

2.8. **Figure 3** shows an extract from the British Geological Survey map for the site location

Figure 3: BGS Geological Map

Site Investigation

2.9. No intrusive ground investigations have been undertaken within the site to inform of the specific geological conditions of the site.

BGS Borehole Records

2.10. The closest borehole record is located at Russell Cottages, Badgeworth. This record indicates ground conditions as Local Lias (described as local deposits of sands and gravels) with groundwater at a depth of 12ft (3.65m).

Cranfield University Soilscapes

2.11. The Cranfield University Soilscapes identify the soils in Badgeworth as loamy, clayey soils with slightly impeded drainage

Drainage

2.12. Severn Trent asset mapping, reproduced in **Appendix C**, identifies that a 150mm diameter foul sewer is located to the east of the site in Cold Pool Lane. There are no combined or surface water sewers within the site.

2.13. The topographical survey, included in **Appendix B,** identifies foul drainage provisions serving Cyder Mill Cottage which is assumed to have connectivity to the Severn Trent Foul sewer. The topographical survey does not identify any drainage provisions to the barn and it is noted that the cottage has a surface water manhole that is assumed to discharge to a soakaway.

3. FLOOD RISK

3.1. This section of the report reviews the existing risk of flooding to the site and requirements for a compliant drainage strategy to meet the requirements of the National Planning Policy Framework and the Planning Practice Guidance including local policies.

3.2. It is necessary to consider the potential consequences of flooding from all sources, which include directly from pluvial flows, rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.

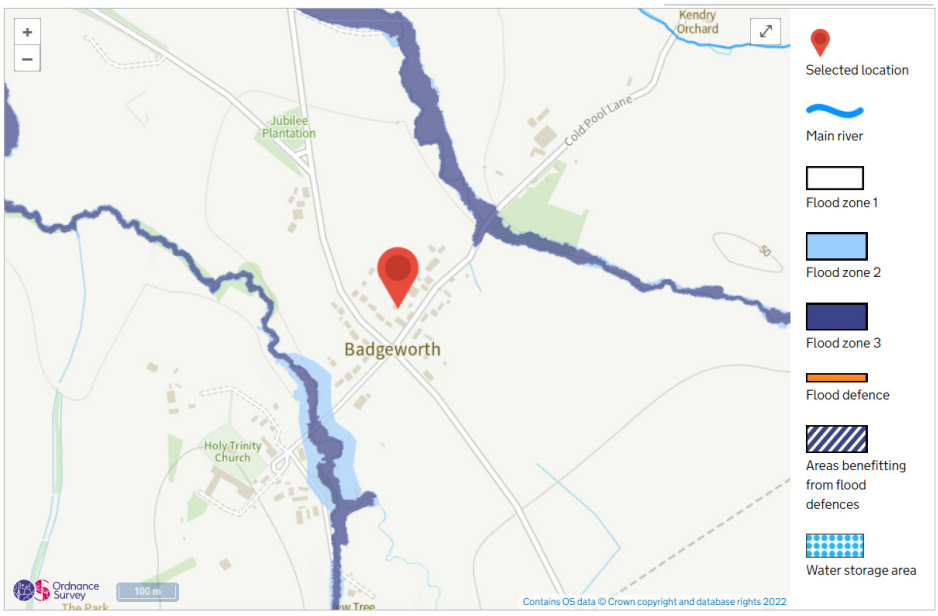
Sources of Flood Risk

3.3. It is necessary to consider the potential consequences of flooding from all sources, which include directly from pluvial flows, rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.

Fluvial Flooding

3.4. The site falls within the catchment of the Ham Brook. **Figure 4** provides an extract of the Flood Risk Map for planning

Figure 4: Environment Agency's Flood Map for Planning



3.5. From an inspection of the Flood Map, it can be seen that the site lies within Flood Zone 1.

Pluvial Flooding

3.6. The Environment Agency's Risk of Flooding from Surface Water Map indicates where surface water may be expected to flood or pond. Surface water flooding happens when rainwater does not drain away through the normal drainage systems or soak into the ground, but lies on or flows over the ground instead. A copy of the Environment Agency's Risk of Flooding from Surface Water Map (RoFSW) is reproduced in **Figure 5** below.

Figure 5: EA Risk of Flooding from Surface Water Map

3.7. Surface water flood risk and flood routes are identified in Cold Pool Lane. There is no surface water flood risk of flow paths within the proposed development site.

Flooding from Groundwater

3.8. Groundwater flooding is most likely to occur in low-lying areas underlain by water-bearing permeable rocks such as sands, gravels, limestone and chalk. Groundwater flooding occurs as a result of water rising from the underlying rocks or from water flowing from abnormal springs. This tends to occur after long periods of sustained high rainfall. Higher rainfall means more water will infiltrate into the ground and cause the water table to rise above normal levels. In low-lying areas, the water table is usually at shallower depths, so during very wet periods, all the additional groundwater flowing towards these areas can cause the water table to rise to the surface causing groundwater flooding.

3.9. There are no records of ground water flooding within the vicinity of the site. BGS borehole records identify that groundwater is potentially at 3mbgl.

Flooding from Overwhelmed Sewers and Drainage Systems

3.10. Flooding from sewers and drainage systems occurs when the sewer or drainage system is overwhelmed as a result of a blockage or excessive flow exceeding its capacity.

3.11. There are no reported incidents of flooding or exceedance events occurring within the Severn Trent networks or private networks.

Flooding from Artificial Sources

3.12. The Environment Agency's Risk of Flooding from Reservoirs Map indicates the site is unaffected by flooding from any reservoirs.

Flood Risk Vulnerability and Flood Zone 'Compatibility'

3.13. Table 2: Flood Risk Vulnerability Classification, in Section 25 of the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-066-20140306), categorises different types of development according to their vulnerability to flood risk. Table 3: Flood risk vulnerability and flood

zone 'compatibility', in Section 25 of the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-067-20140306), maps these vulnerability classes against the flood zones to indicate where development is appropriate and where development should not be permitted.

Figure 6: Extract of Table 2: Flood Risk Vulnerability Classification

More vulnerable

- Hospitals
- Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels.
- Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels.
- Non–residential uses for health services, nurseries and educational establishments.

3.14. With reference to Table 2, the proposed residential development falls into the 'More Vulnerable' flood risk vulnerability classification, which includes buildings used for dwelling houses

3.15. With reference to Table 3, the proposed development is appropriate land use in Flood Zone 1.

Figure 7: Table 3: Flood Risk Vulnerability and Flood Zone 'Compatibility'

Flood Zones	Flood Risk Vulnerability Classification				
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a †	Exception Test required †	✗	Exception Test required	✓	✓
Zone 3b *	Exception Test required *	✗	✗	✗	✓*

Key:

✓ Development is appropriate

✗ Development should not be permitted.

Climate Change

3.16. The NPPF requires development to take account of the impacts of climate change. The allowances to be made for climate change effects when assessing flood risk are related to the lifetime of the development.

3.17. The Environment Agency has recently updated guidance regarding climate change uplift. This means that climate change uplift can now vary between 40% and 50% dependent on location. Developers should use the following link to check the required climate change uplift for their site.

3.18. The development site lies within the Severn Vale Management Catchment, new guidance on rainfall identifies that the 1% annual exceedance rainfall event (1:100 year) has an upper end allowance of 40% for climate change.

4. SURFACE WATER MANAGEMENT

Design Principles

4.1. Key design principles in the following guidance documents steer the approach to managing surface water runoff at sites:

- Building Regulations hierarchy of drainage (H3);
- Interim Code of Practice for SuDS; and
- CIRIA best practice guidance, including the use of the 'SUDS management train'

4.2. Building Regulations hierarchy of drainage outlines the preferred methods for the disposal of surface water with infiltration methods being the preferred option. If this is not possible the next favoured option is to drain to an existing watercourse. If neither of these options are feasible, the regulations state that rainwater discharge should be directed to a sewer.

4.3. The Interim Code of Practice for SUDS provides guidance about the hydraulic design criteria for Sustainable drainage systems. This in general refers to both peak rate of runoff and the volume of runoff, post development. Prior to mitigation measures such as the use of SuDS attenuation features, both the volume and peak rate of runoff may increase post development.

4.4. The design principles for surface water management extend beyond simple hydraulic criteria. CIRIA guidance promotes the use of the SUDS management train, a concept where SUDS techniques are used to treat, convey and store surface water runoff. This approach is considered as part of the SUDS selection methodology.

Sustainable Drainage Systems

4.5. Peak surface water discharge rates to watercourses and sewers should be appropriately managed and where possible reduced. Preference should always be given to SuDS over the traditional methods of buried sewers wherever possible and practical. Sustainable Drainage Systems (SuDS) can address the four key sustainability objectives including: water quantity, water quality, amenity and biodiversity.

4.6. Paragraph 51 in Section 21 of the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-051-20150323) advises that sustainable drainage systems are designed to control surface water runoff close to where it falls and mimic natural drainage as closely as possible. Sustainable drainage systems provide opportunities to:

- reduce the causes and impacts of flooding;
- remove pollutants from urban runoff at source;
- combine water management with green space with benefits for amenity, recreation and wildlife.

4.7. Promoting SuDS to deal with surface water at the source, will limit the required attenuation and in turn reduce the volume of surface water in the nearby watercourse and sewer infrastructure. There may be the potential to utilise SuDS features for conveyance/attenuation of surface water flows within the proposed drainage strategy, opposed to the traditional below ground storage methods. Detailed design should confirm whether this site would be suitable for incorporation of SuDS following more detailed analysis of levels, ground conditions and attenuation requirements.

SuDS Selection

4.8. Based upon the indicative layout, SuDS can be incorporated into the development to provide a degree of treatment before flows are carried off site. The following SuDS Selection matrix reviews those measures that can be implemented in the site, this matrix is indicative only and does not impart that the viable SuDS within the site are to be installed. Appropriate selection and implementation of the various SuDS are to be discussed between the design team.

4.9. This drainage strategy provides a review of the minimum SuDS measures to be implemented based upon viable SuDS Selection Matrix (**Table A**) and based upon site requirements for conveyance, treatment and attenuation of surface water flows.

Table A: SuDS Feasibility Matrix

SuDS Component	Site Suitability	Comments
Green Roofs	✔	Potential for use
Soakaways	✔	Potential for use subject to infiltration testing
Rainwater harvesting systems	✔	Potential for use
Filter Trenches	✘	Not proposed
Infiltration trenches	✔	Potential for use subject to infiltration testing
Swales	✘	Not suitable due to site layout constraints
Bioretention	✘	Not proposed
Pervious Pavements	✔	Potential for use
Geo-cellular Systems	✔	Potential for use
Infiltration Basins	✘	Not proposed due to potentially high groundwater levels
Detention Basins	✘	Not suitable due to site layout constraints
Ponds	✘	Not suitable due to site layout constraints
Wetlands	✘	Not suitable due to site layout constraints
Proprietary Devices	✘	Not proposed

Surface Water Flow Balancing

Catchment Areas

4.10. The existing and proposed impermeable and permeable site areas have been reviewed and are presented in **Table B** below.

Table B: Pre and Post development Impermeable catchment Areas

	Permeable	Impermeable	TOTAL
Pre Development Catchment Areas	715 m²	195 m²	910 m²
Post Development Catchment Areas	410 m²	500 m²	910 m²

4.11. The proposed development will increase impermeable areas with the addition of roofed areas, garage and driveway areas

Greenfield Runoff Rate

4.12. Greenfield runoff rates have been determined using XP Solutions' Micro Drainage software system (Version 2017.1) based on the method set out in IH Report 124, and with catchment descriptors obtained from the Flood Estimation Handbook (FEH), published by the Institute of Hydrology. FSSR 2 and 14 regional growth curve factors have been used to calculate the greenfield peak flow rates for 1, 30 and 100 year return periods.

4.13. Copies of the Micro Drainage greenfield runoff calculations for the site are included in **Appendix D**. A summary of the greenfield runoff rates for the various return period events is shown in **Table C**. The mean annual peak rate of runoff, referred to as Q_{BAR} in IH Report 124, is 0.3l/s/.

Table C: Greenfield Runoff Rates

Return Period (Years)	1	Q_{bar}	30	100
Greenfield Runoff Rates (l/s)	0.2	0.3	0.5	0.7

Pre Development Peak Runoff Rate

4.14. The Modified Rational Method has been used to determine the runoff from the impermeable areas of the existing site (refer to **Table D**)–

Q=2.78CiA

Where

Q= flow (l/s)

I = rainfall intensity (mm/hr)

A = Impermeable Area (ha)

C = runoff coefficient

Table D: Pre development site Modified Rational Method permeable runoff

Return Period	C	I	A	FLOW
1:1 year	0.95	24.335	0.0195	1.253
1:30 year	0.95	59.521	0.0195	3.065
1:100 year	0.95	76.512	0.0195	3.940

Post development unattenuated Peak Runoff Rate

4.15. Where assessing the redeveloped sites peak runoff rate, including allowance for climate change and changes in impermeable areas, the unattenuated peak runoff rate is as presented in **Table E** (calculated utilising the Modified Rational Method).

Table E: Post development site Modified Rational Method impermeable runoff

Return Period	C	I	A	FLOW
1:1 year	0.95	24.335	0.050	3.213
1:30 year	0.95	65.473	0.050	8.646
1:100 year	0.95	107.117	0.050	14.145

4.16. If the site were to discharge at unattenuated rates, the post development site would increase flows for all events due to the change in impermeable areas and allowance for climate change.

Outfall Location

4.17. In terms of what sort of sustainable drainage system should be considered, paragraph 80 in Section 21 of the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-080-20150323) advises that, generally, the aim should be to discharge surface water runoff as high up the following hierarchy of drainage options as reasonably practicable (also stated within The SuDS Manual (CIRIA C753) paragraph 3.2.3):

- into the ground (infiltration);
- to a surface water body;
- to a surface water sewer, highway drain, or another drainage system;
- to a combined sewer.

Infiltration

4.18. The geology of the site is indicated to be the Charmouth Mudstone Formation. Local borehole records identify that the area is underlain by Local Lias which comprises of sands and gravels. Borehole records also identify that groundwater could be 3m bgl.

4.19. Infiltration is assumed to be applicable based within the lias noting that there are no surface water sewers or combined sewers in the vicinity of the site.

4.20. Infiltraiton testing within the site is to be undertaken to prove / disprove the infiltration capacity of the site.

4.21. For the purpose of this report, an infiltration rate of 1×10^{-5} m/s is to be utilised. This represents loams as indicated in table 25.1 of CIRIA C753 The SuDS Manual

Surface water body

4.22. If infiltration was not applicable, discharge to a watercourse cannot be achieved noting that there are none in the immediate vicinity of the site.

Surface water sewer

4.23. If infiltration was not applicable, discharge to a surface water sewer cannot be achieved noting that there are none in the immediate vicinity of the site.

Foul / Combined sewer

4.24. If infiltration was not applicable, discharge to the Severn Trent Foul Sewer is to be considered under consultation with Severn Trent

Discharge rate

4.25. It is proposed the surface water drainage is to be discharged via infiltration subject to further testing.

4.26. If infiltration is not applicable, the limiting surface water discharge rate should not exceed 1l/s for all storm events. This limiting discharge rate represents a reduction in existing discharge rates and also represents the lowest achievable discharge rate via the use of mechanical flow control devices. If discharge is to be to the Severn Trent Foul sewer, the discharge rate is to be agreed.

Surface Water Drainage Strategy

4.27. In view of the requirements of the NPPF, PPG, and design parameters and constraints associated with redeveloping this site, a surface water drainage strategy design has been devised and hydraulically modelled to demonstrate that the scheme can be suitably implemented without increasing the level of flood risk, when the surface water drainage system experiences a 1:100-year rainfall event (including 40% allowance for climate change).

4.28. The surface water drainage scheme has been designed to ensure:

- Sustainable Urban Drainage systems are wholly incorporated within the scheme.
- Consideration is given for the improvement of water quality within the design.
- The designed drainage scheme can satisfactorily retain a critical 1 in 100 Year storm event with climate change.

4.29. Rainwater harvesting in the form of water butts is recommended for implementation within the site.

4.30. The surface water drainage strategy proposes the use of permeable paving to driveway areas noting that the use of shallow infiltration SuDS across the site is preferred due to the potentially high groundwater level that may impede traditional soakaways.

4.31. Drawing MDCPR001-SK001 entitled 'Drainage Strategy' is included in **Appendix E,** this drawing indicates the location and sizes of the required storage facilities to serve the various development areas. The layout is subject to detailed design.

4.32. The hydraulic assessment provides various scenarios up to and included the critical 1 in 100 Year storm event with additional 40% allowance for climate change. The simulations confirm that the storm can be managed and maintained within the site without flooding. The hydraulic models of the proposed surface water network and SuDS devices can be found in **Appendix F.**

4.33. The proposed drainage strategy option would ensure that surface water arising from the developed site would be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the proposed development, while reducing the flood risk to the site itself and elsewhere, taking climate change into account.

4.34. This drainage strategy is to be informed by infiltration testing within the site. Where infiltration rates are applicable, the calculations are to be re-run accordingly. Ground investigations should also indicate the groundwater depths within the site.

Pollution Prevention

4.35. In terms of water quality, the proposed surface water system offers a suitable level of mitigation in accordance with Environment Agency, DEFRA and CIRIA guidance.

4.36. The CIRIA SuDS Manual C753, 2015 details an approach for establishing the hazard posed by the intended land use activities and the extent to which the proposed SuDS components can reduce and mitigate the contamination risk to the receiving waterbody. Referring to Table 26.2 – 'Pollution hazard indices for different land use classifications' (CIRIA C753, 2015) the proposed development and land use results in a low pollution hazard, therefore a 'simple index' method can be used to make a qualitative assessment of the proposed SuDS management.

Figure 8: CIRIA C753, 2015. Table 26.2 – 'Pollution hazard indices for different land use classifications'

TABLE 26.2 Pollution hazard indices for different land use classifications

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways[1]	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways[1]	High	0.8[2]	0.8[2]	0.9[2]

Notes

1 Motorways and trunk roads should follow the guidance and risk assessment process set out in Highways Agency (2009).

2 These should only be used if considered appropriate as part of a detailed risk assessment – required for all these land use types (Table 4.3). When dealing with high hazard sites, the environmental regulator should first be consulted for pre-permitting advice. This will help determine the most appropriate approach to the development of a design solution.

4.37. To ensure that there is adequate treatment, all SuDS components utilised should have a pollution mitigation index that equals or exceeds the pollution hazard index. In reference to Table 26.2, the total pollution hazard index for the development site is (roofs and private driveway):

TSS = 0.7,

Metals = 0.6,

Hydrocarbons = 0.45.

4.38. In reference to Table 26.4 – 'Indicative SuDS mitigation indices for discharges to groundwater' (CIRIA C753, 2015) the inclusion of permeable paving provides a total mitigation of:

TSS = 0.7

Metals = 0.6

Hydrocarbons = 0.7.

Figure 9: CIRIA C753, 2015. Table 26.4 – 'Indicative SuDS mitigation indices for discharges to groundwater'

TABLE 26.4 Indicative SuDS mitigation indices for discharges to groundwater

Characteristics of the material overlying the proposed infiltration surface, through which the runoff percolates[1]	TSS	Metals	Hydrocarbons
A layer of dense vegetation underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.6[4]	0.5	0.6
A soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.4[4]	0.3	0.3
Infiltration trench (where a suitable depth of filtration material is included that provides treatment, ie graded gravel with sufficient smaller particles but not single size coarse aggregate such as 20 mm gravel) underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.4[4]	0.4	0.4
Constructed permeable pavement (where a suitable filtration layer is included that provides treatment, and including a geotextile at the base separating the foundation from the subgrade) underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.7	0.6	0.7
Bioretention underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.8[4]	0.8	0.8
Proprietary treatment systems[5,6]	These must demonstrate that they can address each of the contaminant types to acceptable levels for inflow concentrations relevant to the contributing drainage area.		

4.39. The inclusion of SuDS within the proposed scheme ensures that there is adequate mitigation of the potential hazards from surface water flows. Both sites provide a minimum mitigation measure of permeable paving, additional SuDS may be applicable within the site and as such the mitigation measures and water quality treatment is increased.

5. SuDS MANAGEMENT & MAINTENANCE PLAN

Management & Maintenance

5.1. Maintenance refers to the inspections required to identify performance issues and plan maintenance as required, operation and maintenance of the drainage system, landscape management and waste management associated with contaminated silt and other waste materials resulting from maintenance.

5.2. CIRIA C753 The SuDS Manual provides information in Chapter 32 for the operation and maintenance of SuDS. The maintenance activities are broadly defined as regular, occasional and remedial maintenance. It is noted that some scenarios may require one-off maintenance activities. The SuDS Manual defines maintenance as –

- Regular Maintenance: consists of basic tasks carried out to a frequent and predictable schedule, including inspections/monitoring, silt or oil removal if required more frequently than once a year, vegetation management, sweeping or surfaces and litter / debris removal.
- Occasional maintenance: comprises tasks that are likely to be required periodically, but on a much less frequent and predictable basis than the regular tasks.
- Remedial maintenance: describes the intermittent tasks that may be required to rectify faults associated with the system, although the likelihood of faults can be minimised with good design, constructions and regular maintenance activities.

5.3. Maintenance regimes are to be reviewed on an annual basis to ensure that the approach adopted is meeting its objectives.

5.4. All those responsible for the maintenance operations should adhere to the relevant health and safety legislation for the activities listed within this report (including lone working, if relevant). Method statements and risk assessments should always be completed prior to the undertaking of any works.

Indicative Maintenance & Management Plan

Gravity Drains & Catchpits

5.5. Maintenance will usually be carried out manually, although a suction tanker can be used for sediment/debris removal. If maintenance is not undertaken for longs periods, deposits can become hard-packed and require more effort to remove.

Permeable Surfaces

5.6. Permeable surfaces including permeable block paving, porous asphalt, gravel or free draining soils that allow rain to percolate through the surface into underlying drainage layers. They must be protected from silt, sand, compost, mulch, etc. Permeable block paving and porous asphalt can be cleaned by suction brushing.

5.7. Regular inspection and maintenance is important for the effective operation of permeable pavements, they should be inspected regularly, preferably during and after heavy rainfall to check effective operation and to identify any areas of ponding.

5.8. Care should be taken in adjusting vacuuming equipment to avoid removal of jointing material. In instances where jointing material is lost, this material this should be replaced immediately.

5.9. Depending on the amount of usage and the environment that the permeable pavement has been exposed to, the laying course material may require either replacement or cleaning after a 25 to 30 year period. This would be evident if the infiltration rate of the paving became prolonged, allowing ponding to develop. If this situation should occur, the uplifting and cleaning (or replacing, depending on the costings of the activity) of the laying course may be considered. The laying course material, jointing and blocks may be reused (once cleaned), to aid in minimising costs.

5.10. Inspection and maintenance of the permeable surfaces will be dependent upon the manufacturer's recommendations and installation as per manufacturers details.

5.11. Refer to **Figure 10** for CIRIA C753 The SuDS Manual table 20.15 which provides the operation and maintenance requirements for permeable paving.

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

Figure 10: CIRIA C753, 2015. Table 20.15 – 'Operation and maintenance requirements for pervious pavement'

Blockages & Spillages

Blockage

5.12. In the event of a blockage within the drainage network, the key risk is that of flooding to the surrounding area. The extent and location of flooding is dependent upon the location of the blockage and the associated storm event.

5.13. In the event of a blockage within the network, the network is to be drained down by use of suction equipment and the blockage removed.

5.14. If a blockage does occur and results in flooding, the exceedance flow routes are anticipated to flow in a westerly direction.

Spillages

5.15. Due to the nature of the development, the likelihood of a spillage is minimal.

5.16. Most spillages on development sites are of compounds that do not pose a serious risk to the environment if they enter the drainage in a slow and controlled manner with time available for natural breakdown in a treatment system. Therefore, small spillages of oil, milk or other known organic substances should be removed where possible using soak mats as recommended by the Environment Agency with residual spillage allowed to bio-remediate in the drainage system.

5.17. In the event of a serious spillage, either by volume or of unknown or toxic compounds, then isolate the spillage with soil, turf or fabric and block outlet pipes from chamber(s) downstream of the spillage with a bung. Contact the Environment Agency immediately.

Implementation of the Management Plan & Adoption

5.18. All drainage within the site is to assumed to remain private and the responsibility of the plot owner.

6. FOUL WATER DRAINAGE

Existing Drainage

6.1. The barn is not served by foul drainage. Cyder Mill Cottage is served by foul drainage that discharges to the Severn Trent Water Foul Sewer located in Cold Pool Lane to the south east of the site. Refer to **Appendix B & C** for existing drainage positions.

Development Proposals

6.2. The development will add additional foul flows to the existing network. The additional foul flow is 0.46l/s based upon a singular dwelling producing 4000 litres of foul flow per day.

6.3. It is proposed that the foul water serving the proposed development site will discharge to the Severn Trent Foul Sewer in Cold Pool Lane. This connection is to run along the driveway and be independent to Cyder Mill Cottage.

6.4. The connection to the Severn Trent network is subject to capacity enquiries and connection applications with Severn Trent.

Adoption

6.5. All foul drainage serving the development is to be private.

7. CONCLUSIONS

7.1. This Drainage Strategy has been prepared in relation to the conversion of a Grade II barn to a residential dwelling at Cyder Mill Barn, Cols Pool Lane, Badgeworth, Gloucestershire, GL51 4UP. The key conclusions are:

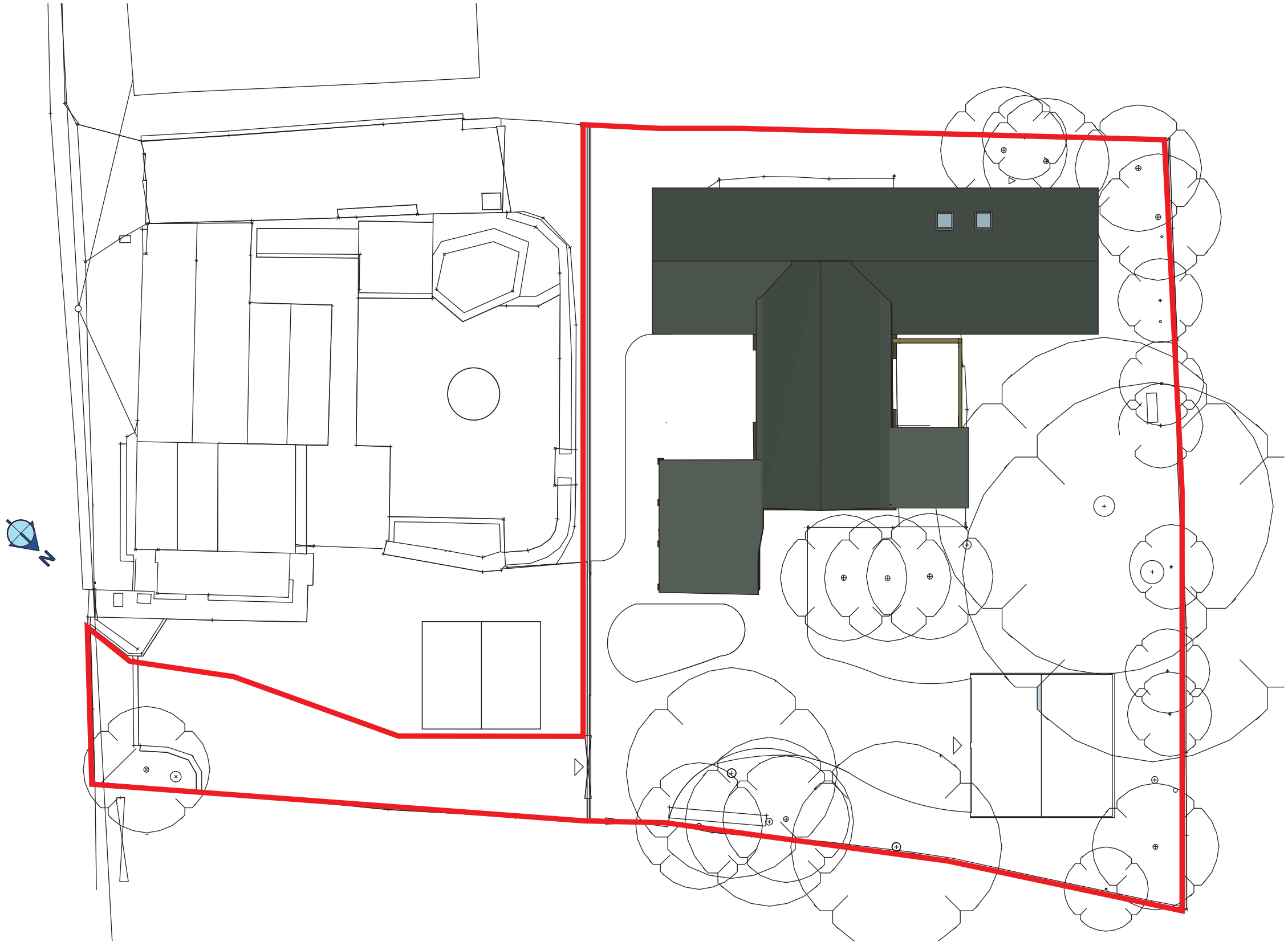
- The site area is 0.091 hectares and classified as a brownfield site.
- Current Environment Agency flood risk mapping identifies that the site is located in Flood Zone 1
- The site is unaffected by surface water flood risk.
- Ground investigations are required to determine the site infiltration capacity. Desktop studies indicate that infiltration should be permissible
- A viable surface water drainage strategy is shown for the site which implements SuDS.
- Surface water arising from the site is to be discharged via permeable paving. Shallow infiltration SuDS are promoted for use noting that the groundwater levels may be within 3m below ground level.
- The implementation of a drainage strategy which incorporates permeable paving reduces the surface water flood risk of the site by the effective management and attenuation of surface water flows.

7.2. The available flood risk information includes: Environment Agency data and interactive Flood Hazard Maps; local flood history data from all sources of flooding and flooding information in the SFRA.

7.3. The overall conclusions drawn from this Drainage Strategy are that the development, located in flood zone 1, would be appropriately safe for its lifetime taking account of the vulnerability of its users and the development would not increase flood risk elsewhere.

APPENDICES

APPENDIX A



PROPOSED SITE LOCATION
SCALE: 1:100 @ A1

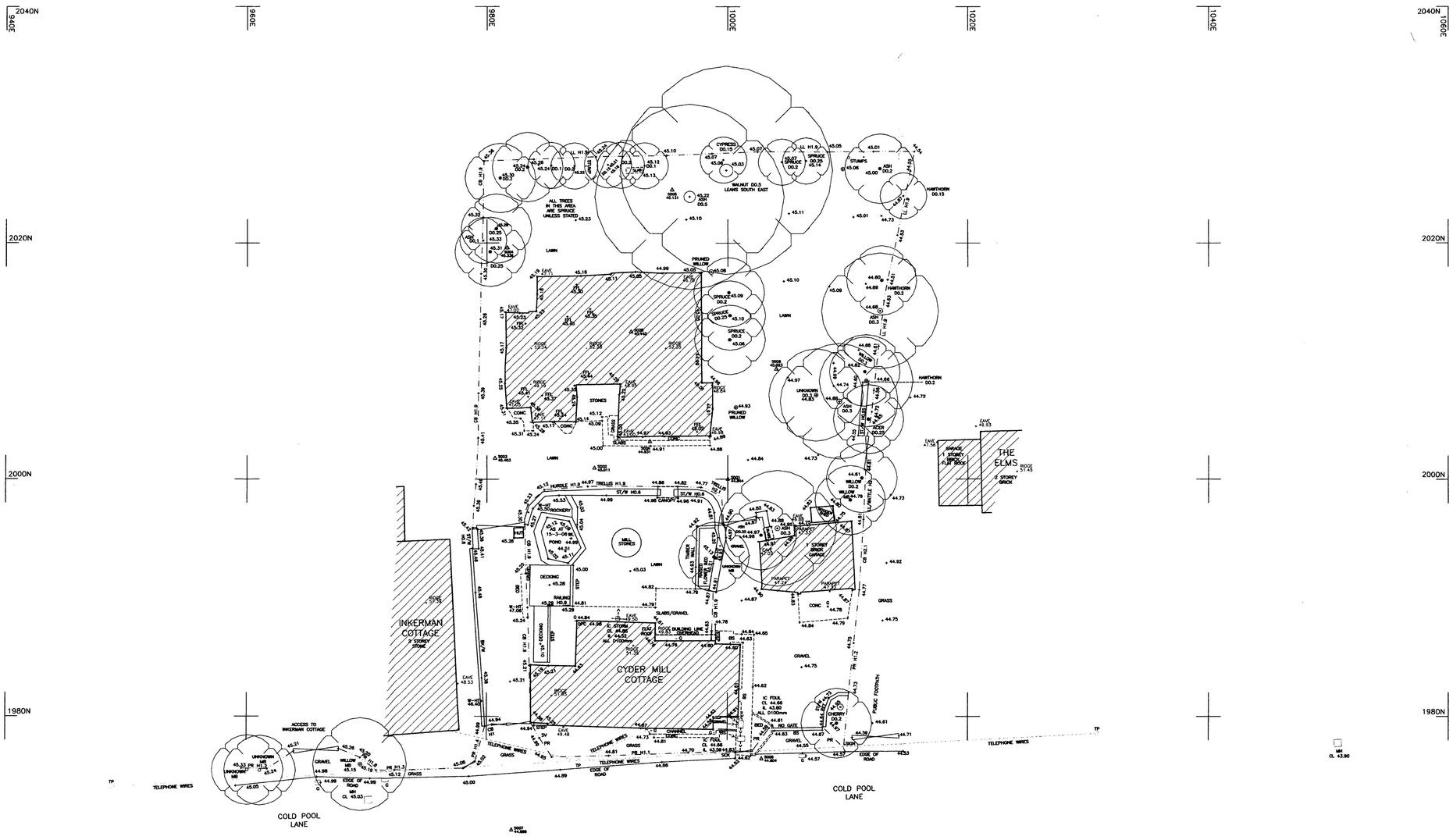
BLUE SQUARE DRAFTING

Blue Square Drafting
Email: bsqdrafting@hotmail.com
Tel: 07852451843

NOTES
No Liability for boundary inaccuracies is accepted. Dimensions, levels and angles to be checked by contractor on site. Responsibility is not accepted for errors made by others made by others in scaling from this drawing. Where applicable you are reminded of your responsibilities under the Party Wall Act 1996
The contractor is to check drawings and to verify all dimensions on site before commencing any work or making any factory produced items. All work to be carried out in accordance with the current Building Regulations.

DRAWN BY	DRAWING NO.	ISSUE	CLIENT	PROJECT
DH	00905A-10	14-01-2022	Gatier Planning Consultants	Cyder Mill Barn Cold Pool Lane Badgeworth, Glos GL51 4UP
DESCRIPTION	REVISION REF.	SCALE:		
Site location	Revision A	1:50@A1		

APPENDIX B



Notes :

- Datum : O.S.B.M on The Old School House, Badgeworth Lane, value 47.03m AOD
- Grid : Local Arbitrary
- Critical dimensions to be checked prior to site works
- Manholes buried or obscured at time of survey may not have been measured
- All internal manhole details to be checked prior to site works
- All kerb levels are channel levels
- Trees :
  - For concentric spread trees the spread plotted is an average value
  - Minimum individual diameter surveyed = 0.15m at 1m up from ground
  - Trunk diameters as plotted are indicative only
  - Species only known where stated
  - Heights (where specified) are approximate to nearest metre

Legend of Abbreviations

AV	Air Valve	W-HT	Top of Wall Level
BH	Borehole	WM	Water Meter
BK/W	Brick Wall	W/M	Wire Mesh Fence
BOL	Bollard	WO	Washout Valve
BS	Brick Setts	WV	Water Valve
BT	British Telecom		
BW	Barbed Wire Fence		
CB	Close Board Fence		
CCTV	Closed Circuit Television Camera		
CELL	Cellar Cover		
CGI	Corrugated Iron Fence		
CL	Cover Level		
C/L	Chain Link Fence		
CONC	Concrete Surface		
CON/P	Concrete Panel Fence		
CF	Chestnut Paling Fence		
DK	Drop Kerb		
E	Electricity Cover		
EP	Electricity Pole		
ER	Earth Rod		
FE	Feather-edged Fence		
FFL	Finished Floor Level		
FH	Fire Hydrant		
FLGP	Flag Pole		
FLP	Floodlight Post		
FP	Footpath		
G	Gully		
GV	Gas Valve		
HW	Head Wall		
IC	Inspection Cover		
IL	Invert Level		
IR	Iron Railing		
LL	Larch-lap Fence		
LP	Lamp Post		
MB	Multi-bulbous Tree		
MH	Manhole		
MP	Marker Post		
MP-E	Marker Post - Electric		
MP-G	Marker Post - Gas		
MP-T	Marker Post - Telephone		
MP-W	Marker Post - Water		
NAME	Road Nameplate		
PAL	Palisade Fence		
POK	Top of Kerb Level		
PR	Post and Rail Fence		
PW	Post and Wire Fence		
RE	Rodding Eye		
RET	Retaining (Wall)		
RS	Road Sign		
S	Storm Drain		
SCK	Stop Cock		
ST/W	Stone Wall		
SV	Sluice Valve		
TEL	Telephone Box		
TL	Traffic Light		
TP	Telegraph Pole		
TV	Cable Television		
UTL	Unable to Lift (Cover)		
VAL	Valve (Unknown Type)		

Stations

Station	Easting	Northing	Level
S001	1000.000	2000.000	44.844
S002	988.945	2000.920	45.011
S003	980.677	2001.754	45.403
S004	981.682	2019.585	45.336
S005	995.341	2024.500	45.131
S006	1003.993	2009.541	45.023
S007	982.090	1970.439	44.899
S008	1002.821	1976.422	44.604
S02A	993.507	2003.189	44.931
S02B	991.953	2012.482	45.442

PLANNING & DEVELOPMENT SERVICES
Officer:-
Scanned:-
Rec'd - 4 [illegible] 7
Ack'd
Ans'd
File

A.D.Horner Limited

Land and Measured Building Surveyors

51 Bridge Street
Pershore
Worcestershire
WR10 1AL

Telephone: 01386-555486
Fax: 01386-555247
E-mail: enquiries@adhorner.co.uk

07/01282

Title	Cyder Mill Cottage, Cold Pool Lane, Badgeworth : Topographic survey		
Client	Mr & Mrs Drury		
Date	March 2006	Drawing No. 06.1831-01	
Scale	1 : 200	Surveyed DJ-PF	Checked ADH

0 metres 10

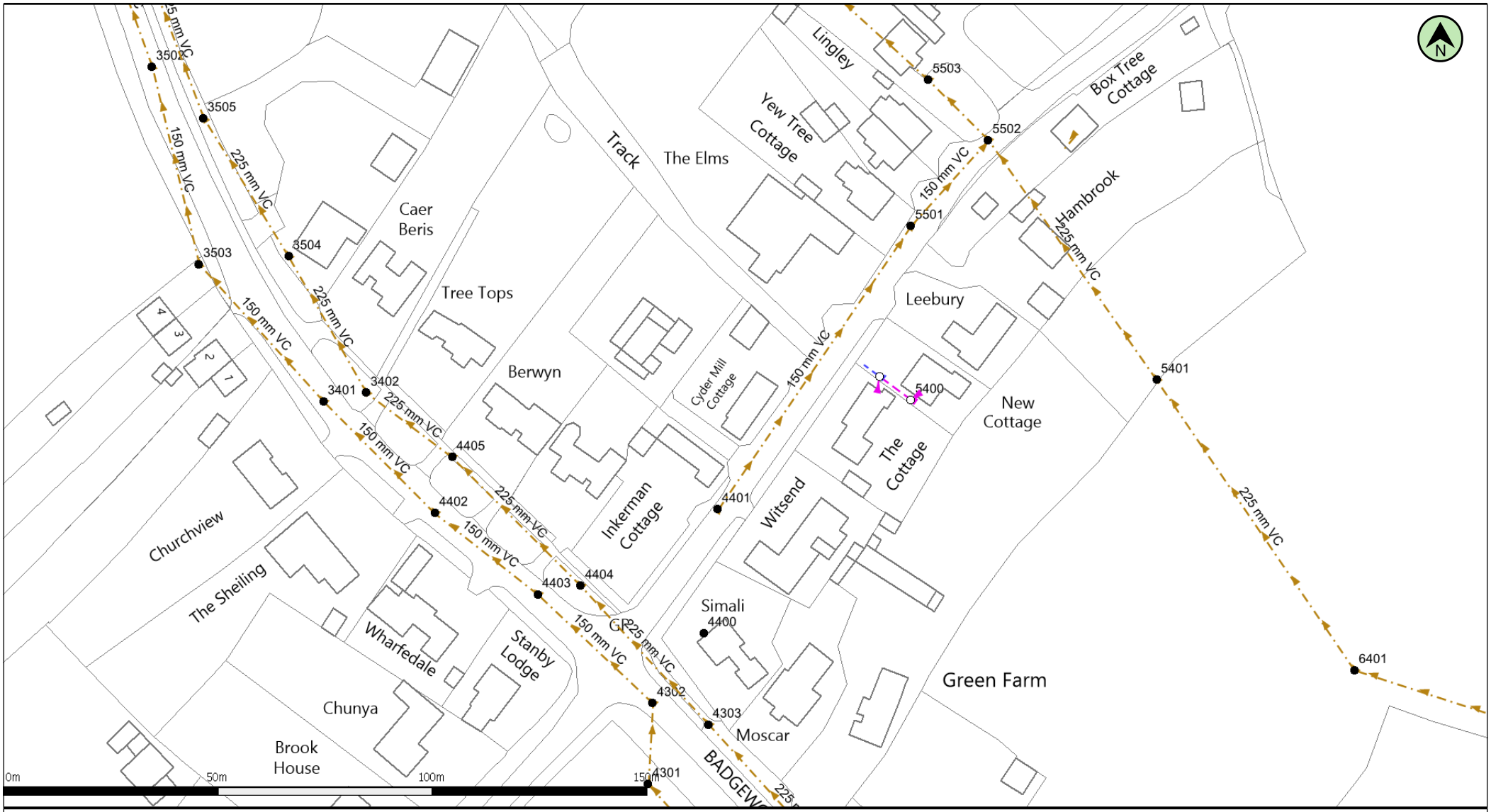
N

Approximate Ordnance Survey Grid North

Revision

10332

APPENDIX C



(c) Crown copyright and database rights 2022 Ordnance Survey 100031673

Date: 08/06/22 Scale: 1:1250 Map Centre: 390477,219468 Data updated: 14/03/22 Our Ref: 873340 - 1 Wastewater Plan A4

Do not scale off this Map. 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. 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 ossess complete records of these assets. These assets may not be displayed on the map. Reproduction by permission of Ordnance Survey on behalf of HMSO. © Crown Copyright and database right 2004. All rights reserved. Ordnance Survey licence number: 100031673. Document users other than SEVERN TRENT WATER business users are advised that thi

- 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
- Section 104 sewers are shown in green
- Private sewers are shown in magenta

mark@sds-consulting.co.uk

MDC-PR001

SEVERN TRENT

GENERAL CONDITIONS AND PRECAUTIONS TO BE TAKEN WHEN CARRYING OUT WORK ADJACENT TO SEVERN TRENT WATER'S APPARATUS

Please ensure that a copy of these conditions is passed to your representative and/or your contractor on site. If any damage is caused to Severn Trent Water Limited (STW) apparatus (defined below), the person, contractor or subcontractor responsible must inform STW immediately on:
0800 783 4444 (24 hours)

a) These general conditions and precautions apply to the public sewerage, water distribution and cables in ducts including (but not limited to) sewers which are the subject of an Agreement under Section 104 of the Water Industry Act 1991(a legal agreement between a developer and STW, where a developer agrees to build sewers to an agreed standard, which STW will then adopt); mains installed in accordance with an agreement for the self-construction of water mains entered into with STW and the assets described at condition b) of these general conditions and precautions. Such apparatus is referred to as “STW Apparatus” in these general conditions and precautions.

b) Please be aware that due to The Private Sewers Transfer Regulations June 2011, the number of public sewers has increased, but many of these are not shown on the public sewer record. However, some idea of their positions may be obtained from the position of inspection covers and their existence must be anticipated.

c) On request, STW will issue a copy of the plan showing the approximate locations of STW Apparatus although in certain instances a charge will be made. The position of private drains, private sewers and water service pipes to properties are not normally shown but their presence must be anticipated. This plan and the information supplied with it is furnished as a general guide only and STW does not guarantee its accuracy.

d) STW does not update these plans on a regular basis. Therefore the position and depth of STW Apparatus may change and this plan is issued subject to any such change. Before any works are carried out, you should confirm whether any changes to the plan have been made since it was issued.

e) The plan must not be relied upon in the event of excavations or other works in the vicinity of STW Apparatus. It is your responsibility to ascertain the precise location of any STW Apparatus prior to undertaking any development or other works (including but not limited to excavations).

f) No person or company shall be relieved from liability for loss and/or damage caused to STW Apparatus by reason of the actual position and/or depths of STW Apparatus being different from those shown on the plan.

In order to achieve safe working conditions adjacent to any STW Apparatus the following should be observed:

1. All STW Apparatus should be located by hand digging prior to the use of mechanical excavators.

2. All information set out in any plans received from us, or given by our staff at the site of the works, about the position and depth of the mains, is approximate. Every possible precaution should be taken to avoid damage to STW Apparatus. You or your contractor must ensure the safety of STW Apparatus and will be responsible for the cost of repairing any loss and/or damage caused (including without limitation replacement parts).

3. Water mains are normally laid at a depth of 900mm. No records are kept of customer service pipes which are normally laid at a depth of 750mm; but some idea of their positions may be obtained from the position of stop tap covers and their existence must be anticipated.

4. During construction work, where heavy plant will cross the line of STW Apparatus, specific crossing points must be agreed with STW and suitably reinforced where required. These crossing points should be clearly marked and crossing of the line of STW Apparatus at other locations must be prevented.

5. Where it is proposed to carry out piling or boring within 20 metres of any STW Apparatus, STW should be consulted to enable any affected STW Apparatus to be surveyed prior to the works commencing.

6. Where excavation of trenches adjacent to any STW Apparatus affects its support, the STW Apparatus must be supported to the satisfaction of STW. Water mains and some sewers are pressurised and can fail if excavation removes support to thrust blocks to bends and other fittings.

7. Where a trench is excavated crossing or parallel to the line of any STW Apparatus, the backfill should be adequately compacted to prevent any settlement which could subsequently cause damage to the STW Apparatus. In special cases, it may be necessary to provide permanent support to STW Apparatus which has been exposed over a length of the excavation before backfilling and reinstatement is carried out. There should be no concrete backfill in contact with the STW Apparatus.

8. No other apparatus should be laid along the line of STW Apparatus irrespective of clearance. Above ground apparatus must not be located within a minimum of 3 metres either side of the centre line of STW Apparatus for smaller sized pipes and 6 metres either side for larger sized pipes without prior approval. No manhole or chamber shall be built over or around any STW Apparatus.

9. A minimum radial clearance of 300 millimetres should be allowed between any plant or equipment being installed and existing STW Apparatus. We reserve the right to increase this distance where strategic assets are affected.

10. Where any STW Apparatus coated with a special wrapping is damaged, even to a minor extent, STW must be notified and the trench left open until the damage has been inspected and the necessary repairs have been carried out. In the case of any material damage to any STW Apparatus causing leakage, weakening of the mechanical strength of the pipe or corrosion-protection damage, the necessary remedial work will be recharged to you.

11. It may be necessary to adjust the finished level of any surface boxes which may fall within your proposed construction. Please ensure that these are not damaged, buried or otherwise rendered inaccessible as a result of the works and that all stop taps, valves, hydrants, etc. remain accessible and operable. Minor reduction in existing levels may result in conflict with STW Apparatus such as valve spindles or tops of hydrants housed under the surface boxes. Checks should be made during site investigations to ascertain the level of such STW Apparatus in order to determine any necessary alterations in advance of the works.

12. With regard to any proposed resurfacing works, you are required to contact STW on the number given above to arrange a site inspection to establish the condition of any STW Apparatus in the nature of surface boxes or manhole covers and frames affected by the works. STW will then advise on any measures to be taken, in the event of this a proportionate charge will be made.

13. You are advised that STW will not agree to either the erection of posts, directly over or within 1.0 metre of valves and hydrants,

14. No explosives are to be used in the vicinity of any STW Apparatus without prior consultation with STW.

TREE PLANTING RESTRICTIONS

There are many problems with the location of trees adjacent to sewers, water mains and other STW Apparatus and these can lead to the loss of trees and hence amenity to the area which many people may have become used to. It is best if the problem is not created in the first place. Set out below are the recommendations for tree planting in close proximity to public sewers, water mains and other STW Apparatus.

15. Please ensure that, in relation to STW Apparatus, the mature root systems and canopies of any tree planted do not and will not encroach within the recommended distances specified in the notes below.

16. Both Poplar and Willow trees have extensive root systems and should not be planted within 12 metres of a sewer, water main or other STW Apparatus.

17. The following trees and those of similar size, be they deciduous or evergreen, should not be planted within 6 metres of a sewer, water main or other STW Apparatus. E.g. Ash, Beech, Birch, most Conifers, Elm, Horse Chestnut, Lime, Oak, Sycamore, Apple and Pear. Asset Protection Statements Updated May 2014

18. STW personnel require a clear path to conduct surveys etc. No shrubs or bushes should be planted within 2 metre of the centre line of a sewer, water main or other STW Apparatus.

19. In certain circumstances, both STW and landowners may wish to plant shrubs/bushes in close proximity to a sewer, water main of other STW Apparatus for screening purposes. The following are shallow rooting and are suitable for this purpose: Blackthorn, Broom, Cotoneaster, Elder, Hazel, Laurel, Privet, Quickthorn, Snowberry, and most ornamental flowering shrubs.

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
3401	F	45.64	42.7	2.94
3402	F	45.6	42.64	2.96
3502	F	44.92	41.85	3.07
3503	F	43	40.06	2.94
3504	F	45.31	42.52	2.79
3505	F	44.93	42.32	2.61
4301	F	46.48	43.73	2.75
4302	F	45.54	43.63	1.91
4303	F	45.55	43.22	2.33
4400	F	-	0	0
4401	F	45.05	43.66	1.39
4402	F	45.66	43.02	2.64
4403	F	45.6	43.32	2.28
4404	F	45.6	43.05	2.55
4405	F	45.66	42.82	2.84
5401	F	44.04	41.92	2.12
5501	F	43.9	42.47	1.43
5502	F	42.89	41.28	1.61
5503	F	43.57	41.2	2.37
6401	F	-	0	0
	S			
5400	S	-	0	0

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

APPENDIX D

	CYDER MILL BARN ICP SuDS	
Date 09/06/2022 13:18 File	Designed by MTD Checked by	
Innovyze	Source Control 2020.1.3	

ICP SUDS Mean Annual Flood

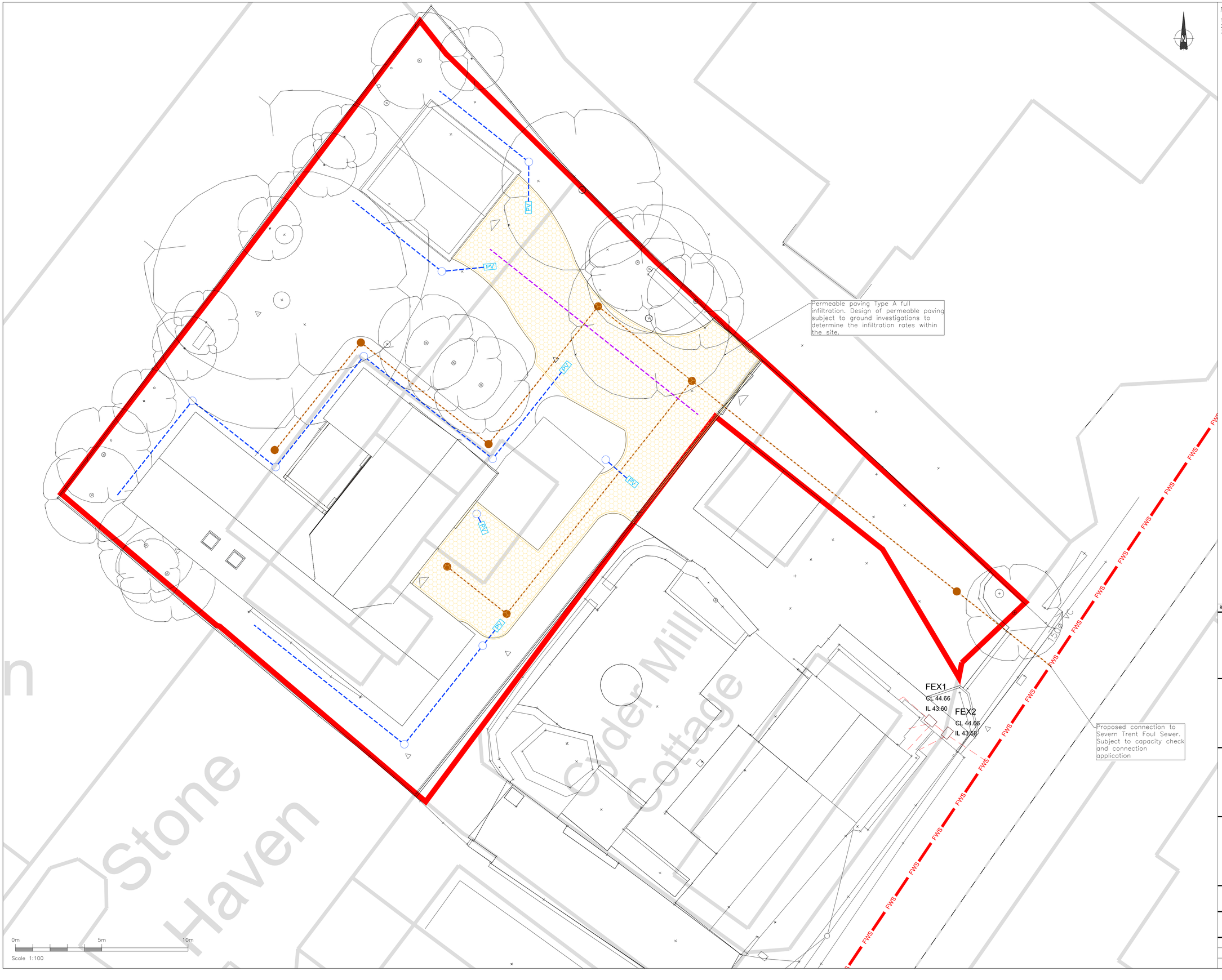
Input

Return Period (years)	30	Soil	0.370
Area (ha)	0.091	Urban	0.000
SAAR (mm)	682	Region Number	Region 4

Results l/s

QBAR Rural	0.3
QBAR Urban	0.3
Q30 years	0.5
Q1 year	0.2
Q30 years	0.5
Q100 years	0.7

APPENDIX E



NOTES:

1. Do not scale from this drawing
2. Drawing for information only
3. Not to be used for construction

KEY:

Main Drainage

- Severn Trent Foul Water Sewer
- Existing Foul Water Drain
- Foul Water Drain
- Surface Water Drain
- Permeable paving outlet – Main discharge channel
- Permavoid – permeable paving inlet
- SUDS Lined Permeable Paving – Light Duty Construction

Rev	Description	Date	Initials	Check

MD CONSULTING

CLIENT:

Gatier PLANNING CONSULTANTS

PROJECT

CYDER MILL BARN

DRAWING

DRAINAGE STRATEGY

Drawing No.

MDCPR001-SK001

Status **Preliminary for Comment**

Not for Construction

Job Number	MDCPR001	Date	June 2022
Scale	1:100 @ A1		
Drawn By	MTD	Checked By	TL

APPENDIX F

	Cyder Mill Barn SW Strategy Permeable Paving	
Date 09/06/2022 14:49 File MDCPR001 PP design.SRCX	Designed by MTD Checked by	
Innovyze	Source Control 2020.1.3	

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 209 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	44.436	0.186	0.8	9.2	O K
30 min Summer	44.496	0.246	0.8	12.2	O K
60 min Summer	44.548	0.298	0.8	14.8	Flood Risk
120 min Summer	44.583	0.333	0.8	16.5	Flood Risk
180 min Summer	44.588	0.338	0.8	16.7	Flood Risk
240 min Summer	44.585	0.335	0.8	16.6	Flood Risk
360 min Summer	44.571	0.321	0.8	15.9	Flood Risk
480 min Summer	44.552	0.302	0.8	15.0	Flood Risk
600 min Summer	44.534	0.284	0.8	14.0	Flood Risk
720 min Summer	44.516	0.266	0.8	13.2	Flood Risk
960 min Summer	44.481	0.231	0.8	11.4	O K
1440 min Summer	44.421	0.171	0.8	8.4	O K
2160 min Summer	44.353	0.103	0.8	5.1	O K
2880 min Summer	44.313	0.063	0.8	3.1	O K
4320 min Summer	44.292	0.042	0.7	2.1	O K
5760 min Summer	44.284	0.034	0.6	1.7	O K
7200 min Summer	44.278	0.028	0.5	1.4	O K
8640 min Summer	44.274	0.024	0.4	1.2	O K
10080 min Summer	44.271	0.021	0.4	1.1	O K
15 min Winter	44.462	0.212	0.8	10.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	115.584	0.0	24
30 min Summer	76.054	0.0	37
60 min Summer	47.821	0.0	66
120 min Summer	29.168	0.0	122
180 min Summer	21.604	0.0	168
240 min Summer	17.380	0.0	196
360 min Summer	12.705	0.0	260
480 min Summer	10.119	0.0	328
600 min Summer	8.477	0.0	396
720 min Summer	7.340	0.0	464
960 min Summer	5.844	0.0	596
1440 min Summer	4.232	0.0	848
2160 min Summer	3.059	0.0	1192
2880 min Summer	2.428	0.0	1512
4320 min Summer	1.751	0.0	2208
5760 min Summer	1.387	0.0	2936
7200 min Summer	1.157	0.0	3672
8640 min Summer	0.998	0.0	4400
10080 min Summer	0.880	0.0	5136
15 min Winter	115.584	0.0	24

	Cyder Mill Barn SW Strategy Permeable Paving	
Date 09/06/2022 14:49 File MDCPR001 PP design.SRCX	Designed by MTD Checked by	
Innovyze	Source Control 2020.1.3	

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	44.529	0.279	0.8	13.8	Flood Risk
60 min Winter	44.591	0.341	0.8	16.9	Flood Risk
120 min Winter	44.635	0.385	0.8	19.1	Flood Risk
180 min Winter	44.644	0.394	0.8	19.5	Flood Risk
240 min Winter	44.639	0.389	0.8	19.3	Flood Risk
360 min Winter	44.620	0.370	0.8	18.3	Flood Risk
480 min Winter	44.594	0.344	0.8	17.0	Flood Risk
600 min Winter	44.566	0.316	0.8	15.6	Flood Risk
720 min Winter	44.539	0.289	0.8	14.3	Flood Risk
960 min Winter	44.486	0.236	0.8	11.7	O K
1440 min Winter	44.395	0.145	0.8	7.2	O K
2160 min Winter	44.308	0.058	0.8	2.9	O K
2880 min Winter	44.293	0.043	0.7	2.1	O K
4320 min Winter	44.281	0.031	0.5	1.5	O K
5760 min Winter	44.274	0.024	0.4	1.2	O K
7200 min Winter	44.270	0.020	0.3	1.0	O K
8640 min Winter	44.268	0.018	0.3	0.9	O K
10080 min Winter	44.266	0.016	0.3	0.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	76.054	0.0	37
60 min Winter	47.821	0.0	64
120 min Winter	29.168	0.0	120
180 min Winter	21.604	0.0	176
240 min Winter	17.380	0.0	226
360 min Winter	12.705	0.0	282
480 min Winter	10.119	0.0	358
600 min Winter	8.477	0.0	432
720 min Winter	7.340	0.0	504
960 min Winter	5.844	0.0	642
1440 min Winter	4.232	0.0	890
2160 min Winter	3.059	0.0	1176
2880 min Winter	2.428	0.0	1496
4320 min Winter	1.751	0.0	2208
5760 min Winter	1.387	0.0	2944
7200 min Winter	1.157	0.0	3672
8640 min Winter	0.998	0.0	4376
10080 min Winter	0.880	0.0	5136

	Cyder Mill Barn SW Strategy Permeable Paving	
Date 09/06/2022 14:49 File MDCPR001 PP design.SRCX	Designed by MTD Checked by	
Innovyze	Source Control 2020.1.3	

Model Details

Storage is Online Cover Level (m) 44.800

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.03600	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	16.5
Max Percolation (l/s)	45.8	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	44.250	Cap Volume Depth (m)	0.400