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

PROPOSED PROPERTY CONVERSION
AT
MOORCOCK FARM
NEAR CLITHEROE

DRAINAGE STRATEGY

Revision	Date	Purpose
A	03/03/2021	PLANNING

Our ref: K37295/01/DS

DOCUMENT CONTROL

Project: Proposed Property Conversion, Moorcock Farm, Clitheroe
Project Number: K37295
Project Description: Drainage Strategy

Issue	Date	Prepared by	Checked by	Approved by
Original Issue	10/09/2020			
A	03/03/2021			

Disclaimer

This report was produced by R. G. Parkins & Partners Ltd for Adam and Alex Dugdale for the specific purpose of providing a Drainage Strategy for a proposed property conversion at Moorcock Farm, near Clitheroe.

This report is for the sole use of Adam and Alex Dugdale. R. G. Parkins & Partners Ltd will not be held responsible for any actions taken or decisions made by any third party as a result of this report.

Meadowside Shap Road Kendal Cumbria LA9 6NY
Tel: (01539) 729393 Fax: (01539) 740609 Email: mail@rgparkins.com
Also at: 97 King Street Lancaster LA1 1RH Tel: (01524) 32548 Fax: (01524) 843989

CONTENTS

FIGURES

TABLES

APPENDICES

GLOSSARY OF TERMS

Term	Description
AOD	Above Ordnance Datum
BGL	Below Ground Level
BGS	British Geological Survey
LCC	Lancashire County Council
EA	Environment Agency
LLFA	Lead Local Flood Authority
NPPF	National Planning Policy Framework
OS	Ordnance Survey
RGP	R G Parkins and Partners Ltd
SuDS	Sustainable Drainage System
UU	United Utilities

1.0 INTRODUCTION

1.1 Background

This following report has been prepared by R. G. Parkins & Partners Ltd (RGP) for Adam and Alex Dugdale in support of proposals for a proposed property conversion at Moorcock Farm near Clitheroe.

RGP has been appointed to undertake a Surface and Foul Water Drainage Strategy to support a planning application that fulfils the requirements of the Local Planning Authority and the Sewerage Undertaker. The following study demonstrates that the proposed changes will not adversely affect flood risk elsewhere.

1.2 Planning Policy

The NPPF [1] and its Planning Practice Guidance [2] states "a site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in the future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use".

1.3 The Proposals in the Context of Planning Policy

The changes to the site are classed as minor development in accordance with The Town and Country Planning Order 2015 [3]. Drawings for the proposed development are provided in Appendix A.

The area covered by the application is 2100 m^2 and by reference to the Environment Agency Flood Map, the site lies in Flood Zone 1. A flood risk assessment is therefore not required. However, there is a requirement for a drainage strategy.

2.0 SITE CHARACTERISATION

2.1 Site Location

Moorcock Farm is a collection of farm buildings located in a rural position in Lancashire, south of Longridge Fell and north of the River Ribble. The nearest towns are Ribchester and Longridge. The property is a few miles east of the M6 motorway. The property is located on the B6243 at an elevation of around 119 m above ordnance datum (mAOD). The National Grid Co Ordinates for the centre of the property are SD6528737872. The site's location is shown in Figure 2.1.

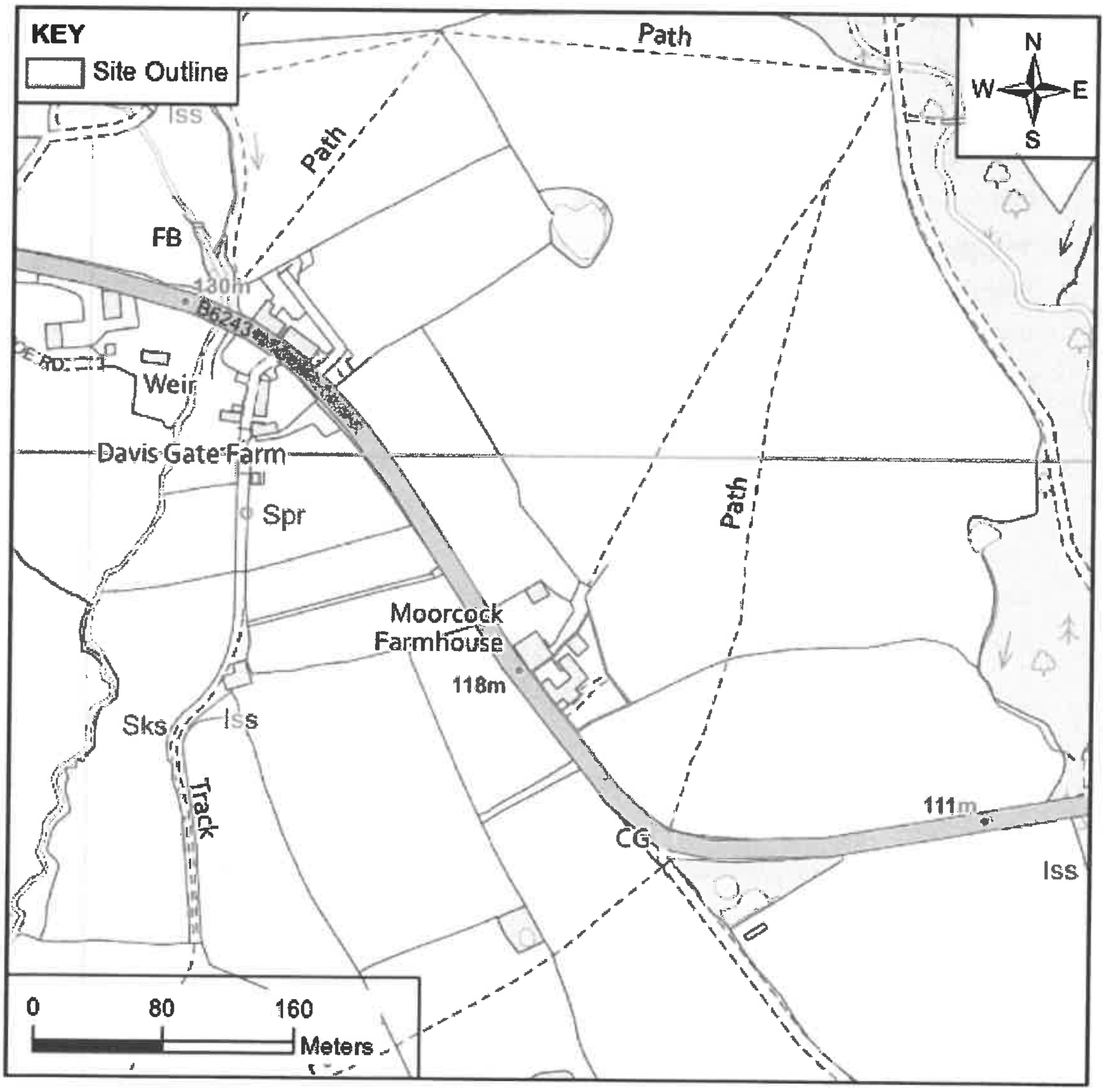


Figure 2.1: Site Location

2.2 Geology

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.

Table 2.1 Site Geological Summary

Geological Unit	Classification	Description
Soil	Soilscape 18	Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils
Drift	Till	Diamicton (Sedimentary glacial deposits)
Solid	Silsden Formation	Mudstone

The geology in the immediate vicinity of the property consists of solid and superficial deposits. The solid geology is mudstone of the Silsden Formation. A little to the north is the sandstone of the Warley Wise Grit Formation. The superficial deposits lie on the solid geology and consist of Devensian Till which is a diamicton. This is a mixture of clay, silt, sand and gravel. Diamictons in northern England are often dominated by the clay fraction which typically controls the permeability characteristics. The permeability is often low but is spatially variable. A short distance from the property there are areas where there are no superficial deposits. This shows that the thickness of the diamicton deposits is spatially variable and may be relatively thin in the vicinity of the property. There are also glaciofluvial deposits of sand and gravel locally but these are some distance from the property so they are not relevant to the drainage.

2.3 Hydrogeology

The solid geology is classed as a Secondary A aquifer which is the second most important aquifer classification after Principle aquifer. The superficial deposits are classified as Secondary (undifferentiated) but are unlikely to be important water sources owing to their limited thickness and relatively poor permeability. There are no water source protection zones within the vicinity of the property. However, the property does sit within a Drinking Water Protected Area related to the lower catchment of the River Ribble.

2.4 Topography

Topographically, the property lies on a coll between two small hills. To the north, the ground elevation is around 130-140 mAOD and to the south at Duddel Hill it is at 125 mAOD while the property itself lies at around 119 mAOD (Figure 2.2). The Environment Agency's surface water flood risk map can be used to indicate the directions of surface and near-surface water movement. This shows that in extreme rainfall, standing or slowly moving water can collect on the B6243 road just to the south of the property. The surface water flood risk map also shows that at such times, water can be present on the surface of fields between the property and a stream called Duddel Brook. This suggests that there is a pathway for surface water movement between the property and Duddel Brook during periods of substantial rainfall. The distance between the property and the brook is approximately 300 m. A smaller stream, Strydd Brook, is to the west of the property at a distance of approximately 310 m but the flood risk map does not suggest a surface pathway to this brook.

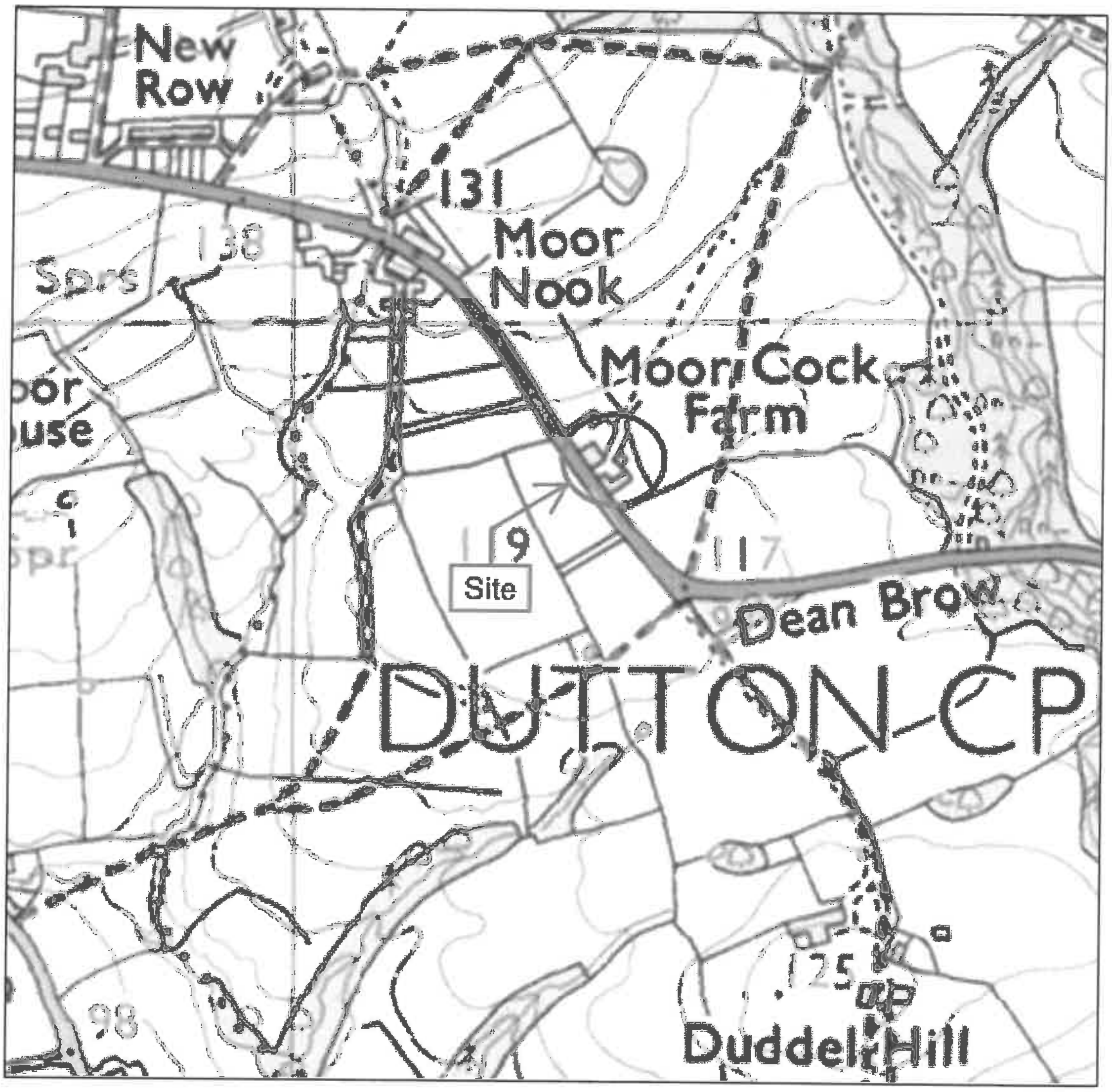


Figure 2.2: Topography and surface water channels in the vicinity of the farm

2.5 Existing Sewers

Records of any United Utilities sewers in the vicinity of the site have been obtained. These are provided in Appendix B. The plans show that there no sewers serving the property or in the wider area. It is understood that the site waste disposal is via a cess pit and soakaway. It is unlikely that this will have sufficient spare capacity for the proposed changes to the site. There is therefore a need for a new system.

2.6 Ground Investigation

Geo Environmental Engineering attended site on 5th February 2021 to undertake ground investigations at the site. Five trial pits were excavated across the site, and the pits encountered topsoil and made ground to depths of between 0.52-1.10 mBGL. Trial pits TP02 and TP02A encountered very unstable made ground comprising gravel and cobbles of brick, concrete, sandstone, slate. Groundwater ingress was noted from the made ground.

Soil infiltration tests were completed in trial pits TP01A, TP02A and TP03. In summary, the water did not drain, and the water level rose in trial pit TP02A, possibly due to ingress due to the overlying made ground.

Geo concluded that given the ground conditions and the results of the infiltration tests, the ground conditions are not considered suitable for soakaway drainage.

For further information refer to Geo Environmental Engineering report GEO2021-4604.

3.0 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 [6]
- Code of Practice for Surface Water Management, BS8582:2013, November 2013 [7]
- Rainfall Runoff Management for Developments, Defra/EA, SC030219, October 2013 [8]
- Designing for Exceedance in Urban Drainage – Good Practice, CIRIA Report C635, 2006 [9]
- Flood Estimation Handbook (FEH) [10]
- Flood Studies Report (FSR), Volume 1, Hydrological Studies, 1993 [11]
- Flood Studies Supplementary Report No 14 (FSSR14), Review of Regional Growth Curves, 1983 [12]
- Flood Estimation for Small Catchments, Marshall & Bayliss, Institute of Hydrology, Report No. 124 (IoH 124), 1994 [13]

The following assessment and drainage strategy is based on the latest site layout plan by John Coward Architects (drawing no. 20011-01-B), which is included in Appendix A for reference. Any alterations to the site plan resulting in changes to impermeable areas will require the drainage strategy to be revisited.

3.2 Site Areas

To support the exploration of options for site drainage, the spatial extent of different types of proposed land cover on the site have been measured. Table 3.1 shows the measured proposed land cover areas. The highest percentage is garden areas at 29% of the total site area. Housing covers 23%, road areas 20% and parking areas 13%.

Table 3.1 Land Cover Areas

Land Cover	Area		Percentage of total site area
	m^2	Ha	
Total housing roof area	492.0	0.049	23%
Total parking and paved area	267.0	0.027	13%
Total road area	428.0	0.043	20%
Garden areas	615.7	0.062	29%

The site can be subdivided into land cover that could be permeable and that which could be impermeable. Potential impermeable areas are regarded as housing, parking, roads, driveways and walkways. All other areas (principally gardens) are regarded as having a permeable surface. Table 3.2 gives the areas of potentially permeable and impermeable land cover and this shows that impermeable areas could cover 36% of the site and permeable areas 64%.

Table 3.2 Area of Potentially Impermeable & Permeable Land Cover

Land Cover	Area		Percentage of total site area
	m^2	Ha	
Total impermeable area	759.0	0.076	36%
Remaining permeable area	1341.0	0.134	64%

3.3 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:

3.3.1 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.

Climate change guidance issued by the Environment Agency came into effect outlining the anticipated changes in extreme rainfall intensity. Table 3.3 shows anticipated changes in extreme rainfall intensity in small and urban catchments. Guidance states that for site-specific flood risk assessments and strategic flood risk assessments, the upper end allowance should be assessed. A climate change allowance of 40% has been selected for the purpose of drainage design based on the 100-year anticipated design life of the proposed development. No properties are located immediately downstream of the site and therefore the site poses low risk to neighbouring property.

Table 3.3 Peak Rainfall Intensity Allowance in Small and Urban Catchments (use 1961 to 1990 baseline)

Applies across all of England	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper end	10%	20%	40%
Central	5%	10%	20%

3.3.2 *Urban Creep*

BS 8582:2013 [7] 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) has been applied to the contributing area.

The inclusion of 10% is highly conservative due to the provision of adequate parking on the site and the density of the properties.

3.3.3 *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.

3.3.4 *Volumetric Runoff Coefficient, Cv*

The volumetric runoff coefficient describes the volume of surface water 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 0.75 for summer and 0.84 for winter and are used for design.

3.3.5 *Rainfall Model*

The calculations use the REFH2 unit hydrograph methodology in line with best practice as outlined in the SuDS Manual [6]. The calculations use the most up to date available catchment descriptors (2013) provided by the Centre for Ecology and Hydrology Flood Estimation Handbook web service.

3.4 Pre Development Runoff Assessment

As the site covers an area of less than 200 ha, (0.21 ha) the Greenfield calculations have been undertaken in accordance with methodology described in IoH 124 [13]. 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 ha site.

Full details of the calculations and the methodology for deriving the Peak Rate of Runoff are in included in Appendix C. A summary of the results is included in Table 3.4.

Table 3.4 Pre Development Runoff Results

Rate of Runoff (l/s)		
Event	Greenfield	Attenuated Discharge
Q1	0.6	0.7
QBAR	0.7	0.7
Q10	1.0	0.7
Q30	1.2	0.7
Q100	1.4	0.7
Q100+ 40% CC	0.9	0.7

Without attenuation or infiltration, the proposed development would increase the Rate of Runoff from the developed areas of the site. To mitigate the potential increase in runoff, a SuDS solution is proposed, as discussed below.

3.5 Surface Water Disposal

Surface water disposal has been considered in line with the hierarchy outlined in the SuDS Manual [6]. The approach considers infiltration drainage in preference to disposal to watercourse, in preference to discharge to sewer.

Infiltration testing indicates soil on the site is unsuitable for the disposal of surface water by this method. For further information refer to Section 2.6.

The entire impermeable area of the site will require a positive drainage solution. Runoff will be attenuated as far as practical to the pre development Qbar rate of 0.7 L/s. A drainage channel/watercourse is located east of the site. In line with the SuDS hierarchy for surface water disposal, discharge of surface water shall be to this drainage channel/ watercourse

3.6 Surface Water Drainage Design

It is proposed that all roof areas will discharge into a geocellular crate system, located within the landscaped area in the south of the site. An advanced silt trap will be located upstream of the inlet, which will provide surface water treatment and access for maintenance. Silt traps isolate silt and other particles by encouraging settlement into removal silt buckets, preventing ingress into the tank. The crates will be founded at a suitable level providing a minimum depth of cover of 600 mm over the top.

A mini flow control chamber will restrict discharge to 0.7 L/s, with discharge shall be to the watercourse to the east of the site via a new 150 dia. pipe.

The access road and parking areas will comprise a permeable gravel surface, allowing for infiltration into the sub base. It is also proposed that a filter drain is located along the edge of the access road, this shall convey exceedance flows from these areas, connecting flows into the surface water drainage system upstream of the geocellular tank.

Microdrainage Source Control calculations for the proposal are included in Appendix C. For further detail refer to the Drainage Layout Plan (K37295/A1/01) included in Appendix A.

3.7 Storage Volume

The proposed surface water network serving the impermeable access roads and pitches has been modelled using Micro Drainage Source Control. FEH catchment descriptors are used to model the rainfall and determine the size of attenuation required. In order to attenuate the future 100 year return design period design storm flows for the positively drained areas of the site, a storage volume of c. 90 m³ is required for the 720 minute winter critical design storm.

3.8 Designing for Local Drainage System Failure

In accordance with the general principles discussed in CIRIA Report C635 – Designing for Exceedance in Urban Drainage [9] the proposed surface water drainage, where practical, should be designed to ensure there is no increased risk of flooding to the buildings on the site or elsewhere as a result of extreme rainfall, lack of maintenance, blockages or other causes. These measures are discussed below.

3.8.1 Blockage & Exceedance

The sustainable drainage systems will be designed to attenuate a 100-year design storm including a 40% allowance for climate change. The drainage system will also provide capacity for lower probability (greater design storm events) which are not critical duration.

In the unlikely case of blockage in the geocellular system or detention basins, associated silt trap and or/flow control chamber, exceedance flows will follow the topographic gradients downslope, away from the barn conversion, into the landscaped area in the south of the site.

Additional Measures

The following general measures will be implemented as part of the detailed drainage design:

Surface Storage & External Levels – where possible parking areas should be designed to offer additional surface 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 proposed surface water system will be designed to provide adequate storage volume against flooding for the Q100 event, including a 40% allowance to account for climate change.

Building Layout & Detail – the buildings will be designed and situated to ensure that they are not at risk of flooding from overland flow. The finished floor and threshold levels 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.

3.9 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.

The permeable surfacing and subbase on the access road, the filter drain and the use of an upstream silt trap will provide sufficient treatment for all impermeable areas of the site served by the drainage system (roof, parking areas and access road).

4.0 FOUL WATER DRAINAGE STRATEGY

Reference to the UU sewer records indicates there are no public sewers in the vicinity of the site. The site will therefore require a packaged treatment plant.

Preliminary foul water calculations for the sizing of a packaged treatment plant have been undertaken in accordance with British Water Code of Practice-Flows and Loads 4. The calculations are provided in Appendix A.

The calculations are based on:

- 1 no. 4 bedroom house (150 l/day per person)

It is concluded a Klargester BioDisc BA packaged treatment system will have sufficient capacity for the dwelling. This system is easy to install and maintain with low running costs. Discharge shall be to the watercourse to the east of the site. For further detail refer to the Drainage Layout Plan (K37295/A1/01), included in Appendix A.

It is noted the discharge volume does not exceed 5m^3/day, therefore an environmental permit will not be required by the EA as part of the submissions. The predicted flow from the development is 0.9 m^3/day.

5.0 CONCLUSIONS AND RECOMMENDATIONS

- Ground investigation and permeability testing found that the site topsoil is underlain very unstable made ground comprising gravel and cobbles of brick, concrete, sandstone, slate. Groundwater ingress was noted from the made ground.

- It is proposed that surface water drainage shall be positively drainage and attenuated, within geocellular crates, prior to discharge at an attenuated rate to match the greenfield runoff Qbar rate of 0.7 L/s. Ultimate discharge shall be to the watercourse east of the site. Car parking areas and the access road shall comprise a gravel finish, with runoff infiltrating into the sub base. A filter drain located along the edge of the access road shall convey exceedance flows from the road and parking areas, upstream of the geocellular tank.

- Foul flows from the site shall discharge into a new packaged treatment plant, with discharge into the watercourse east of the site. A Klargester BioDisc BA packaged treatment system will have sufficient capacity for the dwelling.

- It is noted the discharge volume does not exceed 5m³/day, therefore an environmental permit will not be required by the EA as part of the submissions. The predicted flow from the development is 0.9 m³/day.

6.0 REFERENCES

[1] Ministry of Housing, Communities and Local Government, *National Planning Policy Framework*, February 2019.

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

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

[4] British Geological Survey (BGS), GeoIndex Onshore, Superficial Deposits and Bedrock Geology, 1: 50,000.

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

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

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

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

[9] CIRIA, *Designing for Exceedance in Urban Drainage – Good Practice*, Report C635, London, 2006.

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

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

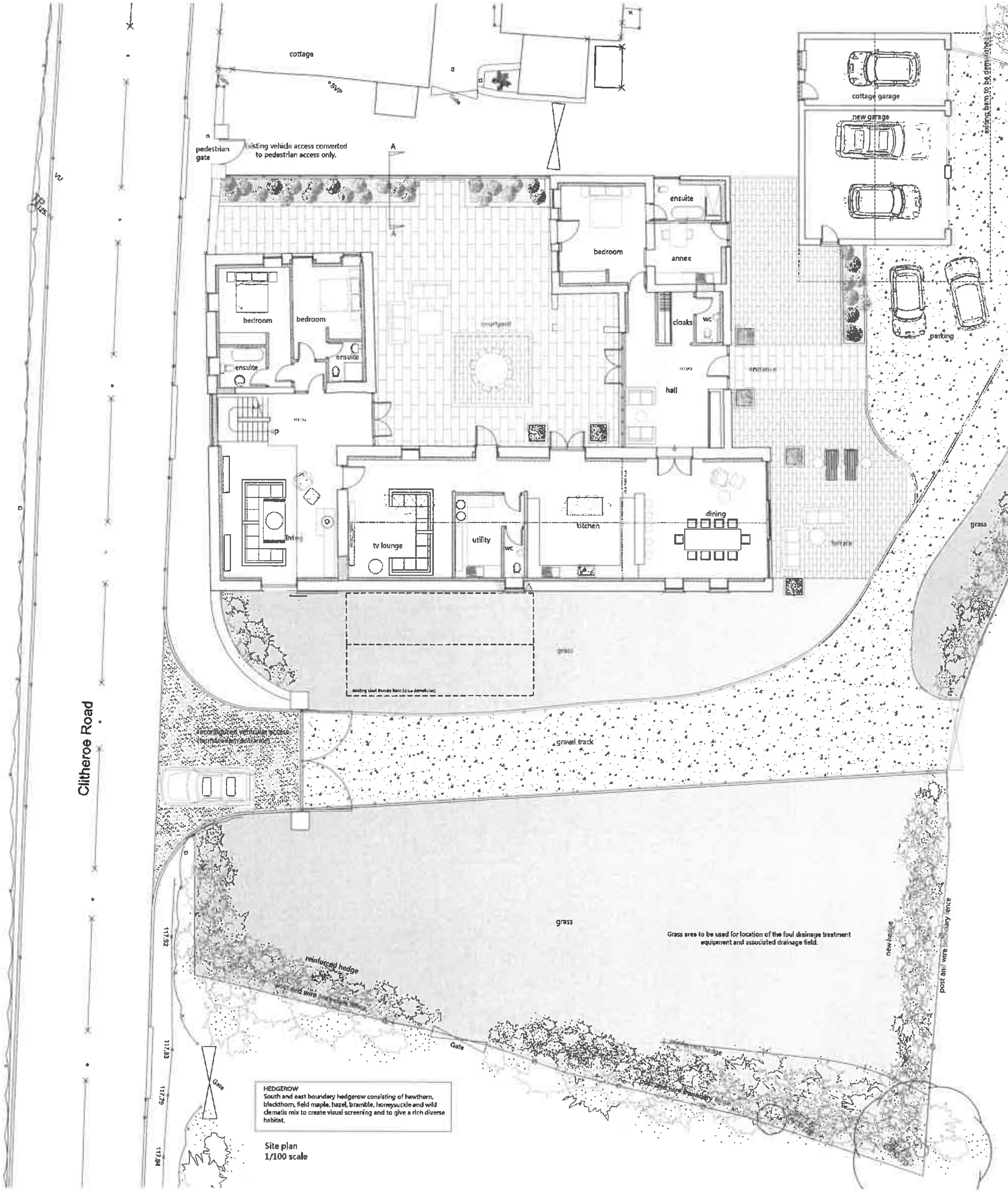
[12] Institute of Hydrology, Flood Studies Supplementary Report No 14 – Review of Regional Growth Curves, August 1983.

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

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

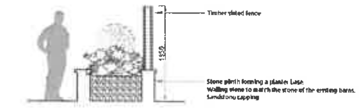
[15] Water UK, Design and Construction Guidance for Foul & Surface Water Sewers Offered for Adoption Under the Code for Adoption Agreements for Water and Sewage Companies Operating Wholly or Mainly in England, Approved Version 10, October 2019

APPENDIX A: PROPOSALS

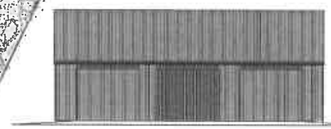


HEDGEROW
South and east boundary hedgerow consisting of hawthorn, blackthorn, field maple, hazel, bramble, honeysuckle and wild clematis mix to create visual screening and to give a rich diverse habitat.

Site plan
1/100 scale



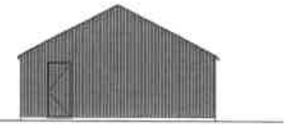
Cross section through boundary fence & planter
Section AA
1/50scale



Garage north east elevation
1/100 scale

Garage north west elevation
1/100 scale

Garage south west elevation
1/100 scale



Garage south east elevation
1/100 scale

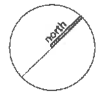
Landscaping finishes.

Paving - Indian Sandstone with a random mixed buff riven finish.

Gravel - River gravel in a random mix.

Boundary hedgerow - mixed species

scale bar in metres
1/100



REV	COMMENT	BY	DATE
A	[illegible]	rjc	[illegible]
B	Post Pre-App Advice Amendments	rjc	[illegible]

THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS ON THE JOB BEFORE STARTING WORK OR PREPARING SHOP DRAWINGS. ANY DISCREPANCIES MUST BE REFERRED TO THE ARCHITECT. DO NOT SCALE FROM THIS DRAWING.

PROJECT

Proposed Barn Conversion
Moorcock Farm
Clitheroe Road, Moor Nook

CLIENT

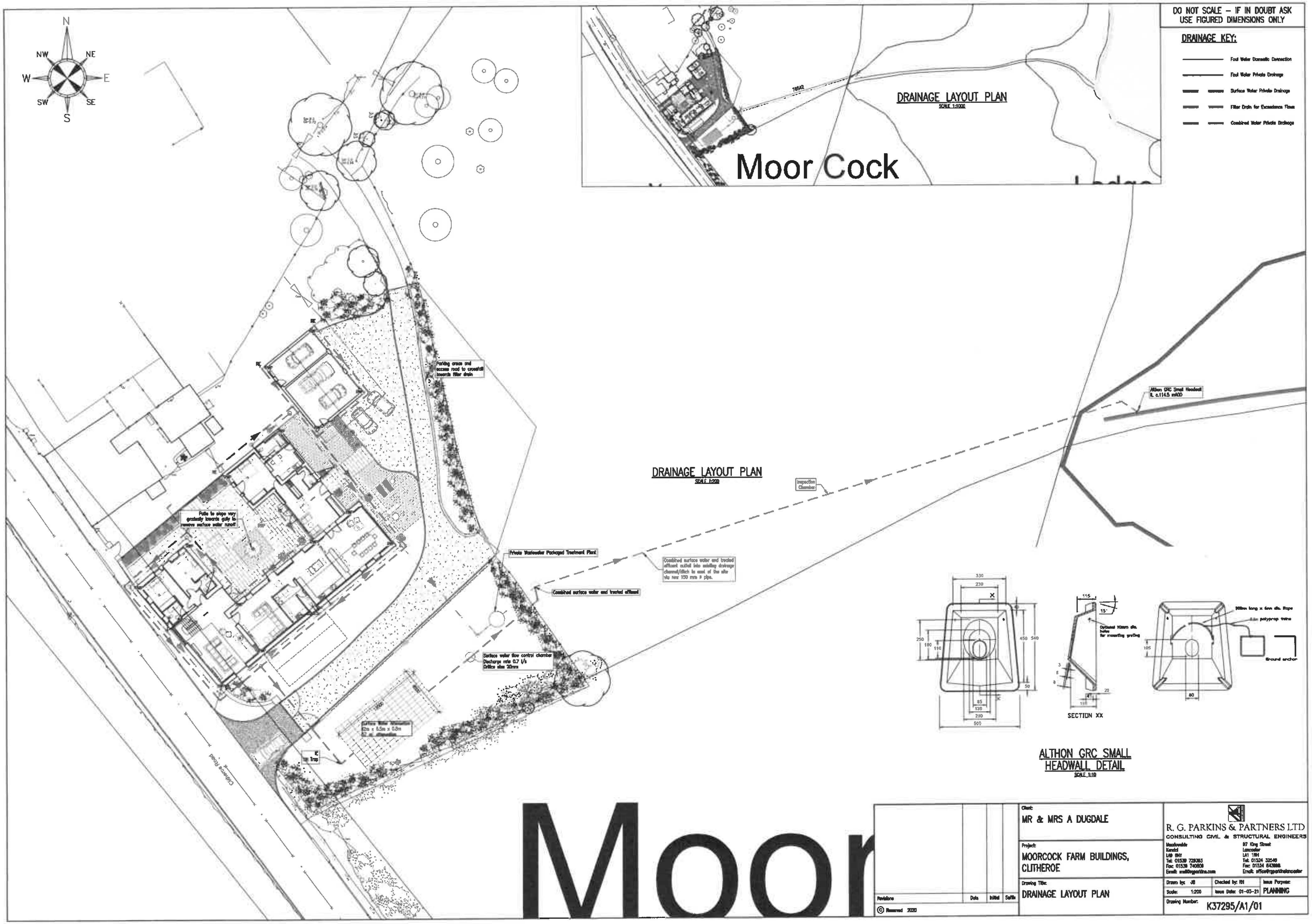
Mr & Mrs Dugdale

TITLE

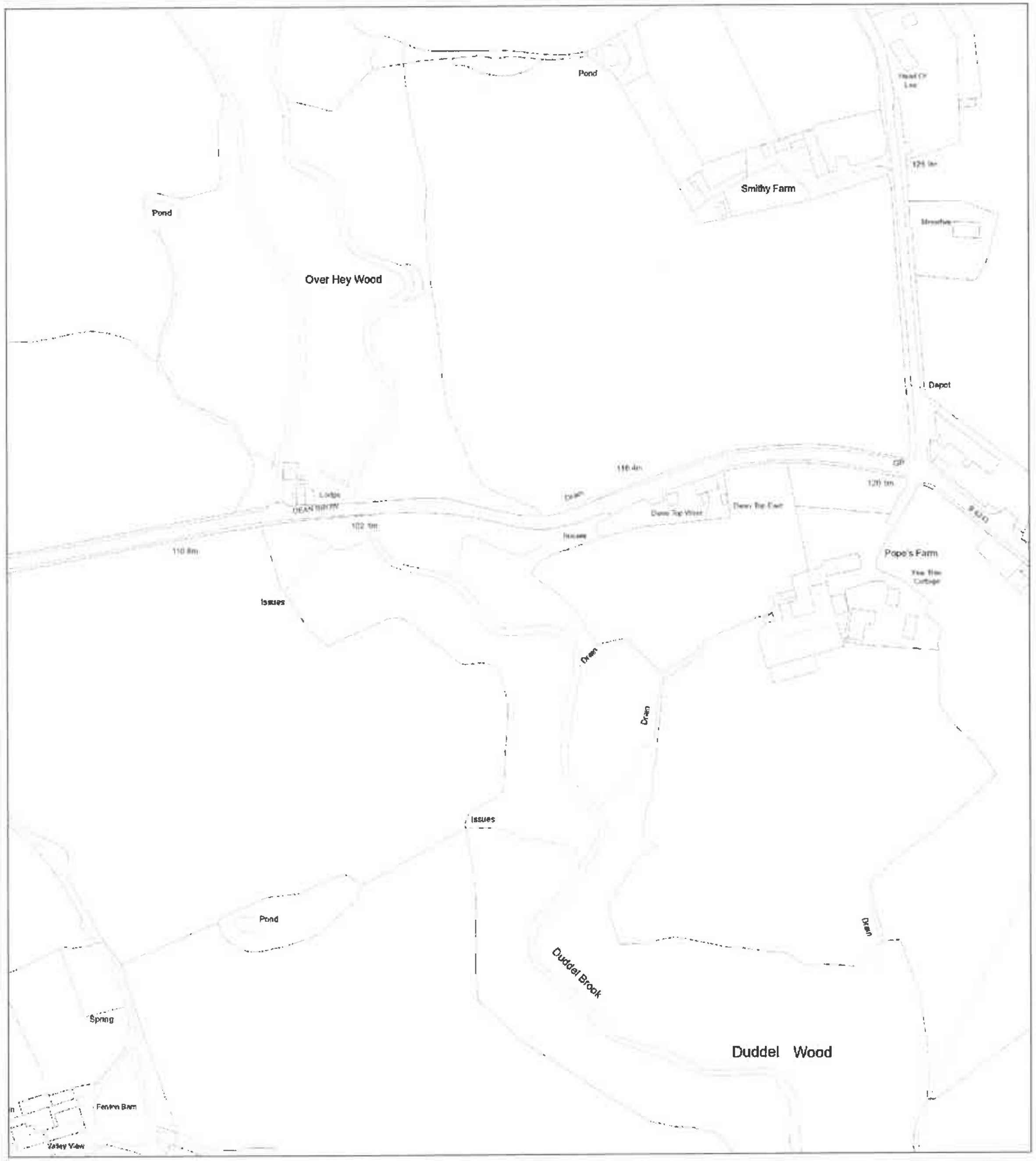
RIBA STAGE 3
Site Plan + Garage

SCALE@A1	DRAWN	CHECKED	DATE
1/100	rjc		30.03.20
JOB NO	DRAWING NO		REVISION
20011	01		B

JOHN COWARD ARCHITECTS LIMITED
No. 3 Unsworth's Yard,
Ford Road,
Cartmel,
Cumbria, LA11 6PG
Tel: (015395) 36596
www.johncowardarchitects.co.uk


DO NOT SCALE – IF IN DOUBT ASK
USE FIGURED DIMENSIONS ONLY
DRAINAGE KEY:
Foul Water Domestic Connection
Foul Water Private Drainage
Surface Water Private Drainage
Filter Drain for Exceedance Flows
Combined Water Private Drainage
DRAINAGE LAYOUT PLAN
SCALE 1:1000
Moor Cock
DRAINAGE LAYOUT PLAN
SCALE 1:200
Private Wastewater Packaged Treatment Plant
Combined surface water and treated effluent
Surface water flow control chamber
Discharge rate 0.7 l/s
Orifice size 20mm
Inspection Chamber
Althon GRC Small Headwall
Clitheroe Road
SECTION XX
ALTHON GRC SMALL
HEADWALL DETAIL
SCALE 1:10
Moor
Client:
MR & MRS A DUGDALE
Project:
MOORCOCK FARM BUILDINGS,
CLITHEROE
Drawing Title:
DRAINAGE LAYOUT PLAN
Revisions
Date
Initial
Suffix
© Reserved 2020
R. G. PARKINS & PARTNERS LTD
CONSULTING CIVIL & STRUCTURAL ENGINEERS
97 King Street
Lancaster
LA1 1RH
Tel: 01524 32540
Fax: 01524 643888
Drawn by: JB
Checked by: RH
Issue Purpose:
PLANNING
Scale: 1:200
Issue Date: 01-03-21
Drawing Number:
K37295/A1/01

APPENDIX B: UNITED UTILITIES DRAINAGE RECORDS



The position of the underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available. United Utilities Water will not accept liability for any loss or damage caused by the actual position being different from those shown.

LEGEND

Abandoned	Foul	Surface Water	Combined	
				Public Sewer
				Private Sewer
				Section 104
				Rising Main
				Sludge Main
				Overflow
				Water Course
				Highway Drain

All point assets follow the standard colour convention:
red - combined; blue - surface water; brown - foul; purple - overflow

- Manhole
- Head of System
- Extent of Survey
- Rodding Eye
- Inlet
- Discharge Point
- Vortex
- Penstock
- Washout Chamber
- Valve
- Air Valve
- Non Return Valve
- Soakaway
- Gully
- Cascade
- Flow Meter
- Hatch Box
- Oil Interceptor
- Summit
- Drop Shaft
- Orifice Plate
- Side Entry Manhole
- Outfall
- Screen Chamber
- Inspection Chamber
- Bifurcation Chamber
- Lamp Hole
- T Junction / Saddle
- Catchpit
- Valve Chamber
- Vent Column
- Vortex Chamber
- Penstock Chamber
- Network Storage Tank
- Sewer Overflow
- Ww Treatment Works
- Ww Pumping Station
- Septic Tank
- Control Kiosk
- Change of Characteristic

MANHOLE FUNCTION

FC Foul
SW Surface Water
CO Combined
OV Overflow

SEWER SHAPE

CI Circular; TR Trapezoidal
EG Egg; AR Arch
OV Oval; BA Barrel
FT Flat Top; HO Horseshoe
RE Rectangular; UN Unspecified
SQ Square

SEWER MATERIAL

AC Asbestos Cement
BR Brick
PE Polyethylene
RP Reinforced Plastic Matrix
CO Concrete
CSB Concrete Segment Bolted
CSU Concrete Segment Unbolted
CC Concrete Box Culverted
PSC Plastic / Steel Composite
GRC Glass Reinforced Plastic
DI Ductile Iron
PVC Polyvinyl Chloride
CI Cast Iron
SI Spun Iron
ST Steel
VC Vitrified Clay
PP Polypropylene
PF Pitch Fibre
MAC Masonry, Coursed
MAR Masonry, Random
U Unspecified

Address or Site Reference:

MOORCOCK FARM CLITHEROE ROAD,
DUTTON,
PRESTON,
PR3 2YT

OS sheet Number: SD6537NE
Scale: 1:1250 **Date:** 22/08/2020
Sheet: 1 of 6
Printed by: Property Searches

SEWER RECORDS

United Utilities — helping life flow smoothly

The position of the underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available. United Utilities Water will not accept liability for any loss or damage caused by the actual position being different from those shown.

LEGEND

Abandoned	Foul	Surface Water	Combined	
				Public Sewer
				Private Sewer
				Section 104
				Rising Main
				Sludge Main
				Overflow
				Water Course
				Highway Drain

All point assets follow the standard colour convention:
red - combined blue - surface water
brown - foul purple - overflow

Manhole	Side Entry Manhole
Head of System	Outfall
Extent of Survey	Screen Chamber
Rodding Eye	Inspection Chamber
Inlet	Bifurcation Chamber
Discharge Point	Lamp Hole
Vortex	T Junction / Saddle
Penstock	Catchpit
Washout Chamber	Valve Chamber
Valve	Vent Column
Air Valve	Vortex Chamber
Non Return Valve	Penstock Chamber
Soakaway	Network Storage Tank
Gully	Sewer Overflow
Cascade	Ww Treatment Works
Flow Meter	Ww Pumping Station
Hatch Box	Septic Tank
Oil Interceptor	Control Kiosk
Summit	Change of Characteristic
Drop Shaft	
Orifice Plate	

MANHOLE FUNCTION

FO Foul
SW Surface Water
CO Combined
OV Overflow

SEWER SHAPE

CI	Circular	TR	Trapezoidal
EG	Egg	AR	Arch
OV	Oval	BA	Barrel
FT	Flat Top	HO	HorseShoe
RE	Rectangular	UN	Unspecified
SQ	Square		

SEWER MATERIAL

AC Asbestos Cement
BR Brick
PE Polyethylene
RP Reinforced Plastic Matrix
CO Concrete
CSB Concrete Segment Bolted
CSU Concrete Segment Unbolted
CC Concrete Box Culverted
PSC Plastic / Steel Composite
GRC Glass Reinforced Plastic
DI Ductile Iron
PVC Polyvinyl Chloride
CI Cast Iron
SI Spun Iron
ST Steel
VC Vitrified Clay
PP Polypropylene
PF Pitch Fibre
MAC Masonry, Coursed
MAR Masonry, Random
U Unspecified

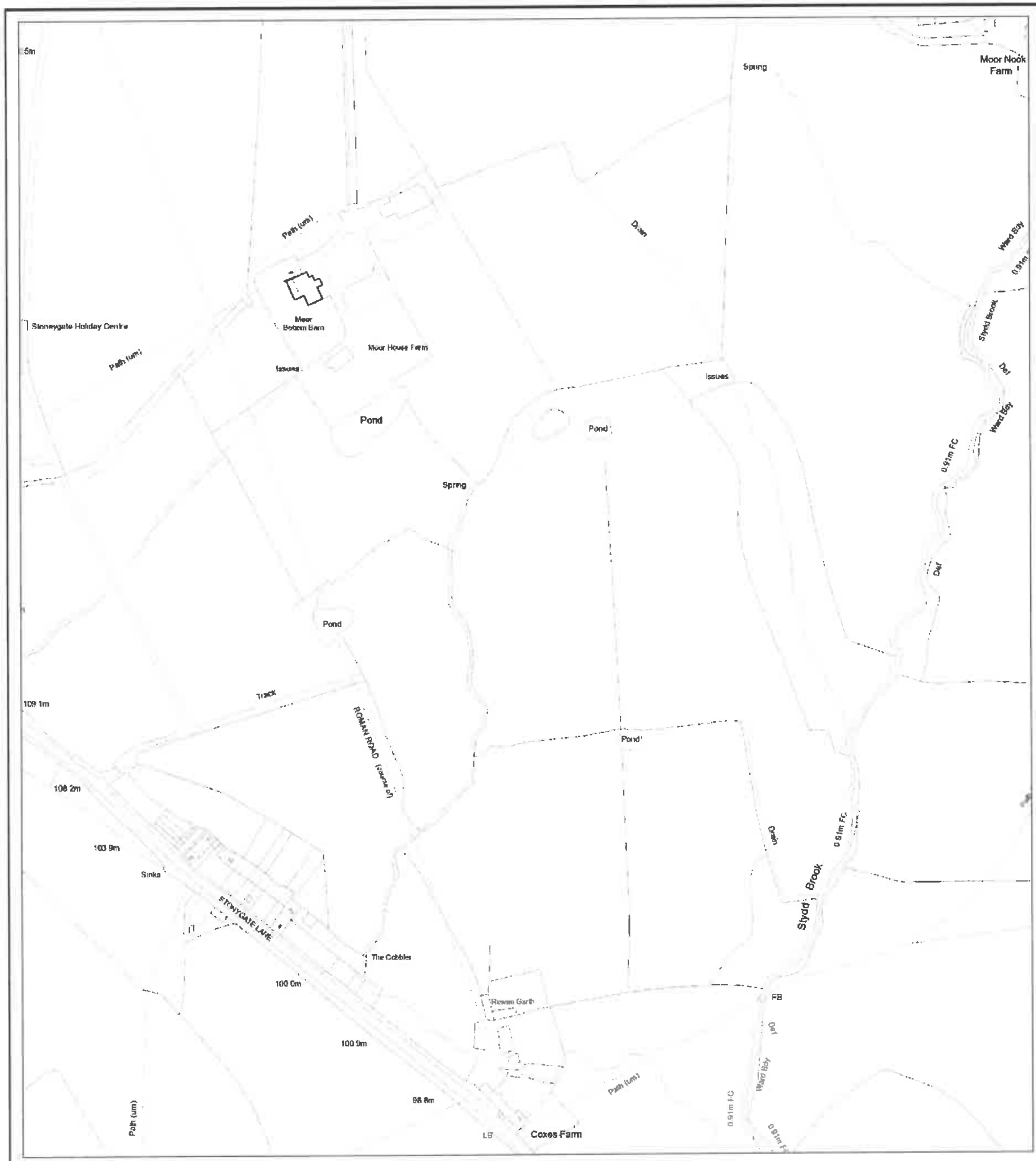
Address or Site Reference:

MOORCOCK FARM CLITHEROE ROAD,
DUTTON,
PRESTON,
PR3 2YT

OS sheet Number: SD6537NW
Scale: 1:1250 **Date:** 22/08/2020
Sheet: 2 of 6
Printed by: Property Searches

SEWER RECORDS

United Utilities — helping life flow smoothly



The position of the underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available. United Utilities Water will not accept liability for any loss or damage caused by the actual position being different from those shown.

LEGEND

Abandoned	Foul	Surface Water	Combined	
				Public Sewer
				Private Sewer
				Section 104
				Rising Main
				Sludge Main
				Overflow
				Water Course
				Highway Drain

All point assets follow the standard colour convention:
red - combined   blue - surface water
brown - foul   purple - overflow

- Manhole
- Head of System
- Extent of Survey
- Rodding Eye
- Inlet
- Discharge Point
- Vortex
- Penstock
- Washout Chamber
- Valve
- Air Valve
- Non Return Valve
- Soakaway
- Gully
- Cascade
- Flow Meter
- Hatch Box
- Oil Interceptor
- Summit
- Drop Shaft
- Orifice Plate
- Side Entry Manhole
- Outfall
- Screen Chamber
- Inspection Chamber
- Bifurcation Chamber
- Lamp Hole
- T Junction / Saddle
- Catchpit
- Valve Chamber
- Vent Column
- Vortex Chamber
- Penstock Chamber
- Network Storage Tank
- Sewer Overflow
- Ww Treatment Works
- Ww Pumping Station
- Septic Tank
- Control Kiosk
- Change of Characteristic

MANHOLE FUNCTION

FO Foul
SW Surface Water
CO Combined
OV Overflow

SEWER SHAPE

CI Circular   TR Trapezoidal
EG Egg   AR Arch
OV Oval   BA Barrel
FT Flat Top   HO HorseShoe
RE Rectangular   UN Unspecified
SQ Square

SEWER MATERIAL

AC Asbestos Cement
BR Brick
PE Polyethylene
RP Reinforced Plastic Matrix
CC Concrete
CSB Concrete Segment Bolted
CSU Concrete Segment Unbolted
CC Concrete Box Culverted
PSC Plastic / Steel Composite
GRC Glass Reinforced Plastic
DI Ductile Iron
PVC Polyvinyl Chloride
CI Cast Iron
SI Spun Iron
ST Steel
VC Vitrified Clay
PP Polypropylene
PF Pitch Fibre
MAC Masonry, Coursed
MAR Masonry, Random
U Unspecified

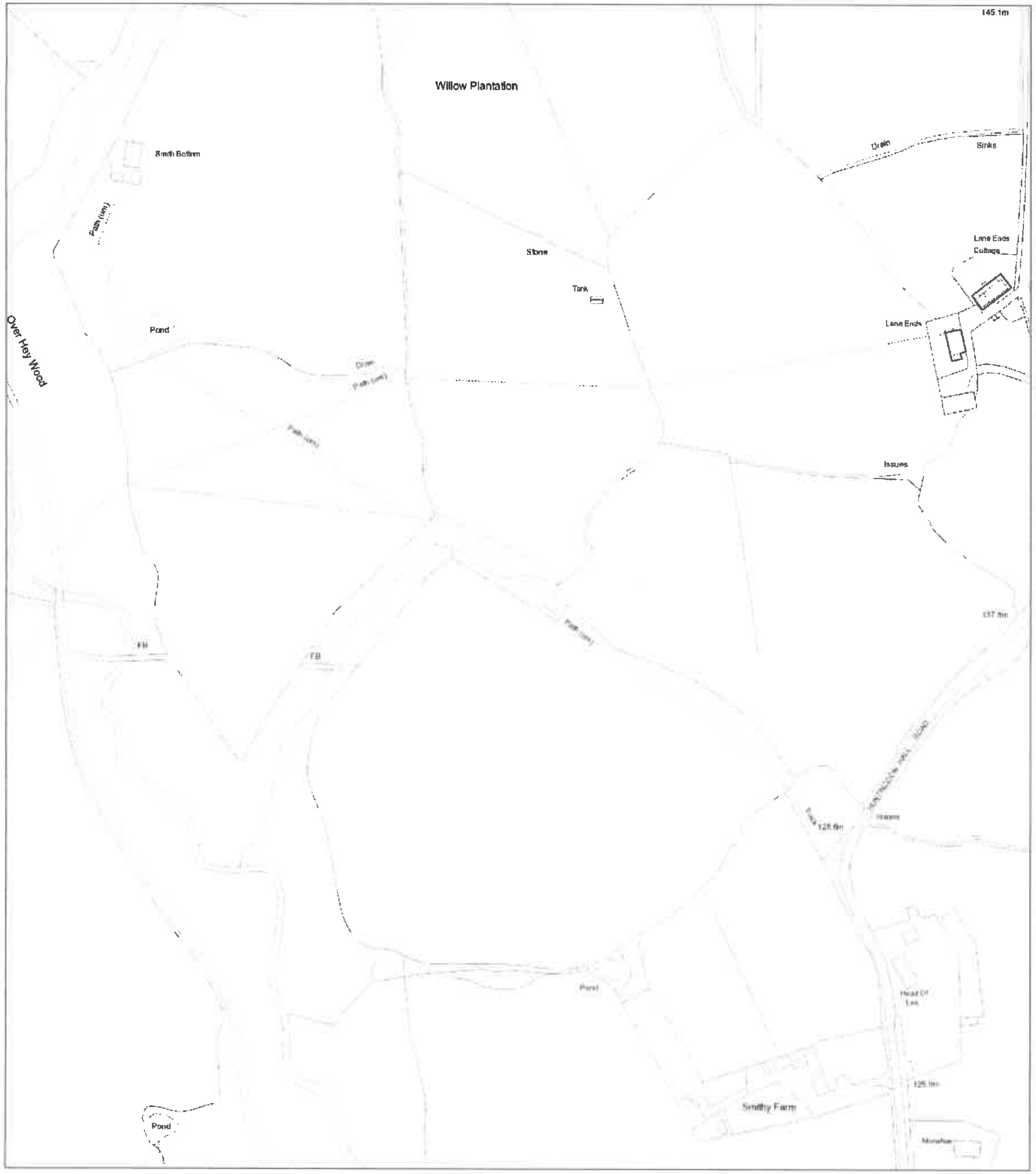
Address or Site Reference:

MOORCOCK FARM CLITHEROE ROAD,
DUTTON,
PRESTON,
PR3 2YT

OS sheet Number: SD6437NE
Scale: 1:1250 **Date:** 22/08/2020
Sheet: 3 of 6
Printed by: Property Searches

SEWER RECORDS

United Utilities — helping life flow smoothly



The position of the underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available. United Utilities Water will not accept liability for any loss or damage caused by the actual position being different from those shown.

LEGEND

Abandoned	Foul	Surface Water	Combined	
				Public Sewer
				Private Sewer
				Section 104
				Rising Main
				Sludge Main
				Overflow
				Water Course
				Highway Drain

All point assets follow the standard colour convention:
red - combined, blue - surface water, brown - foul, purple - overflow

- Manhole
- Head of System
- Extent of Survey
- Rodding Eye
- Inlet
- Discharge Point
- Vortex
- Penstock
- Washout Chamber
- Valve
- Air Valve
- Non Return Valve
- Soakaway
- Gully
- Cascade
- Flow Meter
- Hatch Box
- Oil Interceptor
- Summit
- Drop Shaft
- Orifice Plate
- Side Entry Manhole
- Outfall
- Screen Chamber
- Inspection Chamber
- Bifurcation Chamber
- Lamp Hole
- T Junction / Saddle
- Catchpit
- Valve Chamber
- Vent Column
- Vortex Chamber
- Penstock Chamber
- Network Storage Tank
- Sewer Overflow
- Ww Treatment Works
- Ww Pumping Station
- Septic Tank
- Control Kiosk
- Change of Characteristic

MANHOLE FUNCTION

FO Foul
SW Surface Water
CO Combined
OV Overflow

SEWER SHAPE

CI Circular
EG Egg
OV Oval
FT Flat Top
RE Rectangular
SQ Square
TR Trapezoidal
AR Arch
BA Barrel
HO Horseshoe
UN Unspecified

SEWER MATERIAL

AC Asbestos Cement
BR Brick
PE Polyethylene
RP Reinforced Plastic Matrix
CO Concrete
CSB Concrete Segment Bolted
CSU Concrete Segment Unbolted
CC Concrete Box Culverted
PSC Plastic / Steel Composite
GRC Glass Reinforced Plastic
DI Ductile Iron
PVC Polyvinyl Chloride
CI Cast Iron
SI Spun Iron
ST Steel
VC Vitrified Clay
PP Polypropylene
PF Pitch Fibre
MAC Masonry, Coursed
MAR Masonry, Random
U Unspecified

Address or Site Reference:

MOORCOCK FARM CLITHEROE ROAD,
DUTTON,
PRESTON,
PR3 2YT

OS sheet Number: SD6538SE
Scale: 1:1250
Date: 22/08/2020
Sheet: 4 of 6
Printed by: Property Searches

SEWER RECORDS

United Utilities — helping life flow smoothly

The position of the underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available. United Utilities Water will not accept liability for any loss or damage caused by the actual position being different from those shown.

LEGEND

Abandoned	Foul	Surface Water	Combined	
				Public Sewer
				Private Sewer
				Section 104
				Rising Main
				Sludge Main
				Overflow
				Water Course
				Highway Drain

All point assets follow the standard colour convention:
red - combined, blue - surface water, brown - foul, purple - overflow

- Manhole
- Head of System
- Extent of Survey
- Rodding Eye
- Inlet
- Discharge Point
- Vortex
- Penstock
- Washout Chamber
- Valve
- Air Valve
- Non Return Valve
- Soakaway
- Gully
- Cascade
- Flow Meter
- Hatch Box
- Oil Interceptor
- Summit
- Drop Shaft
- Orifice Plate
- Side Entry Manhole
- Outfall
- Screen Chamber
- Inspection Chamber
- Bifurcation Chamber
- Lamp Hole
- T Junction / Saddle
- Catchpit
- Valve Chamber
- Vent Column
- Vortex Chamber
- Penstock Chamber
- Network Storage Tank
- Sewer Overflow
- WW Treatment Works
- WW Pumping Station
- Septic Tank
- Control Kiosk
- Change of Characteristic

MANHOLE FUNCTION

- FO Foul
- SW Surface Water
- CO Combined
- OV Overflow

SEWER SHAPE

- CI Circular
- EG Egg
- OV Oval
- FT Flat Top
- RE Rectangular
- SQ Square
- TR Trapezoidal
- AR Arch
- BA Barrel
- HO Horseshoe
- UN Unspecified

SEWER MATERIAL

- AC Asbestos Cement
- BR Brick
- PE Polyethylene
- RP Reinforced Plastic Matrix
- CO Concrete
- CSB Concrete Segment Bolted
- CSU Concrete Segment Unbolted
- CC Concrete Box Culverted
- PSC Plastic / Steel Composite
- GRC Glass Reinforced Plastic
- DI Ductile Iron
- PVC Polyvinyl Chloride
- CI Cast Iron
- SI Spun Iron
- ST Steel
- VC Vitrified Clay
- PP Polypropylene
- PF Pitch Fibre
- MAC Masonry, Coursed
- MAR Masonry, Random
- U Unspecified

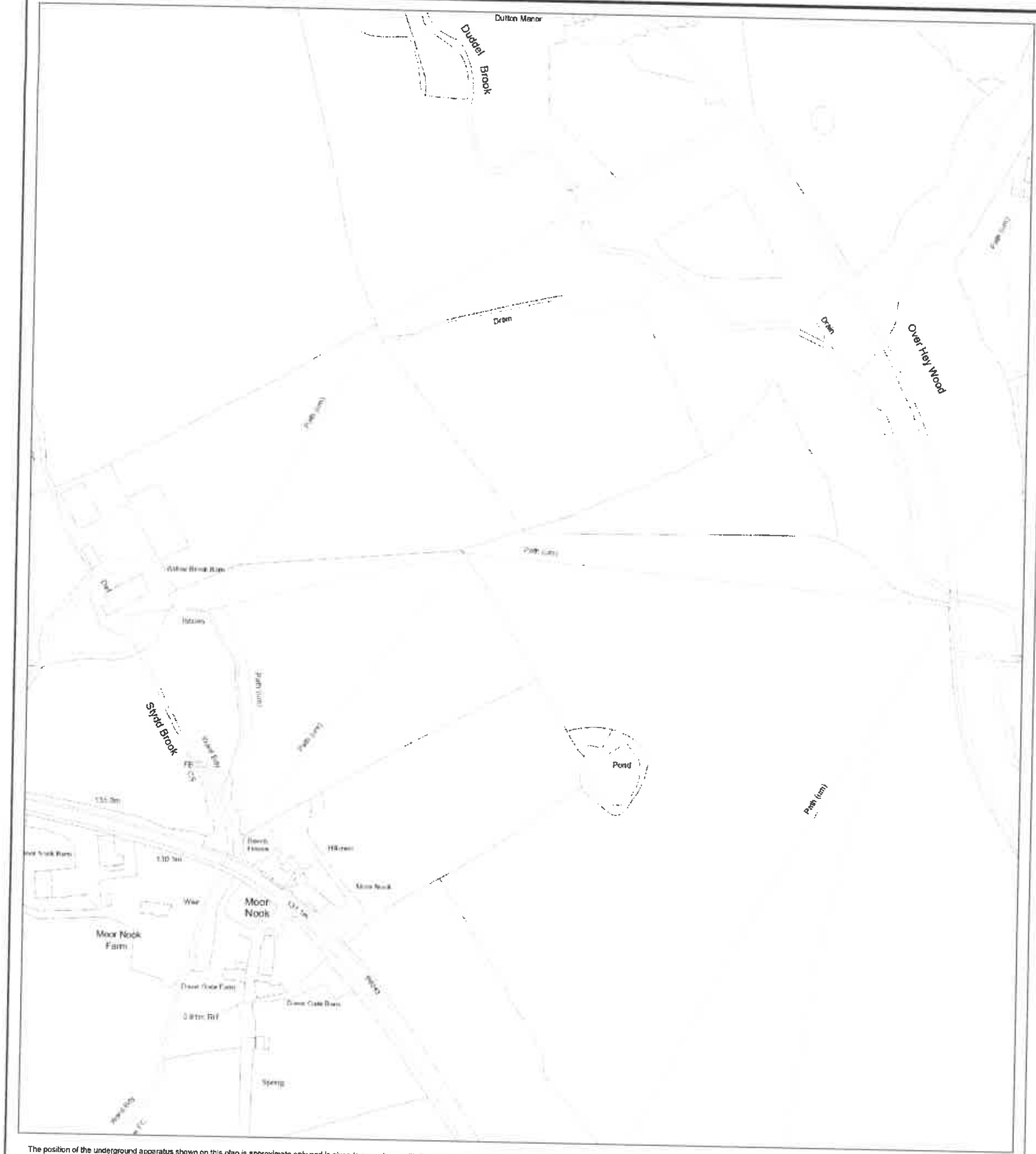
Address or Site Reference:

MOORCOCK FARM CLITHEROE ROAD,
DUTTON,
PRESTON,
PR3 2YT

OS sheet Number: SD6438SE
Scale: 1:1250 **Date:** 22/08/2020
Sheet: 5 of 6
Printed by: Property Searches

SEWER RECORDS

United Utilities — helping life flow smoothly



The position of the underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available. United Utilities Water will not accept liability for any loss or damage caused by the actual position being different from those shown.

LEGEND

Abandoned	Foul	Surface Water	Combined	
				Public Sewer
				Private Sewer
				Section 104
				Rising Main
				Sludge Main
				Overflow
				Water Course
				Highway Drain

All point assets follow the standard colour convention:
red - combined blue - surface water
brown - foul purple - overflow

- Manhole
- Head of System
- Extent of Survey
- Rodding Eye
- Inlet
- Discharge Point
- Vortex
- Penstock
- Washout Chamber
- Valve
- Air Valve
- Non Return Valve
- Soakaway
- Gully
- Cascade
- Flow Meter
- Hatch Box
- Oil Interceptor
- Summit
- Drop Shaft
- Orifice Plate
- Side Entry Manhole
- Outfall
- Screen Chamber
- Inspection Chamber
- Bifurcation Chamber
- Lamp Hole
- T Junction / Saddle
- Catchpit
- Valve Chamber
- Vent Column
- Vortex Chamber
- Penstock Chamber
- Network Storage Tank
- Sewer Overflow
- Ww Treatment Works
- Ww Pumping Station
- Septic Tank
- Control Kiosk
- Change of Characteristic

MANHOLE FUNCTION

FO Foul
SW Surface Water
CO Combined
OV Overflow

SEWER SHAPE

CI Circular
EG Egg
OV Oval
FT Flat Top
RE Rectangular
SQ Square
TR Trapezoidal
AR Arch
BA Barrel
HO HorseShoe
UN Unspecified

SEWER MATERIAL

AC Asbestos Cement
BR Brick
PE Polyethylene
RP Reinforced Plastic Matrix
CO Concrete
CSB Concrete Segment Bolted
CSU Concrete Segment Unbolted
CC Concrete Box Culverted
PSC Plastic / Steel Composite
GRC Glass Reinforced Plastic
DI Ductile Iron
PVC Polyvinyl Chloride
CI Cast Iron
SI Spun Iron
ST Steel
VC Vitrified Clay
PP Polypropylene
PF Pitch Fibre
MAC Masonry, Coursed
MAR Masonry, Random
U Unspecified

Address or Site Reference:

MOORCOCK FARM CLITHEROE ROAD,
DUTTON,
PRESTON,
PR3 2YT

OS sheet Number: SD6538SW
Scale: 1:1250 **Date:** 22/08/2020
Sheet: 6 of 6
Printed by: Property Searches

SEWER RECORDS

United Utilities
helping life flow smoothly

APPENDIX C: CALCULATIONS

GREENFIELD RUNOFF CALCULATIONS
MICRO DRAINAGE SOURCE CONTROL

R G PARKINS & PARTNERS LTD	CALCULATION		Job No.	K37295	Page	1 of 4
Meadowside	Job	Moorcock Farm	Drg no.	N/A	Date	09/02/2021
Shap Road		Clitheroe	Revision	Orig	Initial	JB
KENDAL LA9 6NY	Title	Rate of Run-Off			Checked	OS

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:

Brownfield Site to Brownfield Site (Increased Impermeable Area)

Results Summary

Rate of Run-Off (l/s)			
Event	Greenfield		Post-Development
Q1	0.6		0.6
QBAR	0.7		0.7
Q10	1.0		1.0
Q30	1.2		1.2
Q100	1.4		1.4
Q100 + 30% CC	1.9		1.9

SITE AREAS (LAND COVER AREAS)

Existing Impermeable & Permeable Land Cover

Total Site Area: **0.21** ha **2100** m^2

Existing Impermeable & Permeable Land Cover

Land Cover	Area		Percentage of total site area
	m^2	ha	
Total impermeable area	1032.6	0.103	49%
Remaining permeable area	1067.4	0.107	51%

Proposed Land Cover Areas

Land Cover	Area		Percentage of total site area
	m^2	ha	
Total housing roof area	492.0	0.049	23%
Total parking and paved area	267.0	0.027	13%
Total road area	428.0	0.043	20%
Garden & landscaped areas	1341.0	0.134	64%

Proposed Impermeable & Permeable Land Cover

Land Cover	Area		Percentage of total site area
	m^2	ha	
Total impermeable area	759.0	0.076	36%
Remaining permeable area	1341.0	0.134	64%

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	=	1209	mm	From UKSuds website (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	%	
So, SOIL	=	0.47		

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

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

$QBAR_{rural}$	=	0.458	m^3/s
	=	457.5	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	=	759	m^2
	=	0.001	km^2
	=	0.076	ha
$QBAR_{rural\ site}$	=	0.00069	m^3/s
	=	0.69	l/s

Excluding significant open space which would remain disconnected from the positive drainage system during flood events.

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	0.60
2	0.93	0.65
5	1.19	0.83
10	1.38	0.96
25	1.64	1.14
30	1.7	1.18
50	1.85	1.28
100	2.08	1.44
200	2.32	1.61
500	2.73	1.90
1000	3.04	2.11

Ordinate from FSSR2

Interpolation taken from Figure 24.2 (pg 515) SuDS Manual

R G PARKINS & PARTNERS LTD	CALCULATION		Job No.	K37295	Page	N/A
Meadowside	Job	Moorcock Farm	Drg no.	N/A	Date	09/02/2021
Shap Road		Clitheroe	Revision	Orig	Initial	JB
KENDAL LA9 6NY	Title	Rate of Run-Off			Checked	OS

ESTIMATE OF BROWNFIELD RUNOFF

Total site impermeable area, A = **759** m²

M5-60 rainfall depth **19.2** mm — *[Flood Studies Report (NERC, 1975)]*

Ratio M5-60/M5-2Day, r **0.28** — *[The Wallingford Proceedure - V4 Modified Rational Method, Fig A.2 (Hydraulics Research, 1983)]*

Storm Duration 15 mins — Anticipated critical duration for the site - usually 15 minutes

Duration factor, Z1 0.58 — *[The Wallingford Proceedure - V4 Modified Rational Method, Fig A.3b (Hydraulics Research, 1983)]*

M5-15 rainfall depth = 11.2 mm

Return period ratio, Z2

M1-15	0.61
M10-15	1.22
M30-15	1.50
M100-15	1.93

[The Wallingford Proceedure - V4 Modified Rational Method, Table A1 (Hydraulics Research, 1983)]

Rainfall

	Depth (mm)	Intensity, i (mm/hr)
M1-15	6.9	27
M10-15	13.7	55
M30-15	16.8	67
M100-15	21.6	86

Peak discharge, Qp = Cv Cr i A

Where:

Cv = Volumetric Runoff Coefficient
Cr = Routing Coefficient
i = Rainfall intensity (mm/hour)

Cv = 0.95
Cr = 1.3

Peak Runoff

	l/s
Q1	7.1
Q10	14.3
Q30	17.5
Q100	22.5

R G PARKINS & PARTNERS LTD	CALCULATION		Job No.	K37295	Page	N/A
Meadowside	Job	Moorcock Farm	Drg no.	N/A	Date	09/02/2021
Shap Road		Clitheroe	Revision	Orig	Initial	JB
KENDAL LA9 6NY	Title	Rate of Run-Off			Checked	OS

ESTIMATION OF QBAR (BROWNFIELD RUNOFF RATE)

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

Return Period	Ordinate
1	0.87
2	0.93
5	1.19
10	1.38
25	1.64
30	1.70
50	1.85
100	2.08
200	2.32
500	2.73
1000	3.04

Ordinate from FSSR2

Interpolation taken from Figure 24.2 (pg 515) SuDS Manual

Ordinate used	Qbar l/s
10 year	10.3
30 year	10.3
100 year	10.8

Proposed Brownfield Runoff, Qbar = 10.47 l/s

Using the average Qbar derived from three ordinates.

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

Half Drain Time : 769 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	116.870	0.270	0.0	0.4	0.4	20.0	O K
30 min Summer	116.971	0.371	0.0	0.5	0.5	27.5	O K
60 min Summer	117.084	0.484	0.0	0.6	0.6	35.9	O K
120 min Summer	117.157	0.557	0.0	0.6	0.6	41.3	O K
180 min Summer	117.198	0.598	0.0	0.6	0.6	44.3	O K
240 min Summer	117.225	0.625	0.0	0.7	0.7	46.3	O K
360 min Summer	117.254	0.654	0.0	0.7	0.7	48.5	O K
480 min Summer	117.266	0.666	0.0	0.7	0.7	49.3	O K
600 min Summer	117.269	0.669	0.0	0.7	0.7	49.6	O K
720 min Summer	117.271	0.671	0.0	0.7	0.7	49.7	O K
960 min Summer	117.269	0.669	0.0	0.7	0.7	49.6	O K
1440 min Summer	117.258	0.658	0.0	0.7	0.7	48.7	O K
2160 min Summer	117.230	0.630	0.0	0.7	0.7	46.7	O K
2880 min Summer	117.202	0.602	0.0	0.6	0.6	44.6	O K
4320 min Summer	117.155	0.555	0.0	0.6	0.6	41.2	O K
5760 min Summer	117.119	0.519	0.0	0.6	0.6	38.5	O K
7200 min Summer	117.091	0.491	0.0	0.6	0.6	36.4	O K
8640 min Summer	117.069	0.469	0.0	0.6	0.6	34.7	O K
10080 min Summer	117.051	0.451	0.0	0.6	0.6	33.4	O K
15 min Winter	116.903	0.303	0.0	0.5	0.5	22.4	O K
30 min Winter	117.016	0.416	0.0	0.5	0.5	30.8	O K
60 min Winter	117.143	0.543	0.0	0.6	0.6	40.3	O K
120 min Winter	117.227	0.627	0.0	0.7	0.7	46.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	142.419	0.0	19.4	19
30 min Summer	98.527	0.0	26.2	34
60 min Summer	65.259	0.0	36.9	64
120 min Summer	38.676	0.0	43.7	122
180 min Summer	28.478	0.0	48.3	182
240 min Summer	22.915	0.0	51.7	242
360 min Summer	16.858	0.0	57.0	360
480 min Summer	13.550	0.0	61.0	480
600 min Summer	11.428	0.0	64.1	536
720 min Summer	9.937	0.0	66.7	594
960 min Summer	7.955	0.0	70.3	720
1440 min Summer	5.815	0.0	73.8	982
2160 min Summer	4.260	0.0	87.2	1404
2880 min Summer	3.434	0.0	93.7	1816
4320 min Summer	2.572	0.0	105.0	2632
5760 min Summer	2.121	0.0	116.0	3400
7200 min Summer	1.843	0.0	126.0	4176
8640 min Summer	1.655	0.0	135.7	4928
10080 min Summer	1.519	0.0	145.2	5656
15 min Winter	142.419	0.0	21.6	19
30 min Winter	98.527	0.0	28.8	33
60 min Winter	65.259	0.0	41.3	62
120 min Winter	38.676	0.0	48.9	120

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
180 min Winter	117.275	0.675	0.0	0.7	0.7	50.0	O K
240 min Winter	117.306	0.706	0.0	0.7	0.7	52.3	O K
360 min Winter	117.342	0.742	0.0	0.7	0.7	55.0	O K
480 min Winter	117.360	0.760	0.0	0.7	0.7	56.3	O K
600 min Winter	117.366	0.766	0.0	0.7	0.7	56.7	O K
720 min Winter	117.365	0.765	0.0	0.7	0.7	56.7	O K
960 min Winter	117.359	0.759	0.0	0.7	0.7	56.3	O K
1440 min Winter	117.340	0.740	0.0	0.7	0.7	54.8	O K
2160 min Winter	117.295	0.695	0.0	0.7	0.7	51.5	O K
2880 min Winter	117.251	0.651	0.0	0.7	0.7	48.2	O K
4320 min Winter	117.176	0.576	0.0	0.6	0.6	42.7	O K
5760 min Winter	117.118	0.518	0.0	0.6	0.6	38.4	O K
7200 min Winter	117.072	0.472	0.0	0.6	0.6	35.0	O K
8640 min Winter	117.036	0.436	0.0	0.5	0.5	32.3	O K
10080 min Winter	117.007	0.407	0.0	0.5	0.5	30.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
180 min Winter	28.478	0.0	54.0	180
240 min Winter	22.915	0.0	57.9	238
360 min Winter	16.858	0.0	63.8	352
480 min Winter	13.550	0.0	68.1	462
600 min Winter	11.428	0.0	71.5	570
720 min Winter	9.937	0.0	74.1	670
960 min Winter	7.955	0.0	77.6	752
1440 min Winter	5.815	0.0	80.8	1066
2160 min Winter	4.260	0.0	97.7	1516
2880 min Winter	3.434	0.0	104.9	1956
4320 min Winter	2.572	0.0	117.5	2808
5760 min Winter	2.121	0.0	129.9	3584
7200 min Winter	1.843	0.0	141.1	4392
8640 min Winter	1.655	0.0	152.0	5184
10080 min Winter	1.519	0.0	162.7	5944

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 365292 437875 SD 65292 37875
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.076

Time (mins) From:	To:	Area (ha)
0	4	0.076

Model Details

Storage is Online Cover Level (m) 118.000

Cellular Storage Structure

Invert Level (m) 116.600 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	78.0	78.0	0.801	0.0	107.6
0.800	78.0	107.6			

Orifice Outflow Control

Diameter (m) 0.020 Discharge Coefficient 0.600 Invert Level (m) 116.600

R G PARKINS & PARTNERS LTD	CALCULATION		Job No.	K37295	Page	1
Meadowside	Job	Moorcock Farm	Drg no.	-	Date	19/01/2021
Shap Road		Clitheroe	Revision	-	Initial	JB
KENDAL LA9 6NY	Title	Effluent Disposal			Checked	OS

TREATED EFFLUENT DISPOSAL

Soils are considered unsitable for disposal via infiltration methods

Dwelling size	P/ dwelling	Number of dwellings	P total
4 bedroom house	6	1	6
		Total P	**6**

Private treatment provided by: PACKAGED TREATMENT PLANT

Effluent disposal to: Discharge to Watercourse

PACKAGED TREATMENT PLANT PLANT SIZING

Design P for packaged treatment plant sizing	Flow	BOD	Ammonia as N
	l/day	g	g
6	900	360	48

No environmental permit required

packaged treatment plant: Klargester Biodisc BA

Length	Width	Height	Depth to inlet IL	Depth to outlet IL
mm	mm	mm	mm	mm
1995	1995	2160	750	835