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Drainage Strategy

Proposed Housing Development, Land at Scalegill Road, Moor Row

Washington Homes Ltd

Ref: K40461.DS/001A

Version	Date	Prepared By	Checked By	Approved By
Original	26 January 2024	O. Sugden	T. Melhuish	O. Sugden
A	19 April 2024	O. Sugden	T. Melhuish	O. Sugden

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GLOSSARY OF TERMS

AEP	Annual Exceedance Probability
AOD	Above Ordnance Datum
BGL	Below Ground Level
BGS	British Geological Society
CC	Climate Change
DSM	Digital Surface Model
DTM	Digital Terrain Model
EA	Environment Agency
FEH	Flood Estimation Handbook
FFL	Finished Floor Level
FRA	Flood Risk Assessment
GIS	Geographical Information System
LiDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority
NPPF	National Planning Policy Framework
OS	Ordnance Survey
RGP	RG Parkins & Partners Ltd
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage System
UU	United Utilities

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1. INTRODUCTION

1.1 BACKGROUND

This report has been prepared by R. G. Parkins & Partners Ltd (RGP) for Washington Homes Ltd in support of their proposals to construct 19 No. new dwellings on land North of Scalegill Road, at the western edge of the village of Moor Row.

RGP has been appointed to undertake a Drainage Strategy in accordance with the National Planning Policy Framework (NPPF) [1][2] to support a planning application that fulfils the requirements of the Local Planning Authority, Environment Agency, Lead Local Flood Authority and the Sewerage Undertaker.

The following study outlines the proposed drainage strategy for the development and demonstrates the proposed development will not adversely affect flood risk elsewhere.

The existing greenfield site covers approximately 1.53 ha (15,286 m^2).

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2. SITE CHARACTERISATION

2.1 SITE LOCATION

The land proposed for development is situated towards the western extent of the village of Moor Row (Figure 2.1). The National Grid Co-ordinates to the centre of the site are 300185mE 514420mN.

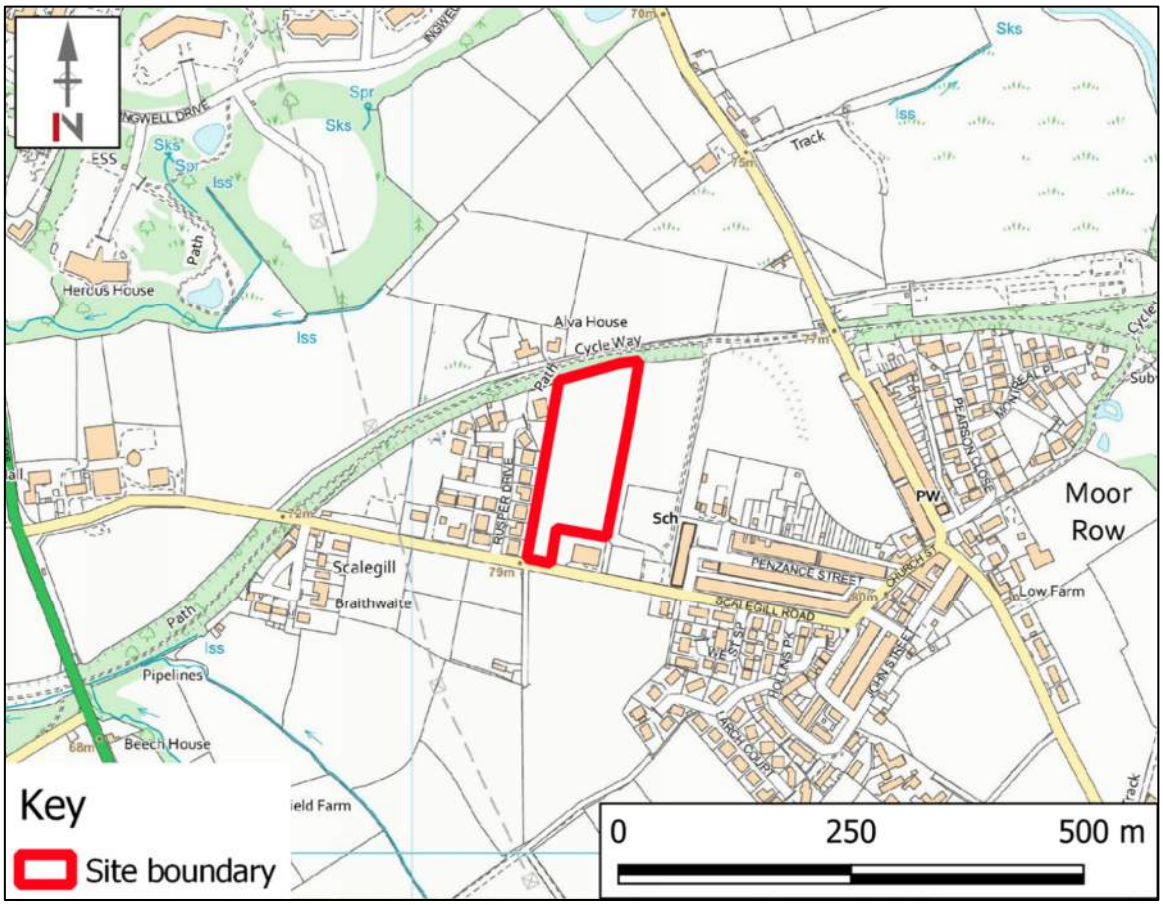

Figure 2.1 Site Location

2.2 SITE DESCRIPTION

The development site is currently greenfield and is used for agriculture and is not currently stock poof. A public highway, Scalegill Road is located to the south of the site, and this contains a gated access. The site area measures 1.5ha (15,352 m^2).

The site is bounded by a residential development, Rusper Drive on its western boundary, a national cycleway and former railway to the north and a school playing field to the east. Immediately south of the site, between the site and public highway is Moor Row Working Men's Club.

Topographically, the site slopes gently from the site access at its southern extent (78.8 mAOD) towards the boundary with the cycle path at its northern extent (72.5 mAOD). The existing ground profile is uniformly sloping with little to no undulation.

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2.3 GEOLOGY & HYDROGEOLOGY

British Geological Survey (BGS) [4] and Land Information Systems (LandIS)[5] mapping indicates the site is underlain by the geological sequences outlined in Table 2.1. The EA Groundwater Vulnerability Map [6] indicates that the site is in a medium-low area of vulnerability and within a Soluble Rock Risk area. There are no Groundwater Source Protection Zones (SPZ) within 5.0 km of the site.

According to the Environment Agency Aquifer Designation Map [6], the site is located over Principal Bedrock and Secondary undifferentiated aquifers.

Table 2.1 Site Geological Summary

Geological Unit	Classification	Description	Aquifer Classification
Soil	Soilscape 17	Slowly permeable seasonally wet acid loamy and clayey soils	N/A
Drift	Till, Devensian – Diamicton	Unsorted sediment with gravel in a fine mud matrix	Secondary Undifferentiated
Solid	Pennine Lower Coal Measures Formation (north)	Sedimentary bedrock	Secondary A
	Brockram – Breccia (central)	Sedimentary bedrock	Principal
	St Bees Sandstone (south)	Sandstone	Secondary A

2.4 HYDROLOGY

The site lies in the Pow Beck Catchment and does not contain any visible surface water drainage features although it is possible land drainage exists. Site levels indicate that surface water runoff drains towards the cycle path / disused railway. Drainage within the cycle path runs in a westerly direction within the south verge / banking to meet Needless Beck, discharging to Scalegill Beck and Pow Beck before discharging to the Irish Sea.

Ground levels at the site entrance indicate no surface water contributions will occur from the public highway. Land to the west is positively drained via a separate drainage system and land to the east falls towards the cycle path and also contains a slight swale feature adjacent to the development site boundary. Therefore, the site will receive no surface water inflows from beyond its boundaries. For further information refer to Section 2.7.

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2.5 EXISTING SURFACE WATER DRAINAGE

There are no identified surface water drainage features within the site boundary however the cycle path on the sites northern boundary contains drainage which was presumably associated with the former railway. This drainage is located at a level below that of the lowest point on the site and would naturally receive site runoff due to topography. An overview of the surface water drainage is provided in Figure 2.2. Further detail is provided in closer proximity to the site in Figure 2.3.

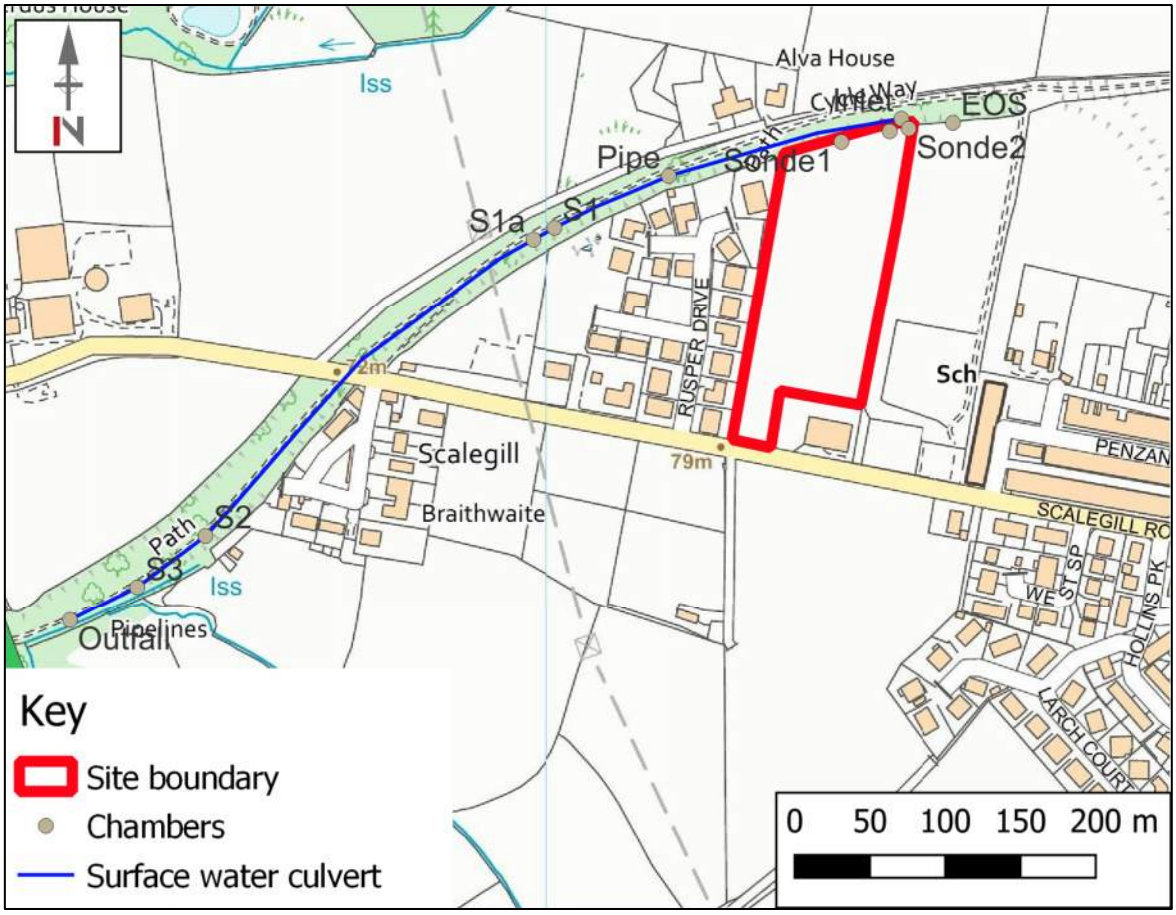

Figure 2.2 Surface water culvert

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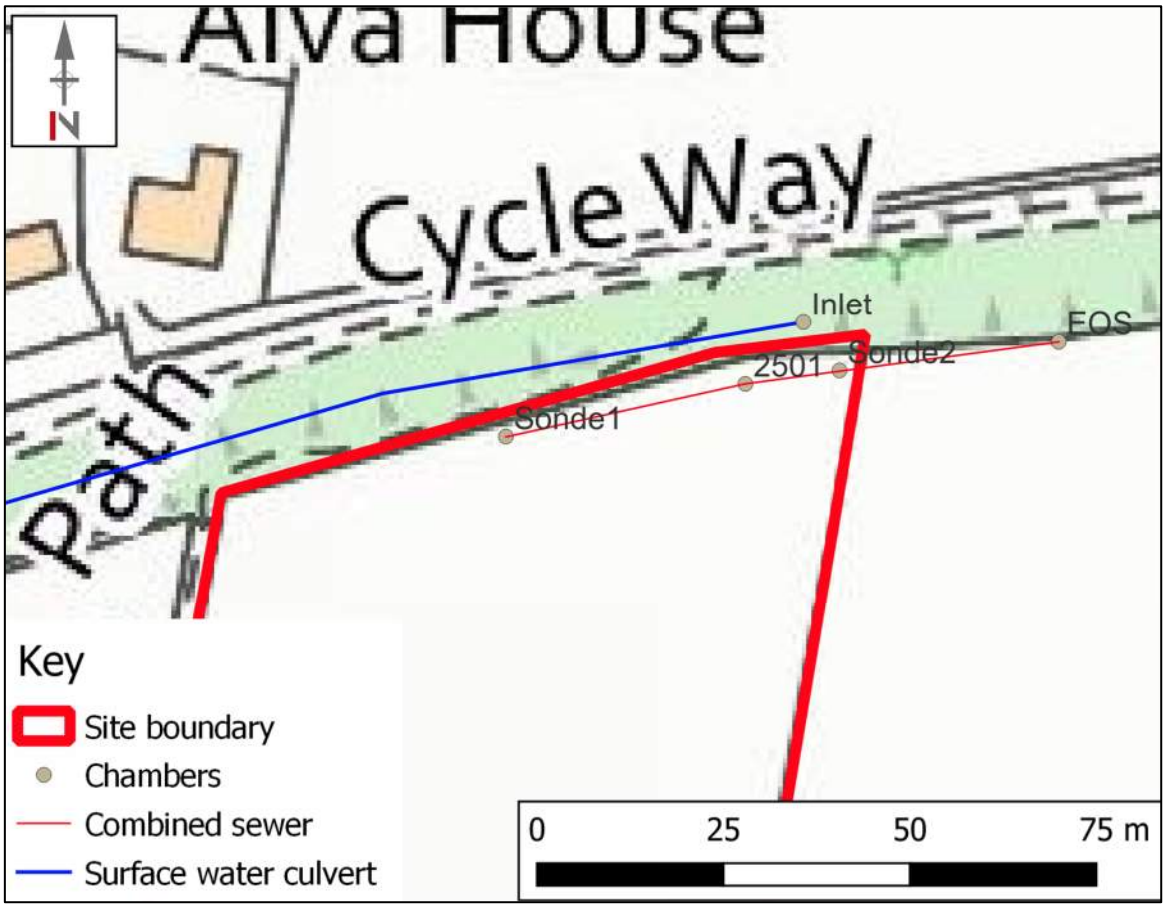

Figure 2.3 Drainage survey adjacent to site

The cycle path drainage has been investigated and found to comprise a ditch at its upstream extent (Figure 2.4) before changing to a stone culvert adjacent to the site boundary. Beyond the site the stone culvert changes to a 400mm diameter pipe, becoming 300mm diameter prior to outfall to an open ditch. The drainage survey was undertaken on 7th July 2023 during dry conditions and the system was surveyed as far as possible without damaging the watercourse. The stone culvert is difficult to survey, and the camera made limited progress. It was possible to investigate the culvert 16.5m downstream of the upstream headwall and culvert depth at this location was 0.7m deep to crown. Further excavations on the line of the stone section were not possible due to vegetation, increasing depth and digger access constraints.

The results of the drainage survey are included in Appendix B.

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Figure 2.4 Culvert inlet and ditch

Figure 2.5 View up culvert inlet

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Figure 2.6 Excavation on Culvert at Extent of Camera Survey

The stone culvert contained water at its inlet however was dry beyond. The culvert changed construction to a 400mm diameter clay pipe at a point approximately 160m downstream of the culvert inlet. The stone culvert appears to be in generally good condition.

Access to the pipe was achievable at 5 locations and this section of the drain is generally located at a depth of 500 – 600mm. Small, shallow stone built chambers are present and three of these were located to allow camera access. It is probable that other buried chambers also exist. At manhole S2 pipe diameter reduces from 400mm to 300mm and the outfall was flowing freely.

The piped section of watercourse is in good condition and would be a suitable connection point for the disposal of surface water.

It is also possible that historic land drainage features may exist within the site although none were encountered during the ground investigation and no incoming drainage was identified within the adjacent surveyed culvert or combined sewer.

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2.6 EXISTING FOUL WATER DRAINAGE

Reference to the United Utilities Sewer Records indicates there is a 300 mm diameter combined sewer located within the site running east to west adjacent to the site's boundary with the cycle path.

Camera survey was undertaken as far as possible. The pipe was dry at time of survey however there is evidence of surface water flow with silt deposition within the pipe impeding camera progress. Contrary to UU records the combined sewer continues for some distance upstream of the site. The sewer was located by sonde at the east site boundary and at the surveys downstream extent where progress was prevented by a stone. The sewer is in good condition however requires cleaning. A further survey following drain cleaning is recommended to provide a pre-construction condition record within the site.

Sonde measurements indicate a sewer depth of 2.27 – 2.60m. The manhole survey provides a more accurate depth of sewer of 2.56m from cover level which sits proud of the surrounding ground by 150mm. United Utilities provide a cover level for this manhole (UU ref 2501) of 73.24 mAOD and invert of 70.78 mAOD, a depth of 2.46m.

The topographic survey was extended to record the manhole cover level and locations of pegs identifying the extent of the sewer / survey.

2.7 EXISTING SURFACE WATER FLOWS

The site is located above the level of the obvious low point at the railway where surface water is likely to pond and levels at the site entrance will prevent incoming flows from the highway.

The surface water mapping product produced by the Environment Agency has been reviewed to determine the EA predicted risk of surface water flooding. The surface water flood maps are not suitable for informing planning decisions, because it is based on relatively coarse resolution DTM (2m), does not represent surface features accurately and makes no account for underground drainage.
The EA surface water flood map product is provided with the following information warning (https://www.data.gov.uk/dataset/d5ca01ec-e535-4d3f-adc0-089b4f03687d/risk-of-flooding-from-surface-water-suitability):

"Information Warnings: Risk of Flooding from Surface Water is not to be used at property level. If the Content is displayed in map form to others we recommend it should not be used with basemapping more detailed than 1:10,000 as the data is open to misinterpretation if used as a more detailed scale. Because of the way they have been produced and the fact that they are indicative, the maps are not appropriate to act as the sole evidence for any specific planning or regulatory decision or assessment of risk in relation to flooding at any scale without further supporting studies or evidence."

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Whilst the product is not suitable for the purpose of informing planning decisions it can be a useful tool to provide an indication of possible overland flow routes.

For the site a low probability 0.1% AEP flow route is predicted along the site's east boundary. This however does not appear correct following a walkover survey.

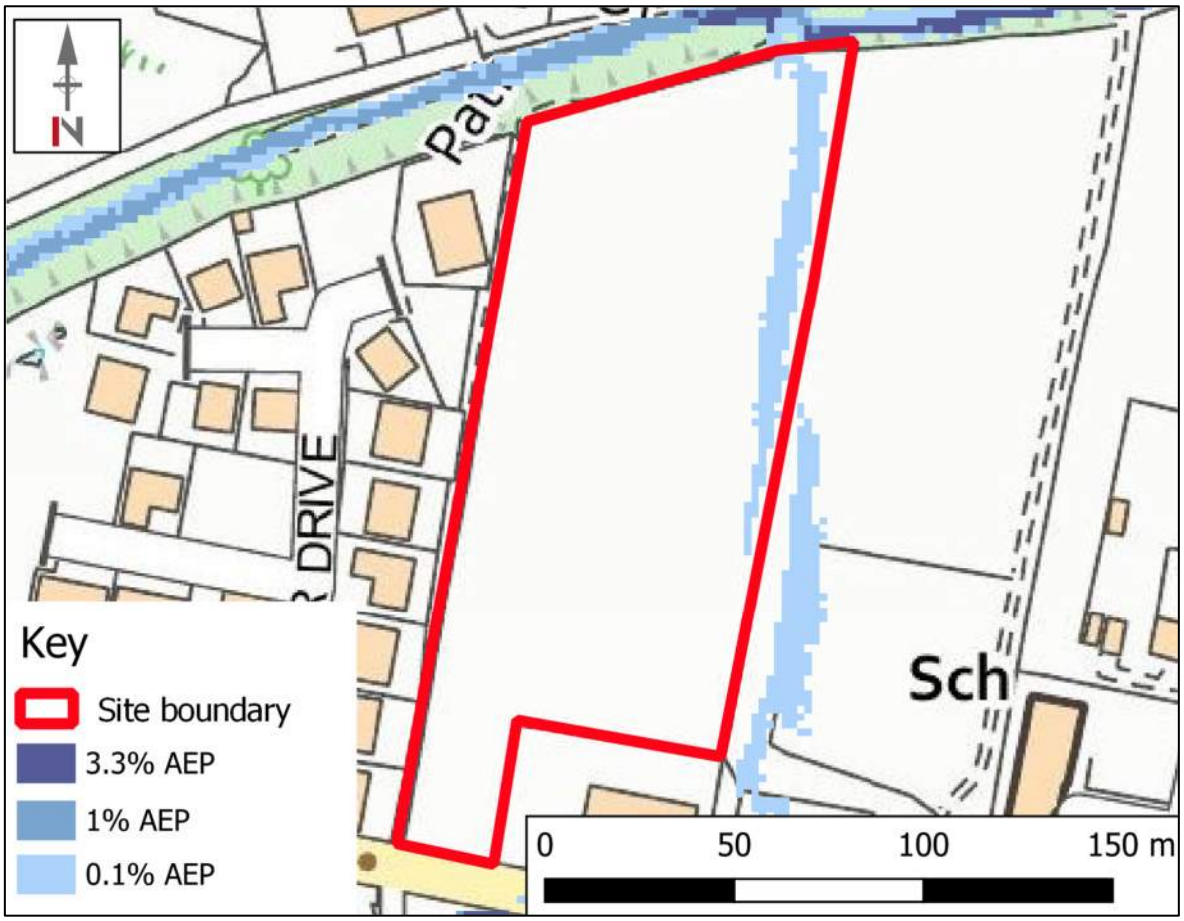

Figure 2.7 EA Surface Water Flood Map

Further investigation has been undertaken using LiDAR data dated 2021 and catchment analysis to define the contributing area to the watercourse. Results provided in Figure 2.8 show the catchment covers little more than the site boundary and disproves the EA surface water flood map product. An area to the south associated with the working man's club is predominantly hardstanding and roof area which is positively drained and would not contribute flow.

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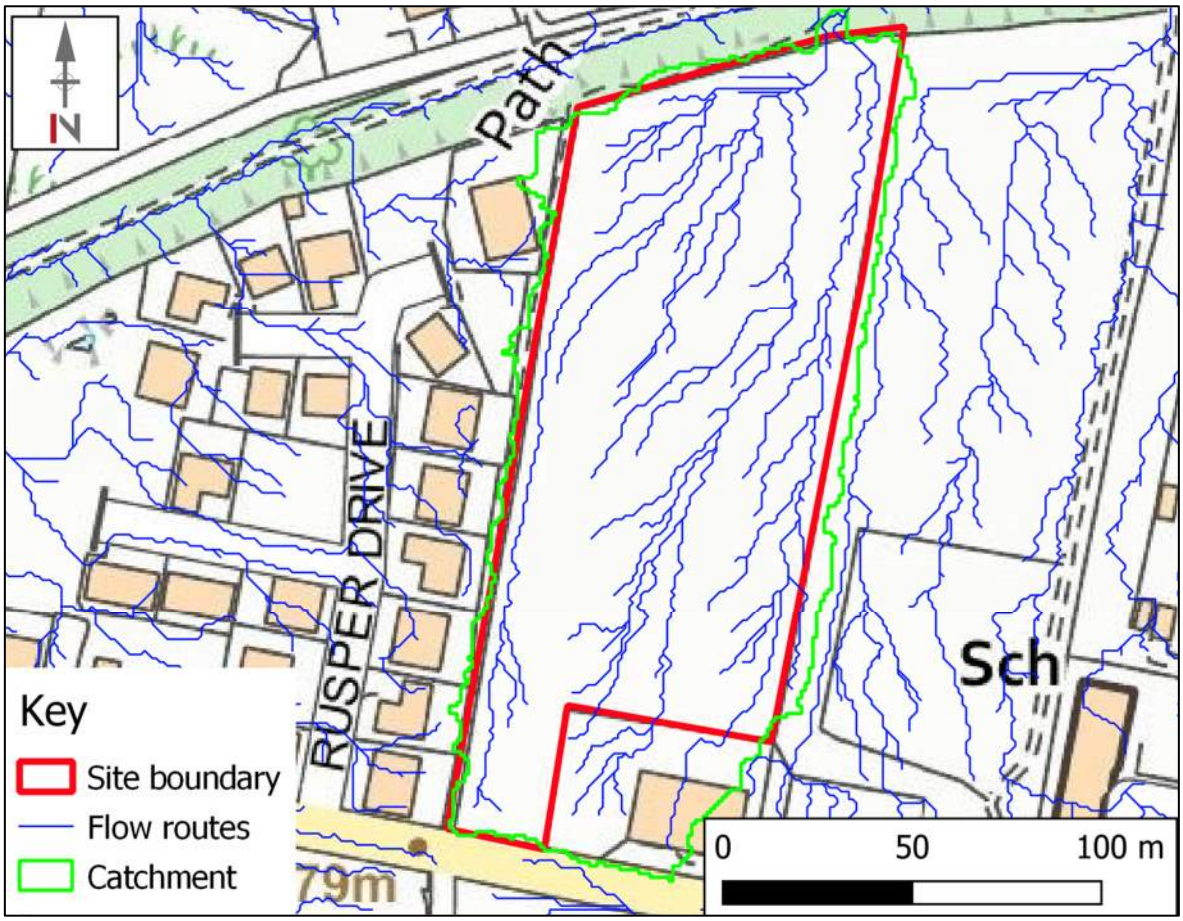

Figure 2.8 Catchment Boundary

2.8 GROUND INVESTIGATION

Ground Investigations including trial pits with permeability tests have been carried out on site in December 2022 and as the trial holes failed to drain down over a significant time period the tests were abandoned proving there is limited soakaway potential for infiltration type drainage systems within the underlying strata. It is therefore not recommended that soakaways are used for the disposal of surface water runoff from the proposed residential development.

For further information refer to the Phase 2 Ground Investigation Report (2023-5970) prepared by Geo Environmental Engineering in November 2023.

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3. SURFACE WATER DRAINAGE STRATEGY

3.1 INTRODUCTION

The principal aim of the following drainage strategy is to design the development to avoid, reduce and delay the discharge of rainfall to public sewers and watercourses in order to protect watercourses and reduce the risk of localised flooding, pollution and other environmental damage. In order to satisfy these criteria this surface water runoff assessment and drainage design has been undertaken in accordance with the following reports and guidance documents:

- SuDS Manual, CIRIA Report C753, 2015[7]
- Code of Practice for Surface Water Management, BS8582:2013, November 2013[8]
- Rainfall Runoff Management for Developments, Defra/EA, SC030219, October 2013[9]
- Designing for Exceedance in Urban Drainage – Good Practice, CIRIA Report C635, 2006[10]
- Flood Estimation Handbook (FEH)[11]
- Flood Studies Report (FSR), Volume 1, Hydrological Studies, 1993[12]
- Flood Studies Supplementary Report No 14 (FSSR14), Review of Regional Growth Curves, 1983[13]
- Flood Estimation for Small Catchments, Marshall & Bayliss, Institute of Hydrology, Report No. 124 (IoH 124), 1994[14]
- Non-Statutory technical Standards for Sustainable Drainage Systems, Defra, March 2015[15]
- Water UK, Design and Construction Guidance for Foul & Surface Water Sewers March 2020[16]
- Design and analysis of urban storm drainage, The Wallingford Procedure, Volume 4 – The Modified Rational Method, 1981[17]

The following assessment and drainage strategy are based on the latest site layout plan by Green Swallow (drawing no.1375-01-G). Any alterations to the site plan resulting in changes to impermeable areas will require the drainage strategy to be revisited.

3.2 SITE AREAS

Based on the gently sloping topography of the existing Greenfield site and on the basis of the flow routing analysis outlined in Section 2.7, it can be concluded that the entirety of the site area drains downslope towards the existing drainage ditch. As such the pre-development Greenfield runoff rates will be calculated based on the positively drained impermeable areas in addition to verges as outlined in the modified Rational Method.

The entire site area (1.535 ha) is currently greenfield and there is no existing known drainage within the site.

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The site can be subdivided into land cover that could be permeable and that which could be impermeable. Potential impermeable areas are regarded as buildings, parking, roads, and hardstanding. All other areas (principally gardens and areas of public open space) are regarded as having a permeable surface. Permeable and Impermeable Areas have been calculated as shown in Table 3.1.

Table 3.1 Area of Potentially Impermeable & Permeable Land Cover

Land Cover	Area		Proportion of total site area
	m²	Ha	
Roof Area	1,956	0.196	13%
Roads, drives and paved areas	3,889	0.389	32%
Detention basin	794	0.079	6%
Remaining Permeable Area	8713	0.871	57%
Total	15,352	1.535	100%

3.3 PRE-DEVELOPMENT GREENFIELD RUNOFF ASSESSMENT

As the area to be drained covers an area of less than 200 ha, the Greenfield calculations have been undertaken in accordance with methodology described in IoH 124[14]. For catchments of less than 50 ha the Greenfield runoff rate is scaled according to the size of the catchment in relation to a 50-hectare site.

The pre-development runoff assessment has been calculated based on the drained areas of the site, measuring 6,639 m^2 being classified as greenfield. A catchment plan is included in Appendix A (drawing K40461/24).

Full details of the calculations and the methodology for deriving the Greenfield Runoff Rate are in included in Appendix C. A summary of the results is included in Table 3.2.

Table 3.2 Pre-Development Peak Runoff Rates

Event	Greenfield Rate of Runoff (l/s)
Q1	5.3
QBAR	**6.1**
Q10	8.4
Q30	10.3
Q100	12.6
Q100 + 50% CC	19.0

Without attenuation, the proposed development would significantly increase the rate of Runoff from the developed areas of the site.

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To mitigate against the potential increase in runoff, it is proposed to contain and attenuate runoff from the development site before being released at a controlled rate to the existing nearby watercourses to match the pre-existing greenfield runoff flow rate (QBAR) of 6.1 l/s.

3.4 SURFACE WATER DRAINAGE DESIGN PARAMETERS

The surface water drainage system has been designed on the following basis using the modified rational method and a generated rainfall profile:

3.4.1 CLIMATE CHANGE

Projections of future climate change indicate that more frequent short-duration, high intensity rainfall and more frequent periods of long-duration rainfall are likely to occur over the next few decades in the UK. These future changes will have implications for river flooding and for local flash flooding. These factors will lead to increased and new risks of flooding within the lifetime of planned developments.

The EA have provided a peak rainfall online map showing the anticipated changes in peak rainfall intensity across the UK. Climate change allowances are now provided on a catchment-by-catchment basis.

The site falls within the South West Lakes Management Catchment. Table 3.3 outlines the EA guidance for this catchment, for the anticipated design life of the proposed development. In line with current guidance and for conservative design, a 50% allowance shall be used within this assessment.

Table 3.3 South West Lakes Management Catchment Peak Rainfall Allowances (1% AEP)

Epoch	Central Allowance (%)	Upper End Allowance (%)
2050s	30	45
2070s	35	50

3.4.2 URBAN CREEP

BS 8582:2013 [8] outlines best practice with regard to Urban Creep. Although not a statutory requirement, future increase in impermeable area due to extensions and introduction of impervious positively drained areas has been considered. An uplift of 10% on impermeable areas associated with plots only (excluding roads) is typically applied to the contributing area.

An increase in drained area of 179 m^2 due to urban creep has been represented in the calculations which corresponds to 10% of plot roof areas. Total modelled areas for each receiving node is outlined in Table 3.4.

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Table 3.4 Contributing areas including 10% urban creep allowance

Receiving node	Road / basin	Plots	Plot area including creep	Total Area
	m^2		m^2	m^2
S01	375.9			375.9
S02	442.9			442.9
S03		1 2 18 19	228.8 302.37 203.4 198.8	933.4
S04	127.6	17	197.67	325.3
S05	128.2	16	186.6	314.8
S06	274.4	3 4 15	182.12 182.92 211.3	850.7
S07	130.3	5 6 13 14	196.97 220.1 193.7 222.18	963.3
S08	121.3	7 12	198.77 206.8	526.9
S09		8 10 11	197.67 306.57 226.58	730.8
S10	304.1	9	289.47	304.1
S12	865.2			865.2

3.4.3 PERCENTAGE IMPERMEABILITY (PIMP)

The percentage impermeability (PIMP) for all impermeable areas is modelled as 100%. The entirety of the impermeable areas is to be positively drained.

3.4.4 VOLUMETRIC RUNOFF COEFFICIENT (CV)

The volumetric runoff coefficient describes the volume of rainfall which runs off an impermeable surface following losses due to infiltration, depression storage, initial wetting and evaporation. The coefficient is dimensionless.

Default industry standard volumetric runoff coefficients are typically 0.75 for summer and 0.84 for winter for drainage design. These can however be specified in greater detail by reference to soil type, rainfall and topography as outlined in , The Wallingford Procedure, Volume 4.

For urban catchments, percentage runoff (PR) can be estimated in accordance with the Wallingford Procedure using the following equation:

$$PR = 0.829\ PIMP + 25.0\ SOIL + 0.078\ UCWI - 20.7$$

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Where the Urban Catchment Wetness Index (UCWI) is a function of the 5-day antecedent precipitation index (API5) and the soil moisture deficit (SMD). UCWI can also be obtained using a best-fit graph derived from multiple catchments to correlate UCWI with Standardised Average Annual Rainfall (SAAR).

For the proposed development site:

PIMP = 100%

SOIL = 0.47

UCWI = 117 (summer), 145 (winter)

PR(summer) = 83, PR(winter) = 85

Volumetric runoff coefficient is described by the below formula:

Cv = PR / 100

Cv (summer) = 0.83, Cv (winter) = 0.85

The percentage runoff equation is thought to underestimate runoff from long duration rainfall events however there is no data available to substantiate or quantify this assertion. It should be noted that the above methodology was developed based on measured flows in 33 catchments. Further increasing the coefficient of runoff has been suggested to account for wetter antecedent conditions than the scenario represented by the winter UCWI above.

Winter design storms are the critical consideration for long duration events whilst summer events are likely to be critical for the shorter duration events. To account for additional catchment wetness winter volumetric runoff coefficient has been further uplifted to 0.9.

3.4.5 RAINFALL MODEL

The calculations use the FEH22 rainfall depth-duration-frequency model with the latest available rainfall descriptors provided by the Centre for Ecology and Hydrology Flood Estimation Handbook web service.

3.5 SURFACE WATER DISPOSAL

Surface water disposal has been considered in line with the hierarchy outlined in the SuDS Manual [7]. The approach considers infiltration drainage in preference to disposal to watercourse, in preference to discharge to sewer.

3.5.1 INFILTRATION

In-situ permeability testing was undertaken as part of the ground investigation at this site (See Section 2.6) and the slow infiltration rates encountered combined with the variable soil conditions precludes disposal of surface water via. infiltration. Soakaways would not form an effective drainage solution for this site.

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On this basis it is therefore considered that disposal of surface water using an attenuation based SuDS system is required.

3.5.2 POSITIVE DRAINAGE – WATERCOURSE

All impermeable site areas i.e. roof, driveway and hardstanding areas will drain via. gravity through a network of pipes and chambers into a detention basin located in the natural low point of the site with a direct outfall to the existing culverted watercourse located within the disused railway / cycle path to the north of the development site.

A length of new sewer within third party land shall be constructed to allow disposal to the watercourse at a point where it is conveyed by 400mm pipe rather than within a stone drain.

This strategy will replicate the existing runoff characteristics of the site.

3.6 SURFACE WATER DRAINAGE NETWORK

Roof water, driveway and road runoff will connect directly into the surface water pipe network upstream of the detention basin, with inspection and manhole chambers utilised to route the new pipework to suit the proposed development layout and allow for future inspection and maintenance.

Due to the relative impermeability of the soils and site topography, all parking areas and private driveways are to be constructed with positive drainage connections to the proposed attenuation system.

3.7 FLOW CONTROL

Because it is not possible to dispose of surface water within the site it is necessary to follow the long term storage approach which requires limiting discharge for all events up to and including the 1% AEP with allowance for climate change to no greater than greenfield Qbar.
A vortex type flow control will therefore restrict discharge from the detention basin to a total discharge rate of 6.1 l/s equivalent to the QBAR rate.

For further details of the drainage layout, please refer to the Outline Drainage Layout plans (K40461-20 & K40461-21) included in Appendix A.

3.8 VOLUMETRIC STORAGE

Storm water storage Detention basins are landscaped depressions that are normally dry except during and immediately following storm events. The vegetated depressions can provide treatment for surface water removing sediment and buoyant materials, as well as nutrients and heavy metals.

Side slopes should be no steeper than 1 in 3 wherever mowing is required, to reduce the risks associated with maintenance activities. Side slopes of 1:3.5 have been selected in this instance to improve on the minimum values and provide a more gentle gradient to the basin.

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The proposed surface water attenuation requirements for the site have been calculated using a Causeway Flow hydraulic model (results are included in Appendix C). A total storage volume of 637 m^3 is provided to emergency spillway level.

Predicted storage volumes and depths are outlined in Table 3.4. The basin has 0.132m freeboard allowance and 92 m^3 spare capacity for the most severe design storm.

Table 3.5 Detention basin storage volumes and depths

Design Event		Water Depth (m)	Storage Volume (m^3)
AEP (%)	Return Period (years)		
50	2	0.341	104
3.3	30	0.611	210
1 + CC	100	1.218	575

3.9 DESIGNING FOR LOCAL DRAINAGE SYSTEM FAILURE

In accordance with the general principles discussed in CIRIA Report C635 – Designing for Exceedance in Urban Drainage [10] the proposed surface water drainage, where practical, should be designed to ensure there is no increased risk of flooding on the site or elsewhere as a result of extreme rainfall, lack of maintenance, blockages or other causes. These measures are discussed below.

Surface Storage & External Levels – where possible driveway/car parking areas will be designed to offer additional surface water storage volume and conveyance of flood water should the SuDS and drainage system fail, flood or exceed capacity. Where appropriate, the kerb lines will be raised to channel surface water runoff back into the drainage system or onto the existing highway.

Drainage Contingency – the sustainable drainage systems have been conservatively designed to attenuate a 100-year design storm including a 50% allowance for climate change. The drainage system will also provide capacity for lower probability (greater design storm events) which are not critical duration.

Building Layout & Detail – the dwellings will be designed and situated to ensure that they are not at risk of flooding from overland flow. The finished floor and threshold levels of the proposed new dwellings will be set above the external levels, and external footpaths will fall away from the dwellings, ensuring that any flood water runs away from, rather than towards the properties.

Blockage and exceedance – Exceedance flows shall be retained on site within the drainage system as far as practical and in the case of extreme events site levels will be set to divert any exceedance flows to fall away from the properties towards green areas. In the unlikely case of exceedance or blockage from the detention basin and/or associated flow control chamber, spills would be directed away from the development where they would follow the existing ground levels towards the existing culverted watercourse. The detention basin is proposed to be sited at the remote end of the site downslope of the dwellings and therefore any flood event should not adversely affect properties in the locality.

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3.10 EXCEEDANCE FLOWS

The rainfall parameters of the model have been increased to identify the locations in the drainage system where spills would occur.

Manhole S02 is the first manhole predicted to flood for a short duration (flashy event) when climate change allowance is increased to 60%. This is considered to be unrealistic due to the drainage connections, downpipes, gutters etc being unable to convey this flow to the sewer. However assuming this flow could enter the surface water drainage system, spill would occur to the access road and be contained by kerbs.

All private drives with the exception of plot 10 fall towards the main access road and property FFLs are set 150mm above external levels. For plot 10 levels fall towards the centre of the drive and levels in the vicinity of the building fall away from the plot. Therefore exceedance flows would not pose a flood risk to the dwellings.

Exceedance flows would follow the access road to the turning head where surface water would pond prior to being drained into the system via the road gully's. Due to storm duration such events produce relatively low flood volumes.

Longer duration events that will be more problematic in terms of flood volume will flood first from the detention basin. Initially flows will be contained with the additional freeboard within the basin. With climate change allowance inflated to 70% the basin will commence spilling via the emergency spillway although flows are very low (4.8l/s). .Discharge shall flow north away from the site and into the verge of the cycle path where it will drain to the existing drainage.

3.11 OPERATIONS & MAINTENANCE RESPONSIBILITY

The private individual plot drainage is to be maintained by the property owners and it is anticipated the overall SuDS features (Detention Basin) will be offered for adoption. Should UU refuse to adopt the drainage system it will be necessary to appoint a third-party management company to maintain the system.

A SuDS 'Operations & Maintenance Plan' has been made available by RGP (report no. K40461-002-O&M) and specifies the requirements for future maintenance of the drainage system. This covers the maintenance activities for the detention basin should UU refuse to adopt the system.

3.12 SURFACE WATER QUALITY

The treatment of surface water is not a statutory requirement. Water quality remains a material consideration but there are no prescriptive standards to be imposed in terms of treatment train management. In the absence of a design standard, the SuDS manual has been used which outlines best practice.

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Pollutants such as suspended solids, heavy metals and organic pollutants may be present in surface water runoff, the quantity and composition of the runoff is highly dependent upon site use. For housing developments, the pollutant load is very low.

The SuDS Manual [7] outlines best practice with regards to treatment of surface water by SuDS components prior to discharge to the environment. SuDS components can be effective in reducing the amount of pollutants within the surface water discharged and therefore environmental impact of the development. SuDS components may be installed in series to form a treatment train to treat the runoff.

The simple index approach as outlined in the SuDS manual has been used to assess the pollution hazard indices and proposed treatment components. Tables 3.5 – 3.7 summarise the pollution hazard and mitigation indices for the various runoff sources and show that adequate treatment of surface water runoff is provided by the provision of a detention basin.

Table 3.6 Pollution Hazard & Mitigation Indices - Roof Areas

Indices	Suspended Solids	Metals	Hydrocarbons
Pollution Hazard	0.2	0.2	0.05
Pollution Mitigation	0.5	0.5	0.6
Treatment Suitability	ADEQUATE	ADEQUATE	ADEQUATE

Table 3.7 Pollution Hazard & Mitigation Indices - Residential Parking

Indices	Suspended Solids	Metals	Hydrocarbons
Pollution Hazard	0.5	0.4	0.4
Pollution Mitigation	0.5	0.5	0.6
Treatment Suitability	ADEQUATE	ADEQUATE	ADEQUATE

Table 3.8 Pollution Hazard & Mitigation Indices - Residential Roads

Indices	Suspended Solids	Metals	Hydrocarbons
Pollution Hazard	0.5	0.4	0.4
Pollution Mitigation	0.5	0.5	0.6
Treatment Suitability	ADEQUATE	ADEQUATE	ADEQUATE

4. FOUL WATER DRAINAGE STRATEGY

A 300mm diameter combined sewer is located at the northern extent of the site and a gravity connection to this sewer is possible. The sewer has been surveyed as far as possible. Although generally in good condition there was a stone downstream of the manhole within the site that prevented survey beyond 32m and settled deposits prevented upstream progress beyond 12m. A copy of the drainage survey report is included in Appendix D.

United Utilities were made aware of the debris within the sewer, and we believe this has since been rectified. Regardless the sewer was found to be in serviceable condition and suitable to receive foul drainage from the site.

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Foul drainage design has been undertaken in accordance with the Sewer Construction Guide and building regulations Part H. The system shall be offered for adoption under a Section 104 agreement.

Using the industry standard 4000l / dwelling per day figure for peak flow results in a peak foul flow rate of 0.88 l/s. This can easily be accommodated by the receiving 300mm diameter combined sewer.

For further detail refer to the Drainage Layout Plan included in Appendix A.

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5. CONCLUSIONS AND RECOMMENDATIONS

In consideration of the Drainage Strategy for the proposed development, the following conclusions and recommendations are made:

- The site is located in Flood Zone 1 with a predicted annual probability of flooding from rivers or the sea of less than 0.1% AEP (1 in 1000).
- The site is shown to be at low risk of surface water flooding and does not receive surface flow from off-site.
- Ground investigations undertaken by Geo Environmental Engineering in November 2023 have shown that the underlying ground conditions across the site have poor levels of permeability and are not deemed suitable for an infiltration-based SuDS solution for a development of this scale.
- The existing sloping topography is more suited to an interception and attenuation-based surface water drainage strategy.
- It is proposed that surface water drainage shall be positively drained and attenuated, using a detention basin, with a flow control device restricting discharge.
- The detention basin attenuation system has been sized to contain flows based on a Q100 + 50% storm event.
- Controlled runoff for the development will be restricted to match the pre-development greenfield runoff (QBAR) rate of 6.1 l/s with outfall proposed to the existing surface water drainage ditch in close proximity to the site to replicate existing site conditions.
- In line with the SuDS hierarchy surface water discharge will be via. the nearest existing watercourse/drainage ditch with the proposed connection point located approximately 70m North of the wider field boundary.
- Exceedance flows within the site are directed by the access road back into the basin with additional storage available within the access road and basin freeboard. Exceedance flows from the site are directed towards the cycle path drainage and away from dwellings.
- Foul flows from the site will discharge into the existing 300 dia. public combined sewer crossing site from east to west, along the northern boundary.
- In addition to these measures, a SuDS Operations and Maintenance Plan has been made available detailing future maintenance requirements of all sustainable drainage systems at detailed design stage to suit the finalised development scale and layout. Although the intention is to provide an adoptable surface water drainage system, should UU refuse to adopt a private system shall be used.

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Registered in England & Wales - Company number 04107150

6. REFERENCES

[1] Ministry of Housing, Communities and Local Government, National Planning Policy Framework, July 2021.

[2] Ministry of Housing, Communities and Local Government, Planning Practice Guidance to the National Planning Policy Framework, July 2018.

[3] Defra/Environment Agency, The Town and Country Planning Order 2015, 2015 No.595, April 2015.

[4] British Geological Survey, 2023. Geoindex. http://mapapps2.bgs.ac.uk/geoindex/home.html

[5] Land Information System (LANDIS) - Soilscapes viewer, Accessed December 2023. http://www.landis.org.uk/soilscapes

[6] Defra Magic Maps, 2023. https://magic.defra.gov.uk/MagicMap.aspx. Accessed December

[7] CIRIA, The SuDS Manual, Report C753, 2015.

[8] BS8582:2013, Code of Practice for Surface Water Management, November 2013.

[9] DEFRA/EA, Rainfall Runoff Management for Developments, SC030219, October 2013.

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[11] Centre for Ecology and Hydrology, Flood Estimation Handbook, Vols. 1 – 5 & FEH CD-ROM 3, 2009.

[12] Institute of Hydrology, Flood Studies Report, Volume 1, Hydrological Studies, 1993.

[13] Institute of Hydrology, Flood Studies Supplementary Report No 14 – Review of Regional Growth Curves, August 1983.

[14] Marshall & Bayliss, 1994. Flood Estimation for Small Catchments, Report No. 124 (IoH 124), Institute of Hydrology.

[15] Department for Environment, Food and Rural Affairs, Non-Statutory Technical Standards for Sustainable Drainage Systems, March 2015

[16] Water UK, Design and Construction Guidance for Foul & Surface Water Sewers Offered for Adoption Under the Code for Adoption Agreements for Water and Sewage Companies Operating Wholly or Mainly in England, Approved Version 2.0, March 2020

[17] Hydraulics Research Limited, The Wallingford Procedure, Volume 4, The modified Rational Method, 1981

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Registered in England & Wales - Company number 04107150

APPENDIX A - DRAWINGS

CATCHMENT PLAN

OUTLINE DRAINAGE LAYOUT

TYPICAL DRAINAGE DETAILS

Rev	Description	Date	Revised by	Checked by	Approved
A	Updated to revised site layout plan	19/04/24	TM	TM	TM

Issue Purpose:

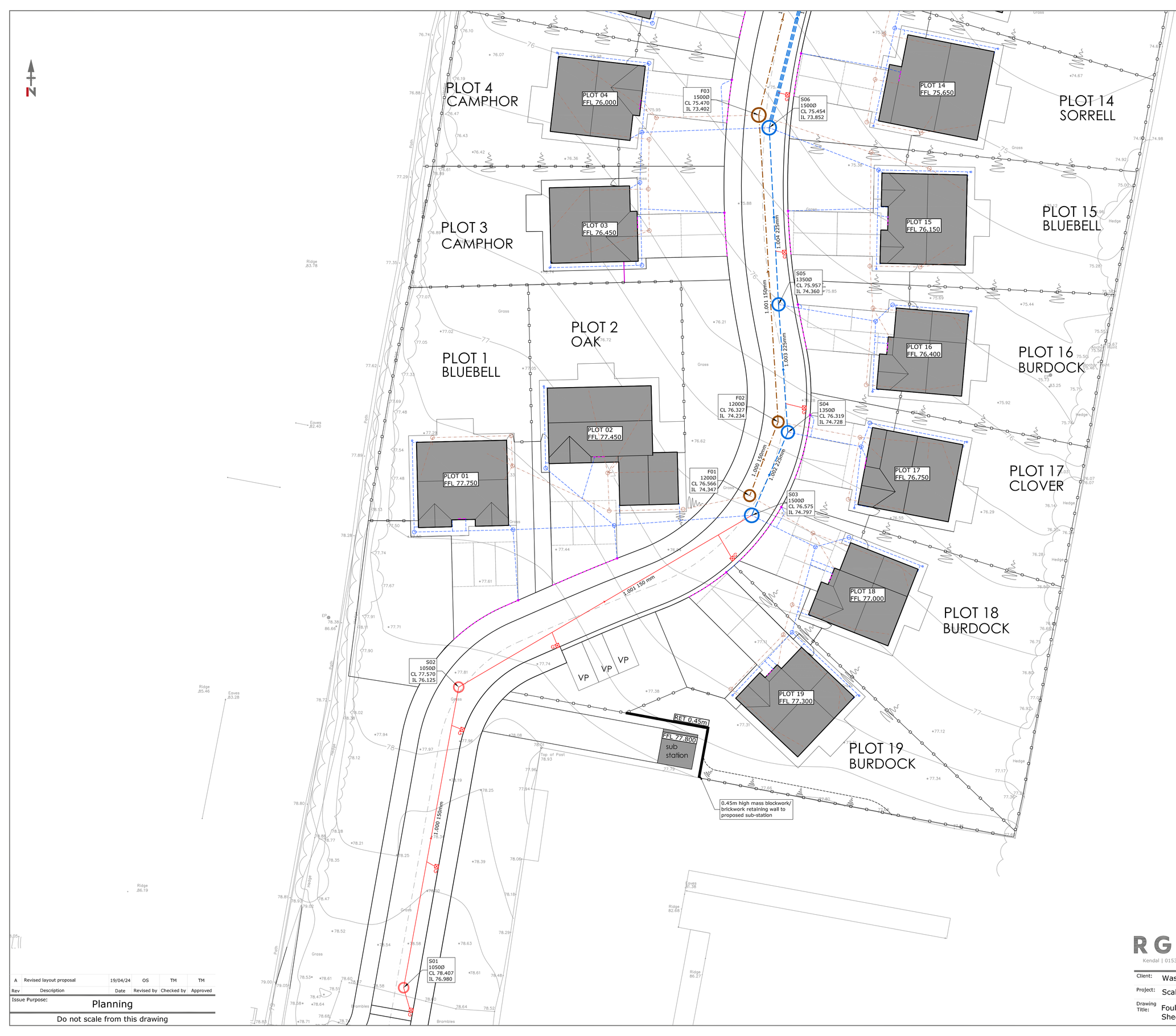
Planning

Do not scale from this drawing

R G PARKINS

Kendal | 01539 729393 Lancaster | 01524 32548

Client:	Washington Homes	Scale @ A1: 1:500	First Issue: 26/01/24	Office of Origin: Kendal	
Project:	Scalegill Road, Moor Row	Drawn by: TM	Checked by: OS	Approved: TM	
Drawing Title:	Surface Water Drainage Catchment Plan	Project No: K40461	Drawing No: 24	Rev: A	
		BIM No: -			



General

1. This drawing should not be scaled - use figured dimensions only. If in doubt, ask.
2. All dimensions are in millimetres unless stated otherwise.
3. This drawing is to be read in conjunction with all relevant Architects drawings as well as all other drawings by RG Parkins (refer to RG Parkins drawing register).
4. The Contractor is responsible for verifying all dimensions on site prior to commencing works.
5. Any specified proprietary products are to be installed in strict accordance with manufacturers guidelines. No specified product should be substituted without gaining approval from RG Parkins.
6. Invert levels shown on all incoming and outgoing pipes for manholes indicate the invert levels at the intersection of the pipes in the centre of the manhole.
7. Connections into the manholes shall be constructed with the soffits level.

Drainage Key

Scale 1:200

- Existing Combined Water Public Sewer
- Existing Surface Water Culvert
- Foul Water Adopted Drainage - S104
- Foul Water Private Drainage
- Surface Water Adopted Drainage - S104
- Surface Water Private Drainage
- Surface Water Private Channel Drain
- Adopted Highways Drainage - S38

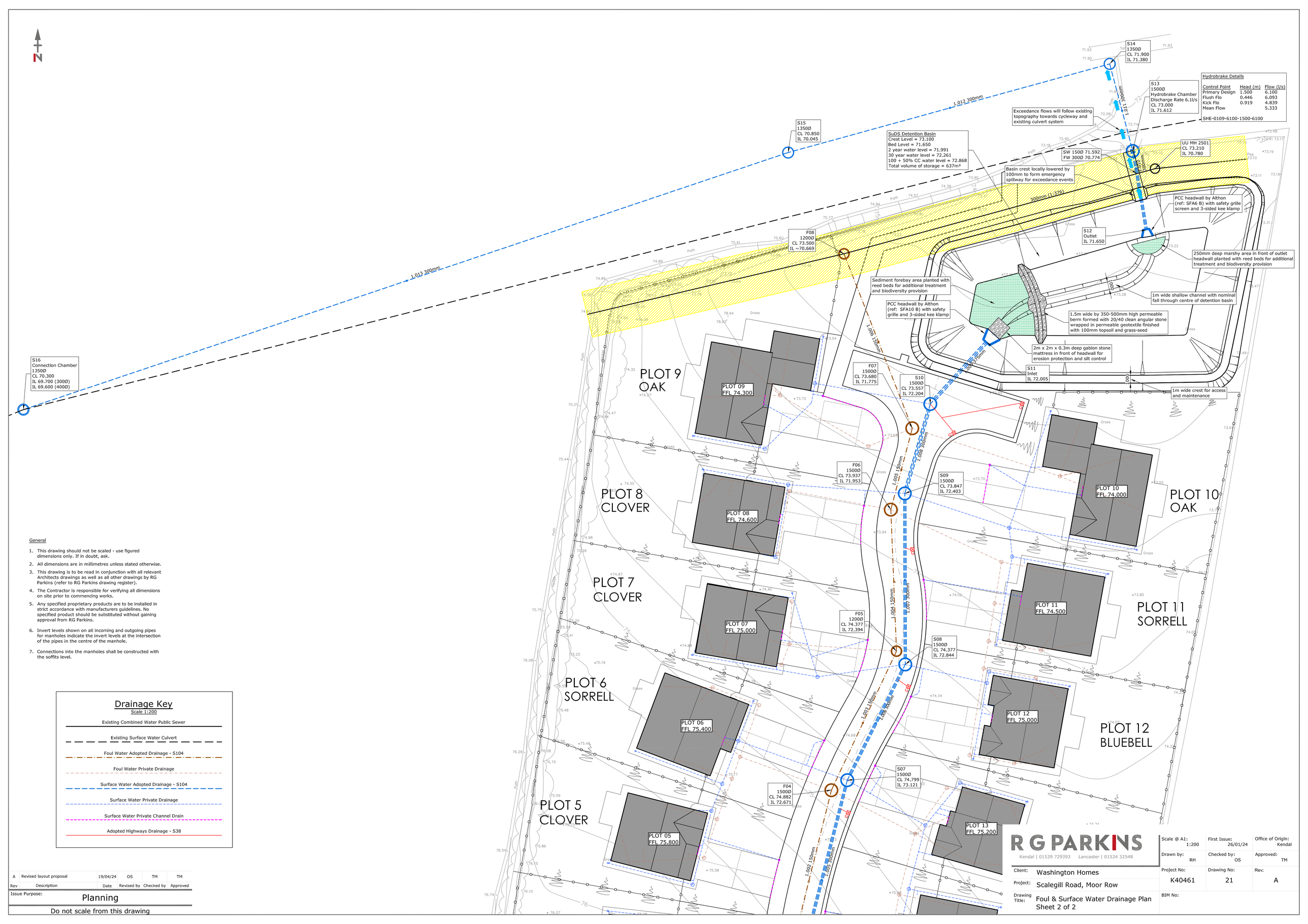
Rev	Description	Date	Revised by	Checked by	Approved
A	Revised layout proposal	19/04/24	OS	TM	TM

Issue Purpose: **Planning**

Do not scale from this drawing

R G PARKINS
Kendal | 01539 729393 Lancaster | 01524 32548

Scale @ A1: 1:200	First Issue: 26/01/24	Office of Origin: Kendal	
Drawn by: RH	Checked by: OS	Approved: TM	
Client: Washington Homes			
Project: Scalegill Road, Moor Row	Project No: K40461	Drawing No: 20	Rev: A
Drawing Title: Foul & Surface Water Drainage Plan Sheet 1 of 2	BIM No:		



General

1. This drawing should not be scaled - use figured dimensions only. If in doubt, ask.
2. All dimensions are in millimetres unless stated otherwise.
3. This drawing is to be read in conjunction with all relevant Architects drawings as well as all other drawings by RG Parkins (refer to RG Parkins drawing register).
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Drainage Key

Scale 1:200

- Existing Combined Water Public Sewer
- Existing Surface Water Culvert
- Foul Water Adopted Drainage - S104
- Foul Water Private Drainage
- Surface Water Adopted Drainage - S104
- Surface Water Private Drainage
- Surface Water Private Channel Drain
- Adopted Highways Drainage - S38

Rev	Description	Date	Revised by	Checked by	Approved
A	Revised layout proposal	19/04/24	OS	TM	TM

Issue Purpose:

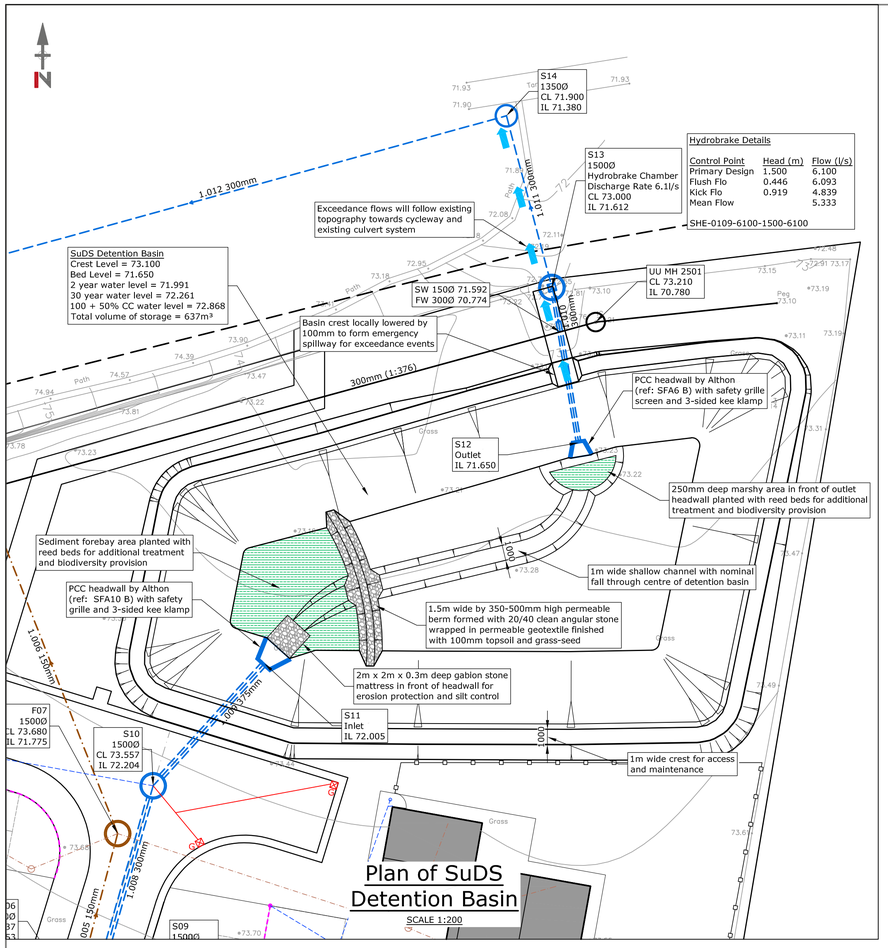
Planning

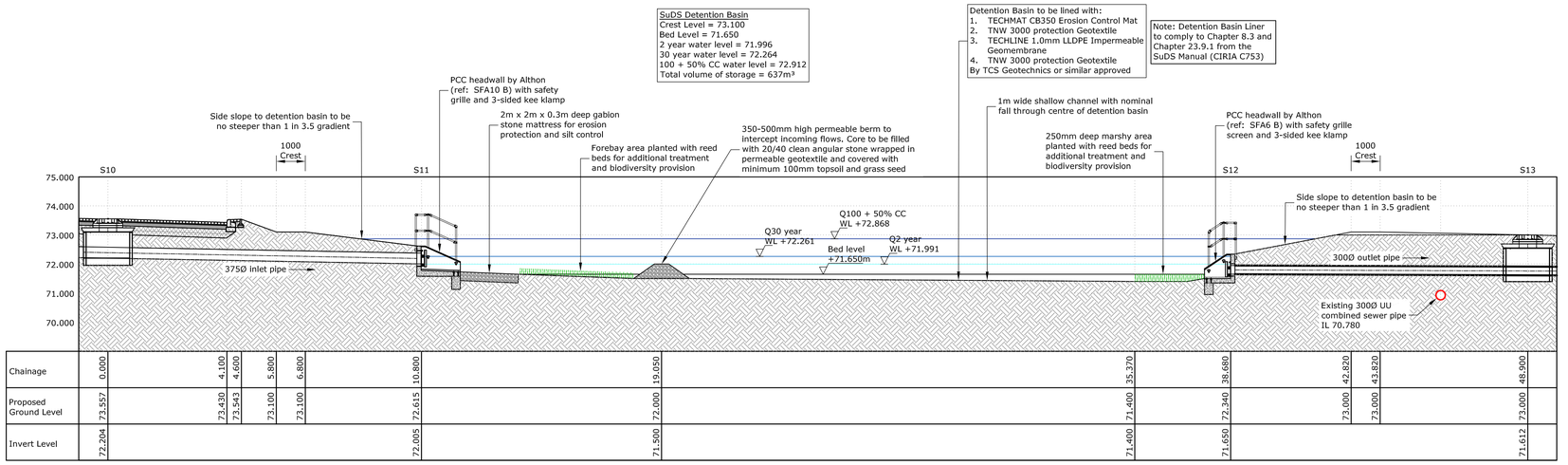
Do not scale from this drawing

R G PARKINS

Kendal | 01539 729393 Lancaster | 01524 32548

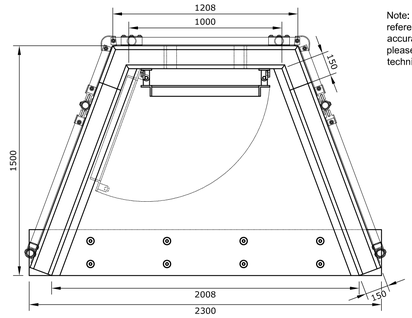
Client:	Washington Homes	Scale @ A1: 1:200	First Issue: 26/01/24	Office of Origin: Kendal	
Project:	Scalegill Road, Moor Row	Drawn by: RH	Checked by: OS	Approved: TM	
Drawing Title:	Foul & Surface Water Drainage Plan Sheet 2 of 2	Project No: K40461	Drawing No: 21	Rev: A	
		BIM No:			



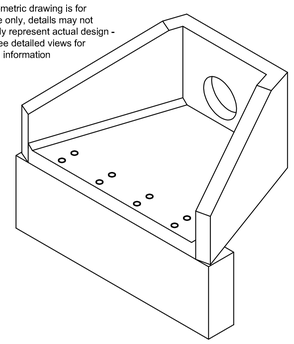


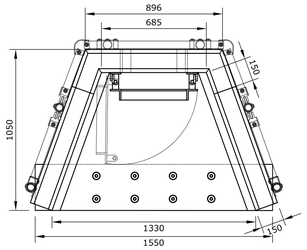
Section Through SuDS Detention Basin

SCALE 1:100

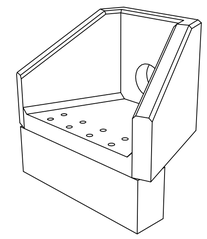


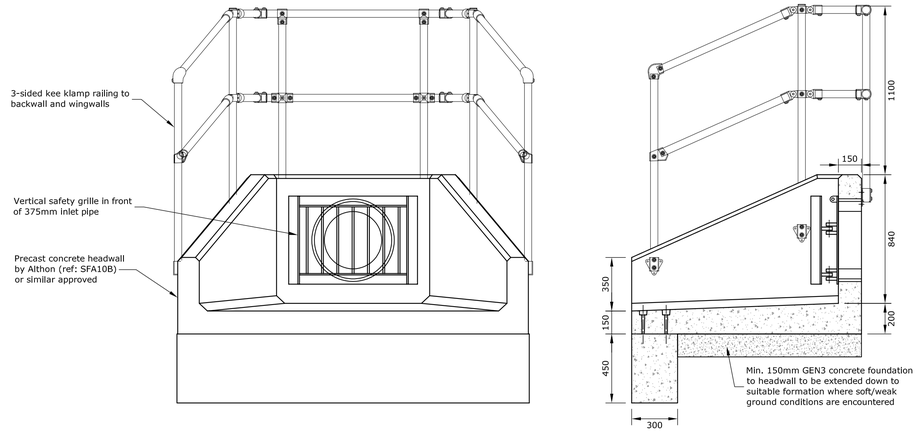
Note: Isometric drawing is for reference only, details may not accurately represent actual design - please see detailed views for technical information





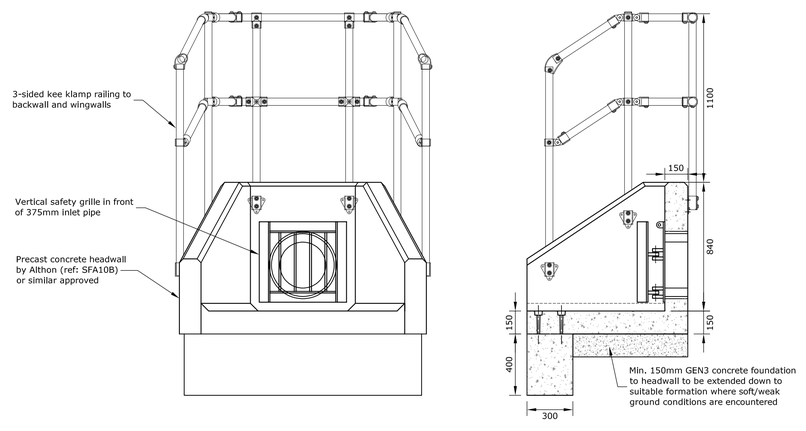
Note: Isometric drawing is for reference only, details may not accurately represent actual design - please see detailed views for technical information





SuDS Detention Basin Inlet Headwall - S11

Scale 1:20



SuDS Detention Basin Outlet Headwall - S12

Scale 1:20

Rev	Description	Date	Revised by	Checked by	Approved
A	Revised layout	19/04/24	OS	TM	OS

Issue Purpose: **Planning**

Do not scale from this drawing

R G PARKINS
Kendal | 01539 729393 Lancaster | 01524 32548

Scale @ A1: As shown	First Issue: 26/01/24	Office of Origin: Kendal	
Drawn by: RH	Checked by: TM	Approved: OS	
Client: Washington Homes	Project No: K40461	Drawing No: 22	Rev: A
Project: Scalegill Road, Moor Row			
Drawing Title: Section Through SuDS Detention Basin & Headwall Details	BIM No:		

APPENDIX B

DRAINAGE SURVEY

Project

Project Name: 2023-06-20460 RG Parkin Scalegill Road Moor Row CA24 3JL
Project Date: 12/07/2023
Inspection Standard: MSCC5 Sewers & Drainage GB (SRM5 Scoring)

R. G. PARKINS & PARTNERS LTD
CONSULTING CIVIL & STRUCTURAL ENGINEERS

Table of Contents

Project Name	Project Number	Project Date
2023-06-20460 RG Parkin Scalegill Road Moor Row CA24 3JL		12/07/2023

Project Information

Project Name	Project Number	Project Date
2023-06-20460 RG Parkin Scalegill Road Moor Row CA24 3JL		12/07/2023

Client

Company: RG Parkin
Department: Meadowside
Street: Shap Road
Town or City: Kendal
Post Code: LA9 6NY

Site

Company: RG Parkin
Street: Scalegill Road
Town or City: Moor Row

Contractor

Company: DRAIN DOCTOR NW
Phone: 08000 266623

DRAIN DOCTOR NW
Tel. 08000 266623

Section Inspection - 07/07/2023 - UU 2501X

Item No.	Insp. No.	Date:	Time:	Client`s Job Ref	Weather	Pre Cleaned	PLR
1	1	07/07/23	16:18	Not Specified	Not Specified	Yes	UU 2501X

Operator	Vehicle	Camera	Preset Length	Legal Status	Alternative ID
Not Specified	Not Specified	Not Specified	Not Specified	Not Specified	Not Specified

Town or Village:	Scale Gill Road	**Inspection Direction:**	Downstream	**Upstream Node:**	UU 2501
Road:	Moor Row	**Inspected Length:**	32.46 m	**Upstream Pipe Depth:**	
Location:		**Total Length:**	32.46 m	**Downstream Node:**	DOWNSTREAM
Surface Type:		**Joint Length:**		**Downstream Pipe Depth:**	

Use:	Combined	**Pipe Shape:**	Circular
Type of Pipe:	Gravity drain/sewer	**Dia/Height:**	300 mm
Flow Control:		**Material:**	Vitrified clay
Year Constructed:	Not Specified	**Lining Type:**	No Lining
Inspection Purpose:	Routine inspection	**Lining Material:**	No Lining

Comments:
Recommendations:

Scale: 1:282

Position [m]		Code	Observation	MPEG	Photo	Grade
0.00		MH	Start node, manhole, reference: UU 2501	00:00:00		
0.00		WL	Water level, 0% of the vertical dimension			
0.00	S01	DES	Settled deposits, fine, 20% cross-sectional area loss, start		UU 2501X_15 25b246-7c	
2.69		JN	Junction at 03 o'clock, 100mm dia	00:00:32		
32.45		OBX	Other obstacles, other object in invert from 04 o'clock to 08 o'clock, 25% cross-sectional area loss: stone ??	00:02:43	UU 2501X_3d 426f73-80	
32.46	F01	DES	Settled deposits, fine, 20% cross-sectional area loss, finish	00:02:43		

Construction Features					Miscellaneous Features				
Structural Defects					Service & Operational Observations				
STR No. Def	**STR Peak**	**STR Mean**	**STR Total**	**STR Grade**	**SER No. Def**	**SER Peak**	**SER Mean**	**SER Total**	**SER Grade**
0	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0

Section Pictures - 07/07/2023 - UU 2501X

Item No.	Inspection Direction	PLR	Client`s Job Ref	Contractor`s Job Ref
1	Downstream	UU 2501X		

UU
2501X_1525b246-7c97-4a47-8638-d2ac21bcdff2_20230712_151704_481.jpg, 0.00 m
Settled deposits, fine, 20% cross-sectional area loss, start

UU
2501X_3d426f73-80a1-4f90-a740-7d70d26a2f4f_20230712_151908_456.jpg, 00:02:43, 32.45 m
Other obstacles, other object in invert from 04 o'clock to 08 o'clock, 25% cross-sectional area loss, stone ??

DRAIN DOCTOR NW
Tel. 08000 266623

Section Inspection - 07/07/2023 - UpstreamX

Item No.	Insp. No.	Date:	Time:	Client`s Job Ref	Weather	Pre Cleaned	PLR
2	1	07/07/23	16:18	Not Specified	Not Specified	Yes	UPSTREAMX

Operator	Vehicle	Camera	Preset Length	Legal Status	Alternative ID
Not Specified	Not Specified	Not Specified	Not Specified	Not Specified	Not Specified

Town or Village:	Scale Gill Road	**Inspection Direction:**	Upstream	**Upstream Node:**	UPSTREAM
Road:	Moor Row	**Inspected Length:**	41.70 m	**Upstream Pipe Depth:**	
Location:		**Total Length:**	41.70 m	**Downstream Node:**	UU 2501
Surface Type:		**Joint Length:**		**Downstream Pipe Depth:**	

Use:	Combined	**Pipe Shape:**	Circular
Type of Pipe:	Gravity drain/sewer	**Dia/Height:**	300 mm
Flow Control:		**Material:**	Vitrified clay
Year Constructed:	Not Specified	**Lining Type:**	No Lining
Inspection Purpose:	Routine inspection	**Lining Material:**	No Lining

Comments:
Recommendations:

Scale: 1:362

Position [m]		Code	Observation	MPEG	Photo	Grade
0.00		MH	Start node, manhole, reference: UU 2501	00:00:00		
0.00		WL	Water level, 0% of the vertical dimension			
0.00	S01	DES	Settled deposits, fine, 10% cross-sectional area loss, start	00:00:27	Upstream X_1f9e9eba-3129-40	
15.48		DES	Settled deposits, fine, 20% cross-sectional area loss	00:01:14	Upstream X_16a7884a-b1a9-4	4
41.64	F01	DES	Settled deposits, fine, 10% cross-sectional area loss, finish	00:00:27		3
41.64		OBX	Other obstacles, other object in invert from 04 o'clock to 08 o'clock, 25% cross-sectional area loss	00:03:03	Upstream X_d0f13ee9-871a-46	5
41.70		SA	Survey abandoned: unable to pass	00:03:05		

Construction Features					Miscellaneous Features				
Structural Defects					Service & Operational Observations				
STR No. Def	**STR Peak**	**STR Mean**	**STR Total**	**STR Grade**	**SER No. Def**	**SER Peak**	**SER Mean**	**SER Total**	**SER Grade**
0	0.0	0.0	0.0	1.0	3	12.0	2.4	99.0	5.0

Section Pictures - 07/07/2023 - UpstreamX

Item No.	Inspection Direction	PLR	Client`s Job Ref	Contractor`s Job Ref
2	Upstream	UPSTREAMX		

UpstreamX_1f9e9eba-3129-4080-a726-869b478841a0_20230712_152033_962.jpg, 00:00:27, 0.00 m
Settled deposits, fine, 10% cross-sectional area loss, start

UpstreamX_16a7884a-b1a9-40ba-a95e-05f619c9b81d_20230712_152100_901.jpg, 00:01:14, 15.48 m
Settled deposits, fine, 20% cross-sectional area loss

UpstreamX_d0f13ee9-871a-4629-ba44-8d6ef983a3a5_20230712_152448_915.jpg, 00:03:03, 41.64 m
Other obstacles, other object in invert from 04 o'clock to 08 o'clock, 25% cross-sectional area loss

DRAIN DOCTOR NW
Tel. 08000 266623

Section Inspection - 07/07/2023 - Culvert 1X

Item No.	Insp. No.	Date:	Time:	Client`s Job Ref	Weather	Pre Cleaned	PLR
3	1	07/07/23	16:19	Not Specified	Not Specified	Yes	CULVERT 1X

Operator	Vehicle	Camera	Preset Length	Legal Status	Alternative ID
Not Specified	Not Specified	Not Specified	Not Specified	Not Specified	Not Specified

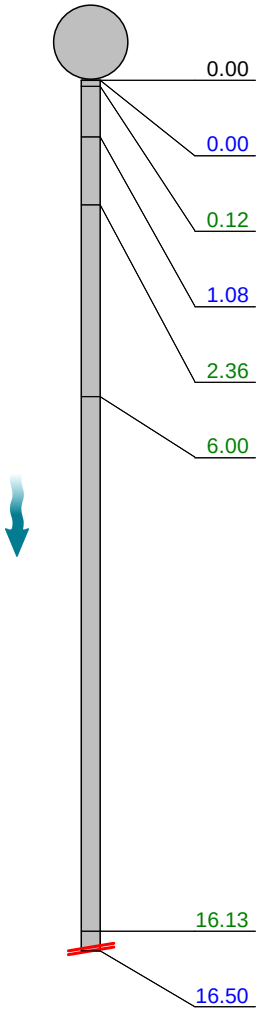
Town or Village:	Scale Gill Road	**Inspection Direction:**	Downstream	**Upstream Node:**	CULVERT 1
Road:	Moor Row	**Inspected Length:**	16.50 m	**Upstream Pipe Depth:**	
Location:		**Total Length:**	16.50 m	**Downstream Node:**	CULVERT 2
Surface Type:		**Joint Length:**		**Downstream Pipe Depth:**	

Use:	Surface water	**Pipe Shape:**	Rectangular		
Type of Pipe:	Gravity drain/sewer	**Dia/Height:**	380 mm	**Width:**	350 mm
Flow Control:		**Material:**	Masonry (random)		
Year Constructed:	Not Specified	**Lining Type:**	No Lining		
Inspection Purpose:	Routine inspection	**Lining Material:**	No Lining		

Comments:
Recommendations:

Scale: 1:143 **Position [m]** **Code** **Observation** **MPEG** **Photo** **Grade**

Depth: m
Culvert 1



Position [m]	Code	Observation	MPEG	Photo	Grade
0.00	OC	Start node, other special chamber, reference: Culvert 1: open pipe	00:00:00		
0.00	WL	Water level, 10% of the vertical dimension	00:00:03		
0.12	DES	Settled deposits, fine, 25% cross-sectional area loss	00:00:13	Culvert 1X_d6dfd373-dab2-4	4
1.08	GP	General photograph taken at this point: connecting culvert from the left ???	00:00:16	Culvert 1X_1094904e-3591-	
2.36	OBX	Other obstacles, other object in invert from 03 o'clock to 07 o'clock, 30% cross-sectional area loss: displaced stone	00:00:21	Culvert 1X_86003402-d99d-	5
6.00	DES	Settled deposits, fine, 15% cross-sectional area loss	00:00:58	Culvert 1X_8f182d66-4aff-4a	3
16.13	DER	Settled deposits, coarse, 40% cross-sectional area loss	00:01:39	Culvert 1X_41f6f3eb-d91f-48	4
16.50	SA	Survey abandoned: unable to pass	00:02:01		

Construction Features					Miscellaneous Features				
Structural Defects					Service & Operational Observations				
STR No. Def	**STR Peak**	**STR Mean**	**STR Total**	**STR Grade**	**SER No. Def**	**SER Peak**	**SER Mean**	**SER Total**	**SER Grade**
0	0.0	0.0	0.0	1.0	4	10.0	1.3	22.0	5.0

Section Pictures - 07/07/2023 - Culvert 1X

Item No.	Inspection Direction	PLR	Client`s Job Ref	Contractor`s Job Ref
3	Downstream	CULVERT 1X		

Culvert
1X_d6dfd373-dab2-499d-98f8-233d747fb44b_20230712_152754_219.jpg, 00:00:13, 0.12 m
Settled deposits, fine, 25% cross-sectional area loss

Culvert
1X_1094904e-3591-43dd-b28d-2fe7ede5a29a_20230712_153001_075.jpg, 00:00:16, 1.08 m
General photograph taken at this point, connecting culvert from the left ???

Culvert
1X_86003402-d99d-4b76-9c86-e92dd74b784f_20230712_152825_223.jpg, 00:00:21, 2.36 m
Other obstacles, other object in invert from 03 o'clock to 07 o'clock, 30% cross-sectional area loss, displaced stone

Culvert
1X_18759280-8c50-49a7-812e-a6b0ab322bbd_20230712_152834_768.jpg, 00:00:21, 2.36 m
Other obstacles, other object in invert from 03 o'clock to 07 o'clock, 30% cross-sectional area loss, displaced stone

Section Pictures - 07/07/2023 - Culvert 1X

Item No.	Inspection Direction	PLR	Client`s Job Ref	Contractor`s Job Ref
3	Downstream	CULVERT 1X		

Culvert
1X_8f182d66-4aff-4aeb-830d-9c08d6412329_20230712_152853_392.jpg, 00:00:58, 6.00 m
Settled deposits, fine, 15% cross-sectional area loss

Culvert
1X_41f6f3eb-d91f-4842-b36a-a9daab8be696_20230712_152917_449.jpg, 00:01:39, 16.13 m
Settled deposits, coarse, 40% cross-sectional area loss

Section Inspection - 07/07/2023 - Culvert 2X

Item No.	Insp. No.	Date:	Time:	Client`s Job Ref	Weather	Pre Cleaned	PLR
4	2	07/07/23	16:24	Not Specified	Not Specified	Yes	CULVERT 2X

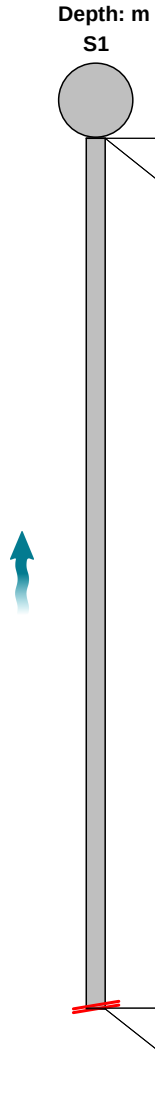
Operator	Vehicle	Camera	Preset Length	Legal Status	Alternative ID
Not Specified	Not Specified	Not Specified	Not Specified	Not Specified	Not Specified

Town or Village:	Scale Gill Road	**Inspection Direction:**	Upstream	**Upstream Node:**	CULVERT 2
Road:	Moor Row	**Inspected Length:**	41.28 m	**Upstream Pipe Depth:**	
Location:		**Total Length:**	41.28 m	**Downstream Node:**	S1
Surface Type:		**Joint Length:**		**Downstream Pipe Depth:**	

Use:	Surface water	**Pipe Shape:**	Circular
Type of Pipe:	Gravity drain/sewer	**Dia/Height:**	400 mm
Flow Control:		**Material:**	Vitrified clay
Year Constructed:	Not Specified	**Lining Type:**	No Lining
Inspection Purpose:	Routine inspection	**Lining Material:**	No Lining

Comments:
Recommendations:

Scale: 1:358



Position [m]	Code	Observation	MPEG	Photo	Grade
0.00	MH	Start node, manhole, reference: S1	00:00:00		
0.00	WL	Water level, 0% of the vertical dimension	00:00:00		
41.27	RM	Roots, mass, 10% cross-sectional area loss	00:03:23		3
41.28	SA	Survey abandoned: unable to pass	00:03:24		

Construction Features					Miscellaneous Features				
Structural Defects					Service & Operational Observations				
STR No. Def	**STR Peak**	**STR Mean**	**STR Total**	**STR Grade**	**SER No. Def**	**SER Peak**	**SER Mean**	**SER Total**	**SER Grade**
0	0.0	0.0	0.0	1.0	1	4.0	0.1	4.0	3.0

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Section Inspection - 07/07/2023 - Culvert 2X

Item No.	Insp. No.	Date:	Time:	Client`s Job Ref	Weather	Pre Cleaned	PLR
4	1	07/07/23	16:19	Not Specified	Not Specified	Yes	CULVERT 2X

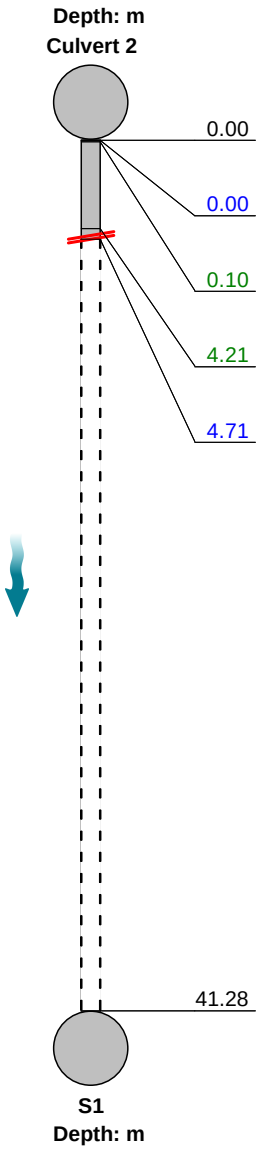
Operator	Vehicle	Camera	Preset Length	Legal Status	Alternative ID
Not Specified	Not Specified	Not Specified	Not Specified	Not Specified	Not Specified

Town or Village:	Scale Gill Road	**Inspection Direction:**	Downstream	**Upstream Node:**	CULVERT 2
Road:	Moor Row	**Inspected Length:**	4.71 m	**Upstream Pipe Depth:**	
Location:		**Total Length:**	41.28 m	**Downstream Node:**	S1
Surface Type:		**Joint Length:**		**Downstream Pipe Depth:**	

Use:	Surface water	**Pipe Shape:**	Circular
Type of Pipe:	Gravity drain/sewer	**Dia/Height:**	400 mm
Flow Control:		**Material:**	Vitrified clay
Year Constructed:	Not Specified	**Lining Type:**	No Lining
Inspection Purpose:	Routine inspection	**Lining Material:**	No Lining

Comments:
Recommendations:

Scale: 1:358



Position [m]	Code	Observation	MPEG	Photo	Grade
0.00	MH	Start node, manhole, reference: Culvert 2	00:00:00		
0.00	WL	Water level, 0% of the vertical dimension	00:00:07		
0.10	DER	Settled deposits, coarse, 15% cross-sectional area loss	00:00:07	Culvert 2X_c420a 4d8-6f79-4	3
4.21	DER	Settled deposits, coarse, 60% cross-sectional area loss	00:00:19	Culvert 2X_3d796 954-06bb-	4
4.71	SA	Survey abandoned: unable to pass	00:00:38		
41.28		End of pipe			

Construction Features					Miscellaneous Features				
Structural Defects					Service & Operational Observations				
STR No. Def	**STR Peak**	**STR Mean**	**STR Total**	**STR Grade**	**SER No. Def**	**SER Peak**	**SER Mean**	**SER Total**	**SER Grade**
0	0.0	0.0	0.0	1.0	2	8.0	2.1	10.0	4.0

Section Pictures - 07/07/2023 - Culvert 2X

Item No.	Inspection Direction	PLR	Client`s Job Ref	Contractor`s Job Ref
4	Downstream	CULVERT 2X		

Culvert
2X_c420a4d8-6f79-4c9a-8500-59d2b430bae7_20230712_153117_352.jpg, 00:00:07, 0.10 m
Settled deposits, coarse, 15% cross-sectional area loss

Culvert
2X_3d796954-06bb-49e0-85b5-42e8f7daafe1_20230712_153133_483.jpg, 00:00:19, 4.21 m
Settled deposits, coarse, 60% cross-sectional area loss

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Section Inspection - 07/07/2023 - S1X

Item No.	Insp. No.	Date:	Time:	Client`s Job Ref	Weather	Pre Cleaned	PLR
5	1	07/07/23	16:27	Not Specified	Not Specified	Yes	S1X

Operator	Vehicle	Camera	Preset Length	Legal Status	Alternative ID
Not Specified	Not Specified	Not Specified	Not Specified	Not Specified	Not Specified

Town or Village:	Scale Gill Road	**Inspection Direction:**	Downstream	**Upstream Node:**	S1
Road:	Moor Row	**Inspected Length:**	85.74 m	**Upstream Pipe Depth:**	
Location:		**Total Length:**	85.74 m	**Downstream Node:**	S1A
Surface Type:		**Joint Length:**		**Downstream Pipe Depth:**	

Use:	Surface water	**Pipe Shape:**	Circular
Type of Pipe:	Gravity drain/sewer	**Dia/Height:**	400 mm
Flow Control:		**Material:**	Vitrified clay
Year Constructed:	Not Specified	**Lining Type:**	No Lining
Inspection Purpose:	Routine inspection	**Lining Material:**	No Lining

Comments:
Recommendations:

Scale: 1:743

Position [m]		Code	Observation	MPEG	Photo	Grade
0.00		MH	Start node, manhole, reference: S1	00:00:00		
41.60	S01	CL	Crack, longitudinal at 01 o'clock, start	00:02:43	S1X_e2f99fed-5821-4776-9c9e	
43.05		RM	Roots, mass, 20% cross-sectional area loss	00:02:48	S1X_45acfc27-6d4f-4806-ab6a-	5
44.50	F01	CL	Crack, longitudinal at 1 o'clock, finish	00:05:17		2 / 2
44.83		RM	Roots, mass, 25% cross-sectional area loss	00:03:05	S1X_3c923e43-07ef-43e7-ab5b	5
61.72		CL	Crack, longitudinal at 11 o'clock	00:04:43	S1X_0da77cd8-fcb1-4675-a079	2 / 2
85.73		SC	Pipe size changes, new size(s), 350mm high, 380mm wide: changes to stone culvert	00:07:12	S1X_467947fe-245f-42d2-9d27	
85.74		SA	Survey abandoned: unable to pass	00:07:12		

Construction Features					Miscellaneous Features				
Structural Defects					Service & Operational Observations				
STR No. Def	**STR Peak**	**STR Mean**	**STR Total**	**STR Grade**	**SER No. Def**	**SER Peak**	**SER Mean**	**SER Total**	**SER Grade**
2	10.0	0.5	40.0	2.0	4	11.0	0.3	24.0	5.0

Section Pictures - 07/07/2023 - S1X

Item No.	Inspection Direction	PLR	Client`s Job Ref	Contractor`s Job Ref
5	Downstream	S1X		

S1X_e2f99fed-5821-4776-9c9e-a2e1b8bafd3b_20230712_153748_131.jpg, 00:02:43, 41.60 m
Crack, longitudinal at 01 o'clock, start

S1X_45acfc27-6d4f-4806-ab6a-398c2d1aa1b4_20230712_153627_751.jpg, 00:02:48, 43.05 m
Roots, mass, 20% cross-sectional area loss

S1X_3c923e43-07ef-43e7-ab5b-b781b3bc5df2_20230712_153641_621.jpg, 00:03:05, 44.83 m
Roots, mass, 25% cross-sectional area loss

S1X_0da77cd8-fcb1-4675-a079-829a03bf0231_20230712_153819_414.jpg, 00:04:43, 61.72 m
Crack, longitudinal at 11 o'clock

Section Pictures - 07/07/2023 - S1X

Item No.	Inspection Direction	PLR	Client`s Job Ref	Contractor`s Job Ref
5	Downstream	S1X		

S1X_467947fe-245f-42d2-9d27-58a3b9efde16_20230712_154112_037.jpg, 00:07:12, 85.73 m
Pipe size changes, new size(s), 350mm high, 380mm wide, changes to stone culvert

Section Inspection - 07/07/2023 - S1aX

Item No.	Insp. No.	Date:	Time:	Client`s Job Ref	Weather	Pre Cleaned	PLR
6	1	07/07/23	16:27	Not Specified	Not Specified	Yes	S1AX

Operator	Vehicle	Camera	Preset Length	Legal Status	Alternative ID
Not Specified	Not Specified	Not Specified	Not Specified	Not Specified	Not Specified

Town or Village:	Scale Gill Road	**Inspection Direction:**	Downstream	**Upstream Node:**	S1A
Road:	Moor Row	**Inspected Length:**	11.26 m	**Upstream Pipe Depth:**	
Location:		**Total Length:**	11.26 m	**Downstream Node:**	S2
Surface Type:		**Joint Length:**		**Downstream Pipe Depth:**	

Use:	Surface water	**Pipe Shape:**	Circular
Type of Pipe:	Gravity drain/sewer	**Dia/Height:**	400 mm
Flow Control:		**Material:**	Vitrified clay
Year Constructed:	Not Specified	**Lining Type:**	No Lining
Inspection Purpose:	Routine inspection	**Lining Material:**	No Lining

Comments:
Recommendations:

Scale: 1:98

Position [m]	Code	Observation	MPEG	Photo	Grade
0.00	MH	Start node, manhole, reference: S1a	00:00:00		
0.00	WL	Water level, 0% of the vertical dimension	00:00:00		
2.60	RF	Roots, fine	00:00:16	S1aX_9d48a358-d887-4d64-8c	
7.80	RF	Roots, fine	00:00:35	S1aX_83cce470-f0bc-443b-b8	
8.25	H	Hole in drain or sewer from 11 o'clock to 01 o'clock	00:00:37	S1aX_454040a4-6254-4383-b5	
11.26	OBX	Other obstacles, other object in invert from 03 o'clock to 09 o'clock, 50% cross-sectional area loss: brick	00:00:46	S1aX_ef45af67-820c-429f-b1a	

Construction Features					Miscellaneous Features				
Structural Defects					Service & Operational Observations				
STR No. Def	STR Peak	STR Mean	STR Total	STR Grade	SER No. Def	SER Peak	SER Mean	SER Total	SER Grade
0	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0

Section Pictures - 07/07/2023 - S1aX

Item No.	Inspection Direction	PLR	Client`s Job Ref	Contractor`s Job Ref
6	Downstream	S1AX		

S1aX_9d48a358-d887-4d64-8c53-e56040260046_20230712_154232_072.jpg, 00:00:16, 2.60 m
Roots, fine

S1aX_83cce470-f0bc-443b-b859-a585f6d0a394_20230712_154244_815.jpg, 00:00:35, 7.80 m
Roots, fine

S1aX_454040a4-6254-4383-b57f-404792e38f38_20230712_154339_036.jpg, 00:00:37, 8.25 m
Hole in drain or sewer from 11 o'clock to 01 o'clock

S1aX_ef45af67-820c-429f-b1af-b6abd90ddd0a_20230712_154306_174.jpg, 00:00:46, 11.26 m
Other obstacles, other object in invert from 03 o'clock to 09 o'clock, 50% cross-sectional area loss, brick

Section Inspection - 07/07/2023 - S1aX

Item No.	Insp. No.	Date:	Time:	Client`s Job Ref	Weather	Pre Cleaned	PLR
6	2	07/07/23	16:19	Not Specified	Not Specified	Yes	S1AX

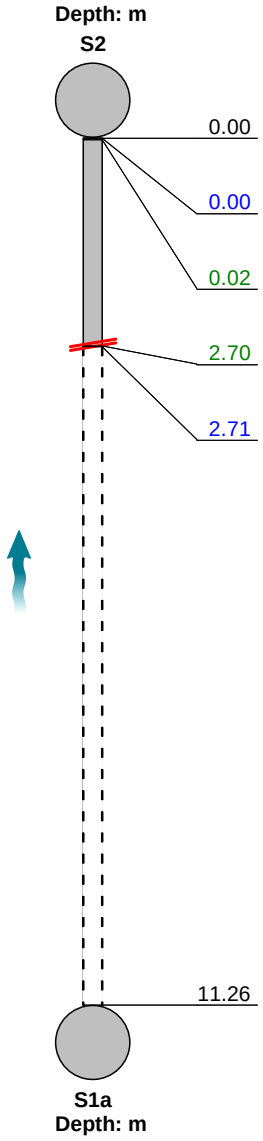
Operator	Vehicle	Camera	Preset Length	Legal Status	Alternative ID
Not Specified	Not Specified	Not Specified	Not Specified	Not Specified	Not Specified

Town or Village:	Scale Gill Road	**Inspection Direction:**	Upstream	**Upstream Node:**	S1A
Road:	Moor Row	**Inspected Length:**	2.71 m	**Upstream Pipe Depth:**	
Location:		**Total Length:**	11.26 m	**Downstream Node:**	S2
Surface Type:		**Joint Length:**		**Downstream Pipe Depth:**	

Use:	Surface water	**Pipe Shape:**	Circular
Type of Pipe:	Gravity drain/sewer	**Dia/Height:**	400 mm
Flow Control:		**Material:**	Vitrified clay
Year Constructed:	Not Specified	**Lining Type:**	No Lining
Inspection Purpose:	Routine inspection	**Lining Material:**	No Lining

Comments:
Recommendations:

Scale: 1:98

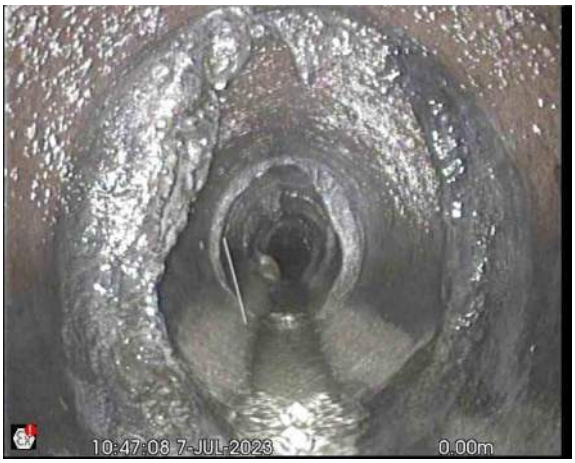


Position [m]	Code	Observation	MPEG	Photo	Grade
0.00	MH	Start node, manhole, reference: S2	00:00:00		
0.00	WL	Water level, 0% of the vertical dimension	00:00:00		
0.02	DEEJ	Attached deposits, encrustation at joint from 12 o'clock to 12 o'clock, 15% cross-sectional area loss	00:00:07	S1aX_74b68c6f-5bdb-4b7e-b4	3
2.70	DEEJ	Attached deposits, encrustation at joint from 12 o'clock to 12 o'clock, 20% cross-sectional area loss	00:00:53	S1aX_85baacd2-e3dc-47e1-ad	3
2.71	SA	Survey abandoned: unable to pass	00:00:53		
11.26		End of pipe			

Construction Features					Miscellaneous Features				
Structural Defects					Service & Operational Observations				
STR No. Def	**STR Peak**	**STR Mean**	**STR Total**	**STR Grade**	**SER No. Def**	**SER Peak**	**SER Mean**	**SER Total**	**SER Grade**
0	0.0	0.0	0.0	1.0	2	2.0	0.4	4.0	3.0

Section Pictures - 07/07/2023 - S1aX

Item No.	Inspection Direction	PLR	Client`s Job Ref	Contractor`s Job Ref
6	Upstream	S1AX		



S1aX_74b68c6f-5bdb-4b7e-b449-aba34dede2d0_20230712_154434_773.jpg, 00:00:07, 0.02 m
Attached deposits, encrustation at joint from 12 o'clock to 12 o'clock, 15% cross-sectional area loss

S1aX_85baacd2-e3dc-47e1-ad39-c863b252ea2d_20230712_154515_279.jpg, 00:00:53, 2.70 m
Attached deposits, encrustation at joint from 12 o'clock to 12 o'clock, 20% cross-sectional area loss

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Section Inspection - 07/07/2023 - S2X

Item No.	Insp. No.	Date:	Time:	Client`s Job Ref	Weather	Pre Cleaned	PLR
7	2	07/07/23	16:23	Not Specified	Not Specified	Yes	S2X

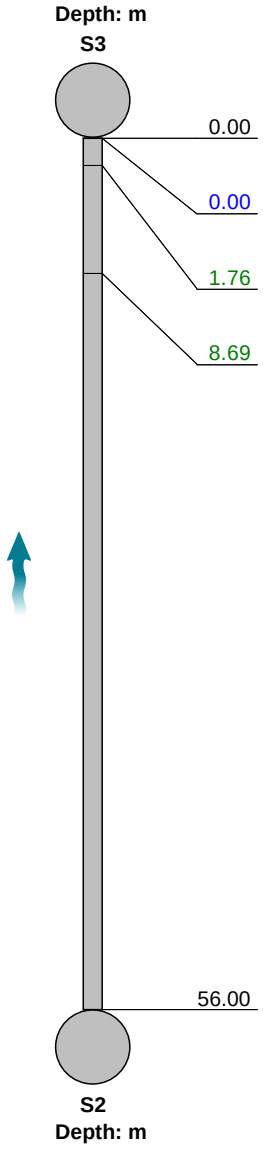
Operator	Vehicle	Camera	Preset Length	Legal Status	Alternative ID
Not Specified	Not Specified	Not Specified	Not Specified	Not Specified	Not Specified

Town or Village:	Scale Gill Road	**Inspection Direction:**	Upstream	**Upstream Node:**	S2
Road:	Moor Row	**Inspected Length:**	56.00 m	**Upstream Pipe Depth:**	
Location:		**Total Length:**	56.00 m	**Downstream Node:**	S3
Surface Type:		**Joint Length:**		**Downstream Pipe Depth:**	

Use:	Surface water	**Pipe Shape:**	Circular
Type of Pipe:	Gravity drain/sewer	**Dia/Height:**	300 mm
Flow Control:		**Material:**	Vitrified clay
Year Constructed:	Not Specified	**Lining Type:**	No Lining
Inspection Purpose:	Routine inspection	**Lining Material:**	No Lining

Comments:
Recommendations:

Scale: 1:485



Position [m]	Code	Observation	MPEG	Photo	Grade
0.00	MH	Start node, manhole, reference: S3	00:00:00		
0.00	WL	Water level, 5% of the vertical dimension	00:00:08		
1.76	DEEJ	Attached deposits, encrustation at joint from 12 o'clock to 12 o'clock, 10% cross-sectional area loss	00:00:16	S2X_005f 8f51-6fc4-4540-8758	3
8.69	RT	Roots, tap: seen in survey from other direction	00:00:46		4
56.00	MHF	Finish node, manhole, reference: S2	00:04:13		

Construction Features					Miscellaneous Features				
Structural Defects					Service & Operational Observations				
STR No. Def	**STR Peak**	**STR Mean**	**STR Total**	**STR Grade**	**SER No. Def**	**SER Peak**	**SER Mean**	**SER Total**	**SER Grade**
0	0.0	0.0	0.0	1.0	2	5.0	0.1	7.0	4.0

Section Pictures - 07/07/2023 - S2X

Item No.	Inspection Direction	PLR	Client`s Job Ref	Contractor`s Job Ref
7	Upstream	S2X		

S2X_005f8f51-6fc4-4540-8758-8f36a8146638_20230712_155007_199.jpg, 00:00:16, 1.76 m
Attached deposits, encrustation at joint from 12 o'clock to 12 o'clock, 10% cross-sectional area loss

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Section Inspection - 07/07/2023 - S2X

Item No.	Insp. No.	Date:	Time:	Client`s Job Ref	Weather	Pre Cleaned	PLR
7	1	07/07/23	16:21	Not Specified	Not Specified	Yes	S2X

Operator	Vehicle	Camera	Preset Length	Legal Status	Alternative ID
Not Specified	Not Specified	Not Specified	Not Specified	Not Specified	Not Specified

Town or Village:	Scale Gill Road	**Inspection Direction:**	Downstream	**Upstream Node:**	S2
Road:	Moor Row	**Inspected Length:**	46.44 m	**Upstream Pipe Depth:**	
Location:		**Total Length:**	56.00 m	**Downstream Node:**	S3
Surface Type:		**Joint Length:**		**Downstream Pipe Depth:**	

Use:	Surface water	**Pipe Shape:**	Circular
Type of Pipe:	Gravity drain/sewer	**Dia/Height:**	300 mm
Flow Control:		**Material:**	Vitrified clay
Year Constructed:	Not Specified	**Lining Type:**	No Lining
Inspection Purpose:	Routine inspection	**Lining Material:**	No Lining

Comments:
Recommendations:

Scale: 1:485

Position [m]	Code	Observation	MPEG	Photo	Grade
0.00	MH	Start node, manhole, reference: S2	00:00:00		
0.00	WL	Water level, 5% of the vertical dimension	00:00:06		
0.00	DEEJ	Attached deposits, encrustation at joint from 12 o'clock to 12 o'clock, 25% cross-sectional area loss: thorughout pipe	00:00:32	S2X_d35bcb8c-475d-49be-a2d	4
46.43	RT	Roots, tap	00:03:35	S2X_97c2849a-d9bb-4510-8ab	4
46.44	SA	Survey abandoned: unable to pass	00:03:52		
56.00		End of pipe			

Construction Features					Miscellaneous Features				
Structural Defects					Service & Operational Observations				
STR No. Def	**STR Peak**	**STR Mean**	**STR Total**	**STR Grade**	**SER No. Def**	**SER Peak**	**SER Mean**	**SER Total**	**SER Grade**
0	0.0	0.0	0.0	1.0	2	5.0	0.2	10.0	4.0

Section Pictures - 07/07/2023 - S2X

Item No.	Inspection Direction	PLR	Client`s Job Ref	Contractor`s Job Ref
7	Downstream	S2X		

S2X_d35bcb8c-475d-49be-a2de-f415b27af1f6_20230712_154751_477.jpg, 00:00:32, 0.00 m
Attached deposits, encrustation at joint from 12 o'clock to 12 o'clock, 25% cross-sectional area loss, thorughout pipe

S2X_97c2849a-d9bb-4510-8ab3-7ec4e5bc6d6d_20230712_154840_160.jpg, 00:03:35, 46.43 m
Roots, tap

Section Inspection - 07/07/2023 - S3X

Item No.	Insp. No.	Date:	Time:	Client`s Job Ref	Weather	Pre Cleaned	PLR
8	1	07/07/23	16:22	Not Specified	Not Specified	Yes	S3X

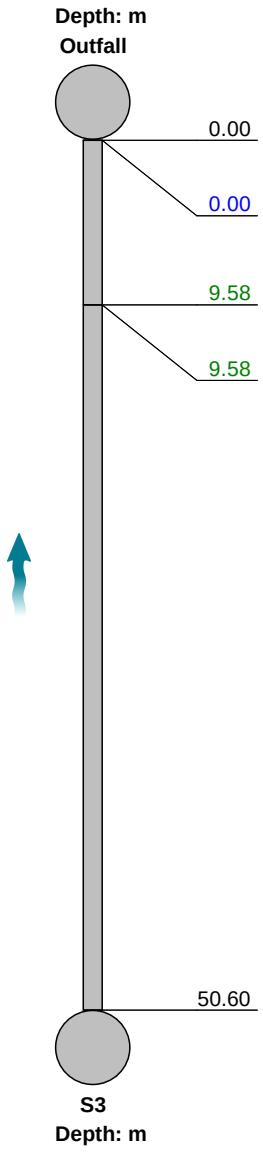
Operator	Vehicle	Camera	Preset Length	Legal Status	Alternative ID
Not Specified	Not Specified	Not Specified	Not Specified	Not Specified	Not Specified

Town or Village:	Scale Gill Road	**Inspection Direction:**	Upstream	**Upstream Node:**	S3
Road:	Moor Row	**Inspected Length:**	50.60 m	**Upstream Pipe Depth:**	
Location:		**Total Length:**	50.60 m	**Downstream Node:**	OUTFALL
Surface Type:		**Joint Length:**		**Downstream Pipe Depth:**	

Use:	Surface water	**Pipe Shape:**	Circular
Type of Pipe:	Gravity drain/sewer	**Dia/Height:**	400 mm
Flow Control:		**Material:**	Vitrified clay
Year Constructed:	Not Specified	**Lining Type:**	No Lining
Inspection Purpose:	Routine inspection	**Lining Material:**	No Lining

Comments:
Recommendations:

Scale: 1:439



Position [m]	Code	Observation	MPEG	Photo	Grade
0.00	MH	Start node, manhole, reference: Outfall	00:00:00		
0.00	WL	Water level, 15% of the vertical dimension	00:00:03		
9.58	DEEJ	Attached deposits, encrustation at joint from 12 o'clock to 12 o'clock, 10% cross-sectional area loss: Through out length of pipe	00:00:48	S3X_f002 6768-a756 -481a-961	3
9.58	IDJ	Infiltration, dripping at joint at 12 o'clock: through out pipe	00:00:48	S3X_7876 0974-7af3- 4e6e-be33	
50.60	MHF	Finish node, manhole, reference: S3	00:03:54		

Construction Features					Miscellaneous Features				
Structural Defects					Service & Operational Observations				
STR No. Def	**STR Peak**	**STR Mean**	**STR Total**	**STR Grade**	**SER No. Def**	**SER Peak**	**SER Mean**	**SER Total**	**SER Grade**
0	0.0	0.0	0.0	1.0	1	2.0	0.0	2.0	3.0

Section Pictures - 07/07/2023 - S3X

Item No.	Inspection Direction	PLR	Client`s Job Ref	Contractor`s Job Ref
8	Upstream	S3X		

S3X_f0026768-a756-481a-9617-00cbd74a359b_20230712_155246_863.jpg, 00:00:48, 9.58 m
Attached deposits, encrustation at joint from 12 o'clock to 12 o'clock, 10% cross-sectional area loss, Through out length of pipe

S3X_78760974-7af3-4e6e-be33-efc7330ed7c5_20230712_155451_998.jpg, 00:00:48, 9.58 m
Infiltration, dripping at joint at 12 o'clock, through out pipe

3 - BOX CULVERT CHANGES TO PIPE

Issues

ETL

Victoria Villa

Alva House

CULVERT 2

CULVERT 1

Cycle Path

Post

77

MARK 3

MARK 2

MARK 1

2501

2502

1501

300 VC

S1A

S1

S2

S3

0401

9400

Path (um)

4502

4501

375 CO

300 CO

2401

3401

4402

Allotment Gardens

Lo-bracken

Clarack House

Club

Playground

Car Park

72.9m

78.6m

LB

8303

8302

8308

Westgarth

8307

Janmar

Raeanda

8305

8304

225 VC

GALEGILL PLACE

Scalegill

2301

3302

3303

Moor Row Community Primary School

Hall

PENZANCE STREET

3301

3207

3201

4308

4305

4301

4303

4302

4304

4310

4306

4307

4309

Moor

MANHOLE RECORD CHART

REFERENCE MH UU2501 DATE 07/07/2023

LOCATION RG Parkin Scalegill Road Moor Row

CARRIAGEWAY [ ] FOOTPATH [ ] VERGE [ ] OUTSIDE HIGHWAY BOUNDARY [✓]

COVER SHAPE [✓] [ ] [ ] [ ] [ ] [ ] OTHER _____

HEAVY DUTY [✓] MEDIUM DUTY [ ] LIGHT DUTY [ ] SIZE 500 dia

COVER CONDITION OK [✓] ATTENTION REQUIRED [ ] _____

CHAMBER

REGULATING COURSE	OK	X	ATTENTION REQUIRED			
SHAFT	OK	x	ATTENTION REQUIRED		SIZE	
CHAMBER	OK	✓	ATTENTION REQUIRED		SIZE	1100 x 1000
BENCHING / CHANNEL	OK	✓	ATTENTION REQUIRED			
STEP IRONS / LADDER	OK	✓	ATTENTION REQUIRED			

CONSTRUCTION

BRICK [✓] PRECAST [ ] INSITU CONC. [ ] BOLTED SEC. [ ] OTHER [ ] _____

SERVICE

SILT / DEBRIS [ ] DEPTH _____ mm INFILTRATION [ ] VERMIN [ ]

SURCHARGE EVIDENT [ ] DEPTH _____ mm TOXIC ATMOSPHERE [ ]

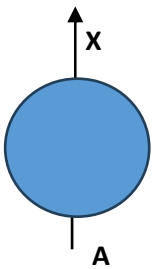
USE

FOUL [ ] SURFACE WATER [✓] COMBINED [ ] WATERCOURSE [ ] T/EFFLUENT [ ]

CHAMBER CONTENT	INCOMING PIPES				
(I) PIPE	A	B	C	D	E
(II) DEPTH TO INV. (mm)	2550				
(III) SIZE (mm)	300				
(IV) SHAPE	O				
)(V) BACKDROP (mm)					

OUTGOING PIPES		
X	Y	Z
2560		
300		
O		

DETAILS



LOCATION

COMMENTS

Disclaimer: Condition Survey – to be used as a guide only

SHEET NO.	JOB NO.	SURVEYOR

APPENDIX C - CALCULATIONS

PRE-DEVELOPMENT RUNOFF

LIVE DESIGN CALCULATIONS

TREATMENT CALCULATIONS

R G PARKINS
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Email: office@rgparkinslancaster.co.uk

Wallingford Runoff Estimation	Job Number K40461	Page Number 1 of 4
	Calc by OS	Check by
Scalegill Road Moor Row	Date 27/11/2023	Revised

DESIGN BASIS MEMORANDUM - PEAK RATE OF RUN-OFF CALCULATION

Design Brief

The following peak rate of run-off calculations have been undertaken to determine changes in peak flow resulting from the development of a greenfield or brownfield site. These calculations are for the **Peak Rate of Run-Off** requirements only.

Background Information & References

The site area **is less than** 200ha and the Greenfield (pre-development) calculation has been undertaken in accordance with methodology described by Marshall & Bayliss, Institute of Hydrology, Report No. 124, Flood Estimation for Small Catchments, 1994 (IoH 124).

In addition, the following references have been used in the preparation of these calculations:

- Interim Code of Practice for Sustainable Drainage Systems (SUDS), CIRIA, 2004
- CIRIA, The SUDS Manual, Report C753, 2015
- Designing for Exceedance in Urban Drainage - good practice, CIRIA Report C635, 2006
- Flood Estimation Handbook (FEH)
- Flood Studies Report (FSR), Volume 1, Hydrological Studies, 1993
- Flood Studies Supplementary Report No 2 (FSSR2), The Estimation of Low Return Period Floods
- Flood Studies Supplementary Report No 14 (FSSR14), Review of Regional Growth Curves, 1983
- Planning Practice guidance of the National Planning Policy Framework, Recommended national precautionary sensitivity ranges for peak rainfall intensities, peak river flows, offshore wind speeds and wave heights.

Proposed Land Use Changes

Changes to the existing site are as follows:

Greenfield Site to Brownfield Site

Results Summary

Rate of Run-Off (l/s)	
Event	**Greenfield**
Q1	5.3
QBAR	6.1
Q10	8.4
Q30	10.3
Q100	12.6
Q100 + 50% CC	19.0

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Wallingford Runoff Estimation	Job Number K40461	Page Number 2 of 4
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SITE AREAS (LAND COVER AREAS)

Existing Impermeable & Permeable Land Cover

Total Site Area: **1.5352** ha **15352** m²

Existing Impermeable & Permeable Land Cover

Land Cover	Area		Percentage of total site area
	m²	ha	
Total impermeable area	0.0	0.000	0%
Remaining permeable area	15352.0	1.535	100%

Proposed Land Cover Areas

Land Cover	Area		Percentage of total site area
	m²	ha	
Total housing roof area	1956	0.196	13%
Total road, parking and paved area	3889	0.389	25%
Basin	794	0.079	5%
Garden & landscaped areas	8712.8	0.871	57%

1.0

Proposed Impermeable & Permeable Land Cover

Land Cover	Area		Percentage of total site area
	m²	ha	
Total impermeable area	5845.2	1.535	38%
Remaining permeable area	8712.8	0.871	57%

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Wallingford Runoff Estimation	Job Number K40461	Page Number 3 of 4
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Scalegill Road Moor Row	Date 27/11/2023	Revised

ESTIMATION OF QBAR (RURAL) (GREENFIELD RUNOFF RATE)

IoH 124 based on research on small catchments < 25 km2

Method is based on regression analysis of response times
using catchments from 0.9 to 22.9 km^2

$QBAR_{rural}$ is mean annual flood on rural catchment
$QBAR_{rural}$ depends on SOIL, SAAR and AREA most significantly

$QBAR_{rural} = 0.00108 \times AREA^{0.89} \times SAAR^{1.17} \times SOIL^{2.17}$

For SOIL refer to FSR Vol 1, Section 4.2.3 and 4.2.6 and IoH 124

Contributing watershed area

Area, A	=	500000	m^2	insert 50 ha for EA
	=	0.500	km^2	small catchment method
	=	50.000	ha	

SAAR = **1210** mm — From FEH Web Service (point data)

Soil index based on soil type, SOIL

$$= \frac{(0.1S1+0.3S2+0.37S3+0.47S4+0.53S5)}{(S1+S2+S3+S4+S5)}$$

Where: S1	=		%
S2	=		%
S3	=		%
S4	=	**100**	%
S5	=		%
		100	%

UK Suds website provides a value of 4 based on the equivalent Host value. This seems reasonable based on ground investigation.

So, SOIL = **0.47**

Note: for very small catchments it is far better to rely on local site investigation information.

$QBAR_{rural}$	=	0.458	m^3/s
	=	458.0	l/s

Small rural catchments less than 50 ha
The Environment Agency recommends that this method should be used for development sizes from 0 to 50 ha and should linearly interpolate the formula to 50 ha.

So, catchment size	=	**6639**	m^2	Excluding significant open space which would remain disconnected from the positive drainage system during flood events.
	=	0.007	km^2	
	=	0.664	ha	
$QBAR_{rural\ site}$	=	0.00608	m^3/s	
	=	**6.1**	l/s	

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Wallingford Runoff Estimation	Job Number K40461	Page Number 4 of 4
	Calc by OS	Check by
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GREENFIELD RETURN PERIOD ORDINATES

QBAR can be factored by the UK FSR regional growth curves for return periods <2 years and for all other return periods to obtain peak flow estimates for required return periods.

These regional growth curves are constant throughout a region, whatever the catchment type and size.

See Table 2.39 for region curve ordinates
Use FSSR2 Growth Curves to estimate Qbar

Reference- Pg 173-FSR V.1, ch 2.6.2

Region = **10**

Use Figure A1.1 to determine region

GREENFIELD RETURN PERIOD FLOW RATES

Return Period	Ordinate	Q (l/s)
1	0.87	5.29
2	0.93	5.66
5	1.19	7.24
10	1.38	8.39
25	1.64	9.97
30	1.7	10.34
50	1.85	11.25
100	2.08	12.65
200	2.32	14.11
500	2.73	16.60
1000	3.04	18.49

Ordinate from FSSR2

Interpolation taken from Figure 24.2 (pg 515) SuDS Manual

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
S01	0.038	5.00	78.407	1050	300139.914	514321.910	1.427
S02	0.044	5.00	77.570	1050	300146.227	514356.385	1.445
S03	0.093	5.00	76.575	1500	300179.845	514376.090	1.853
S04	0.033	5.00	76.319	1350	300183.994	514385.622	1.666
S05	0.032	5.00	75.957	1350	300182.923	514400.283	1.672
S06	0.085	5.00	75.454	1500	300181.847	514420.544	1.677
S07	0.096	5.00	74.799	1500	300188.324	514445.954	1.678
S08	0.053	5.00	74.377	1500	300195.787	514460.837	1.533
S09	0.073	5.00	73.847	1500	300195.726	514482.824	1.369
S10	0.030	5.00	73.557	1500	300199.007	514494.327	1.353
S11 inlet	0.000	5.00	73.100		300208.950	514505.286	1.400
S12	0.083	5.00	73.100		300225.837	514523.267	1.450
S13			73.000	1500	300225.194	514526.275	1.388
S14			71.900	1350	300222.071	514538.058	0.520
S15			70.850	1350	300180.727	514526.663	0.805
S16			70.300	1350	300082.385	514493.606	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	S01	S02	35.048	0.600	76.980	76.125	0.855	41.0	150	5.37	50.0
1.001	S02	S03	38.967	0.600	76.125	74.872	1.253	31.1	150	5.73	50.0
1.002	S03	S04	10.396	0.600	74.722	74.653	0.069	150.3	225	5.89	50.0
1.003	S04	S05	14.700	0.600	74.653	74.285	0.368	40.0	225	6.01	50.0
1.004	S05	S06	20.290	0.600	74.285	73.778	0.507	40.0	225	6.17	50.0
1.005	S06	S07	26.223	0.600	73.777	73.121	0.656	40.0	300	6.35	50.0
1.006	S07	S08	16.649	0.600	73.121	72.844	0.277	60.0	300	6.48	50.0
1.007	S08	S09	21.987	0.600	72.844	72.478	0.366	60.0	300	6.67	50.0
1.008	S09	S10	11.962	0.600	72.478	72.279	0.199	60.0	300	6.76	50.0
1.009	S10	S11 inlet	14.797	0.600	72.204	72.005	0.199	74.4	375	6.88	50.0
1.010	S12	S13	3.076	0.600	71.650	71.612	0.038	80.0	300	5.03	50.0
1.011	S13	S14	12.190	0.600	71.612	71.380	0.232	52.5	300	5.12	50.0
1.012	S14	S15	42.886	0.600	71.380	70.045	1.335	32.1	300	5.38	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
1.000	1.576	27.9	9.3	1.277	1.295	0.038	0.0
1.001	1.811	32.0	20.0	1.295	1.553	0.082	0.0
1.002	1.064	42.3	42.7	1.628	1.441	0.175	0.0
1.003	2.074	82.5	50.7	1.441	1.447	0.208	0.0
1.004	2.074	82.5	58.5	1.447	1.451	0.240	0.0
1.005	2.493	176.2	79.3	1.377	1.378	0.325	0.0
1.006	2.033	143.7	102.7	1.378	1.233	0.421	0.0
1.007	2.033	143.7	115.6	1.233	1.069	0.474	0.0
1.008	2.033	143.7	133.4	1.069	0.978	0.547	0.0
1.009	2.103	232.3	140.8	0.978	0.720	0.577	0.0
1.010	1.759	124.3	20.2	1.150	1.088	0.083	0.0
1.011	2.173	153.6	20.2	1.088	0.220	0.083	0.0
1.012	2.783	196.7	20.2	0.220	0.505	0.083	0.0

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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)
1.013	S15	S16	103.749	0.600	70.045	69.700	0.345	300.7	300	7.30	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
1.013	0.901	63.7	20.2	0.505	0.300	0.083	0.0

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	35.048	41.0	150	Circular	78.407	76.980	1.277	77.570	76.125	1.295
1.001	38.967	31.1	150	Circular	77.570	76.125	1.295	76.575	74.872	1.553
1.002	10.396	150.3	225	Circular	76.575	74.722	1.628	76.319	74.653	1.441
1.003	14.700	40.0	225	Circular	76.319	74.653	1.441	75.957	74.285	1.447
1.004	20.290	40.0	225	Circular	75.957	74.285	1.447	75.454	73.778	1.451
1.005	26.223	40.0	300	Circular	75.454	73.777	1.377	74.799	73.121	1.378
1.006	16.649	60.0	300	Circular	74.799	73.121	1.378	74.377	72.844	1.233
1.007	21.987	60.0	300	Circular	74.377	72.844	1.233	73.847	72.478	1.069
1.008	11.962	60.0	300	Circular	73.847	72.478	1.069	73.557	72.279	0.978
1.009	14.797	74.4	375	Circular	73.557	72.204	0.978	73.100	72.005	0.720
1.010	3.076	80.0	300	Circular	73.100	71.650	1.150	73.000	71.612	1.088
1.011	12.190	52.5	300	Circular	73.000	71.612	1.088	71.900	71.380	0.220
1.012	42.886	32.1	300	Circular	71.900	71.380	0.220	70.850	70.045	0.505
1.013	103.749	300.7	300	Circular	70.850	70.045	0.505	70.300	69.700	0.300

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	S01	1050	Manhole	Adoptable	S02	1050	Manhole	Adoptable
1.001	S02	1050	Manhole	Adoptable	S03	1500	Manhole	Adoptable
1.002	S03	1500	Manhole	Adoptable	S04	1350	Manhole	Adoptable
1.003	S04	1350	Manhole	Adoptable	S05	1350	Manhole	Adoptable
1.004	S05	1350	Manhole	Adoptable	S06	1500	Manhole	Adoptable
1.005	S06	1500	Manhole	Adoptable	S07	1500	Manhole	Adoptable
1.006	S07	1500	Manhole	Adoptable	S08	1500	Manhole	Adoptable
1.007	S08	1500	Manhole	Adoptable	S09	1500	Manhole	Adoptable
1.008	S09	1500	Manhole	Adoptable	S10	1500	Manhole	Adoptable
1.009	S10	1500	Manhole	Adoptable	S11 inlet		Junction	
1.010	S12		Junction		S13	1500	Manhole	Adoptable
1.011	S13	1500	Manhole	Adoptable	S14	1350	Manhole	Adoptable
1.012	S14	1350	Manhole	Adoptable	S15	1350	Manhole	Adoptable
1.013	S15	1350	Manhole	Adoptable	S16	1350	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S01	300139.914	514321.910	78.407	1.427	1050				
						0	1.000	76.980	150

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Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S02	300146.227	514356.385	77.570	1.445	1050	1	1.000	76.125	150
									
						0	1.001	76.125	150
S03	300179.845	514376.090	76.575	1.853	1500	1	1.001	74.872	150
									
						0	1.002	74.722	225
S04	300183.994	514385.622	76.319	1.666	1350	1	1.002	74.653	225
									
						0	1.003	74.653	225
S05	300182.923	514400.283	75.957	1.672	1350	1	1.003	74.285	225
									
						0	1.004	74.285	225
S06	300181.847	514420.544	75.454	1.677	1500	1	1.004	73.778	225
									
						0	1.005	73.777	300
S07	300188.324	514445.954	74.799	1.678	1500	1	1.005	73.121	300
									
						0	1.006	73.121	300
S08	300195.787	514460.837	74.377	1.533	1500	1	1.006	72.844	300
									
						0	1.007	72.844	300
S09	300195.726	514482.824	73.847	1.369	1500	1	1.007	72.478	300
									
						0	1.008	72.478	300
S10	300199.007	514494.327	73.557	1.353	1500	1	1.008	72.279	300
									
						0	1.009	72.204	375
S11 inlet	300208.950	514505.286	73.100	1.400		1	1.009	72.005	375
									
S12	300225.837	514523.267	73.100	1.450					
						0	1.010	71.650	300
S13	300225.194	514526.275	73.000	1.388	1500	1	1.010	71.612	300
									
						0	1.011	71.612	300
S14	300222.071	514538.058	71.900	0.520	1350	1	1.011	71.380	300
									
						0	1.012	71.380	300

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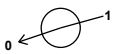
Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S15	300180.727	514526.663	70.850	0.805	1350	1	1.012	70.045	300
									
						0	1.013	70.045	300
S16	300082.385	514493.606	70.300	0.600	1350	1	1.013	69.700	300
									

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Detailed	Additional Storage (m³/ha)	20.0
Summer CV	0.830	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	0.900	Drain Down Time (mins)	240	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160
30	120	240	480	720	1440	2880

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	0	0	0
100	50	0	0

Node S13 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	71.612	Product Number	CTL-SHE-0109-6100-1500-6100
Design Depth (m)	1.500	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	6.1	Min Node Diameter (mm)	1200

Node S12 Offline Weir Control

Flap Valve	x	Invert Level (m)	73.000	Discharge Coefficient	0.590
Loop to Node		Width (m)	1.400		

Node S12 Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Main Channel Length (m)	20.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	71.650	Main Channel Slope (1:X)	400.0
Safety Factor	2.0	Time to half empty (mins)		Main Channel n	0.030

Inlets

S11 inlet

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Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	249.1	0.0	0.400	370.4	0.0	0.800	509.1	0.0	1.150	644.4	0.0
0.100	277.8	0.0	0.500	403.5	0.0	0.900	546.4	0.0	1.250	685.3	0.0
0.200	307.6	0.0	0.600	437.6	0.0	1.000	584.8	0.0	1.350	727.4	0.0
0.300	338.4	0.0	0.700	472.8	0.0	1.050	604.4	0.0	1.450	770.6	0.0

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Results for 2 year Critical Storm Duration. Lowest mass balance: 99.48%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S01	10	77.025	0.045	5.5	0.0627	0.0000	OK
15 minute winter	S02	11	76.188	0.063	11.8	0.0933	0.0000	OK
15 minute winter	S03	10	74.852	0.130	24.9	0.3595	0.0000	OK
15 minute winter	S04	10	74.750	0.097	29.3	0.1778	0.0000	OK
15 minute winter	S05	11	74.391	0.106	33.7	0.1918	0.0000	OK
15 minute winter	S06	11	73.880	0.103	45.6	0.2878	0.0000	OK
15 minute winter	S07	11	73.267	0.146	59.0	0.4248	0.0000	OK
15 minute winter	S08	11	72.997	0.153	66.8	0.3758	0.0000	OK
15 minute winter	S09	11	72.657	0.179	77.0	0.5067	0.0000	OK
15 minute winter	S10	11	72.364	0.160	81.2	0.3543	0.0000	OK
360 minute winter	S11 inlet	272	71.991	0.291	18.6	0.0000	0.0000	OK
360 minute winter	S12	272	71.991	0.341	22.6	0.3899	0.0000	SURCHARGED
360 minute winter	S13	272	71.990	0.378	16.9	0.6685	0.0000	SURCHARGED
360 minute winter	S14	272	71.416	0.036	6.1	0.0515	0.0000	OK
360 minute winter	S15	272	70.108	0.063	6.1	0.0904	0.0000	OK
360 minute winter	S16	272	69.758	0.058	6.1	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S01	1.000	S02	5.4	0.951	0.194	0.2003	
15 minute winter	S02	1.001	S03	11.5	1.650	0.359	0.2718	
15 minute winter	S03	1.002	S04	24.5	1.229	0.580	0.2086	
15 minute winter	S04	1.003	S05	29.2	1.684	0.355	0.2552	
15 minute winter	S05	1.004	S06	33.9	1.888	0.411	0.3643	
15 minute winter	S06	1.005	S07	45.8	1.656	0.260	0.7279	
15 minute winter	S07	1.006	S08	59.5	1.698	0.414	0.5832	
15 minute winter	S08	1.007	S09	67.0	1.678	0.466	0.8778	
15 minute winter	S09	1.008	S10	77.1	1.917	0.537	0.4811	
15 minute winter	S10	1.009	S11 inlet	81.2	1.881	0.350	0.6388	
360 minute winter	S11 inlet	Flow through pond	S12	12.2	0.030	0.000	93.3119	
360 minute winter	S12	1.010	S13	16.9	0.570	0.136	0.2166	
360 minute winter	S12	Weir		0.0				0.0
360 minute winter	S13	Hydro-Brake®	S14	6.1				
360 minute winter	S14	1.012	S15	6.1	0.798	0.031	0.3332	
360 minute winter	S15	1.013	S16	6.1	0.598	0.095	1.0536	174.2

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Results for 30 year Critical Storm Duration. Lowest mass balance: 99.48%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S01	10	77.045	0.065	11.0	0.0909	0.0000	OK
15 minute winter	S02	11	76.222	0.097	23.7	0.1432	0.0000	OK
15 minute winter	S03	11	74.961	0.239	49.8	0.6622	0.0000	SURCHARGED
15 minute winter	S04	11	74.807	0.154	57.8	0.2808	0.0000	OK
15 minute winter	S05	11	74.454	0.169	66.8	0.3066	0.0000	OK
15 minute winter	S06	10	73.932	0.155	90.7	0.4303	0.0000	OK
15 minute winter	S07	12	73.438	0.317	117.6	0.9232	0.0000	SURCHARGED
15 minute winter	S08	12	73.207	0.363	129.7	0.8935	0.0000	SURCHARGED
15 minute winter	S09	11	72.849	0.371	144.1	1.0519	0.0000	SURCHARGED
15 minute summer	S10	11	72.438	0.234	149.4	0.5177	0.0000	OK
480 minute winter	S11 inlet	384	72.261	0.561	25.8	0.0000	0.0000	OK
480 minute winter	S12	384	72.261	0.611	24.6	0.6994	0.0000	SURCHARGED
480 minute winter	S13	384	72.261	0.649	21.3	1.1462	0.0000	SURCHARGED
960 minute summer	S14	960	71.416	0.036	6.1	0.0516	0.0000	OK
1440 minute winter	S15	1290	70.108	0.063	6.1	0.0906	0.0000	OK
1440 minute winter	S16	1290	69.758	0.058	6.1	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S01	1.000	S02	10.9	1.121	0.390	0.3394	
15 minute winter	S02	1.001	S03	23.0	1.943	0.719	0.4616	
15 minute winter	S03	1.002	S04	48.8	1.399	1.153	0.3568	
15 minute winter	S04	1.003	S05	57.9	1.900	0.702	0.4475	
15 minute winter	S05	1.004	S06	66.5	2.194	0.806	0.6165	
15 minute winter	S06	1.005	S07	90.1	1.808	0.511	1.3957	
15 minute winter	S07	1.006	S08	114.3	1.806	0.795	1.1724	
15 minute winter	S08	1.007	S09	124.0	1.791	0.863	1.5483	
15 minute winter	S09	1.008	S10	145.2	2.064	1.010	0.8287	
15 minute summer	S10	1.009	S11 inlet	149.6	2.172	0.644	1.0191	
480 minute winter	S11 inlet	Flow through pond	S12	14.2	0.034	0.000	198.2242	
480 minute winter	S12	1.010	S13	21.3	0.565	0.171	0.2166	
480 minute winter	S12	Weir		0.0				0.0
480 minute winter	S13	Hydro-Brake®	S14	6.1				
960 minute summer	S14	1.012	S15	6.1	0.799	0.031	0.3342	
1440 minute winter	S15	1.013	S16	6.1	0.598	0.096	1.0567	478.5

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Results for 100 year +50% CC Critical Storm Duration. Lowest mass balance: 99.48%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S01	13	77.546	0.566	20.6	0.7913	0.0000	SURCHARGED
15 minute winter	S02	13	77.323	1.198	41.9	1.7674	0.0000	FLOOD RISK
15 minute winter	S03	13	76.171	1.449	78.8	4.0144	0.0000	SURCHARGED
15 minute winter	S04	13	75.957	1.304	79.4	2.3835	0.0000	SURCHARGED
15 minute winter	S05	12	75.553	1.268	86.5	2.3002	0.0000	SURCHARGED
15 minute winter	S06	12	74.893	1.116	121.8	3.1025	0.0000	SURCHARGED
15 minute winter	S07	12	74.510	1.389	161.6	4.0432	0.0000	FLOOD RISK
15 minute winter	S08	12	74.027	1.183	180.9	2.9082	0.0000	SURCHARGED
15 minute winter	S09	12	73.247	0.769	213.1	2.1791	0.0000	SURCHARGED
1440 minute winter	S10	1140	72.868	0.664	34.3	1.4682	0.0000	SURCHARGED
1440 minute winter	S11 inlet	1140	72.868	1.168	27.6	0.0000	0.0000	OK
1440 minute winter	S12	1140	72.868	1.218	20.1	1.3945	0.0000	FLOOD RISK
1440 minute winter	S13	1140	72.868	1.256	19.6	2.2189	0.0000	FLOOD RISK
15 minute winter	S14	139	71.416	0.036	6.1	0.0516	0.0000	OK
15 minute summer	S15	105	70.108	0.063	6.1	0.0906	0.0000	OK
15 minute summer	S16	105	69.758	0.058	6.1	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S01	1.000	S02	18.8	1.226	0.674	0.6170	
15 minute winter	S02	1.001	S03	30.9	1.889	0.965	0.6860	
15 minute winter	S03	1.002	S04	62.2	1.564	1.471	0.4135	
15 minute winter	S04	1.003	S05	75.1	1.908	0.910	0.5846	
15 minute winter	S05	1.004	S06	89.3	2.244	1.082	0.8070	
15 minute winter	S06	1.005	S07	120.4	1.795	0.684	1.8466	
15 minute winter	S07	1.006	S08	158.5	2.250	1.103	1.1724	
15 minute winter	S08	1.007	S09	181.2	2.573	1.261	1.5483	
15 minute winter	S09	1.008	S10	213.0	3.024	1.482	0.8338	
1440 minute winter	S10	1.009	S11 inlet	27.6	1.250	0.119	1.6321	
1440 minute winter	S11 inlet	Flow through pond	S12	16.5	0.019	0.000	528.6071	
1440 minute winter	S12	1.010	S13	19.6	0.593	0.158	0.2166	
1440 minute winter	S12	Weir		0.0				0.0
1440 minute winter	S13	Hydro-Brake®	S14	6.1				
15 minute winter	S14	1.012	S15	6.1	1.458	0.031	0.3342	
15 minute summer	S15	1.013	S16	6.1	0.598	0.096	1.0567	89.0

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DESIGN BASIS MEMORANDUM - SUSTAINABLE DRAINAGE TREATMENT OF SURFACE WATER

Design Brief

The following calculations outline the recommended treatment requirements for a sustaionable drainage system as outlined in the SuDS Manual 2015. The method used is the simple index approach outlined in section 26. The requirement for oil interceptors has been assessed in line with the now withdrawn Pollution Prevention Guidance document PPG3, produced by the Environment Agency. An oil interceptor is not required for the proposed development.

Treatment within SuDS components is affected by the flow rate and volume of water which passes through the component. It is not reasonable or practical to treat the entirety of the runoff for infrequent greater intensity design storms. In any case the majority of the pollutants are removed from surfaces by the more frequent rainfall events and in the first flush resulting from the initial runoff from the larger events.
and to a certain capacity.

The following references have been used in the preparation of these calculations:

- SUDS Manual, CIRIA Report C753, 2015
- Pollution Mitigation Indicies provided by Hydro International

Results Summary

Roof Area:

Treatment component 1 Detention basin

Treatment component 2 None

Indices	Suspended Solids	Metals	Hydrocarbons
Pollution Hazard	0.2	0.2	0.05
Pollution Mitigation	0.5	0.5	0.6
Treatment Suitability	Adequate	Adequate	Adequate

Residential Parking:

Treatment component 1 Detention basin
Treatment component 2 None

Indices	Suspended Solids	Metals	Hydrocarbons
Pollution Hazard	0.5	0.4	0.4
Pollution Mitigation	0.5	0.5	0.6
Treatment Suitability	Adequate	Adequate	Adequate

Residential Roads

Treatment component 1 Detention basin
Treatment component 2 None

Indices	Suspended Solids	Metals	Hydrocarbons
Pollution Hazard	0.5	0.4	0.4
Pollution Mitigation	0.5	0.5	0.6
Treatment Suitability	Adequate	Adequate	Adequate

POLLUTION HAZARD INDEX

		Pollution Hazard Indices		
Source of Runoff	Pollution Hazard	Suspended Solids	Metals	Hydro-carbons
Residential roofing	Very low	0.2	0.2	0.05

POLLUTION MITIGATION INDEX

The receiving water body shall be: Surface Water

		Pollution Mitigation Indices		
Suds Component		Suspended Solids	Metals	Hydro-carbons
1	Detention basin	0.5	0.5	0.6
2	None	0	0	0
3	None	0	0	0
4	None	0	0	0
Total Pollution Mitigation Index		**0.5**	**0.5**	**0.6**

ASSESSMENT OF TREATMENT PROPOSAL

Indices	Suspended Solids	Metals	Hydro-carbons
Pollution Hazard	0.2	0.2	0.05
Pollution Mitigation	0.5	0.5	0.6
	Adequate	Adequate	Adequate

R G PARKINS Kendal | 01539 729393 Lancaster | 01524 32548	CALCULATION		Job No.	K40461	Page	3 of 4
	Job	Scalegill Rd	Drg no.		Date	30/11/2023
		Moor Row	Revision		Initial	OS
	Title	Sustainable Drainage - Treatment			Checked	

POLLUTION HAZARD INDEX

		Pollution Hazard Indices		
Source of Runoff	Pollution Hazard	Suspended Solids	Metals	Hydro-carbons
Residential parking	Low	0.5	0.4	0.4

POLLUTION MITIGATION INDEX

The receiving water body shall be: Surface Water

		Pollution Mitigation Indices		
Suds Component		Suspended Solids	Metals	Hydro-carbons
1	Detention basin	0.5	0.5	0.6
2	None	0	0	0
3	None	0	0	0
4	None	0	0	0
Total Pollution Mitigation Index		**0.5**	**0.5**	**0.6**

ASSESSMENT OF TREATMENT PROPOSAL

Indices	Suspended Solids	Metals	Hydro-carbons
Pollution Hazard	0.5	0.4	0.4
Pollution Mitigation	0.5	0.5	0.6
	Adequate	Adequate	Adequate

R G PARKINS Kendal | 01539 729393 Lancaster | 01524 32548	CALCULATION		Job No.	K40461	Page	4 of 4
	Job	Scalegill Rd	Drg no.		Date	30/11/2023
		Moor Row	Revision		Initial	OS
	Title	Sustainable Drainage - Treatment			Checked	

POLLUTION HAZARD INDEX

		Pollution Hazard Indices		
Source of Runoff	Pollution Hazard	Suspended Solids	Metals	Hydro-carbons
Low traffic roads (e.g. residential roads and general access roads, < 300 traffic movements/day)	Low	0.5	0.4	0.4

POLLUTION MITIGATION INDEX

The receiving water body shall be: Surface Water

		Pollution Mitigation Indices		
Suds Component		Suspended Solids	Metals	Hydro-carbons
1	Detention basin	0.5	0.5	0.6
2	None	0	0	0
3	None	0	0	0
4	None	0	0	0
Total Pollution Mitigation Index		**0.5**	**0.5**	**0.6**

ASSESSMENT OF TREATMENT PROPOSAL

Indices	Suspended Solids	Metals	Hydro-carbons
Pollution Hazard	0.5	0.4	0.4
Pollution Mitigation	0.5	0.5	0.6
	Adequate	Adequate	Adequate

APPENDIX D - CORRESPONDANCE

UU CORRESPONDANCE

S104 Pre-Design Response Form

Version 1 (Nov 22)

United Utilities Reference Number:			**04451386**
Applicant details			
Company name	Washington Homes Ltd		
Contact name	Oliver Sugden		
Site details			
Site name/address (including nearest postcode)	Scalegill Road, Moor Row, Cumbria, CA24 3LT		
Developer Engineer assessment			
Area for discussion/assessment	Multiple phases/landowners ☐ Multiple points of connection ☐ Pumped discharge ☐ Adoptable Infiltration Viability ☐ Adoptable SuDS Components ☐ Storage components ☐ Other ☒		
SuDS Component(s) >	Pond / Wetland ☐	Basin ☒	Infiltration System ☐
	Swale ☐	Bio retention system ☐	Filter Drains ☐
Developer Engineer comments	I have reviewed the documents submitted to reach the conclusion that United Utilities would accept the culvert as the discharge point for the surface water onsite subject to a full review once a S104 application is submitted. You have ticked the SuDs box indicating your drainage plan will include a basin. Please use the link below for guidance: https://www.unitedutilities.com/builders-developers/wastewater-services/sustainable-drainage-systems/ If you have any design questions or require any engineering advice please provide a drainage plan and respond with your question for review. ***Please note that this guidance/advice is not an acceptance for suitability of section 104 agreement, which will only be given once a full design review and acceptance has been given (please see sewerage sector guidance for more information, this can be found on Water UK website)****		
Meeting required to discuss further	Yes ☐	No ☒	
Reason for meeting			
Assistant Developer Engineer Name:	Lucy Clarke	Date (XX/XX/XX):	14/08/23
Applicant comments			

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