



Flood Risk Assessment for Development at Castleton Sidings, Rochdale, OL11 3BZ. Rev. 3.

Contract Ref: FD086

Kellen Homes Limited

Contents

Quality Assurance Record	4
Contributors for Townsend Water Engineering Limited:.....	4
Document Status and Revision History:.....	4
Limitation of Liability and Use.....	4
1. INTRODUCTION.....	5
1.1 Purpose of this Report.....	5
1.2 Sources of Information and Consultation.....	5
1.3 Policy Context.....	5
1.4 Structure of this Report.....	5
2. SPATIAL PLANNING CONSIDERATION.....	7
2.1 Location and Background.....	7
2.2 Topography.....	9
2.3 Geology and Soil.....	9
2.4 Flood Zone and Surface Water flooding.....	9
2.5 NPPF Vulnerability.....	11
2.6 Climate Change Allowances for Peak Rainfall Intensity.....	12
3. FLOOD HAZARD FOR EXISTING SITE.....	14
3.1 Source of Flood Risk.....	14
4. ASSESSMENT OF FLOOD RISK FOR PROPOSED DEVELOPMENT.....	16
4.1 Development Proposals.....	16
4.2 Fluvial Flood Management.....	16
5. DRAINAGE STRATEGY.....	17
5.1.1 Surface Water.....	17
5.2 Infiltration Rates.....	17
5.3 Run-off.....	17
5.4 Surface water drainage strategy.....	17
5.4.1 Hierarchy of Discharge.....	17
5.4.2 Sizing of SUDS features.....	17
5.4.3 Maintenance Plan.....	18
6. SUMMARY & CONCLUSIONS.....	21
7. REFERENCES.....	22
Appendix A: Topographical Survey.....	23
Appendix B: Proposed Layout.....	24
Appendix C: LLFA confirmation of Discharge.....	25
Appendix D; Concept Drainage Design.....	26

Figure 1: Site location (Source: Bing Map).....	8
Figure 2: Aerial View of the site (Source: Google Maps)	9
Figure 3: Flood Risk Maps.....	10
Figure 4: Flood Risk Maps: Surface Water (Source: EA Open Dataset)	11
Figure 6: Extent of Flooding from Reservoirs (Source; EA Flood Warning Information Service) ..	15
Figure 7: Proposed Site (Source: Client).....	16
Table 1: Site Details.....	7
Table 2: Flood Risk Vulnerability Classification (Source: NPPF Technical Guide).....	12
Table 3: Flood Risk Vulnerability and flood zone compatibility (Source: NPPF Technical Guide).	12
Table 4: Peak rainfall intensity allowance	13
Table 5: Operation and Maintenance Requirements for swales	18
Table 6: Operation and Maintenance Requirements for Pervious Pavements	19
Table 7: Operation and Maintenance Requirements for geocellular tanks	20

Quality Assurance Record

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1	15/03/2023	A. Osborne	C. Townsend	C. Townsend	1 st Issue
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3	17/05/2023	A. Osborne	C. Townsend	C. Townsend	3 rd Issue

Limitation of Liability and Use

The work described in this report was undertaken for the party or parties stated; for the purpose or purposes stated; to the time and budget constraints stated. No liability is accepted for use by other parties or for other purposes, or unreasonably beyond the terms and parameters of its commission and its delivery to normal professional standards.

1. INTRODUCTION

1.1 Purpose of this Report

Townsend Water Engineering Ltd. has been appointed by Mr Andrew Brown at Kellen Homes for a Flood Risk Assessment (FRA) of a development of approximately 191 residential dwellings with associated gardens and landscaped areas, estate roads, pavements, and infrastructure at Castleton Sidings, Rochdale, OL11 3BZ (Grid Ref: 388024, 410335). This report has been prepared in support of the planning permission for the aforementioned development.

The report is based on the available flood risk information for the site detailed in Section 1.2 and prepared in accordance with the planning policy requirements set out in Section 1.3. The scope of the FRA is consistent with the 'Site Specific Flood Risk Assessment Checklist' from the National Planning Policy Framework (NPPF) and accompanying Planning Practice Guidance (PPG):

<https://www.gov.uk/guidance/flood-risk-and-coastal-change#Site-Specific-Flood-Risk-Assessment-checklist-section>

1.2 Sources of Information and Consultation

This Report has been informed by:

- Existing Site Plan drawings and respective topographic plan delivered by Kellen Homes Limited;
- EA Product 4 data;
- Defra Magic Map <https://magic.defra.gov.uk/magicmap.aspx>;
- The EA online flood maps;
- <https://flood-map-for-planning.service.gov.uk/>; and
- <https://flood-warning-information.service.gov.uk/long-term-flood-risk/>.

1.3 Policy Context

This report has been prepared in accordance with the relevant national, regional and local planning policy and statutory guidance as follows:

1. National policy contained within the National Planning Policy Framework (NPPF) dated July 2021, issued by Communities and Local Government with reference to Section 14 'Meeting the challenge of climate change, flooding and coastal change';
2. The NPPF Planning Practice Guidance (PPG) released in March 2014 ('Flood Risk and Coastal Change' section) and updated in July 2021 to incorporate the EA 'Flood Risk Assessments: Climate Change Allowances' guidance.

1.4 Structure of this Report

The Report has been prepared based on the following structure:

1. Section 2 refers to spatial planning considerations by reference to the proposed land use, flood zoning and NPPF vulnerability;

2. Section 3 presents the assessment of existing flood risk at the site;
3. Section 4 presents the proposed development and findings of flooding;
4. Section 5 presents the drainage strategy; and
5. Section 6 provides a summary of the assessments.

Additional Appendices are provided that deal with the following:

Appendix A: Topographical Survey;

Appendix B: Proposed Layout;

Appendix C: Confirmation of discharges from statutory bodies; and

Appendix D: Concept Drainage Design.

2. SPATIAL PLANNING CONSIDERATION

2.1 Location and Background

The location of the proposed development site is shown in Figure 1 and Figure 2, with location details found in Table 1. The site is located at Castleton Sidings, Rochdale, OL11 3BZ (Grid Ref: 388024, 410335). (Table 1: Site Details). The proposed development is for a Hybrid planning application comprising:

“Full planning application for residential development, including access, car parking, landscaping, open space and associated engineering and infrastructure including an electric substation and foul water pump station.

“Outline planning permission with all matters reserved for the principle of development to facilitate the East Lancashire Railway (ELR) extension”.

The entire development site is approximately 10.93ha and is currently a disused railway depot that has been mostly demolished, with some old railway tracks still in existence. There is a 600mm culvert crossing the middle of the site from South to North, the culvert outfalls into *Trub Brook* in the South-East. According to United Utilities Sewer Maps, there is a combined sewer on the Northern boundary.

To the North of the site is a golf course, further North is a residential area. There is a railway to the East, further East is a field and a residential area. To the South are woods followed by a railway and fields. To the West is the golf course, and to the South-West is a pond. Please see Figure 1 and Figure 2 indicating these features.

Table 1: Site Details

Reference	Value
OS X (Eastings)	388024
OS Y (Northings)	410335
Nearest Post Code	OL11 3BZ
Nat. Grid	SD880103

Grid reference details taken from the site Grid Reference Finder

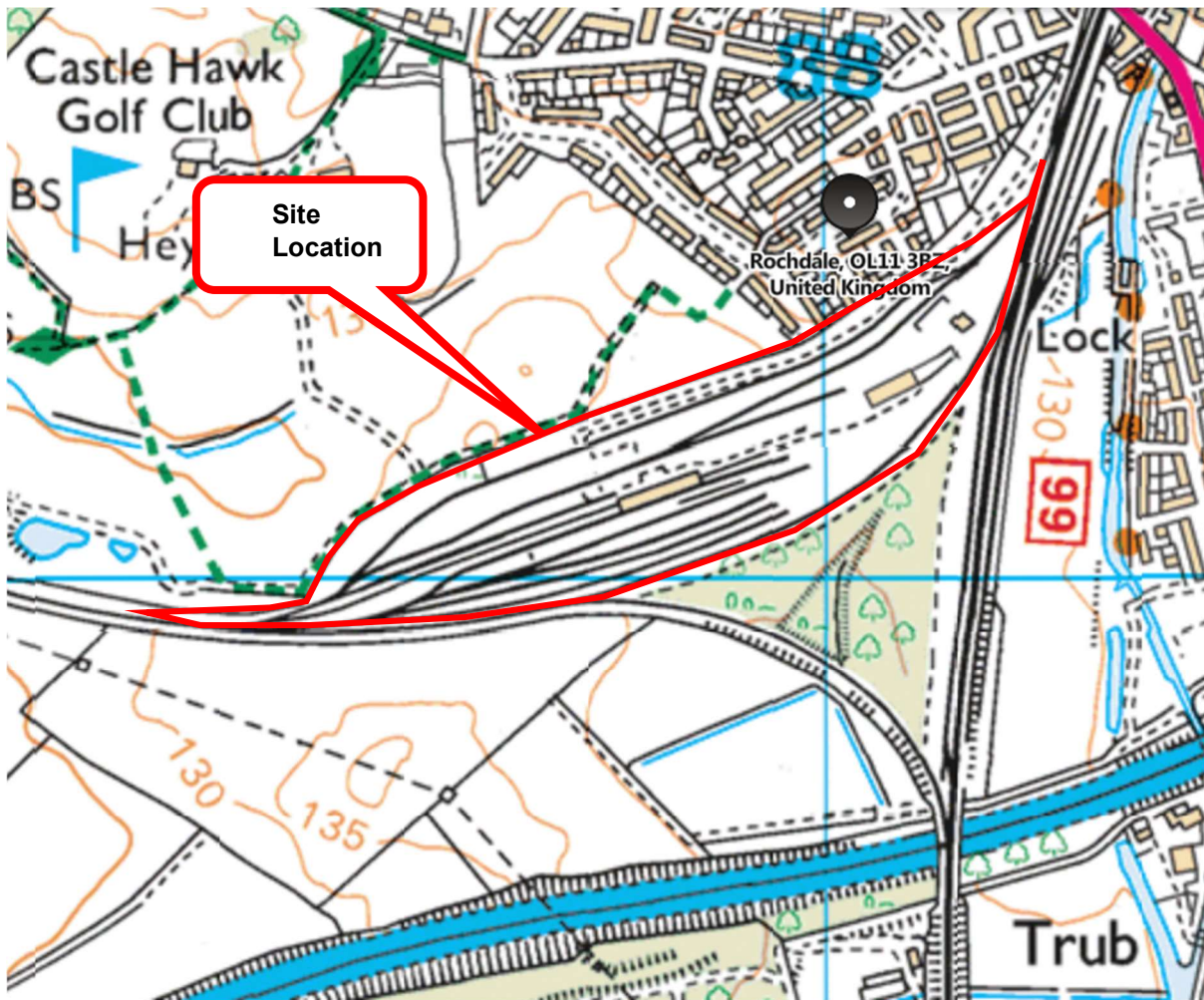


Figure 1: Site location (Source: Bing Map)



Figure 2: Aerial View of the site (Source: Google Maps)

2.2 Topography

The existing ground elevations on site is shown in the topographic survey (Appendix A). The survey indicates that the site is highest in the North-East corner and lowest to the South-West. Ground levels vary between 136mAOD and 130mAOD. The ground sweeps down to the South-West, towards *Trub Brook* watercourse.

2.3 Geology and Soil

A Geo-Environmental report Published by EP3 in May 2021 was undertaken for the site. Trial pits and window samples were undertaken. The results of these tests indicate that the site is underlain with clay and contaminated made ground. This suggests that soakaways are not suitable for this site.

2.4 Flood Zone and Surface Water flooding

The existing site is within a Flood Zone 1, please see Figure 3. An area with a 0.1% chance of flooding (1 in 1000 year event plus climate change). This suggests that the site is at low risk of flooding.

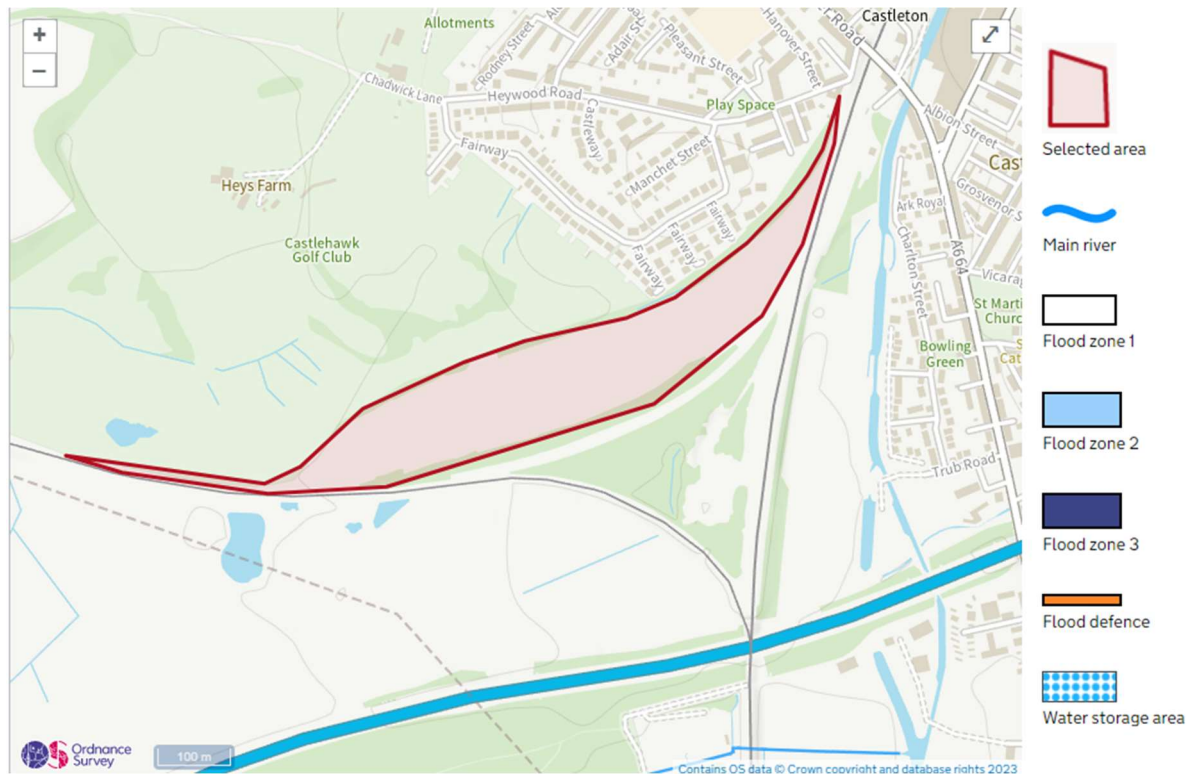


Figure 3: Flood Risk Maps

The existing site is predominantly at very low risk of surface water flooding, this means that this area has a chance of flooding of less than 0.1% each year. However, as shown in Figure 4: Flood Risk Maps: Surface Water (Source: EA Open Dataset), there are some areas at a high risk of surface water flooding. The layout has taken this into account and no housing has been placed within these areas.

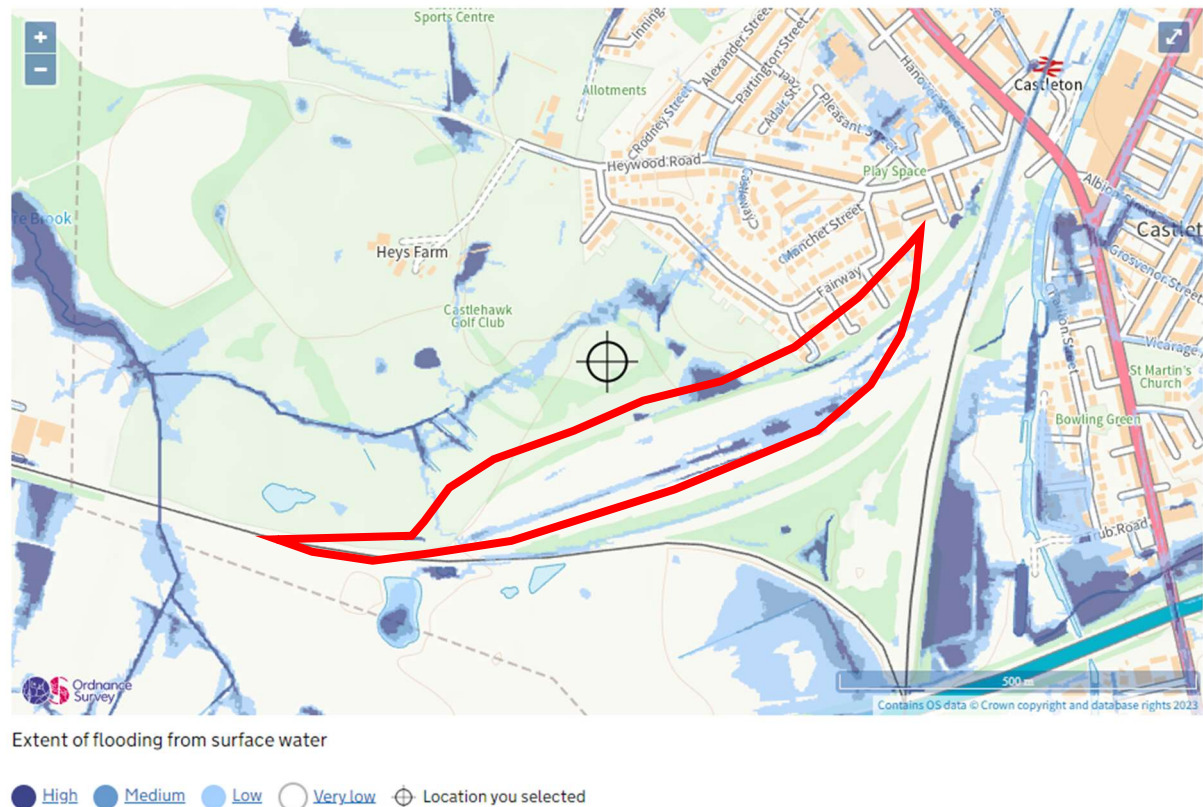


Figure 4: Flood Risk Maps: Surface Water (Source: EA Open Dataset)

Furthermore surface water flooding will be mitigated by the inclusion of a new drainage systems which will attenuate up to and including the 1 in 100 year event plus climate change. Therefore, the site is believed to be at low risk of surface water flooding.

2.5 NPPF Vulnerability

The development will be classed as 'More Vulnerable' under the NPPF vulnerability classification (Table 2). The flood risk vulnerability and flood zone compatibility are displayed in Table 3: Flood Risk Vulnerability and flood zone compatibility (Source: NPPF Technical Guide). As noted in Section 2.4, the site is within Flood Zone 1 according to the EA flood risk map for planning.

Table 2: Flood Risk Vulnerability Classification (Source: NPPF Technical Guide)

More vulnerable (MV)
Hospitals, residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels
Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels.
Non-residential uses for health services, nurseries and educational establishments.
Landfill and sites used for waste management facilities for hazardous waste ⁶ .
Sites used for holiday or short let caravans and camping, subject to a specific warning and evacuation plan. ⁷

Table 3: Flood Risk Vulnerability and flood zone compatibility (Source: NPPF Technical Guide)

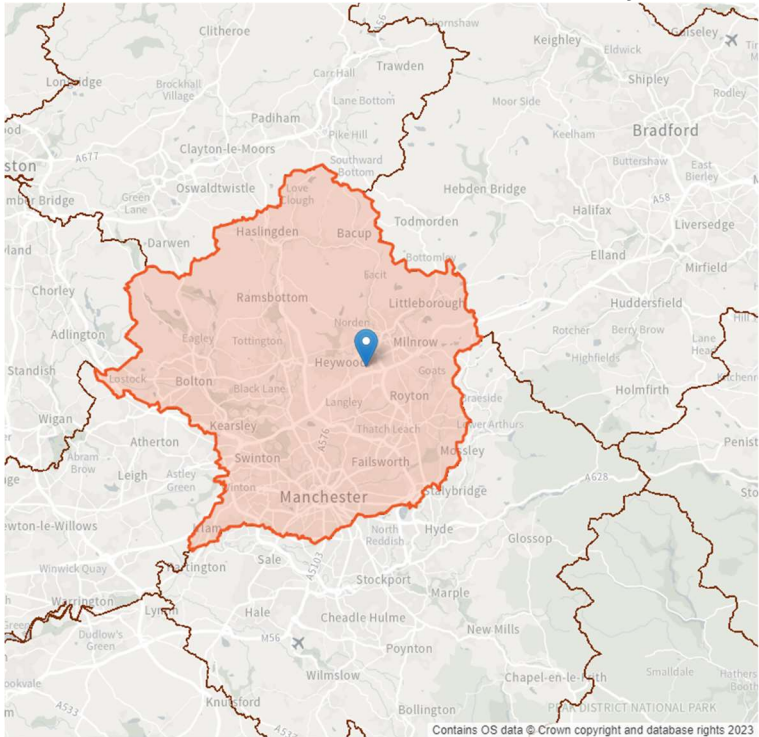
Flood Zone	Definition	Essential Infrastructure	Water compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
1	$T > 1,000$	✓	✓	✓	✓	✓
2	$100 < T_{fluv} < 1,000$ $200 < T_{tidal} < 1,000$	✓	✓	Exc. Test	✓	✓
3a	$T_{fluv} < 100$ $T_{tidal} < 200$	Exc. Test	✓	✗	Exc. Test	✓
3b (functional flood plain)	$T_{fluv} < 20$	Exc. Test	✓	✗	✗	✗

As the site is within a Flood Zone 1, the site passes the sequential test. Please see Table 3: Flood Risk Vulnerability and flood zone compatibility (Source: NPPF Technical Guide). The small parts of surface water flooding have been left as public open space or road. This is discussed in more detail in section 3.

2.6 Climate Change Allowances for Peak Rainfall Intensity

The Environment Agency and NPPF require a consideration of the impacts of climate change in Flood Risk Assessments (FRA). In May 2022, the Environment Agency updated the climate change allowances required in Flood Risk Assessments (Environment Agency, 2022); this advice updates previous climate change allowances to support the NPPF (DCLG, 2021). Table 4: Peak rainfall intensity allowance shows anticipated changes in small catchments, recommending a progressive increase, reaching 45% for the 'Upper End' allowance by 2070. This allowance would be recommended for this proposed development, which is classified as 'More Vulnerable' and has been taken to have a 100-year design life. The 45% climate change allowance is based on the 90th percentile, meaning that there is a 90% chance that rainfall will not increase by more than the 45% increment.

Table 4: Peak rainfall intensity allowance



**Irwell Management
Catchment peak rainfall
allowances**

**3.3% annual exceedance
rainfall event**

Epoch	3.3% annual exceedance rainfall event	
	Central allowance	Upper end allowance
2050s	25%	35%
2070s	30%	40%

**1% annual exceedance
rainfall event**

Epoch	1% annual exceedance rainfall event	
	Central allowance	Upper end allowance
2050s	25%	40%
2070s	30%	45%

*Use '2050s' for development with a lifetime up to 2060 and use the 2070s epoch for development with a lifetime between 2061 and 2125.

3. FLOOD HAZARD FOR EXISTING SITE

3.1 Source of Flood Risk

Flood sources and their possibilities are shown below.

3.1.1 Flood Risk from Fluvial Sources

The proposed development is in a flood zone 1. Therefore, the site is considered to be at low risk of fluvial flooding.

There is a 600mm culvert running through the site from North to South. It is proposed to fill in the culvert within the site. A CCTV survey was undertaken and indicates that the culvert only drained the site. Therefore, it is acceptable to remove the culvert. The drainage catchment that the culvert drains will be incorporated into the new drainage system.

3.1.2 Surface Water

The majority of the existing site is at very low risk of surface water flooding. As mentioned in section 2.4, some areas of the site are at a medium to high risk of surface water flooding; no houses will be placed in these areas. Please see Figure 4.

Furthermore, surface water flooding will be mitigated by the inclusion of a new drainage systems which will attenuate up to and including the 1 in 100 year event plus climate change. Therefore the site is believed to be at low risk of surface water flooding.

3.1.3 Flood Risk from Reservoir /Canals / Other Artificial Sources

Figure 5: Extent of Flooding from Reservoirs (Source; EA Flood Warning Information Service), indicates that the site is not within potential risk of flooding in the event of a breach from reservoirs(over 25,000 m³ of water. Flooding from reservoir is considered to be extremely unlikely and the risk of flooding to the site considered to be low.

Rochdale canal is 260m East of the site. The canal is believed to be of no flood risk to the site as there is an embankment between the site and Rochdale canal. Therefore, there is no flood risk from canals or other artificial sources as there are no artificial sources within the vicinity of the site.

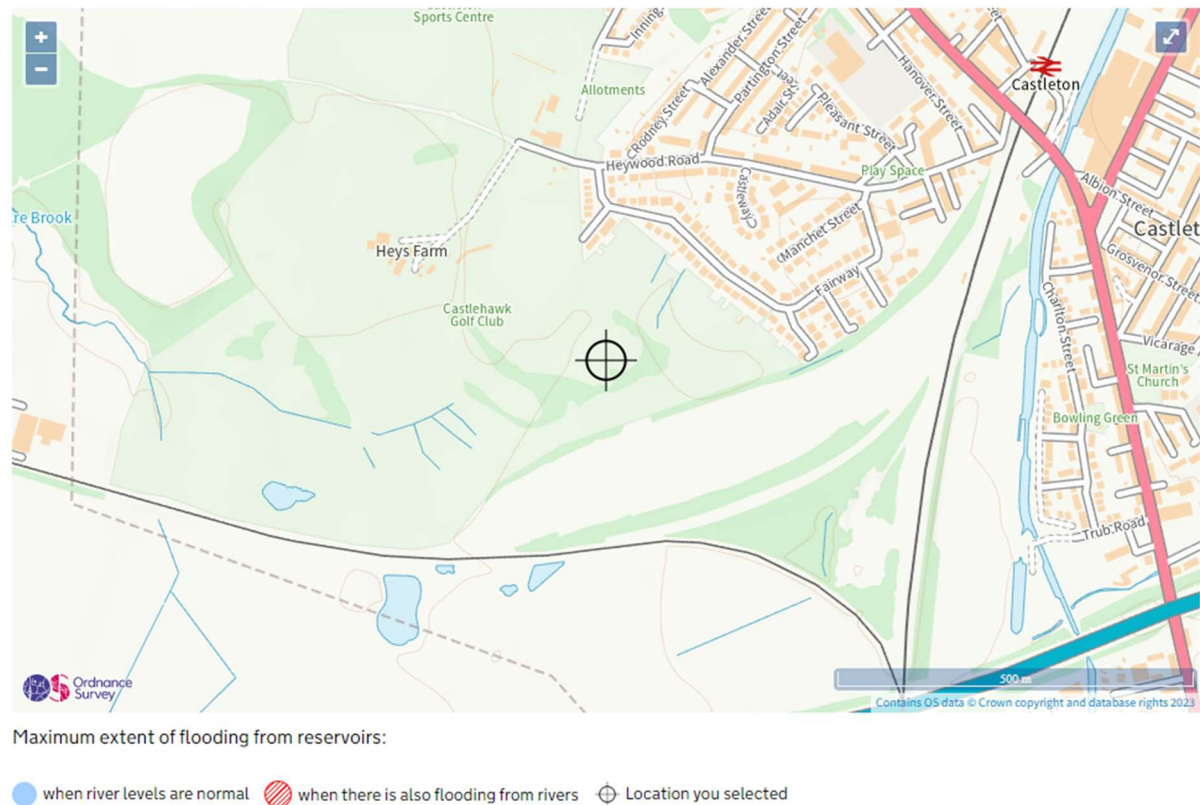


Figure 5: Extent of Flooding from Reservoirs (Source: EA Flood Warning Information Service)

3.1.4 Flood Risk from Groundwater

According to SFRA, the site is at low risk from groundwater. Therefore, the risk of groundwater flooding is low for this site.

3.1.5 Flood Risk from Sewers

The proposed site has no surface water sewers crossing it and therefore, the existing flood risk from sewers is believed to be low.

There is a combined sewer in the Northern corner of the site. This will be where the foul water will drain. It is believed this is in working order and does not flood the site.

4. ASSESSMENT OF FLOOD RISK FOR PROPOSED DEVELOPMENT

4.1 Development Proposals

It is proposed to create 191 dwellings at Castleton Sidings, Rochdale, OL11 3BZ, as shown on the indicative masterplan Figure 6. Each plot will have a private driveway constructed from impermeable materials, with shared access roads.

The development area is 10.93ha according to the client. The total developable area is 6.3917ha and the impermeable area is 1.9317ha. Please see appendix B.



Figure 6: Proposed Site (Source: Client)

4.2 Fluvial Flood Management

The site is within a flood Zone 1; therefore, it is believed that fluvial flooding is at low risk.

5. DRAINAGE STRATEGY

5.1.1 Surface Water

The existing site is a brownfield site, which drains via a culvert ultimately into the watercourse *Trub Brook* to the South of the site.

5.2 Infiltration Rates

As said in section 2.3, infiltration does not work on this site due to the underlying clay and contaminated made ground.

5.3 Run-off

Brownfield rates have been agreed with Rochdale County Council at 90l/s. Please see appendix C.

5.4 Surface water drainage strategy

5.4.1 Hierarchy of Discharge

As detailed in section 2.3, infiltration is not feasible at this site. Therefore, it is proposed to drain into the existing 150mm culverted watercourse and outfall into *Trub Brook*.

5.4.2 Sizing of SUDS features

As discussed in section 4.1 of this report, the proposed impermeable surface area of the dwellings and associated features is 1.9317ha . It is intended that the proposed surface water system will be adopted by United Utilities.

The discharge will be restricted to 90l/s via a Hydrobreak in the 1 in 100 year event plus climate change. The storage will be held primarily in oversized pipes up to and including the 1 in 100 year event plus 45% climate change.

Modelling of the surface water runoff to the design parameters was carried out using the Source Control of Info Drainage, an industry leading software which allows design and analysis of SuDS features. Original model results are displayed in Appendix D: Info Drainage modelling results. The following conservative assumptions and design parameters have been set within the Hydraulic model:

- Dwellings, walkways, parking spaces and access roads area equals 1.9317ha;
- Rainfall intensity was obtained using the Flood Studies Report (FSR) methodology, and increased by 45%, the upper end allowance for climate change over the 100 years design life of the proposed residential development (Appendix D), in line with the requirements of the NPPF;
- No runoff losses have been assumed in the modelling, therefore, all the design rainfall landing on the impermeable surfaces is expected to reach the attenuation basin;
- As per the conclusions in Section 3.3, the soil has been modelled with an infiltration rate of zero (0.0) m/hr;
- A Hydro-Break has been used to restrict the discharge to 90l/s; and
- A flood risk permit will be required for the outfall.

Please see Appendix D for the calculations and the design.

5.4.3 Maintenance Plan

Structures which manage surface water runoff require little maintenance, however a regular maintenance schedule e.g., after heavy rainfall, should be established by the site owners to reduce the risk of blockage within the drainage system and ensure the design remains in good working order. It is proposed for the drainage system to be adopted by United Utilities. The following maintenance will be undertaken for the swales, geocellular storage and pervious pavement:

Table 5: Operation and Maintenance Requirements for swales

TABLE 17.1 Operation and maintenance requirements for swales		
Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly, or as required
	Cut grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for > 48 hours	Monthly, or when required
	Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly
Occasional maintenance	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required	As required or if bare soil is exposed over 10% or more of the swale treatment area
Remedial actions	Repair erosion or other damage by re-turfing or reseeded	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

Table 6: Operation and Maintenance Requirements for Pervious Pavements

TABLE 20.15	Operation and maintenance requirements for pervious pavements		
	Maintenance schedule	Required action	Typical frequency
	Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
			As required
	Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
		Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
	Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
		Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
		Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
	Monitoring	Initial inspection	Monthly for three months after installation
Inspect for evidence of poor operation and/or weed growth – if required, take remedial action		Three-monthly, 48 h after large storms in first six months	
Inspect silt accumulation rates and establish appropriate brushing frequencies		Annually	
Monitor inspection chambers		Annually	

Table 7: Operation and Maintenance Requirements for geocellular tanks

TABLE 21.3	Operation and maintenance requirements for attenuation storage tanks		
	Maintenance schedule	Required action	Typical frequency
	Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
		Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
		For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually
		Remove sediment from pre-treatment structures and/or internal forebays	Annually, or as required
	Remedial actions	Repair/rehabilitate inlets, outlet, overflows and vents	As required
	Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
Survey inside of tank for sediment build-up and remove if necessary		Every 5 years or as required	

6. SUMMARY & CONCLUSIONS

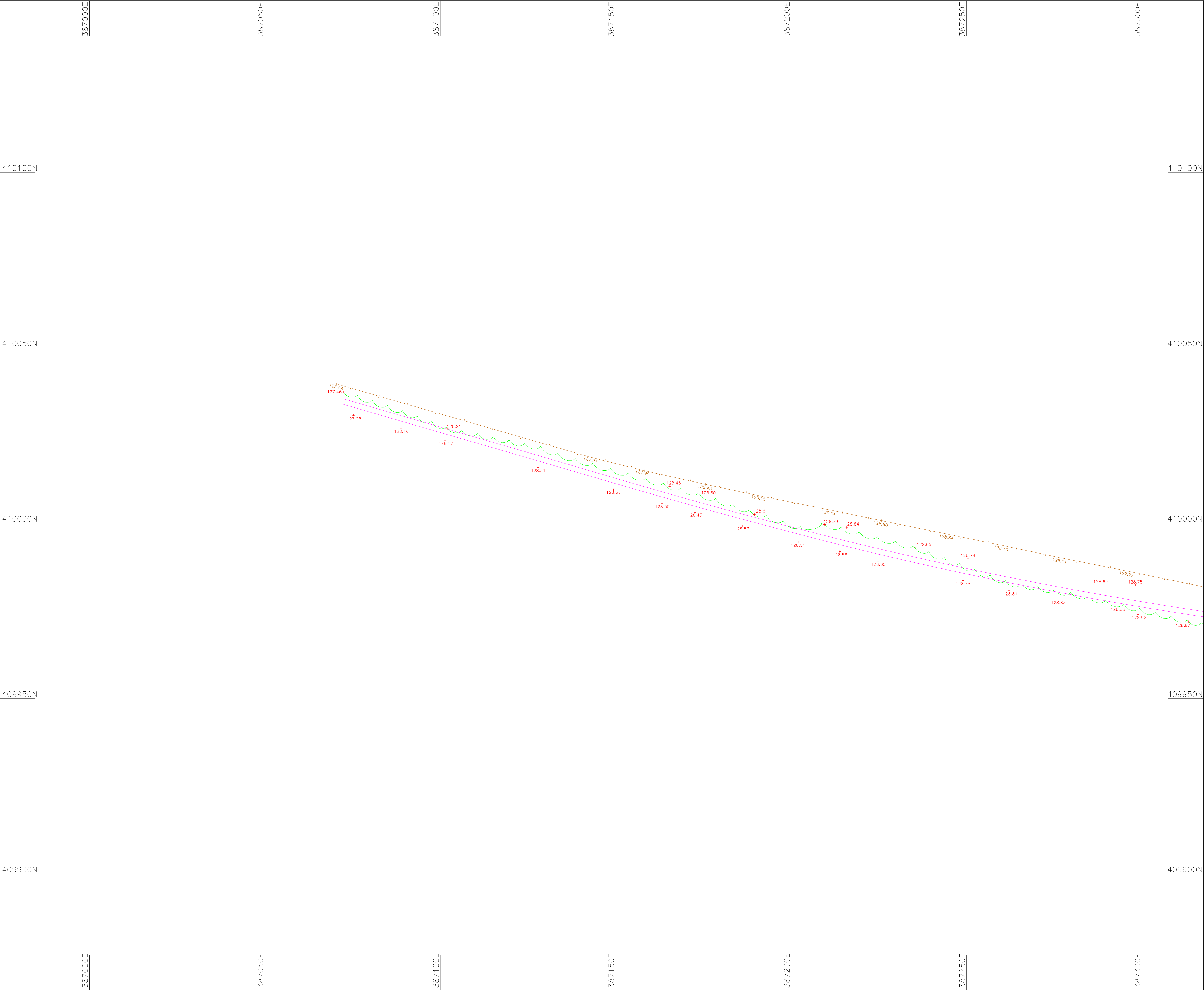
A summary of the main conclusions for the FRA is presented below:

- Development proposals are for a development of approximately 191 residential units at land at Castleton Sidings, Rochdale OL11 3BZ;
- The development site is approximately 10.93ha. The impermeable area is 1.9317ha;
- The site is within a Flood Zone 1;
- The existing 600mm diameter culvert that crosses the site will remain in situ and be utilised as our surface water discharge point;
- All forms of flooding (Fluvial, Surface Water, Ground Water, Infrastructure and Sewer) at this site is low;
- The proposed development passes the sequential test;
- According to Site Investigations, infiltration does not work at the site due to the underlying contaminated ground;
- The discharge will be set at 90l/s this has been agreed with the LLFA. The site will discharge to the culvert that flows to *Trub Brook* on the Southern border of the site. A flood risk permit will be required from the Environment Agency for the outfall;
- The proposed development will have storage up to and including the 1 in 100 year event plus climate change of 45%;
- The public drainage will be offered up to United Utilities or NAV; and
- The attenuation for the 1 in 100 year event plus climate change will be held in offline storage crates.

7. REFERENCES

Author	Date	Title/Description
Department for Communities and Local Government	Mar 2012	Technical Guidance to the National Planning Policy Framework
Ministry of Housing, Communities and Local Government.	Feb 2019	National Planning Policy Framework

Appendix A: Topographical Survey



ABBREVIATIONS		
AB Automatic Barrier	GV Gas Valve	RW Retaining Wall
AC Air Conditioning	HR Hand Rail	SG Sapping
Apx Approximate	H High	SC Stop Cock
B Ballard	HT Height	Sec Security fence
BB Bellona Beacon	IB Illuminated Bollard	SH Speed Hump
Bd Building Level	IC Inspection Cover	SK Spike
Bh Borehole	IL Invert Level	Sn Sign
BL Bed / Beam Level	im Intercom	SOL Solft Level
BL Brick Paving	IRF Iron Rail Fence	SOS Emergency telephone
BRW Brick Retaining Wall	KO Kerb Outlet	Sp Stump
BS Bus Stop/Shelter	KT Kert Top	SPP Steel Palisade Fence
BT British Telecom	L Light	SPS Stone Paving Slabs
BW Brick Wall	LF Lamp Hole	SPP Steel Paving Slabs
BWF Barb Wire Fence	LP Lamp Post	SRW Stone Retaining Wall
C Column	m Metres	St Stoy
CB Call Box	Max Maximum	SuL Sump Level
CBa Crush Barrier	MC Motorway Commis	SV Stop Valve
CBF Close Board Fence	MH Manhole	SW Surface Water
CCTV Closed Circuit TV	Mk Marker	Ta Tarmac surface
Ca Closed Circuit TV	MC Multiple Girth tree	Temp Temporary
CLF Chain Link Fence	Min Minimum	TH Trial Hole
CLF Chain Link Fence	MP Marker Post	TL Threshold Level
Conc Concrete surface	MRF Metal Rolling Fence	Tk Tank
CPE Concrete Panel Fence	MW Monitoring Wall	TM Ticket Machine
CPS Concrete Paving Slabs	NP Name Plate	TP Telephone Pole
CTV Cable Television	NPV No Pipe Visible	TPS Tactile Paving Slabs
CW Combined Water	OhL Overhead Line	TS Traffic Signal
D Diameter	OHF Overhead Power	TV Cable TV
Dp Downpipe	OhT Overhead Telecoms	UB Utility Box
DPL Damp course level	P Post	US Underside
DRF Diamond Rail Fence	P Post	UTL Unable To Lift
Ea Eaves level	PB Post Box	UTS Unable To Survey
EB Electricity Box	PC Pedestrian Crossing	VC Virtual City
EL Electricity cover	PCF Post & Chain Fence	W Width
EP Electricity Pole	Pe Pipe	WB Water Box
FB Flower Bed	PM Parking Meter	WF Wooden Fence
FD Full Depth	WL Water Level	WM Water Meter
FH Fire Hydrant	PRF Post & Rail Fence	WM Water Meter
FL Floor Level	PWF Post & Wire Fence	WMF Welded Mesh Fence
FP Flag Pole	RB Removable Bollard	WPF Wooden Panel Fence
FW Foul Water	RE Rodding Eye	Wo Washout
G Gully	RS Road Sign	# Diameter in mm
Ga Gravel surface	RSI Road Sign Illuminated	➔ Direction of flow
GP Gate Post		

NOTES

PLAN GRID IS LOCAL BASED UPON O.S. NATIONAL GRID
SITE CENTRED ON SURVEY STATION PSL3. SCALE FACTOR=1
ALL LEVELS RELATE TO ORDNANCE DATUM, (OSGM15)
ESTABLISHED USING THE O.S. NATIONAL ACTIVE GPS NETWORK

02	Additional trees & manholes added	AS	KM	26/04/21
01	Adjacent roads / additional levels added	CD	KM	11/02/21
00	Original issue	CD	KM	01/02/21
Issue	Details	By	Chk'd	Date

SHEET LAYOUT

Sheet 1 of 5

Sheet 2 of 5

Sheet 3 of 5

Sheet 4 of 5

Sheet 5 of 5

SURVEY CONTROL STATIONS			
Number	Easting	Northing	Height
PSL1	388068.106	410265.323	134.427
PSL2	388091.594	410196.391	135.865
PSL3	387981.027	410217.308	133.689
PSL4	387834.677	410172.415	132.549
PSL5	387761.291	410142.529	132.106
PSL6	387788.018	410075.429	131.929
PSL7	387771.329	410111.404	132.173
PSL8	387599.563	410044.829	132.213
PSL9	387800.616	410095.126	131.778
PSL10	387886.262	410121.519	131.825
PSL11	387962.141	410144.130	131.982
PSL12	388049.714	410175.233	135.792
PSL21	388164.052	410352.281	135.195
PSL22	388208.039	410409.846	135.717
PSL23	388245.219	410504.887	136.772

North arrow pointing up.

Scale 1:500

0.0 5.0 10.0 15.0 20.0 25.0 30.0 35.0 40.0 45.0 metres

SURVEYED BY AS/CD/WA	DRAWN BY CD/KM	SCALE 1:500
DATE OF ISSUE FEBRUARY 2021	© A1	
TITLE HEYWOOD ROAD CASTLETON ROCHDALE TOPOGRAPHICAL SURVEY		
DRAWING No. PS-2093-TS	ISSUE 02	
SHEET 1 OF 5		

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RICS CIOB

ABAutomatic Barrier

ACAir Conditioning

AppxApproximate

BBollard

BBBellisha Beacon

BDBackdrop Level

BoBoathole

BLBed / Boom Level

BPBBrick Paving

BRWBrick Retaining Wall

BSBus Stop/Shelter

BTBritish Telecom

BWBBrick Wall

PWFBorb Wire Fence

C Cable

CBColl Box

CbuCrank Barrier

CCFClose Board Fence

CCVClosed Circuit TV

CaChain Link

CIFCorrupted Iron Fence

CLFChain Link Fence

ConcConcrete surface

CPFConcrete Panel Fence

CPSConcrete Paving Slabs

CTVCable Television

CWCombined Water

D Diameter

DoDownpipe

DPCDampp course level

DRFDiamond Rail Fence

E Eaves level

EBElectricity Box

ELElectricity cover

FDFull Depth

FHFire Hydrant

FLFloor Level

FPGFlag Pole

FWFoot Water

G Gully

GrGravel surface

GPGate Post

GVGas Valve

HRHand Rail

H High

IBIlluminated Ballard

ICInspection Cover

ILInvert Level

ImIntercom

IRFIron Rail Fence

KDOkerb Outlet

KTKerb Top

L Light

LHLamp Hole

LP Lamp Post

m Metres

MaxMaximum

MCManhole

MOMultiple

MKMarker

MGMultiple Girth tree

MinMinimum

MRFMetal Rolling Fence

MWMonitoring Well

MPName Plate

NPVNo Pipe Visible

OHLOverhead Line

OPHOverhead Power

OHTOverhead Telecons

OPLOrnamental Planting

P Post

PBPPost Box

PCPedestrian Crossing

PCFPost & Chain Fence

PeParking Meter

PPFPost & Panel Fence

PRFPost & Rail Fence

PWFPost & Wire Fence

RBRemovable Ballard

RERooding Eye

RSRoad Sign

RSLRoad Sign Illuminated

RWRetaining Wall

S Sapping

SCStop Cock

SecSecurity fence

SHSpeed Hump

SkSlope

SnSnipe

SolSoft/L Level

SDSEmergency telephone

SpSpume

SPFSteel Palisade Fence

SSStone Paving Slabs

SRFSteel Roofing Fence

SRWStone Retaining Wall

StStay

SuSump Level

SVStop Valve

SWSurface Water

TaTarmac surface

T Temporary

THTrial Hole

TM Tank

TLTicket Machine

TPTelephone Pole

TSTraffic Signal

TVCable TV

UBUtility Box

Underside

UTLUnable To Lift

UTLUnable To Survey

Virrified City

W Width

WBWooden Fence

WLWater Level

WMWater Meter

WWFWelded Mesh Fence

WOWooden Panel Fence

WoWashout

ØDiameter in mm

→Direction of flow

NOTES

PLAN GRID IS LOCAL BASED UPON O.S. NATIONAL GRID SITE CENTRED ON SURVEY STATION PSL3. SCALE FACTOR=1 ALL LEVELS RELATE TO ORDNANCE DATUM, (OSGM15) ESTABLISHED USING THE O.S. NATIONAL ACTIVE GPS NETWORK

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SHEET LAYOUT

Sheet 1 of 5

Sheet 2 of 5

Sheet 3 of 5

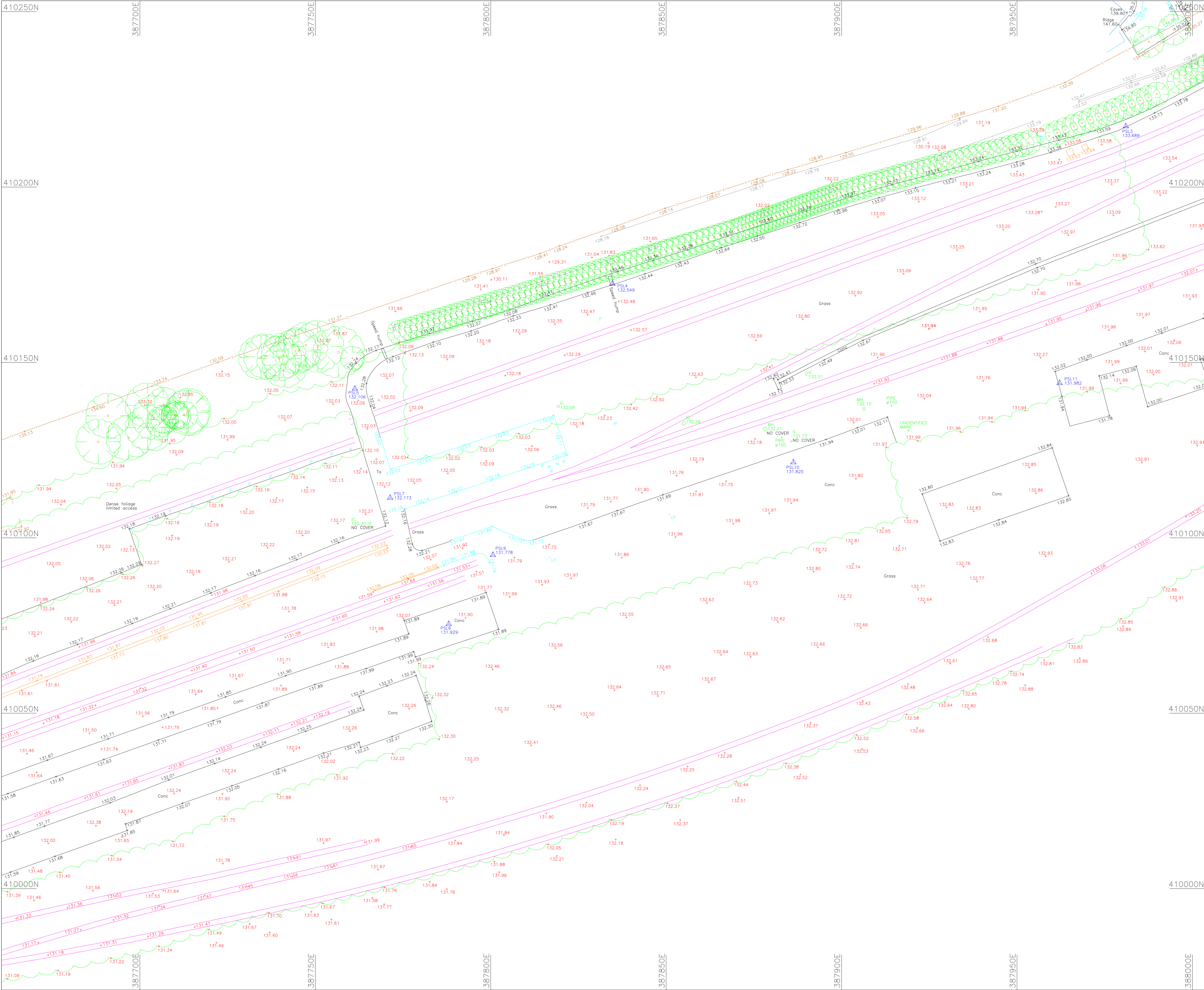
Sheet 4 of 5

Sheet 5 of 5

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PSL10	387886.262	410121.519	131.825
PSL11	387962.141	410144.130	131.982
PSL12	388049.714	410175.233	135.792
PSL21	385164.052	410352.281	135.195
PSL22	388208.039	410409.846	135.717
PSL23	388245.219	410504.887	136.772

N



ABBREVIATIONS		
AB Automatic Barrier	GV Gas Valve	RW Retaining Wall
AC Air Conditioning	HR Hand Rail	SC Sapping Level
Apx Approximate	H High	SC Stop Lock
B Ballard	HL Height	SH Security fence
BB Bellina Beacon	IB Illuminated Bollard	SH Speed Hump
BD Backdrop Level	IC Inspection Cover	SK Slope
Bh Borehole	IL Invert Level	SL Sign
BL Bed / Boom Level	im Intercom	SOL Soft Level
BP Brick Paving	IRF Iron Rail Fence	SOS Emergency telephone
BRW Brick Retaining Wall	KO Kerb Outlet	Sp Stump
BS Bus Stop/Shelter	KT Kerb Top	SPT Steel Palisade Fence
BT British Telecom	L Light	SPS Stone Paving Slabs
BW Brick Wall	LH Lamp Hole	SST Steel Railing Fence
BWF Barb Wire Fence	LP Lamp Post	SRW Stone Retaining Wall
C Column	m Metres	ST Sloy
CB Cell Box	Max Maximum	Sul Sump Level
CBU Curb Barrier	MC Manhole	SW Surface Water
CBF Close Board Fence	MH Manhole	Temp Temporary
CCTV Closed Circuit TV	Mk Marker	Ta Tarmac surface
Cc Closed Circuit TV	MO Multiple	Ts Trench
CLF Chain Link Fence	Min Minimum	TH Threshold Level
CLF Chain Link Fence	MP Manure Post	Tk Tank
Conc Concrete surface	MRF Metal Railing Fence	TL Ticket Machine
COP Concrete Panel Fence	MW Monitoring Wall	TP Telephone Pole
CPS Concrete Paving Slabs	NP Name Plate	TPS Traffic Paving Slabs
CTV Cable Television	NPV No Pipe Visible	TV Cable TV
CW Combined Water	OhL Overhead Line	TS Traffic Signal
D Diameter	OHF Overhead Power	UB Utility Box
Dp Downpipe	OHT Overhead Telecoms	US Underside
DRD Damp course level	OP Post	UTL Unable To Lift
DRF Diamond Fence	P Post	UTS Unable To Survey
Eo Eaves level	PC Pedestrian Crossing	VC Virtual City
EB Electricity Box	PCF Post & Chain Fence	W Width
EL Electricity cover	Pe Pipe	WB Water Box
EP Electricity Pole	PM Parking Meter	WF Wooden Fence
FB Flower Bed	PL Post & Panel Fence	WM Water Meter
FD Full Depth	PRF Post & Rail Fence	WMF Welded Mesh Fence
FI Fire Hydrant	PWF Post & Wire Fence	WPF Wooden Panel Fence
FL Floor Level	RE Removable Bollard	Wo Washout
FP Flag Pole	RS Road Sign	# Diameter in mm
FW Foul Water	RSI Road Sign Illuminated	→ Direction of flow
G Gully		
Ga Gravel surface		
GP Gate Post		

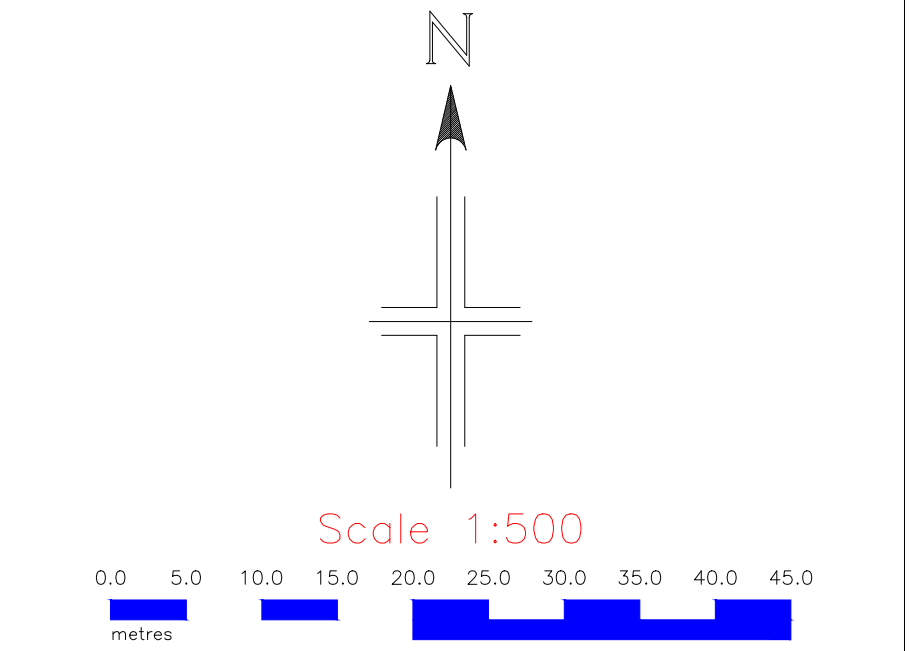
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Sheet 1 of 5	Sheet 2 of 5	Sheet 3 of 5
		Sheet 4 of 5
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DATE OF ISSUE FEBRUARY 2021		© A1

TITLE

HEYWOOD ROAD
CASTLETON
ROCHDALE

TOPOGRAPHICAL SURVEY

DRAWING No. PS-2093-TS

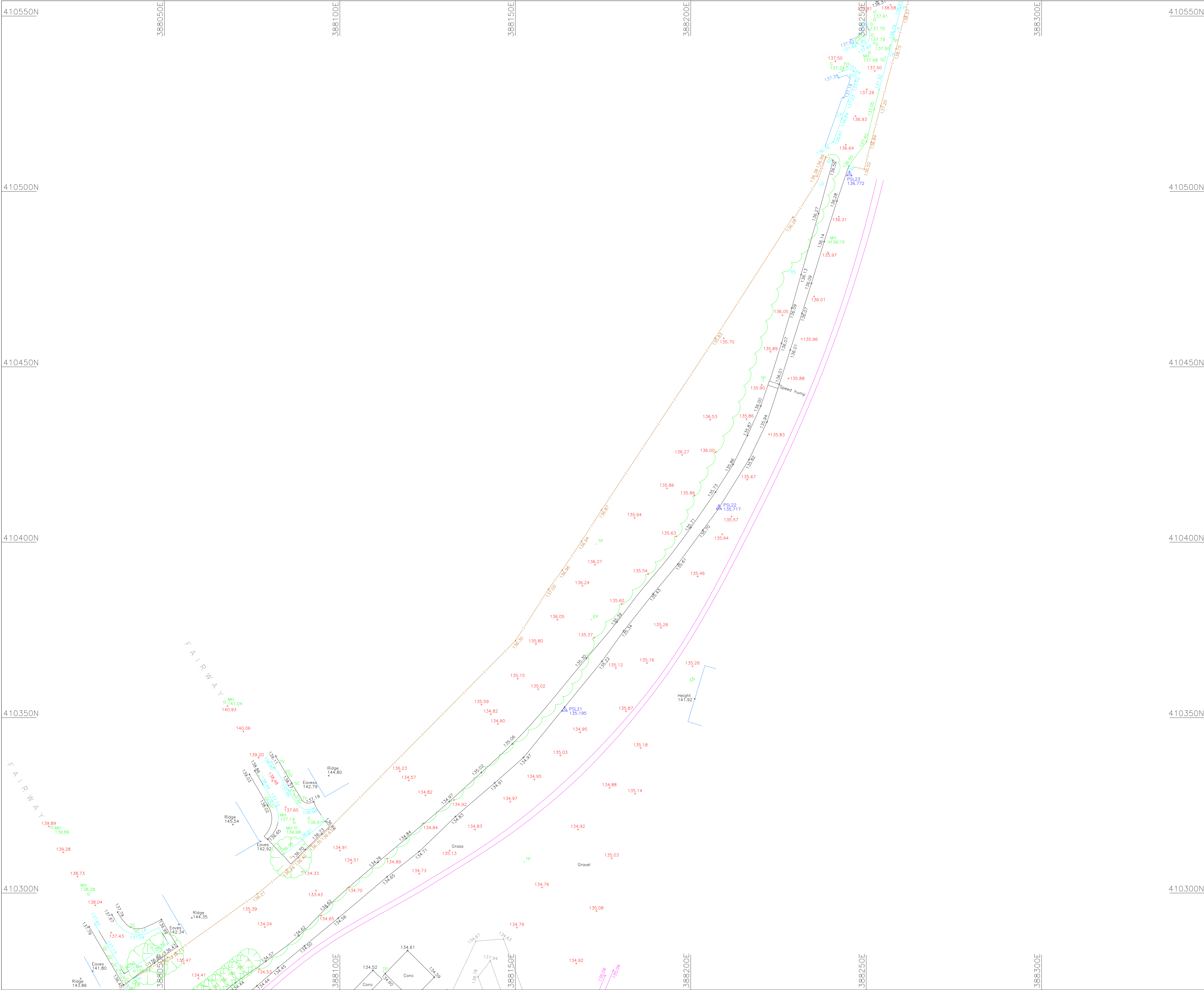
ISSUE 02

SHEET 3 OF 5

PARAGON SURVEYS
Chartered Surveyors
GEOMATICS: Land & Engineering Surveyors

8 Carr House Lane
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Northern Office: Gosforth Lodge, Gosforth, Seascale, Cumbria. CA20 1AS

RICS CIOB



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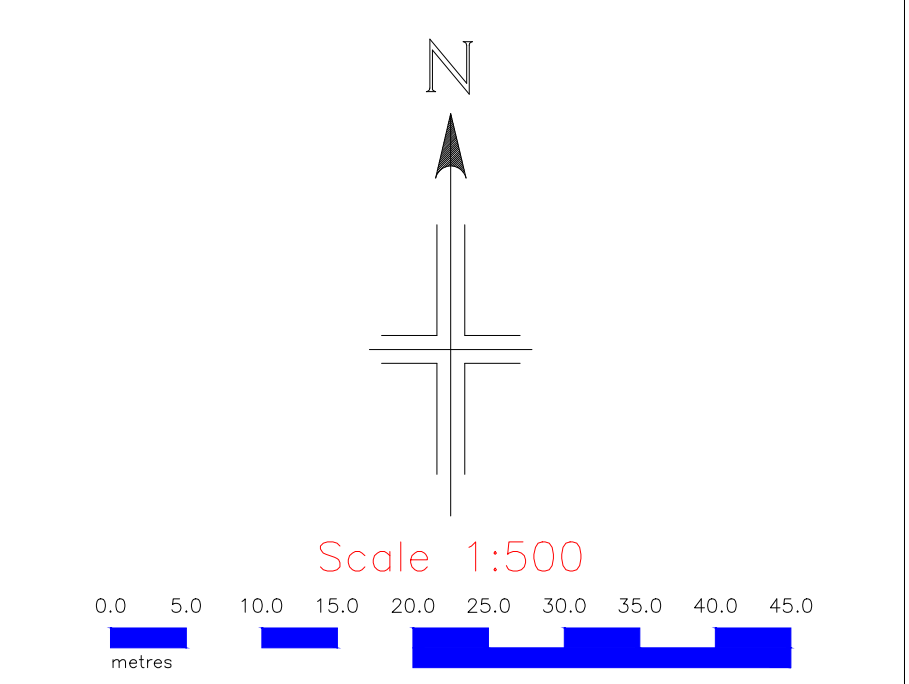
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DRAWING No. PS-2093-TS	ISSUE 02	
SHEET 4 OF 5		

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RICS CIOB

[illegible]

Appendix B: Proposed Layout



Rev	Date	Amend	Initials

Development	
CASTLETON SIDINGS	
Location	
ROCHDALE	
Drawing Title	
Colour Site Layout	
Job Number	Drawing Number
KH003	KH003-A-100
Revision	Scale
-	1:1000 - A1
Drawn By	Date
BP	09.02.23
Checked by	Date Checked
RC	-

1st Floor, 103 Dalton Avenue, Birchwood Park,
Warrington WA3 6YE
T: 01925 363108 W: www.kellenhomes.com



Appendix C: LLFA confirmation of Discharge

Charles Townsend

From: Stephen McCann <Stephen.McCann@Rochdale.Gov.UK>
Sent: 09 July 2021 12:24
To: ElannaHerod@campbellreith.com; Tom Foster
Cc: GarryTaylor@campbellreith.com
Subject: RE: QUESTIONS re. Confirmation of future Discharge of rate - to culvert : Castleton, Rochdale - Discharge Rate Enquiry
Attachments: Land Ownership queries - Castleton Sidings - notes.pdf
Follow Up Flag: Follow up
Flag Status: Flagged

Hello Elanna and Tom

I looked at the Campbell Reith CAD drawing of the brownfield areas for the site and I'm happy with your calculation with 30% reduction i.e. SW discharge flow rate of 90 l/s (rounded up from 87.6 l/s).
The design of your proposed vortex control should be for this. I'm not sure what attenuation measures you will include?

A pond is less expensive than a buried attenuation tank?
One way to reduce runoff is to have some impermeable surfaces for parking areas.
Perhaps there is scope for a pond on the southern boundary? However, I leave the details to you.

It's worth noting that Land Registry does not have a known owner for Areas A and B on the appended Plan. Area C is the farmer, as you know.

Stephen McCann
Drainage & Flooding Engineer
Highways, Property & Strategic Housing



☎ 01706 924606
☎ 07552 570262
✉ stephen.mccann@rochdale.gov.uk

Rochdale Borough Council
Floor 2, Number One Riverside
Smith Street, Rochdale, OL16 1XU

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For news and social media updates go to www.rochdale.gov.uk/news

Please consider the environment before printing this email.

From: ElannaHerod@campbellreith.com <ElannaHerod@campbellreith.com>
Sent: 08 July 2021 12:35
To: Stephen McCann <Stephen.McCann@Rochdale.Gov.UK>
Cc: Tom Foster <TomFoster@kellenhomes.com>; GarryTaylor@campbellreith.com
Subject: RE: QUESTIONS re. Confirmation of future Discharge of rate - to culvert : Castleton, Rochdale - Discharge Rate Enquiry

Good afternoon Stephen,

Thank you for your email. Please find attached the CAD file of the brownfield areas at Castleton for your review.

Kind Regards

Elanna Herod
Project Engineer

CampbellReith
consulting engineers

No. 1 Marsden Street
Manchester
M2 1HW

Tel: +44 (0)161 819 3062
www.campbellreith.com

From: "Stephen McCann" <Stephen.McCann@Rochdale.Gov.UK>
To: "ElannaHerod@campbellreith.com" <ElannaHerod@campbellreith.com>
Cc: "Tom Foster" <TomFoster@kellenhomes.com>
Date: 01/07/2021 13:23
Subject: RE: QUESTIONS re. Confirmation of future Discharge of rate - to culvert : Castleton, Rochdale - Discharge Rate Enquiry

Hello Elanna,
See below for my responses in [Blue Text](#)

Stephen McCann
Drainage & Flooding Engineer
Highways, Property & Strategic Housing



 [01706 924606](tel:01706924606)
 [07552 570262](tel:07552570262)
 stephen.mccann@rochdale.gov.uk

Rochdale Borough Council
Floor 2, Number One Riverside
Smith Street, Rochdale, OL16 1XU

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For news and social media updates go to www.rochdale.gov.uk/news

Please consider the environment before printing this email.

From: ElannaHerod@campbellreith.com <ElannaHerod@campbellreith.com>

Sent: 30 June 2021 13:22

To: Stephen McCann <Stephen.McCann@Rochdale.Gov.UK>

Subject: Re: Confirmation of future Discharge of rate - to culvert : Castleton, Rochdale - Discharge Rate Enquiry

Good morning Stephen,

I hope you are well.

Did you manage to visit the Castleton Sidings site to have a look at the culvert?

No. I've been twice but could not get into the site. There is a massive chain and padlock to the sidings and a Danger sign so I couldn't get in. If you want me to be able to visit, I'll need a very clear sketch about how to access the site to find the culvert.

The existing hardstanding areas on the site equate to 1 Ha and are anticipated to be positively drained discharging to the existing culvert on site, which is considered to be an ordinary watercourse based on an assessment of historic maps.

Therefore, in response to your email below and our previous conversations I have reassessed the existing runoff rate for the site based on the inclusion of the hardstanding areas.

Using the modified rational method and a rainfall depth of 24.3mm taken from the FEH web service for the 1 in 2 year critical storm event the QBAR brownfield runoff rate is calculated to be 64.6Ha

For the remaining greenfield areas, which equates to 5.6Ha, I have used the FSR Method within the MicroDrainage software. The table below shows the existing combined runoff rate.

Existing Runoff Rate

Return Period	Brownfield runoff rate (l/s)	Greenfield runoff rate (l/s)	Total (l/s)
QBAR	64.6	42.4	107

In order to provide a betterment we have reduced the brownfield runoff rate by 30%. We are therefore proposing to restrict flows from the development to 87.6 l/s as tabulated below.

Proposed Runoff Rate

Return Period	Reduced Brownfield runoff rate (l/s)	Greenfield runoff rate (l/s)	Total (l/s)
QBAR	45.2	42.4	87.6

I have attached a sketch showing the areas of hardstanding currently on site as well as the revised brownfield and greenfield runoff rate calculations.

Can you please review the above information and confirm if the proposed development can be restricted to the proposed rate of 87.6 l/s?

Before I formally comment upon your Brownfield and Reduced runoff rates

If you want me to confirm your Brownfield and Reduced runoff rates, I'll need a CAD drawing of the hardstanding areas so I can cross-check correlate with your calcs.

However, the more critical issue you have is:-

Will you be able to discharge to a recognised watercourse?

Today I have looked again at maps and can see that the 'culvert-drain' probably exits to a ditch which has been artificially straightened. Your discharge point is not, as far as I can tell an 'ordinary watercourse' but an artificial land-drain. Consequently one needs to consider the impact on the land-owners through which this ditch runs before it finally arrives at the Trub Brook Stream, after crossing under the M62. I previously asked if you knew the land-owners, but got no response. I have therefore asked a colleague to give me land-registry information for areas A, B and C – see appended Land Ownership. There are also queries that I am raising with you on the LLFA Notes. If I am provided with some guidance on how to get to the site, I will go and look next week and I may be able to answer one of two of those questions.

The Developer must (as you and Tom Foster are doing) try to discharge to a watercourse but the responsibility to work out all the issues around it do not devolve to me, as Drainage Officer. I can try to assist, but I am not focussed on this particular task. Stephen McCann

Kind Regards

Elanna Herod
Project Engineer

CampbellReith
consulting engineers

No. 1 Marsden Street
Manchester
M2 1HW

Tel: +44 (0)161 819 3062
www.campbellreith.com

From: "Stephen McCann" <Stephen.McCann@Rochdale.Gov.UK>
To: "ElannaHerod@campbellreith.com" <ElannaHerod@campbellreith.com>
Date: 10/06/2021 14:23
Subject: Confirmation of future Discharge of rate - to culvert : Castleton, Rochdale - Discharge Rate Enquiry

Hi Elanna,

I have now had time to consider your email and agree that the Greenfield rate for the whole site of 47 l/s will be accepted from a Planning viewpoint.

Although I am agreeing that the rate of 47 l/s surface water discharge is appropriate, I still don't know what other 3rd party landowners may think about the Developer using the 'culvert'. I will go to site to have look. In the meantime, perhaps you can advise me (or ask Tom Foster) of the extent of Kellen Homes ownership. I'll then ask my colleague to lookup who owns the downstream sections.

Stephen McCann
Drainage & Flooding Engineer
Highways, Property & Strategic Housing



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Please consider the environment before printing this email.

From: ElannaHerod@campbellreith.com <ElannaHerod@campbellreith.com>

Sent: 10 June 2021 12:35

To: Stephen McCann <Stephen.McCann@Rochdale.Gov.UK>

Subject: RE: 13655: Castleton, Rochdale - Discharge Rate Enquiry

Hi Stephen,

Thank you for your email.

I will pass your query regarding the ownership of the culvert to Kellen Homes. I do not believe we have any information regarding the condition of the culvert under the railway line and M62. If required could a drainage survey be conditioned as part of the forthcoming application?

I have also re-calculated the brownfield and greenfield runoff rate for the site. Based on the site investigation undertaken at the site I do not believe the HR Wallingford methodology provided the correct SPR value as the ground is predominantly underlain by clay. I have therefore attached the greenfield runoff rate calculated through MicroDrainage which provides a better representative of the soil conditions on site, a summary of the results is tabulated below.

Greenfield runoff rate based on developable area (6.31Ha)

QBAR - 47.3 l/s

1 in 1 year - 41.1 l/s

1 in 30 year - 80.2 l/s

1 in 100 year - 98.4 l/s

Combined Brownfield and Greenfield runoff rates.

Table 1: Existing Runoff Rates

Return Period	Brownfield 0.67Ha (l/s)	Greenfield 5.6Ha (l/s)	Combined Rate (l/s)
1	38.5	36.5	75.0
30	75.3	71.2	146.5
100	92.1	87.3	179.4

In order to provide a betterment we are proposing to reduce the existing brownfield rate by 30%.

Table 2: Proposed Runoff Rates

Return Period	Brownfield (-30%) (l/s)	Greenfield (l/s)	Combined Rate (l/s)
1	27.0	41.1	68.1
30	52.7	3.0	132.9
100	64.5	3.7	162.9

Can you please confirm if you are happy for us to use the proposed combined rate in Table 2 or if we need to restrict proposed flows to the QBAR rate of 47.3 l/s? I have attached the amended calculations and an extract from the site investigation report for your reference.

Kind Regards

Elanna Herod
Project Engineer

From: "Stephen McCann" <Stephen.McCann@Rochdale.Gov.UK>
To: "ElannaHerod@campbellreith.com" <ElannaHerod@campbellreith.com>
Date: 10/06/2021 11:38
Subject: RE: 13655: Castleton, Rochdale - Discharge Rate Enquiry

Hello Elanna,

I'm trying to answer more than one question below but if I've left any of your questions unanswered, just ask me again.

Now that I've looked at the footpath, I can see how to get to the site, which I will try to do next week. I tried to approach from the north east which was blocked by locked gates by railway authorities.

Feel free to forward this email to Tom Kellen or not – I don't know so I just leave it to you.

Using the 'culvert' to discharge the attenuated surface water flows

Although it is logical that the developer should discharge surface water flows to the identified 'culvert'. To my mind, the Developer needs to confirm that the route of the 'culvert' is viable in the long term and that any interested landowner is aware of the issue. I checked on the Council's land-registry and the Council does not own any land along the route of the 'culvert'.

As far as I can tell the 'culvert' is not classed as an ordinary watercourse i.e. it is not a historical stream that has been piped (culverted); I haven't done a historical map search yet so feel free to challenge that initial guess. If classed as an Ordinary Watercourse, then any landowner must accept attenuated discharge into the watercourse but if the culvert is only a private drain, then they will need to approve the connection. I haven't done historical search because I currently busy with numerous issues and the onus is on the Developer to provide the solution.

Although I have said before that the 'culvert' looks to be the most sustainable drainage solution, this doesn't mean that any other land-owners / third parties will accept this as a 'solution'.

Please can you answer the questions on the LLFA Notes sheet or ask Tom to answer them? If you don't know the answer, you can write "not known".

Future attenuated discharge rates

I have looked at your 'Brownfield SW runoff rates' spreadsheet. I can see that you have stated that 50mm/hr is assumed to be for average 1 in 2 year storm. I question that value; I understand that the runoff rate in Rochdale is much close to 25mm/hr. Please can you either provide background evidence for your rainfall rate or re-do the calc? As LLFA, I would look for the Developer restricting the SW from the site to be Qbar OR you can have a 'complex' hydrobrake with 2 controls.

North West SuDS ProForma

It looks like this is a new form that the Council wants Applicants to complete but I am not 'up-to-speed' with what you have to complete.

I don't know if you or Tom Foster have a contact to help you complete the form - so you can ask them if you are uncertain of any aspects to it?

As far as I understand it, the Drainage Conditions will be recommended by me to Planning and I'll probably be sent the completed SuDS form so you can simply put any queries on that form.

regards

Stephen McCann

Drainage & Flooding Engineer
Highways, Property & Strategic Housing



 [01706 924606](tel:01706924606)

 [07552 570262](tel:07552570262)

 stephen.mccann@rochdale.gov.uk

Rochdale Borough Council
Floor 2, Number One Riverside
Smith Street, Rochdale, OL16 1XU

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Please consider the environment before printing this email.

From: ElannaHerod@campbellreith.com <ElannaHerod@campbellreith.com>

Sent: 07 June 2021 11:44

To: Stephen McCann <Stephen.McCann@Rochdale.Gov.UK>

Subject: 13655: Castleton, Rochdale - Discharge Rate Enquiry

:CAUTION: This email originated from outside of the organisation. Do not click links or open attachments unless you recognise the sender and know the content is safe.

Good morning Stephen,

I am currently working on the drainage strategy for the site located at the former Castleton Railway Sidings in Rochdale, OL11 3AU. I believe you have already been in discussions with our Client Tom Foster at Kellen Homes and have agreed in principle a surface water connection into the existing 1200mm dia culvert located within the site. I would therefore like to seek confirmation of the allowable discharge rate to the culvert from the proposed development.

The developable area extends to approximately 6.3Ha and is predominantly greenfield. However, the site still contains areas of hardstanding associated with the the former access roads and buildings equating to approx 0.67Ha. An intrusive site investigation concluded that the ground conditions were unfavourable for infiltration and there are no watercourses within close proximity to the site. It is therefore anticipated that the roads and buildings formerly drained to this culvert.

Using the modified rational method and the HR Wallingford Greenfield Runoff Estimation tool the existing runoff rate from the site is calculated as follows:

Table 1: Existing Runoff Rates

Return Period	Brownfield 0.67Ha (l/s)	Greenfield 5.6Ha (l/s)	Combined Rate (l/s)
QBAR	n/a	1.8	1.8
1	77.1	1.6	78.7
30	150.6	3.0	153.6
100	184.2	3.7	187.9

In order to provide a betterment we are proposing to reduce the existing brownfield rate by 30%.

Table 2: Proposed Runoff Rates

Return Period	Brownfield (-30%) (l/s)	Greenfield (l/s)	Combined Rate (l/s)
1	53.9	1.6	55.5
30	105.4	3.0	108.4
100	129.0	3.7	132.7

Can you please confirm if the combined rates in Table 2 are acceptable in principle for the discharge of surface water runoff from the proposed development into the existing on-site culvert? I have attached a copy of the calculations for your review.

If require any additional information or would like to discuss further please don't hesitate to contact me.

Kind Regards

Elanna Herod
Project Engineer

CampbellReith
consulting engineers

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Manchester
M2 1HW

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Click [here](#) to report this email as spam.[attachment "Brownfield Exist SW Run-off.pdf" deleted by Elanna Herod/CRH] [attachment "LLFA notes re. drainage from Castleton Sidings.docx" deleted by Elanna Herod/CRH]

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Ownership queries - Castleton Sidings.docx" deleted by Elanna Herod/CRH] [attachment "LLFA notes & queries re. drainage from Castleton Sidings.docx" deleted by Elanna Herod/CRH]

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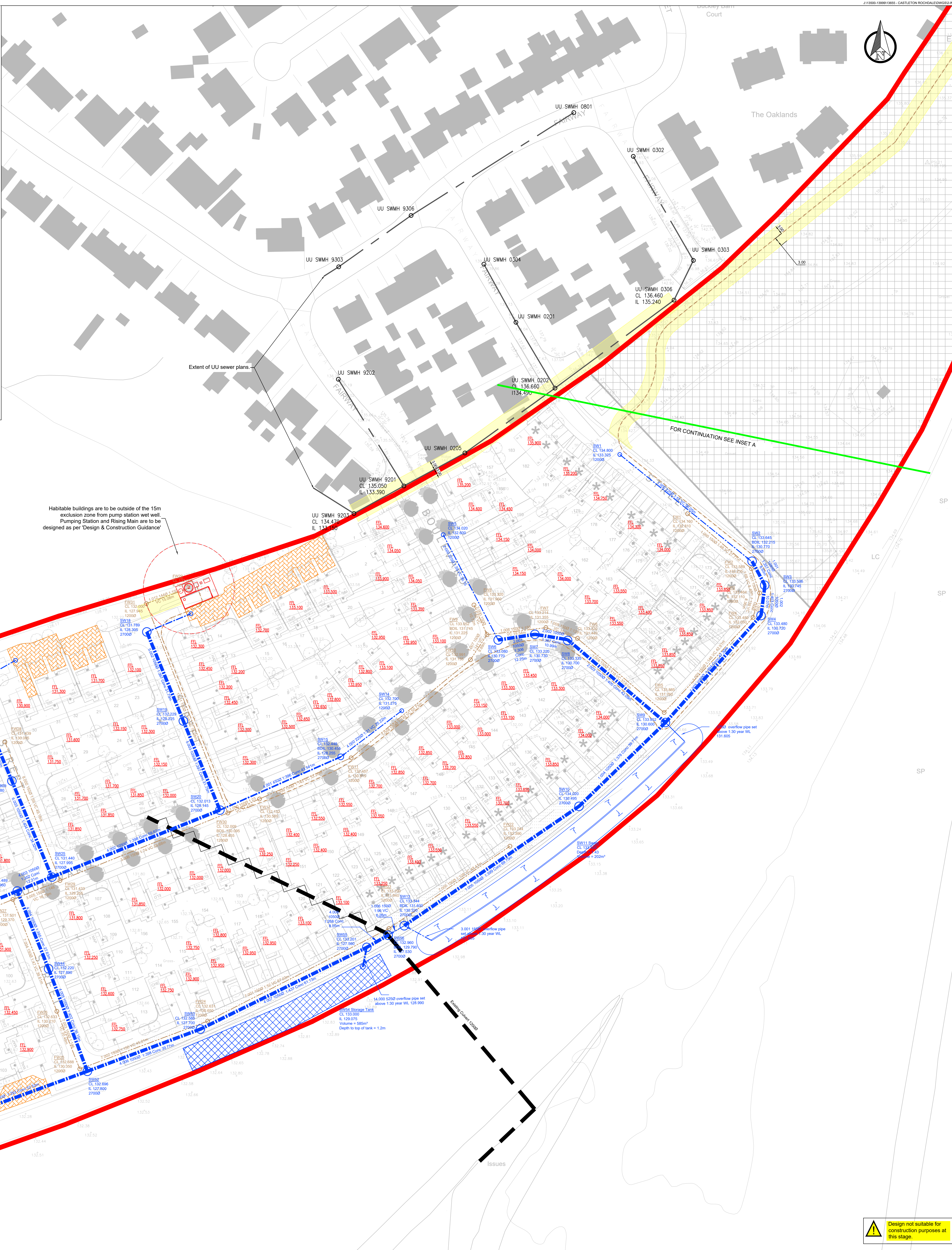
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Appendix D; Concept Drainage Design



Notes

- Do not scale from this drawing on print or electronically. Work from figured dimensions only.
- No deviation from the details on this drawing is allowed without CampbellReith's prior permission in writing.
- Read this drawing with all Architect's, Service Engineer's and CampbellReith's relevant details, specifications and drawings.
- All work is to be done in accordance with the relevant specifications issued by CampbellReith, British Standard Codes of Practice, Statutory Requirements and the Contract Documents.
- Drawing status:
 - P: Preliminary** Evolving drawings for approvals, tenders, billings etc.
 - C: Construction** Fully developed drawings issued under instructions for construction.
- Only status **C** drawings to be used for construction.
- Suitability code:
 - Work in progress**
 - S0 - Work in progress Shared (Non-contractual)**
 - S1 - For coordination, S2 - For information, S3 - For internal review and comment, S4 - For construction approval**
 - Documentation (For contractors purposes)**
 - D1 - For Costing, D2 - For Tender, D3 - For contractor design, D4 - for manufacture/procurement.**
 - Construction**
 - A - For construction, B - For construction but with comments (i.e. areas in abeyance), CR - Construction Record (Final Construction ONLY. Any deviations to that which is on site is not the liability of CampbellReith)**
- Utilities:
 - The positions of Statutory Undertakers' mains & services shown on this drawing have been based on information extracted from records obtained from various Utilities Companies. These must be regarded as approximate only. The accuracy or completeness of the information or the location of such apparatus as shown on this drawing is not guaranteed and no warranty is given or implied regarding the position, depth, size, gradient thereof. The Contractor must make his own enquiries of the Utilities Companies and Public Authorities and satisfy himself as to the exact position of services and depth, sizes, gradient thereof. In the interests of safety, the approximate position of underground cables should be obtained by use of electronic cable locators and this position confirmed by careful trial-holing using hand-dug methods.
- Proposed Masterplan based on Kellen Homes Limited drawing 'Draft Planning Layout PL01 (received from Kellen Homes on 27/05/21). This Masterplan has been inserted only for the topographical survey and no guarantee as to the accuracy of the layout in relation to the survey is given or implied. Masterplan shown for information only.
- All existing survey information shown or referred to is based upon topographical survey prepared by Paragon Surveys, dated February 2021 as supplied to CampbellReith - no warranty as to the accuracy of the information is given or implied.
- Existing United Utilities Sewer locations based on UU Sewer Maps received 23.03.2021
- Rising main length is 672m.
- Silt trap manholes required upstream of geocellular tank, specific manholes to be detailed at appropriate stage.
- Permeable paving to be lined with geomembrane. Depth of sub-base used in calculations is 450mm.
- 29.3m³ 24 hour emergency storage requirement based on 196 dwellings and 160 litres per dwelling as per Sewers For Adoption.

Key

- Proposed SW Drainage
- Proposed FW Drainage
- Proposed Rising Main
- Existing UU Surface Water Sewer
- Existing UU Combined Sewer
- Site Boundary
- Sewer Easement
- Proposed Permeable Paving
- Existing Culvert
- Existing Culvert to be Abandoned

Rev	Description	Date	By
P4	Amended to suit new masterplan	15/06/21	RF
P3	Amended to client comments	19/05/21	CS
P2	Rising main updated, existing drainage added & plot 1 garage FFL updated	11/05/21	CS
P1	Issued for information	04/05/21	RF

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Job Title

Castleton, Rochdale

Client

Kellen Homes Limited

Preliminary

Drainage Strategy

Drawn by	Date made	Scale @ A0	Checked by	Suitability	CR Project
RF	07/04/21	1:500	EH	S2	13655

Project No.	Originator	Volume	Lvl/Loc	Type	Role	Number	Rev
13655	CRH	ZZ	XX	DR	C	4050	P4

Design not suitable for construction purposes at this stage.

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CampbellReith		Page 2
Raven House 29 Linkfield Lane Surrey RH1 1SS	13655: Castleton Rochdale SW Network 4050-P2	
Date 15/06/2021	Designed by EH	
File 13655-CRH-ZZ-XX-MD-4050-P2_SW Network.MDX	Checked by	
XP Solutions		Network 2020.1

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
S6.000	45.400#	1.360	33.4	0.100	5.00	0.0	0.600		o	225	Pipe/Conduit	
S6.001	11.569	0.505	22.9	0.000	0.00	0.0	0.600		o	225	Pipe/Conduit	
S6.002	34.319	0.085	403.8	0.000	0.00	0.0	0.600		o	1050	Pipe/Conduit	
S6.003	34.319	0.085	403.8	0.104	0.00	0.0	0.600		o	1050	Pipe/Conduit	
S4.003	12.314	0.035	351.8	0.194	0.00	0.0	0.600		o	1050	Pipe/Conduit	
S7.000	8.511	0.275	30.9	0.069	5.00	0.0	0.600		o	150	Pipe/Conduit	
S7.001	15.600#	0.565	27.6	0.000	0.00	0.0	0.600		o	150	Pipe/Conduit	
S8.000	10.447	0.375	27.9	0.079	5.00	0.0	0.600		o	150	Pipe/Conduit	
S8.001	12.400#	0.695	17.8	0.000	0.00	0.0	0.600		o	150	Pipe/Conduit	
S7.002	22.713	0.060	378.6	0.000	0.00	0.0	0.600		o	1050	Pipe/Conduit	
S7.003	30.605	0.080	382.6	0.000	0.00	0.0	0.600		o	1050	Pipe/Conduit	
S9.000	12.982	0.130	99.9	0.075	5.00	0.0	0.600		o	150	Pipe/Conduit	
S9.001	13.200#	1.060	12.5	0.000	0.00	0.0	0.600		o	150	Pipe/Conduit	
S9.002	47.197	0.120	393.3	0.082	0.00	0.0	0.600		o	1050	Pipe/Conduit	
S9.003	21.227	0.055	385.9	0.169	0.00	0.0	0.600		o	1050	Pipe/Conduit	
S7.004	32.203	0.080	402.5	0.056	0.00	0.0	0.600		o	1050	Pipe/Conduit	
S7.005	29.327	0.075	391.0	0.000	0.00	0.0	0.600		o	1050	Pipe/Conduit	
S10.000	33.500#	1.115	30.0	0.078	5.00	0.0	0.600		o	225	Pipe/Conduit	
S10.001	12.395	0.630	19.7	0.000	0.00	0.0	0.600		o	225	Pipe/Conduit	
S10.002	38.830	0.100	388.3	0.000	0.00	0.0	0.600		o	1050	Pipe/Conduit	
S10.003	32.737	0.085	385.1	0.129	0.00	0.0	0.600		o	1050	Pipe/Conduit	
S7.006	47.598	0.120	396.7	0.161	0.00	0.0	0.600		o	1050	Pipe/Conduit	
S4.004	27.625	0.070	394.6	0.161	0.00	0.0	0.600		o	1050	Pipe/Conduit	
S4.005	36.148	0.090	401.6	0.114	0.00	0.0	0.600		o	1050	Pipe/Conduit	
S11.000	29.532	0.075	393.8	0.076	5.00	0.0	0.600		o	1050	Pipe/Conduit	
S12.000	45.400#	0.455	99.8	0.077	5.00	0.0	0.600		o	150	Pipe/Conduit	
S12.001	16.200#	0.670	24.2	0.000	0.00	0.0	0.600		o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S6.000	50.00	5.33	130.855	0.100	0.0	0.0	0.0	2.27	90.3	13.5
S6.001	50.00	5.40	129.495	0.100	0.0	0.0	0.0	2.75	109.2	13.5
S6.002	50.00	5.74	128.165	0.100	0.0	0.0	0.0	1.71	1479.6	13.5
S6.003	50.00	6.07	128.080	0.204	0.0	0.0	0.0	1.71	1479.6	27.6
S4.003	50.00	7.22	127.995	0.964	0.0	0.0	0.0	1.83	1585.9	130.5
S7.000	50.00	5.08	131.450	0.069	0.0	0.0	0.0	1.82	32.1	9.3
S7.001	50.00	5.21	130.790	0.069	0.0	0.0	0.0	1.92	34.0	9.3
S8.000	50.00	5.09	131.750	0.079	0.0	0.0	0.0	1.91	33.8	10.7
S8.001	50.00	5.18	130.920	0.079	0.0	0.0	0.0	2.40	42.3	10.7
S7.002	50.00	5.43	128.375	0.148	0.0	0.0	0.0	1.77	1528.5	20.0
S7.003	50.00	5.72	128.315	0.148	0.0	0.0	0.0	1.76	1520.4	20.0
S9.000	50.00	5.22	131.450	0.075	0.0	0.0	0.0	1.01	17.8	10.2
S9.001	50.00	5.29	131.320	0.075	0.0	0.0	0.0	2.87	50.7	10.2
S9.002	50.00	5.75	128.410	0.157	0.0	0.0	0.0	1.73	1499.3	21.3
S9.003	50.00	5.95	128.290	0.326	0.0	0.0	0.0	1.75	1513.6	44.1
S7.004	50.00	6.26	128.235	0.530	0.0	0.0	0.0	1.71	1481.9	71.8
S7.005	50.00	6.54	128.155	0.530	0.0	0.0	0.0	1.74	1503.7	71.8
S10.000	50.00	5.23	130.835	0.078	0.0	0.0	0.0	2.40	95.3	10.6
S10.001	50.00	5.30	129.720	0.078	0.0	0.0	0.0	2.96	117.8	10.6
S10.002	50.00	5.67	128.265	0.078	0.0	0.0	0.0	1.74	1509.0	10.6
S10.003	50.00	5.99	128.165	0.207	0.0	0.0	0.0	1.75	1515.2	28.0
S7.006	50.00	7.00	128.080	0.898	0.0	0.0	0.0	1.72	1492.9	121.6
S4.004	50.00	7.49	127.960	2.023	0.0	0.0	0.0	1.73	1496.8	273.9
S4.005	50.00	7.84	127.890	2.137	0.0	0.0	0.0	1.71	1483.6	289.4
S11.000	50.00	5.28	128.190	0.076	0.0	0.0	0.0	1.73	1498.4	10.3
S12.000	50.00	5.75	131.550	0.077	0.0	0.0	0.0	1.01	17.8	10.4
S12.001	50.00	5.88	131.095	0.077	0.0	0.0	0.0	2.06	36.3	10.4

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
S11.001	52.897	0.135	391.8	0.112	0.00	0.0	0.600		o	1050	Pipe/Conduit	
S13.000	3.974	0.040	99.4	0.131	5.00	0.0	0.600		o	225	Pipe/Conduit	
S13.001	3.000#	0.320	9.4	0.000	0.00	0.0	0.600		o	225	Pipe/Conduit	
S11.002	52.524	0.180	291.8	0.000	0.00	0.0	0.600		o	1050	Pipe/Conduit	
S4.006	39.768	0.100	397.7	0.040	0.00	0.0	0.600		o	1050	Pipe/Conduit	
S4.007	61.133	0.140	436.7	0.106	0.00	0.0	0.600		o	1050	Pipe/Conduit	
S14.000	12.558	0.030	418.6	0.000	5.00	0.0	0.600		o	525	Pipe/Conduit	
S4.008	8.053	0.320	25.2	0.160	0.00	0.0	0.600		o	1050	Pipe/Conduit	
S1.007	74.982	0.185	405.3	0.000	0.00	0.0	0.600		o	1200	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S11.001	50.00	6.39	128.115	0.265	0.0	0.0	0.0	1.73	1502.2	35.9
S13.000	50.00	5.05	132.380	0.131	0.0	0.0	0.0	1.31	52.2	17.7
S13.001	50.00	5.06	132.340	0.131	0.0	0.0	0.0	4.30	170.9	17.7
S11.002	50.00	6.83	127.980	0.396	0.0	0.0	0.0	2.01	1742.4	53.6
S4.006	50.00	8.23	127.800	2.573	0.0	0.0	0.0	1.72	1491.0	348.4
S4.007	50.00	8.85	127.700	2.679	0.0	0.0	0.0	1.64	1422.4	362.8
S14.000	50.00	5.19	129.075	0.000	0.0	0.0	0.0	1.09	235.6	0.0
S4.008	50.00	8.87	127.560	2.839	0.0	0.0	0.0	6.88	5960.3	384.4
S1.007	50.00	14.03	127.090	3.655	0.0	0.0	0.0	1.85	2094.6	494.9

CampbellReith					Page 4						
Raven House 29 Linkfield Lane Surrey RH1 1SS					13655: Castleton Rochdale SW Network 4050-P2						
Date 15/06/2021					Designed by EH						
File 13655-CRH-ZZ-XX-MD-4050-P2_SW Network.MDX					Checked by						
XP Solutions					Network 2020.1						
Manhole Schedules for Storm											
MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S1	134.800	1.475	Open Manhole	1200	S1.000	133.325	225				
S2	133.645	2.875	Open Manhole	2700	S1.001	130.770	1050	S1.000	132.215	225	620
S3	133.506	2.761	Open Manhole	2700	S1.002	130.745	1050	S1.001	130.745	1050	
S4	133.480	2.760	Open Manhole	2700	S1.003	130.720	1050	S1.002	130.720	1050	
S5	134.020	1.420	Open Manhole	1200	S2.000	132.600	225				
S6	133.080	2.310	Open Manhole	2700	S2.001	130.770	1050	S2.000	131.595	225	
S7	133.220	2.490	Open Manhole	2700	S2.002	130.730	1050	S2.001	130.730	1050	
S8	133.335	2.635	Open Manhole	2700	S2.003	130.700	1050	S2.002	130.700	1050	
S9	133.952	3.357	Open Manhole	2700	S1.004	130.600	1050	S1.003	130.600	1050	
								S2.003	130.595	1050	
S10	134.020	3.525	Open Manhole	2700	S1.005	130.495	1050	S1.004	130.495	1050	
S11	133.500	1.425	Junction		S3.000	132.075	300				
S12	133.300	1.500	Open Manhole	1200	S3.001	131.800	150	S3.000	131.800	300	
S13	133.344	3.024	Open Manhole	2700	S1.006	130.320	150	S1.005	130.320	1050	
								S3.001	131.600	150	1280
S14	132.700	1.425	Open Manhole	1200	S4.000	131.275	225				
S15	132.448	3.593	Open Manhole	1800	S4.001	128.855	450	S4.000	130.455	225	1375
S16	132.270	0.450	Open Manhole	1200	S5.000	131.820	150				
S17	131.750	0.450	Open Manhole	1200	S5.001	131.300	150	S5.000	131.300	150	
S18	131.789	3.484	Open Manhole	2700	S5.002	128.305	1050	S5.001	130.400	150	1195
S19	132.229	4.004	Open Manhole	2700	S5.003	128.225	1050	S5.002	128.225	1050	
S20	132.013	3.868	Open Manhole	2700	S4.002	128.145	1050	S4.001	128.745	450	
								S5.003	128.145	1050	
S21	131.305	0.450	Open Manhole	1200	S6.000	130.855	225				
S22	130.800	1.305	Open Manhole	1200	S6.001	129.495	225	S6.000	129.495	225	
S23	130.477	2.312	Open Manhole	2700	S6.002	128.165	1050	S6.001	128.990	225	
S24	131.909	3.829	Open Manhole	2700	S6.003	128.080	1050	S6.002	128.080	1050	
S25	131.440	3.445	Open Manhole	2700	S4.003	127.995	1050	S4.002	127.995	1050	
								S6.003	127.995	1050	
S26	131.900	0.450	Open Manhole	1200	S7.000	131.450	150				
S27	131.624	0.834	Open Manhole	1200	S7.001	130.790	150	S7.000	131.175	150	385
S28	132.200	0.450	Open Manhole	1200	S8.000	131.750	150				
S29	131.827	0.907	Open Manhole	1200	S8.001	130.920	150	S8.000	131.375	150	455
S30	131.710	3.335	Open Manhole	2700	S7.002	128.375	1050	S7.001	130.225	150	950
								S8.001	130.225	150	950
S31	131.813	3.498	Open Manhole	2700	S7.003	128.315	1050	S7.002	128.315	1050	
S32	131.900	0.450	Open Manhole	1200	S9.000	131.450	150				
S33	132.000	0.680	Open Manhole	1200	S9.001	131.320	150	S9.000	131.320	150	
S34	132.782	4.372	Open Manhole	2700	S9.002	128.410	1050	S9.001	130.260	150	950
S35	132.258	3.968	Open Manhole	2700	S9.003	128.290	1050	S9.002	128.290	1050	
S36	132.096	3.861	Open Manhole	2700	S7.004	128.235	1050	S7.003	128.235	1050	
								S9.003	128.235	1050	
S37	132.259	4.104	Open Manhole	2700	S7.005	128.155	1050	S7.004	128.155	1050	
S38	131.285	0.450	Open Manhole	1200	S10.000	130.835	225				
S39	131.000	1.280	Open Manhole	1200	S10.001	129.720	225	S10.000	129.720	225	
S40	130.710	2.445	Open Manhole	2700	S10.002	128.265	1050	S10.001	129.090	225	
S41	132.054	3.889	Open Manhole	2700	S10.003	128.165	1050	S10.002	128.165	1050	
S42	131.972	3.892	Open Manhole	2700	S7.006	128.080	1050	S7.005	128.080	1050	
								S10.003	128.080	1050	
S43	131.489	3.529	Open Manhole	2700	S4.004	127.960	1050	S4.003	127.960	1050	
								S7.006	127.960	1050	
S44	132.220	4.330	Open Manhole	2700	S4.005	127.890	1050	S4.004	127.890	1050	
S45	132.392	4.202	Open Manhole	2700	S11.000	128.190	1050				
S46	132.000	0.450	Open Manhole	1200	S12.000	131.550	150				
S47	132.682	1.587	Open Manhole	1200	S12.001	131.095	150	S12.000	131.095	150	
S48	132.783	4.668	Open Manhole	2700	S11.001	128.115	1050	S11.000	128.115	1050	
								S12.001	130.425	150	1410
S49	132.832	0.452	Open Manhole	1200	S13.000	132.380	225				
S50	132.832	0.492	Open Manhole	1200	S13.001	132.340	225	S13.000	132.340	225	
S51	132.832	4.852	Open Manhole	2700	S11.002	127.980	1050	S11.001	127.980	1050	
								S13.001	132.020	225	3215
S52	132.696	4.896	Open Manhole	2700	S4.006	127.800	1050	S4.005	127.800	1050	
								S11.002	127.800	1050	
S53	132.580	4.880	Open Manhole	2700	S4.007	127.700	1050	S4.006	127.700	1050	
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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S54	133.000	3.925	Open Manhole	1500	S14.000	129.075	525				
S55	133.201	5.641	Open Manhole	2700	S4.008	127.560	1050	S4.007	127.560	1050	
								S14.000	129.045	525	960
S56	132.960	5.870	Open Manhole	2700	S1.007	127.090	1200	S1.006	129.790	150	1650
								S4.008	127.240	1050	
S	133.425	6.520	Open Manhole	2700		OUTFALL		S1.007	126.905	1200	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S1	388062.647	410256.071	388062.647	410256.071	Required	
S2	388106.276	410220.886	388106.276	410220.886	Required	
S3	388110.418	410212.978	388110.418	410212.978	Required	
S4	388109.218	410202.985	388109.218	410202.985	Required	
S5	388004.430	410229.627	388004.430	410229.627	Required	
S6	388022.537	410194.918	388022.537	410194.918	Required	
S7	388034.646	410196.785	388034.646	410196.785	Required	
S8	388045.452	410194.760	388045.452	410194.760	Required	
S9	388077.703	410167.713	388077.703	410167.713	Required	
S10	388049.198	410140.073	388049.198	410140.073	Required	
S11	388084.615	410162.922			No Entry	
S12	387997.260	410097.928	387997.260	410097.928	Required	
S13	387991.597	410100.739	387991.597	410100.739	Required	
S14	387990.743	410171.599	387990.743	410171.599	Required	
S15	387970.624	410156.388	387970.624	410156.388	Required	
S16	387931.650	410207.964	387931.650	410207.964	Required	
S17	387916.998	410202.139	387916.998	410202.139	Required	
S18	387906.687	410197.581	387906.687	410197.581	Required	
S19	387918.734	410168.205	387918.734	410168.205	Required	
S20	387930.781	410138.829	387930.781	410138.829	Required	
S21	387869.619	410187.499	387869.619	410187.499	Required	
S22	387860.007	410183.655	387860.007	410183.655	Required	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S23	387848.996	410180.105	387848.996	410180.105	Required	
S24	387862.196	410148.426	387862.196	410148.426	Required	
S25	387875.397	410116.748	387875.397	410116.748	Required	
S26	387716.805	410043.724	387716.805	410043.724	Required	
S27	387713.687	410051.644	387713.687	410051.644	Required	
S28	387703.493	410079.223	387703.493	410079.223	Required	
S29	387707.031	410069.393	387707.031	410069.393	Required	
S30	387710.570	410059.563	387710.570	410059.563	Required	
S31	387732.012	410067.057	387732.012	410067.057	Required	
S32	387712.456	410133.317	387712.456	410133.317	Required	
S33	387724.901	410137.016	387724.901	410137.016	Required	
S34	387738.472	410140.092	387738.472	410140.092	Required	
S35	387755.747	410096.171	387755.747	410096.171	Required	
S36	387761.370	410075.701	387761.370	410075.701	Required	
S37	387792.659	410083.317	387792.659	410083.317	Required	
S38	387816.045	410169.977	387816.045	410169.977	Required	
S39	387804.442	410166.109	387804.442	410166.109	Required	
S40	387793.404	410160.471	387793.404	410160.471	Required	
S41	387807.763	410124.393	387807.763	410124.393	Required	
S42	387819.965	410094.015	387819.965	410094.015	Required	
S43	387863.975	410112.146	387863.975	410112.146	Required	
S44	387874.291	410086.520	387874.291	410086.520	Required	
S45	387779.316	410047.864	387779.316	410047.864	Required	
S46	387770.124	410015.295	387770.124	410015.295	Required	
S47	387779.059	410018.103	387779.059	410018.103	Required	
S48	387787.112	410019.380	387787.112	410019.380	Required	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S50	387839.587	410030.284	387839.587	410030.284	Required	
S51	387837.742	410034.701	387837.742	410034.701	Required	
S52	387887.082	410052.711	387887.082	410052.711	Required	
S53	387924.343	410066.610	387924.343	410066.610	Required	
S54	387974.707	410081.842	387974.707	410081.842	Required	
S55	387979.213	410093.564	387979.213	410093.564	Required	
S56	387986.209	410097.553	387986.209	410097.553	Required	
S	388034.564	410040.246			No Entry	

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.007	S	133.425	126.905	0.000	2700	0

Simulation Criteria for Storm

Volumetric Runoff Coeff 0.750 Manhole Headloss Coeff (Global) 0.500 Inlet Coefficient 0.800
Areal Reduction Factor 1.000 Foul Sewage per hectare (l/s) 0.000 Flow per Person per Day (l/per/day) 0.000
Hot Start (mins) 0 Additional Flow - % of Total Flow 0.000 Run Time (mins) 60
Hot Start Level (mm) 0 MADD Factor * 10m³/ha Storage 2.000 Output Interval (mins) 1

Number of Input Hydrographs 0 Number of Offline Controls 1 Number of Time/Area Diagrams 0
Number of Online Controls 5 Number of Storage Structures 9 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.400 Cv (Summer) 0.750
Return Period (years) 100 Ratio R 0.344 Cv (Winter) 0.840
Region England and Wales Profile Type Summer Storm Duration (mins) 30

CampbellReith		Page 8
Raven House 29 Linkfield Lane Surrey RH1 1SS	13655: Castleton Rochdale SW Network 4050-P2	
Date 15/06/2021	Designed by EH	
File 13655-CRH-ZZ-XX-MD-4050-P2_SW Network.MDX	Checked by	
XP Solutions		Network 2020.1

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S13, DS/PN: S1.006, Volume (m³): 75.5

Unit Reference	MD-SHE-0119-1000-3000-1000	Sump Available	Yes
Design Head (m)	3.000	Diameter (mm)	119
Design Flow (l/s)	10.0	Invert Level (m)	130.320
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	150
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points			Control Points		
	Head (m)	Flow (l/s)		Head (m)	Flow (l/s)
Design Point (Calculated)	3.000	10.0	Kick-Flo®	1.063	6.1
Flush-Flo™	0.522	7.7	Mean Flow over Head Range	-	7.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.2	0.600	7.7	1.600	7.4	2.600	9.3	5.000	12.7	7.500	15.5
0.200	6.7	0.800	7.4	1.800	7.9	3.000	10.0	5.500	13.3	8.000	15.9
0.300	7.3	1.000	6.6	2.000	8.3	3.500	10.7	6.000	13.9	8.500	16.4
0.400	7.6	1.200	6.5	2.200	8.6	4.000	11.5	6.500	14.4	9.000	16.9
0.500	7.7	1.400	7.0	2.400	9.0	4.500	12.1	7.000	15.0	9.500	17.3

Orifice Manhole: S27, DS/PN: S7.001, Volume (m³): 1.1

Diameter (m) 0.106 Discharge Coefficient 0.600 Invert Level (m) 130.790

Orifice Manhole: S29, DS/PN: S8.001, Volume (m³): 1.2

Diameter (m) 0.106 Discharge Coefficient 0.600 Invert Level (m) 130.920

Orifice Manhole: S33, DS/PN: S9.001, Volume (m³): 1.0

Diameter (m) 0.086 Discharge Coefficient 0.600 Invert Level (m) 131.320

Hydro-Brake® Optimum Manhole: S55, DS/PN: S4.008, Volume (m³): 85.2

Unit Reference	MD-SHE-0235-3750-2800-3750	Sump Available	Yes
Design Head (m)	2.800	Diameter (mm)	235
Design Flow (l/s)	37.5	Invert Level (m)	127.560
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	300
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	2100
Application	Surface		

Control Points			Control Points		
	Head (m)	Flow (l/s)		Head (m)	Flow (l/s)
Design Point (Calculated)	2.800	37.4	Kick-Flo®	1.701	29.5
Flush-Flo™	0.806	37.5	Mean Flow over Head Range	-	32.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.8	0.600	36.9	1.600	31.8	2.600	36.1	5.000	49.5	7.500	60.3
0.200	23.7	0.800	37.5	1.800	30.3	3.000	38.7	5.500	51.8	8.000	62.2
0.300	32.1	1.000	37.2	2.000	31.8	3.500	41.7	6.000	54.1	8.500	64.0
0.400	34.5	1.200	36.3	2.200	33.3	4.000	44.5	6.500	56.2	9.000	65.8
0.500	36.0	1.400	34.7	2.400	34.8	4.500	47.1	7.000	58.3	9.500	67.6

CampbellReith		Page 9																		
Raven House 29 Linkfield Lane Surrey RH1 1SS	13655: Castleton Rochdale SW Network 4050-P2																			
Date 15/06/2021	Designed by EH																			
File 13655-CRH-ZZ-XX-MD-4050-P2_SW Network.MDX	Checked by																			
XP Solutions	Network 2020.1																			
<u>Offline Controls for Storm</u> <u>Pipe Manhole: S9, DS/PN: S1.004, Loop to PN: S3.000</u> <table><tr><td>Diameter (m)</td><td>0.375</td><td>Length (m)</td><td>8.000</td><td>Coefficient of Contraction</td><td>0.600</td></tr><tr><td>Section Type</td><td>Pipe/Conduit</td><td>Roughness k (mm)</td><td>0.600</td><td>Upstream Invert Level (m)</td><td>132.100</td></tr><tr><td>Slope (1:X)</td><td>325.0</td><td>Entry Loss Coefficient</td><td>0.500</td><td></td><td></td></tr></table>			Diameter (m)	0.375	Length (m)	8.000	Coefficient of Contraction	0.600	Section Type	Pipe/Conduit	Roughness k (mm)	0.600	Upstream Invert Level (m)	132.100	Slope (1:X)	325.0	Entry Loss Coefficient	0.500		
Diameter (m)	0.375	Length (m)	8.000	Coefficient of Contraction	0.600															
Section Type	Pipe/Conduit	Roughness k (mm)	0.600	Upstream Invert Level (m)	132.100															
Slope (1:X)	325.0	Entry Loss Coefficient	0.500																	
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CampbellReith		Page 10																																																																																																																																																																																																																														
Raven House 29 Linkfield Lane Surrey RH1 1SS	13655: Castleton Rochdale SW Network 4050-P2																																																																																																																																																																																																																															
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XP Solutions	Network 2020.1																																																																																																																																																																																																																															
<u>Storage Structures for Storm</u> <u>Porous Car Park Manhole: S16, DS/PN: S5.000</u> <table><tr><td>Infiltration Coefficient Base (m/hr)</td><td>0.00000</td><td>Porosity</td><td>0.30</td><td>Slope (1:X)</td><td>100.0</td></tr><tr><td>Membrane Percolation (mm/hr)</td><td>1000</td><td>Invert Level (m)</td><td>131.820</td><td>Depression Storage (mm)</td><td>5</td></tr><tr><td>Max Percolation (l/s)</td><td>65.0</td><td>Width (m)</td><td>6.0</td><td>Evaporation (mm/day)</td><td>3</td></tr><tr><td>Safety Factor</td><td>2.0</td><td>Length (m)</td><td>39.0</td><td>Membrane Depth (mm)</td><td>0</td></tr></table> <u>Porous Car Park Manhole: S21, DS/PN: S6.000</u> <table><tr><td>Infiltration Coefficient Base (m/hr)</td><td>0.00000</td><td>Porosity</td><td>0.30</td><td>Slope (1:X)</td><td>33.0</td></tr><tr><td>Membrane Percolation (mm/hr)</td><td>1000</td><td>Invert Level (m)</td><td>130.855</td><td>Depression Storage (mm)</td><td>5</td></tr><tr><td>Max Percolation (l/s)</td><td>45.8</td><td>Width (m)</td><td>5.5</td><td>Evaporation (mm/day)</td><td>3</td></tr><tr><td>Safety Factor</td><td>2.0</td><td>Length (m)</td><td>30.0</td><td>Membrane Depth (mm)</td><td>0</td></tr></table> <u>Porous Car Park Manhole: S26, DS/PN: S7.000</u> <table><tr><td>Infiltration Coefficient Base (m/hr)</td><td>0.00000</td><td>Porosity</td><td>0.30</td><td>Slope (1:X)</td><td>100.0</td></tr><tr><td>Membrane Percolation (mm/hr)</td><td>1000</td><td>Invert Level (m)</td><td>131.450</td><td>Depression Storage (mm)</td><td>5</td></tr><tr><td>Max Percolation (l/s)</td><td>42.2</td><td>Width (m)</td><td>8.0</td><td>Evaporation (mm/day)</td><td>3</td></tr><tr><td>Safety Factor</td><td>2.0</td><td>Length (m)</td><td>19.0</td><td>Membrane Depth (mm)</td><td>0</td></tr></table> <u>Porous Car Park Manhole: S28, DS/PN: S8.000</u> <table><tr><td>Infiltration Coefficient Base (m/hr)</td><td>0.00000</td><td>Porosity</td><td>0.30</td><td>Slope (1:X)</td><td>100.0</td></tr><tr><td>Membrane Percolation (mm/hr)</td><td>1000</td><td>Invert Level (m)</td><td>131.750</td><td>Depression Storage (mm)</td><td>5</td></tr><tr><td>Max Percolation (l/s)</td><td>36.1</td><td>Width (m)</td><td>5.0</td><td>Evaporation (mm/day)</td><td>3</td></tr><tr><td>Safety Factor</td><td>2.0</td><td>Length (m)</td><td>26.0</td><td>Membrane Depth (mm)</td><td>0</td></tr></table> <u>Porous Car Park Manhole: S32, DS/PN: S9.000</u> <table><tr><td>Infiltration Coefficient Base (m/hr)</td><td>0.00000</td><td>Porosity</td><td>0.30</td><td>Slope (1:X)</td><td>100.0</td></tr><tr><td>Membrane Percolation (mm/hr)</td><td>1000</td><td>Invert Level (m)</td><td>131.450</td><td>Depression Storage (mm)</td><td>5</td></tr><tr><td>Max Percolation (l/s)</td><td>23.6</td><td>Width (m)</td><td>5.0</td><td>Evaporation (mm/day)</td><td>3</td></tr><tr><td>Safety Factor</td><td>2.0</td><td>Length (m)</td><td>17.0</td><td>Membrane Depth (mm)</td><td>0</td></tr></table> <u>Porous Car Park Manhole: S38, DS/PN: S10.000</u> <table><tr><td>Infiltration Coefficient Base (m/hr)</td><td>0.00000</td><td>Porosity</td><td>0.30</td><td>Slope (1:X)</td><td>30.0</td></tr><tr><td>Membrane Percolation (mm/hr)</td><td>1000</td><td>Invert Level (m)</td><td>130.835</td><td>Depression Storage (mm)</td><td>5</td></tr><tr><td>Max Percolation (l/s)</td><td>85.6</td><td>Width (m)</td><td>11.0</td><td>Evaporation (mm/day)</td><td>3</td></tr><tr><td>Safety Factor</td><td>2.0</td><td>Length (m)</td><td>28.0</td><td>Membrane Depth (mm)</td><td>0</td></tr></table> <u>Porous Car Park Manhole: S46, DS/PN: S12.000</u> <table><tr><td>Infiltration Coefficient Base (m/hr)</td><td>0.00000</td><td>Porosity</td><td>0.30</td><td>Slope (1:X)</td><td>100.0</td></tr><tr><td>Membrane Percolation (mm/hr)</td><td>1000</td><td>Invert Level (m)</td><td>131.550</td><td>Depression Storage (mm)</td><td>5</td></tr><tr><td>Max Percolation (l/s)</td><td>58.3</td><td>Width (m)</td><td>5.0</td><td>Evaporation (mm/day)</td><td>3</td></tr><tr><td>Safety Factor</td><td>2.0</td><td>Length (m)</td><td>42.0</td><td>Membrane Depth (mm)</td><td>0</td></tr></table> <u>Porous Car Park Manhole: S49, DS/PN: S13.000</u> <table><tr><td>Infiltration Coefficient Base (m/hr)</td><td>0.00000</td><td>Porosity</td><td>0.30</td><td>Slope (1:X)</td><td>100.0</td></tr><tr><td>Membrane Percolation (mm/hr)</td><td>1000</td><td>Invert Level (m)</td><td>132.380</td><td>Depression Storage (mm)</td><td>5</td></tr><tr><td>Max Percolation (l/s)</td><td>184.7</td><td>Width (m)</td><td>5.0</td><td>Evaporation (mm/day)</td><td>3</td></tr><tr><td>Safety Factor</td><td>2.0</td><td>Length (m)</td><td>133.0</td><td>Membrane Depth (mm)</td><td>0</td></tr></table> <u>Cellular Storage Manhole: S54, DS/PN: S14.000</u> <table><tr><td>Invert Level (m)</td><td>129.075</td><td>Infiltration Coefficient Side (m/hr)</td><td>0.00000</td><td>Porosity</td><td>0.95</td></tr><tr><td>Infiltration Coefficient Base (m/hr)</td><td>0.00000</td><td>Safety Factor</td><td>2.0</td><td></td><td></td></tr></table> <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>550.0</td><td>550.0</td><td>1.200</td><td>550.0</td><td>662.6</td><td>1.201</td><td>0.0</td><td>662.6</td></tr></table>			Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.30	Slope (1:X)	100.0	Membrane Percolation (mm/hr)	1000	Invert Level (m)	131.820	Depression Storage (mm)	5	Max Percolation (l/s)	65.0	Width (m)	6.0	Evaporation (mm/day)	3	Safety Factor	2.0	Length (m)	39.0	Membrane Depth (mm)	0	Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.30	Slope (1:X)	33.0	Membrane Percolation (mm/hr)	1000	Invert Level (m)	130.855	Depression Storage (mm)	5	Max Percolation (l/s)	45.8	Width (m)	5.5	Evaporation (mm/day)	3	Safety Factor	2.0	Length (m)	30.0	Membrane Depth (mm)	0	Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.30	Slope (1:X)	100.0	Membrane Percolation (mm/hr)	1000	Invert Level (m)	131.450	Depression Storage (mm)	5	Max Percolation (l/s)	42.2	Width (m)	8.0	Evaporation (mm/day)	3	Safety Factor	2.0	Length (m)	19.0	Membrane Depth (mm)	0	Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.30	Slope (1:X)	100.0	Membrane Percolation (mm/hr)	1000	Invert Level (m)	131.750	Depression Storage (mm)	5	Max Percolation (l/s)	36.1	Width (m)	5.0	Evaporation (mm/day)	3	Safety Factor	2.0	Length (m)	26.0	Membrane Depth (mm)	0	Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.30	Slope (1:X)	100.0	Membrane Percolation (mm/hr)	1000	Invert Level (m)	131.450	Depression Storage (mm)	5	Max Percolation (l/s)	23.6	Width (m)	5.0	Evaporation (mm/day)	3	Safety Factor	2.0	Length (m)	17.0	Membrane Depth (mm)	0	Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.30	Slope (1:X)	30.0	Membrane Percolation (mm/hr)	1000	Invert Level (m)	130.835	Depression Storage (mm)	5	Max Percolation (l/s)	85.6	Width (m)	11.0	Evaporation (mm/day)	3	Safety Factor	2.0	Length (m)	28.0	Membrane Depth (mm)	0	Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.30	Slope (1:X)	100.0	Membrane Percolation (mm/hr)	1000	Invert Level (m)	131.550	Depression Storage (mm)	5	Max Percolation (l/s)	58.3	Width (m)	5.0	Evaporation (mm/day)	3	Safety Factor	2.0	Length (m)	42.0	Membrane Depth (mm)	0	Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.30	Slope (1:X)	100.0	Membrane Percolation (mm/hr)	1000	Invert Level (m)	132.380	Depression Storage (mm)	5	Max Percolation (l/s)	184.7	Width (m)	5.0	Evaporation (mm/day)	3	Safety Factor	2.0	Length (m)	133.0	Membrane Depth (mm)	0	Invert Level (m)	129.075	Infiltration Coefficient Side (m/hr)	0.00000	Porosity	0.95	Infiltration Coefficient Base (m/hr)	0.00000	Safety Factor	2.0			Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	550.0	550.0	1.200	550.0	662.6	1.201	0.0	662.6
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.30	Slope (1:X)	100.0																																																																																																																																																																																																																											
Membrane Percolation (mm/hr)	1000	Invert Level (m)	131.820	Depression Storage (mm)	5																																																																																																																																																																																																																											
Max Percolation (l/s)	65.0	Width (m)	6.0	Evaporation (mm/day)	3																																																																																																																																																																																																																											
Safety Factor	2.0	Length (m)	39.0	Membrane Depth (mm)	0																																																																																																																																																																																																																											
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.30	Slope (1:X)	33.0																																																																																																																																																																																																																											
Membrane Percolation (mm/hr)	1000	Invert Level (m)	130.855	Depression Storage (mm)	5																																																																																																																																																																																																																											
Max Percolation (l/s)	45.8	Width (m)	5.5	Evaporation (mm/day)	3																																																																																																																																																																																																																											
Safety Factor	2.0	Length (m)	30.0	Membrane Depth (mm)	0																																																																																																																																																																																																																											
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.30	Slope (1:X)	100.0																																																																																																																																																																																																																											
Membrane Percolation (mm/hr)	1000	Invert Level (m)	131.450	Depression Storage (mm)	5																																																																																																																																																																																																																											
Max Percolation (l/s)	42.2	Width (m)	8.0	Evaporation (mm/day)	3																																																																																																																																																																																																																											
Safety Factor	2.0	Length (m)	19.0	Membrane Depth (mm)	0																																																																																																																																																																																																																											
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.30	Slope (1:X)	100.0																																																																																																																																																																																																																											
Membrane Percolation (mm/hr)	1000	Invert Level (m)	131.750	Depression Storage (mm)	5																																																																																																																																																																																																																											
Max Percolation (l/s)	36.1	Width (m)	5.0	Evaporation (mm/day)	3																																																																																																																																																																																																																											
Safety Factor	2.0	Length (m)	26.0	Membrane Depth (mm)	0																																																																																																																																																																																																																											
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.30	Slope (1:X)	100.0																																																																																																																																																																																																																											
Membrane Percolation (mm/hr)	1000	Invert Level (m)	131.450	Depression Storage (mm)	5																																																																																																																																																																																																																											
Max Percolation (l/s)	23.6	Width (m)	5.0	Evaporation (mm/day)	3																																																																																																																																																																																																																											
Safety Factor	2.0	Length (m)	17.0	Membrane Depth (mm)	0																																																																																																																																																																																																																											
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.30	Slope (1:X)	30.0																																																																																																																																																																																																																											
Membrane Percolation (mm/hr)	1000	Invert Level (m)	130.835	Depression Storage (mm)	5																																																																																																																																																																																																																											
Max Percolation (l/s)	85.6	Width (m)	11.0	Evaporation (mm/day)	3																																																																																																																																																																																																																											
Safety Factor	2.0	Length (m)	28.0	Membrane Depth (mm)	0																																																																																																																																																																																																																											
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.30	Slope (1:X)	100.0																																																																																																																																																																																																																											
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Max Percolation (l/s)	58.3	Width (m)	5.0	Evaporation (mm/day)	3																																																																																																																																																																																																																											
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Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.30	Slope (1:X)	100.0																																																																																																																																																																																																																											
Membrane Percolation (mm/hr)	1000	Invert Level (m)	132.380	Depression Storage (mm)	5																																																																																																																																																																																																																											
Max Percolation (l/s)	184.7	Width (m)	5.0	Evaporation (mm/day)	3																																																																																																																																																																																																																											
Safety Factor	2.0	Length (m)	133.0	Membrane Depth (mm)	0																																																																																																																																																																																																																											
Invert Level (m)	129.075	Infiltration Coefficient Side (m/hr)	0.00000	Porosity	0.95																																																																																																																																																																																																																											
Infiltration Coefficient Base (m/hr)	0.00000	Safety Factor	2.0																																																																																																																																																																																																																													
Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)																																																																																																																																																																																																																								
0.000	550.0	550.0	1.200	550.0	662.6	1.201	0.0	662.6																																																																																																																																																																																																																								
©1982-2020 Innovyze																																																																																																																																																																																																																																

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

		Half Drain	Pipe		
PN	US/MH Name	Time (mins)	Flow (l/s)	Status	Level Exceeded
S1.000	S1		18.4	OK	
S1.001	S2		4.7	OK	
S1.002	S3		4.4	OK	
S1.003	S4		5.8	OK	
S2.000	S5		14.6	OK	
S2.001	S6		5.5	OK	
S2.002	S7		5.2	OK	
S2.003	S8		9.4	OK	
S1.004	S9		14.1	OK	
S1.005	S10		13.7	OK	
S3.000	S11		0.0	OK	
S3.001	S12		0.0	OK	
S1.006	S13		7.5	SURCHARGED	
S4.000	S14		23.4	OK	
S4.001	S15		23.5	OK	
S5.000	S16	5	12.3	OK	
S5.001	S17		12.4	OK	
S5.002	S18		12.2	OK	
S5.003	S19		12.2	OK	
S4.002	S20		24.8	OK	
S6.000	S21	5	11.6	OK	
S6.001	S22		11.7	OK	
S6.002	S23		4.2	OK	
S6.003	S24		7.4	OK	
S4.003	S25		34.6	OK	
S7.000	S26	5	7.5	OK	
S7.001	S27		7.6	SURCHARGED	
S8.000	S28	5	9.1	OK	
S8.001	S29		8.9	SURCHARGED	
S7.002	S30		15.7	OK	
S7.003	S31		14.9	OK	
S9.000	S32	5	7.0	OK	2
S9.001	S33		6.0	SURCHARGED	
S9.002	S34		13.3	OK	
S9.003	S35		26.2	OK	
S7.004	S36		42.4	OK	
S7.005	S37		22.9	OK	
S10.000	S38	5	9.0	OK	
S10.001	S39		8.9	OK	
S10.002	S40		3.5	OK	
S10.003	S41		8.7	OK	
S7.006	S42		36.0	OK	
S4.004	S43		69.9	OK	
S4.005	S44		69.6	OK	
S11.000	S45		3.3	OK	
S12.000	S46	5	7.6	OK	
S12.001	S47		7.5	OK	
S11.001	S48		10.9	OK	
S13.000	S49	6	10.8	OK	
S13.001	S50		10.9	OK	
S11.002	S51		12.7	OK	
S4.006	S52		61.2	OK	
S4.007	S53		52.5	OK	
S14.000	S54		0.0	OK	
S4.008	S55		37.4	OK	
S1.007	S56		44.3	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

		Half Drain	Pipe		
PN	US/MH Name	Time (mins)	Flow (l/s)	Status	Level Exceeded
S1.000	S1		44.9	OK	
S1.001	S2		9.8	OK	
S1.002	S3		7.8	OK	
S1.003	S4		9.7	OK	
S2.000	S5		35.9	OK	
S2.001	S6		11.7	OK	
S2.002	S7		9.2	OK	
S2.003	S8		17.0	OK	
S1.004	S9		16.3	OK	
S1.005	S10		14.4	SURCHARGED	
S3.000	S11		0.0	OK	
S3.001	S12		0.0	OK	
S1.006	S13		7.5	SURCHARGED	
S4.000	S14		57.2	OK	
S4.001	S15		57.6	OK	
S5.000	S16	6	18.7	FLOOD RISK	
S5.001	S17		18.7	OK	
S5.002	S18		7.9	OK	
S5.003	S19		12.6	OK	
S4.002	S20		25.4	OK	
S6.000	S21	5	28.4	OK	
S6.001	S22		28.5	OK	
S6.002	S23		5.8	OK	
S6.003	S24		6.7	OK	
S4.003	S25		28.1	OK	
S7.000	S26	5	18.5	OK	
S7.001	S27		17.5	FLOOD RISK	
S8.000	S28	4	21.5	OK	
S8.001	S29		19.8	FLOOD RISK	
S7.002	S30		9.1	OK	
S7.003	S31		7.3	OK	
S9.000	S32	11	8.3	FLOOD RISK	2
S9.001	S33		8.2	SURCHARGED	
S9.002	S34		9.8	OK	
S9.003	S35		17.0	OK	
S7.004	S36		25.1	OK	
S7.005	S37		22.2	OK	
S10.000	S38	5	22.1	OK	
S10.001	S39		22.3	OK	
S10.002	S40		4.3	OK	
S10.003	S41		7.9	OK	
S7.006	S42		31.9	OK	
S4.004	S43		56.8	OK	
S4.005	S44		56.8	SURCHARGED	
S11.000	S45		4.1	OK	
S12.000	S46	4	17.2	OK	
S12.001	S47		17.2	OK	
S11.001	S48		11.1	OK	
S13.000	S49	5	29.9	FLOOD RISK	
S13.001	S50		29.8	OK	
S11.002	S51		13.5	OK	
S4.006	S52		50.4	SURCHARGED	
S4.007	S53		45.2	SURCHARGED	
S14.000	S54		0.0	OK	
S4.008	S55		37.4	SURCHARGED	
S1.007	S56		44.7	OK	

CampbellReith		Page 16
Raven House 29 Linkfield Lane Surrey RH1 1SS	13655: Castleton Rochdale SW Network 4050-P2	
Date 15/06/2021	Designed by EH	
File 13655-CRH-ZZ-XX-MD-4050-P2_SW Network.MDX	Checked by	
XP Solutions		Network 2020.1

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

		Half Drain	Pipe		
PN	US/MH Name	Time (mins)	Flow (l/s)	Status	Level Exceeded
S1.000	S1		76.4	SURCHARGED	
S1.001	S2		119.0	SURCHARGED	
S1.002	S3		203.6	SURCHARGED	
S1.003	S4		174.3	SURCHARGED	
S2.000	S5		15.8	SURCHARGED	
S2.001	S6		123.0	FLOOD RISK	
S2.002	S7		201.3	FLOOD RISK	
S2.003	S8		198.9	FLOOD RISK	
S1.004	S9		392.5	SURCHARGED	
S1.005	S10		143.0	SURCHARGED	
S3.000	S11		44.8	OK	
S3.001	S12		11.7	SURCHARGED	
S1.006	S13		9.5	FLOOD RISK	
S4.000	S14		98.0	SURCHARGED	
S4.001	S15		20.7	SURCHARGED	
S5.000	S16	14	21.4	FLOOD RISK	
S5.001	S17		21.4	OK	
S5.002	S18		18.6	SURCHARGED	
S5.003	S19		51.0	SURCHARGED	
S4.002	S20		67.6	SURCHARGED	
S6.000	S21	5	51.2	OK	
S6.001	S22		9.4	SURCHARGED	
S6.002	S23		16.8	FLOOD RISK	
S6.003	S24		33.4	SURCHARGED	
S4.003	S25		119.5	SURCHARGED	
S7.000	S26	6	20.8	FLOOD RISK	
S7.001	S27		19.1	FLOOD RISK	
S8.000	S28	6	23.4	FLOOD RISK	
S8.001	S29		21.4	FLOOD RISK	
S7.002	S30		19.1	SURCHARGED	
S7.003	S31		29.3	SURCHARGED	
S9.000	S32	17	10.9	FLOOD	2
S9.001	S33		10.7	FLOOD RISK	
S9.002	S34		19.6	SURCHARGED	
S9.003	S35		55.7	SURCHARGED	
S7.004	S36		93.7	SURCHARGED	
S7.005	S37		68.1	SURCHARGED	
S10.000	S38	5	40.0	OK	
S10.001	S39		7.3	SURCHARGED	
S10.002	S40		13.7	SURCHARGED	
S10.003	S41		35.0	SURCHARGED	
S7.006	S42		75.0	SURCHARGED	
S4.004	S43		169.2	SURCHARGED	
S4.005	S44		178.6	SURCHARGED	
S11.000	S45		16.8	SURCHARGED	
S12.000	S46	7	19.5	FLOOD RISK	
S12.001	S47		19.5	OK	
S11.001	S48		41.6	SURCHARGED	
S13.000	S49	6	49.7	FLOOD RISK	
S13.001	S50		49.9	OK	
S11.002	S51		51.9	SURCHARGED	
S4.006	S52		215.2	SURCHARGED	
S4.007	S53		223.7	SURCHARGED	
S14.000	S54	200	35.3	SURCHARGED	
S4.008	S55		37.4	SURCHARGED	
S1.007	S56		45.6	OK	