

Our Ref: 1305/2022.08.12/LLFA/JB

Flood and Water Management
Invicta House
Maidstone
Kent
ME14 1XX



Ada House
Pynes Hill
Exeter
EX2 5TU
Tel: 01392 409007

12th August 2022

FAO: Emily Neale, Graduate Flood Risk Officer

**Response to comments from Lead Local Flood Authority to application No. App
Ref:20220432**

LLFA comment

1. Part of the drainage strategy proposed indicates that the surface water will drain and connect to a Southern Water Storm Sewer beneath Wrotham Road. Any proposed connection into the surface water sewer should be made in discussion with Southern Water and we would advise that they are consulted with these proposals also.

Response

Southern Water have considered supplied information below and attached and confirmed they can take surface water flows from the development into the local surface water network as the on-site drainage arrangements will result in a betterment to the discharge rates from the site.

We note in this capacity check response that there is insufficient capacity in the foul receiving sewer for the development. However, Southern Water confirm the following,

"Southern Water aim to provide this within 24 months following the date that planning has been granted for developments not identified as strategic sites in our current business plan. Strategic sites are larger developments and will often take longer than 24 months for a full solution to be provided."

Information provided during capacity enquiry

During the pre-development connection enquiry Southern Water asked us to substantiate any surface water connection of the site to the adopted surface water sewer. We have undertaken a CCTV survey of on-site drainage and identified an

existing surface water connection to the off-site adopted drainage network (see enclosures). We have undertaken an estimation of the roof area of the previously demolished building and the area of impermeable hardstanding that could be connected to the existing drainage connection by the current extant planning application. The extant planning application would allow for connection of an area in excess of the previously connected roof area. Therefore, we have conservatively assessed the existing discharge from the site based on the circa 1000m² area of previously connected roof. In assessing the existing discharge rate we have limited discharge from the site to those based on the peak discharge supported by the 150mm sewer that leaves the site, assumed to be laid at a gradient that meets self-cleansing velocity requirements for surface water systems, 17.75l/s. If the 150mm discharge pipe was laid at 1in150, the peak discharge would be 14.46l/s.

The table below indicates the existing discharges from the site at the 2yr, 30yr and 100yr return period brownfield rates limited where necessary by the terminal discharge capacity of the off-site connection.

Brownfield Rainfall event	Existing Discharge (l/s)	Proposed rainfall event	Proposed Discharge (l/s)	Betterment
1in2yr	12.33	1in2yr+40%CC	4.9	~60%
1in30yr	33.63 (but limited to 17.75 l/s)	1in30yr+40%CC	5.0	~71%
1in100yr	44.70 (but limited to 17.75 l/s)	1in100yr+40%CC	5.0	~71%

LLFA comment

2. We note that the Microdrainage calculations on page 32 of the report use rainfall model FSR data rather than FEH data. The Rainfall details on page 32 use Rainfall model FSR with rainfall depth M5-60 of 20.00mm rather than the 26.25mm suggested in the Kent County Council Drainage and Planning Policy. We would expect to see the drainage system modelled using 2013 FeH rainfall data in any appropriate modelling or simulation software. Where 2013 FeH data is not available, 26.25mm should be manually input for the M5-60 value, as per the requirements of our latest drainage and planning policy statement (June 2019).

Response

We have revised the attenuation model using FEH2013 rainfall data, and revised the tank size to suit.

LLFA comment

3. As of the 10th of May 2022, the Environment Agency's climate change allowances have been updated. As part of this update, revisions have been made to the 'Peak Rainfall Intensity Allowances' that are used in applying climate change percentages to new drainage schemes. We would seek that these values are applied to all new development/ drainage schemes. The latest information on the allowances and map can be found at the following link:

<https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

Response

The below extract from the website that details the new allowances indicates that development with a 100year lifespan (to 2122) should apply an upper end allowance of 40% to the 1in100 year event as per the supplied modelling in the FRA and the revised FEH2013 calculations.

According to the NPPF guidance the following storms and allowance might be applicable throughout the development life-time.

Development with a lifetime beyond 2100. The assessment should look at the 3.3% and 1% rainfall events assessed at the 2070 epoch using the upper end allowances. Therefore, the following storms apply: 1in30yr+35%CC, 1in100yr+40%CC

If the development is considered in the time period between 2061 and 2100 the assessment should look at the 3.3% and 1% rainfall events at the 2070 epoch using the central allowances. Therefore, the following storms apply: 1in30yr+20%CC, 1in100yr+20%CC.

If the development is considered in the time period upto 2060 the assessment should look at the 3.3% and 1% rainfall events at the 2050 epoch using the central allowances. Therefore, the following storms apply: 1in30yr+20%CC, 1in100yr+20%CC.

Therefore, the calculations provided have considered the worst-case storm event under all lifetimes as the 1in100yr+40%CC.

Medway Management Catchment peak rainfall allowances		
3.3% annual exceedance rainfall event		
Epoch	Central allowance	Upper end allowance
2050s	20%	35%
2070s	20%	35%

1% annual exceedance rainfall event		
Epoch	Central allowance	Upper end allowance
2050s	20%	45%
2070s	20%	40%

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

LLFA comment

4. The topography of the site means that not all of the site would naturally fall towards the north west corner. The preliminary drainage layout plan provided indicates that some of the surface water is directed towards the open space in the southwest corner of the site. This would be an ideal opportunity to integrate full SuDS design by utilising the open space with an above ground attenuation feature. This would allow greater enhancement to the local environment and increase biodiversity and we would appreciate it if the design would include all open spaces as part of the SuDS features.

Response

The surface water drainage is shown generally entering a private drainage system, the arrows indicate overland exceedance routes rather than surface flows for general surface water drainage. The overland surface water flow routes generally follow the proposed ground levels.

The open spaces provided in the site plan are included as functional private communal spaces for social and private amenity purposes of apartment residents. The functional amenity of these spaces are primarily as managed outdoor garden spaces with areas in which residents can choose to socialise with each other or to find quieter spaces for more private enjoyment. It is not practical or desirable, in terms of function of the space, to include an open drainage feature, such a pond, as a SuDS feature in the open spaces. The earthworks associated with even a shallow storage feature would be disproportionate to the extent of the open space available. The function and aesthetic of the space as a managed garden area is an integral part of the development. To the south, east and west of the proposed building the source for surface water is from the rainwater pipe (RWP) discharges from roof drainage. It would not be practical to allow these discharges to flow over ground to an open surface water feature such as a pond, nor could it be allowed to discharge to a swale feature local to the building line as patios need to have direct access to the wider garden area without residents needing to negotiate uneven potentially wet surface features near the building. Therefore, discharges from RWPs will of necessity need to discharge to a sewered system to avoid undesirable surface unevenness. The use of filter drain features are not consistent with the developers aesthetic or functional use of the space. There would be limited benefit of collecting RWP discharges in underdrains to filter drain features as discharges would not be exposed to grasses, vegetation and filter media.

The site is currently a brownfield site, with limited green space, and the inclusion within the site plan of the indicated outdoor spaces already adds positively to the increase in biodiversity and amenity in a way that is in keeping with the purpose of the development. As such it is not necessary for the SuDS system to be a focus for the creation of amenity or biodiversity.

Nevertheless, the developer has added some surface SuDS features where they offer particular benefit at source. Permeable paving has been included to provide at source treatment to vehicle accesses and parking that contribute most to degradation of water quality. The areas of permeable paving have been determined and located so as to provide treatment to parking and access area based on the 2-to-1 ratio of impermeable to permeable areas, as outlined in CIRIA C753. The area of permeable surface provided is ~275m³ and the area of impermeable surface drained to these permeable surface is ~281m³.

Yours sincerely

James Blyth

Senior Engineer

Enc.

Southern Water Capacity Check Response

CCTV Survey

Southern Water Asset Records.

Sketch estimating roof area.

Brownfield discharge rate calculation for 1000m²

Revised FEH2013 MicroDrainage Calculation

Revised PDL.



James Blyth
Awcock Ward Partnership Ltd
Ada House
Pynes Hill
Exeter
Devon
EX2 5TU

Your ref

Our ref
DSA000010003

Date
10 August 2022

Contact
Tel 0330 303 0119

Dear Mr Blyth,

Level 1 Capacity Check Enquiry: Windmill Street, Former Police Station, 133 Windmill Street, Gravesend, Kent, DA12 1DB.

We have completed the capacity check for the above development site and the results are as follows:

Foul Water

There is currently inadequate capacity within the foul sewerage network to accommodate a foul flow of **0.65 l/s** for the above development at manhole reference TQ6473**6801** or TQ6473**7801**. The proposed development would increase flows to the public sewerage system which may increase the risk of flooding to existing properties and land. Additional off-site sewers or improvements to existing sewers will be required to provide sufficient capacity to service the development. Southern Water has a duty to provide Network capacity from the point of practical connection (point of equivalent or larger diameter pipe) funded by the New Infrastructure Charge.

Southern Water aim to provide this within 24 months following the date that planning has been granted for developments not identified as strategic sites in our current business plan. Strategic sites are larger developments and will often take longer than 24 months for a full solution to be provided.

The nearest point where capacity is currently available is at **GRAV WTW** which is located approximately **2 Km** Northeast of the proposed development site. Rights are not issued for a direct connection to Wastewater Treatment Works (WTW). Please note that connection to the WTW will have to be agreed by Southern Water Services before being carried out.

Alternatively, the developer can discharge foul flow no greater than existing levels if proven to be connected and it is ensured that there is no overall increase in flows into the foul system. You will be required to provide a topographical site survey and/or a CCTV survey showing the existing connection points, pipe sizes, gradients and calculations confirming the proposed foul flow will be no greater than the existing contributing flows.

Surface Water

The documents submitted indicate that the proposed surface water flows are now restricted and hence will support the system to be more efficient. Therefore, surface water may be discharged to the existing sewer, provided the rate of discharge to the sewer is no greater than existing contributing flows.

New Infrastructure Charging

Please note as of 1st April 2018 we have moved to the “New Connections Services Charging Arrangements”. We understand that this may cause uncertainty for customers, particularly where they may have already committed to a development based on previous charging arrangements. We have worked with our stakeholders and Water UK to agree a set of principles by which we will base our charges. Please read through our new charging arrangement documents available at the following link: southernwater.co.uk/developing-building/connection-charging-arrangements

Alternatively, New Appointees and Variations (NAVs), also known as ‘inset’ companies, can provide new connection services or take ownership of the new water and wastewater connection infrastructure provided for a new development. NAVs are appointed by Ofwat and replace the regional water company. It is for the developer to choose whether to use a NAV or the regional water company to supply services for new sites, according to certain legal criteria.

Connecting to our network

It should be noted that this information is only a hydraulic assessment of the existing sewerage network and does not grant approval for a connection to the public sewerage system. A formal Sewer Connection (S106) application is required to be completed and approved by Southern Water Services. To make an application visit: developerservices.southernwater.co.uk

Please note the information provided above does not grant approval for any designs/drawings submitted for the capacity analysis. The results quoted above are only valid for 12 months from the date of issue of this letter.

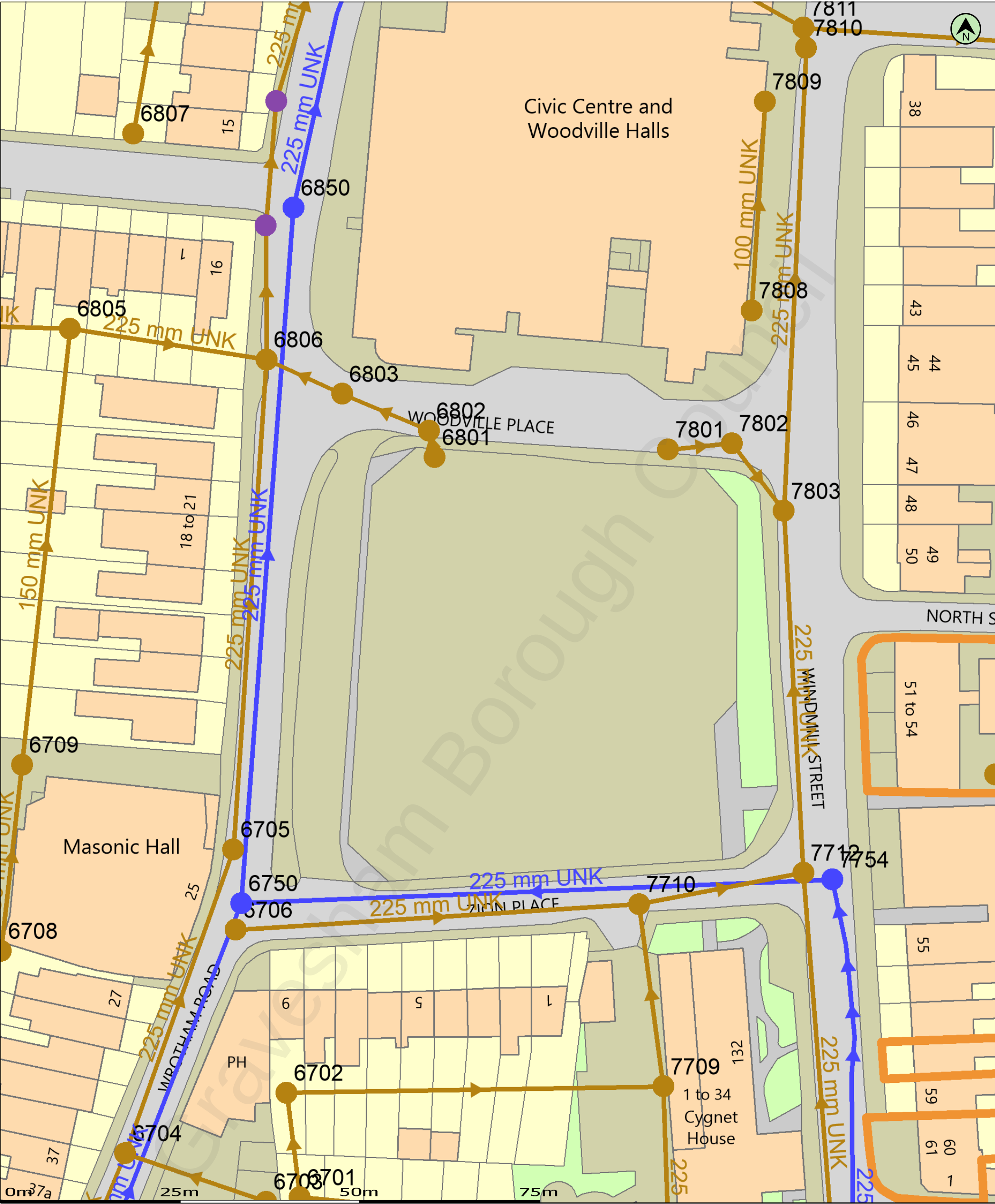
Should it be necessary to contact us please quote our above reference number relating to this application by email at southernwaterplanning@southernwater.co.uk

Yours sincerely,

Future Growth Planning Team

Business Channels

southernwater.co.uk/developing-building/planning-your-development



(c) Crown copyright and database rights 2021 Ordnance Survey 100031673
Data updated: 20/10/21

Scale: 1:500
Map Centre: 564699,173807

Date: 05/11/21
Our Ref: 695436 - 3

Wastewater Plan A3
Powered by digdat

john.duncan@nrswa.net

Gravesend



The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. This plan is produced by Southern Water Services Ltd (c) Crown copyright and database rights 2021 Ordnance Survey 100031673. This map is to be used for the purposes of viewing the location of Southern Water plant only. Any other uses of the map data or further copies is not permitted.

WARNING: BAC pipes are constructed of Bonded Asbestos Cement.

WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement.



CCTV SURVEYS



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**5 SUFFOLK ROAD
MALDON
ESSEX
CM9 6AX**

Telephone: 07971 910370

CCTV REPORT

CLIENT	CHURCHILL RETIREMENT LIVING
LOCATION	WOODVILLE PLACE GRAVESEND KENT
DATE	24/11/2021
REF	071416

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REGISTER OF APPENDICES

- A. MANHOLE INSPECTION REPORT
- B. COPIES OF SITE HAND WRITTEN DAILY RECORD SHEETS
- C. ANNOTATED SITE DRAWINGS

GENERAL INFORMATION

Utility Surveys Ltd have been appointed by Churchill Retirement Living to undertake a Sewer Condition Survey at the location identified. This survey commenced on 24 November 2021.

CONTACT INFORMATION

SITE ADDRESS: WOODVILLE PLACE GRAVESEND KENT	SITE CONTACT: N/A CONTACT NO: EMAIL:
CLIENT DETAILS: CHURCHILL RETIREMENT LIVING CHURCHILL HOUSE 6 CHERTSEY ROAD BYFLEET KT14 7AG	CONTACT: CONOR LAVERY CONTACT NO: 01932 338941 EMAIL:

UTILITY SURVEYS LTD CONTACT DETAILS

OFFICE	SIMON GARDINER 07971 910370 simon@utilitysurveysltd.co.uk
RIG MANAGER	SIMON GARDINER

SITE DESCRIPTION

Site Description

DEVELOPMENT SITE

Site Boundaries

CLEARLY DEFINED ON SUPPLIED DRAWINGS

SURVEY BRIEF

Sewer Condition Inspection Survey

The Purpose of the Sewer Condition Inspection Survey was to establish the location and extent of foul and/ or surface water drainage systems and to document their condition prior to any further works.

- A full condition survey can only be produced if precleansing / jetting is carried out in conjunction with the CCTV survey.
- If precleansing is not carried out at the time of the survey further faults and conditional defects may be present but not recorded in this report.

In addition Utility Surveys Ltd have;

- Attempted to investigate all agreed areas, although if not all could be fully accessed (see Daily Record Sheet).
- Produced a report to establish the location and extent of foul and surface water drainage systems and to document their condition prior to any further works.
- Provided the basic information from which a remediation or management plan can be instigated.
- Highlighted the requirement for urgent action to repair or remediation works to the surveyed drainage system.
- Incorporated in the results any additional manholes/ drainage found, which may have been buried, obscured or not identified in the original scope of works.

Agreed Restrictions and Exclusions

This report is based upon a Sewer Condition Inspection Survey of an unfamiliar site.

During the course of the survey all reasonable efforts were made to identify and access all Manholes and foul/ surface drainage/ outfall, throughout the site.

Some installations/ areas may not have been inspected due to access and or safety reasons (e.g. Wet Wells, Large Unventilated Tanks, Traffic Management Situations). Unless an accepted safe system of work has been devised.

Access may not have been gained to several areas of the site due to conditions outside the control of the client or contractor, any such areas have been documented within this report (see Daily Record Sheet).

Any diagrams/ CAD drawings in the report are not to be scaled and are illustrative only to indicate approximate locations.

Manhole covers will not be lifted if:

- a) There is a danger of damaging surrounding flooring or finishes.
- b) They are covered, i.e. under fitted carpets, flooring, tiling or paving etc.
- c) Under fittings, fixtures, fencing, equipment etc.

Buried manholes will be located, if possible, position marked. If instructed, excavated in soft ground only up to a depth of 350mm with temporary reinstatement.

No allowance has been made for any precleansing unless stated in the quotation.

Full and free access to all areas affected is to be arranged by the instructing party.

SURVEY TECHNIQUES

The areas set out within the survey brief underwent inspection for a Sewer Condition Inspection Survey each area within the agreed scope of works was surveyed for location extent and condition of foul and/ or surface water drainage systems and CCTV footage gathered for confirmation. Every reasonable effort was made to investigate all aspects of the drainage system. Additional photographs were taken where relevant to the inspection.

There were no deviations from the agreed scope of works.

This Sewer Condition Inspection Survey was carried out in accordance with the Utility Surveys Ltd documented 'in-house' procedure 820 'Code of Working Practice' based on National Sewerage Association guidance. The Sewer Condition Inspection Survey Report states information recorded at the time of survey only, based on visual and CCTV assessment in accordance with sewer classification codings issued by WRC, incorporating the following inspection criteria:

CONDITION of pipe work
LOCATION of pipe work
EXTENT of the pipe work

A defect grade description has been provided for the identification of defective pipe work.

Changes to any of the above criteria shall necessitate the need for reassessment

These gradings and the reports can be used to form the basis of a planned preventative maintenance programme. This can be the subject of further discussions with our technical support team.

Drainage Report



Prepared For

Site

**CHURCHILL RETIREMENT LIVING
CHURCHILL HOUSE
6 CHERTSEY ROAD
BYFLEET
KT14 7AG**

**WOODVILLE PLACE
GRAVESEND
KENT**



UTILITY SURVEYS LIMITED
Surveyor: Simon Gardiner
simon@utilitysurveysltd.co.uk

Total Defects for Project



Total DRB Grades for Project



071416 Woodville Place Gravesend - CCTV Survey Report : 28/11/21

Name :	UTILITY SURVEYS LIMITED
Contact :	SIMON GARDINER
Location :	5 SUFFOLK ROAD
Town :	MALDON
Region :	ESSEX
Postcode :	CM9 6AX
Email :	simon@utilitysurveysltd.co.uk
Contact Number :	
Surveyor :	Simon Gardiner
Valid Certification No :	L1103

Client Information

Name :	CHURCHILL RETIREMENT LIVING
Contact :	CONOR LAVERY
Location :	CHURCHILL HOUSE
Town :	6 CHERTSEY ROAD
Region :	BYFLEET
Postcode :	KT14 7AG
Tel :	01932 338941
Mobile :	
Email :	
Fax :	

Site Information

Name :	
Contact :	
Location :	WOODVILLE PLACE
Town :	GRAVESEND
Region :	KENT
Postcode :	
Tel :	
Mobile :	
Email :	
Fax :	

Total Defects for Project



Total DRB Grades for Project



Report interpretation.

Overview:

Each section of the drainage system is allocated a score indicating areas that require attention. These areas are detailed in the Overview section on the following page and also at the bottom right of the first few pages. We use colour coding as an indicator of severity. Additional information concerning rehabilitation options/recommendations is included in the Overview page, which can also be used as an, "at a glance" indication of system condition. More in depth information for each section, including images can be found later in the report. Grade indicators are as follows:

Grade A: Drain is serviceable no recommendations required

Grade B: There is an issue that might require remedial works

Grade C: There is a defect that requires remedial works, the drain is not serviceable.

Observations:

Each section of drainage reported on (manhole to manhole for example), contains detailed information about that drain and any observations made concerning condition are detailed below the header section. The observations are colour coded and given a severity score, with more significant defects being given a higher score, using a scale from 1 to 5 as detailed below:

Severity 1 to 2: These defects may require remedial monitoring

Severity 3: These defects probably require some form of remedial works

Severity 4 to 5: Defects that will require remedial repair or replacement

General:

The information provided is relevant at the time of survey. The coding system in this report is based on the Manual of Sewer Condition Classification, 5th edition (MSCC5) domestic codes (BS EN 13508-1:2003). This is the official standard for the water industry.

The severity system is based on significant experience in general practice and the 1 -5 grades represent the severity of individual defects: 5 representing a more serious defect.

Please feel free to contact us for further explanation or pricing for remedial works required.

Total Defects for Project



Total DRB Grades for Project



Overview

Section: 1 From: S1 To: MAIN	Grade B	DRB Grade: B Pipe Size: 100 Material: Vitrified Clay (i.e. all clayware) Use: Combined
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Total Defects for Project



Total DRB Grades for Project



Site: WOODVILLE PLACE, GRAVESEND

Section 1

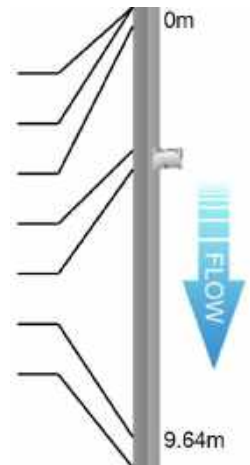
Client: CHURCHILL RETIREMENT LIVING	Location (Street Name): WOODVILLE PLACE	City/Town/Village GRAVESEND	Cust Job Ref.	Surveyors Name: Simon Gardiner	Date: 28/11/2021
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Start Node Ref: S1	Finish Node Ref: MAIN	Direction: D	Height/Dia: 100
Start Node Depth: 0.00	Finish Node Depth: 0.00	Use: C	Shape: C
Start Node Coordinate:	Finish Node Coordinate:	Material: VC	Cleaned N

Node Type	Cover Condition	Benching Condition	1/2 Channel Condition	Node Condition Remarks
MH				

Drain Type	Lining Type	Lining Mat.	Year Const.	Weather	Flow Cont.	Length	General Remarks
A				D	N	9.64	

Position	Code	Description	CD	Pic	Video Ref	
00.00m	MH	Start node type, manhole				
00.00m	WL	Water level 0%			0:00:00	
00.40m	R	S1 Roots	S1		0:00:00	
03.00m	R	F1 Roots	F1		0:00:00	
03.40m	JN	Junction 11 : 100mm Diameter	0_3		0:00:31	
09.00m	LDF	Line of drain/sewer deviates down [full]			0:01:19	
09.64m	WRF	Finish node type, major connection without				



Total Defects for section

DRB Grade for Section



Descriptive Report with Remarks and Observation Images

Section 1

Pos	Video Ref	Code	Description	Image
00.00m		MH	Start node type, manhole S1	
00.00m	0:00:00	WL	Water level: 0% Height/Diameter	
00.40m	0:00:00	S1 R	Roots 0.4m - 3m - Severity 3 FINE ROOTS	
03.00m	0:00:00	F1 R	Roots Defect End - Severity 3 FINE ROOTS	
03.40m	0:00:31	JN	Junction at 11 o'clock: 100mm Diameter	Image Provided - Ref: 0_3 
09.00m	0:01:19	LDF	Line of drain/sewer deviates down [full]	
09.64m		WRF	Finish node type, major connection without manhole JOINS MAIN	

Total Defects for section



DRB Grade for Section

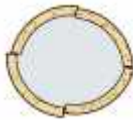


A guide to defects and other observations in drainage systems

More detailed information can be found in the National Standard (BS EN 13508-1:2003) and in the Manual of Sewer Condition Classification (MSCC) 5th Edition, written by the Water Research Centre (WRc).

Use	
Code	Description
C	Combined
F	Foul
S	Surface Water
T	Trade Effluent
W	Culverted Watercourse
Z	Other
Common Materials	
Code	Description
VC	Vitrified Clay
PVC	Polyvinyl Chloride
CO	Concrete
CI	Cast Iron
PF	Pitch Fibre
PE	Polyethylene
DI	Ductile Iron

Start Node	Description	Finish Node
MH	Manhole	MHF
IC	Inspection Chamber	ICF
GY	Gulley	GYF
RE	Rodding Eye	REF
SK	Soakaway	SKF
BN	Buchan Trap	BNF
BR	Major Connection without Ref	BRF
CP	Catch Pit	CPF
OC	Other Special Chamber	OCF
OF	Outfall	OFF
OS	Oil Separator	OSF
WR	Major Connection without mh	WRF
LH	Lamphole	LHF

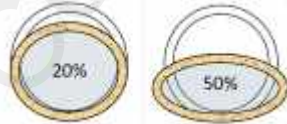
Code	Observation	Description	Attributes	
B	Broken	Pieces pipe have visibly moved	Defined by clock references. Associated with deformity in rigid pipe	
CC CL CM CR	Cracks	Cracks are break lines that are not visibly open	Defined by clock reference position/s. Longitudinal and radiating cracks attract only one clock reference	
CN	Connection	Lateral pipe has been connected after original construction	Described by clock reference position and diameter	

Total Defects for section



DRB Grade for Section

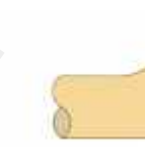
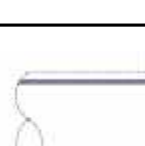
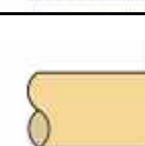
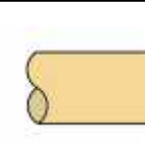
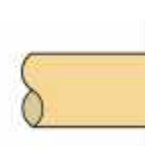
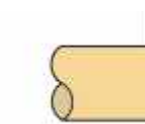


CX(I)	Defective Connection (Intruding)	Defective by intrusion or damage due to factors including: cracks, fractures, obstruction, position etc	Described by clock reference position and diameter (+ % intrusion)	
CU	Loss of Vision	Lens of camera is obscured by debris, water etc. Operator is unable to see drain clearly	'W' can be added if loss of vision is due to water	
D	Deformed	Pipe has lost its structure	Described by percentage loss of height or width. Recorded in 5% increments	
DEE	Deposits Encrustation	Eg. Attached scale deposits evident	Described by clock referenced position and percentage loss of cross-sectional area (5% increments)	
DEG	Deposits Grease	Attached grease deposits evident	Described by clock referenced position and percentage loss of cross-sectional area (5% increments)	
DER DES	Deposits Coarse/Fine	Settled deposits on the invert of the pipe.	Described by percentage loss of height or diameter. Recorded in 5% increments.	
FC FL FM FR	Fractures	Fractures are visibly open. Pieces of pipe have not moved	Defined by clock reference position/s. Longitudinal and radiating fractures attract only one clock reference	
H	Holes	Section of pipe fabric is missing	Defined by clock reference location. Normally two clock references	
I	Infiltration	Water is infiltrating the pipe, normally via a joint but could be via another defect	Can be described in Remarks using terms such as Seeper, Dripper and Runner	
JDL	Joint Displaced Large	Pipe has moved at joint, perpendicular to axis of pipe	More than 1.5 times the pipe wall thickness must be visible	

Total Defects for section

DRB Grade for Section

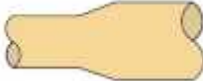


JDM	Joint Displaced Medium	Pipe has moved at joint, perpendicular to axis of pipe	Between 1 and 1.5 times the pipe wall thickness must be visible	
JN	Junction	Lateral pipe was installed at construction	Described by clock reference position and diameter	
JX	Defective Junction	Lateral pipe was installed at construction but is defective in some way	Joint can be defective due to factors including: cracks, fractures, obstruction, position etc	
LD LU LL LR	Line Deviation	LD = Line Down, LU = Line Up, LL = Line Left, LR = Line Right. Not related to CIPP lining.	Additional modifiers are added: Q = Quarter (22.5), H = Half (45), F = Full (90). In degrees.	
LC	Lining Changes	If the drain is lined, the lining material has changed	Position of lining material change	
MC	Material Change	The pipe material has changed	Position of change is noted. Type of material change can be defined	
OB	Obstruction/Obstacle	An obstruction or obstacle is affecting the flow through the pipe	Described in percentage loss of cross-sectional area	
OJL	Open Joint Large	Pipe has moved at joint, along the axis of pipe	More than 1.5 times the pipe wall thickness must be visible	
OJM	Open Joint Medium	Pipe has moved at joint, along the axis of pipe	Between 1 and 1.5 times the pipe wall thickness must be visible	
PC	Pipe Length Changes	Length of individual pipe changes	New length described at this position	

Total Defects for section

DRB Grade for Section



R	Roots	Evidence of root ingress	Roots will normally infiltrate via bad joints, cracks, fractures, breaks etc	
REM	Remark	General remark	Used for additional information	
S	Surface Damage	This might include corrosion, spalling and chemical attack	Position only. Additional information can be added in Remarks	
SA	Survey Abandoned	Used when a survey cannot continue for any reason	The reason for abandoning a survey should be noted in the remarks area	
SC	Shape Changes	Dimension of drain changes	Diameter dimension change recorded. Second dimension is recorded for no circular pipe changes	
SR	Sealing Ring	Sealing ring intrudes into pipe at joint	Described by clock reference position	
V	Vermin	Evidence of Vermin in pipe	Can also be used for evidence within manhole etc	
WL	Water Level	Used to record changes in water level. Always shown at the beginning of every survey, if dry noted as 00.	Described by percentage of height or diameter. Recorded in 5% increments	
XP	Collapsed	Drain is suffering from complete loss of structural integrity. Always followed by SA - Survey Abandoned	Percentage loss of cross-sectional area is recorded. Other related structural defects are not recorded	

REGISTER OF APPENDICES

- A. MANHOLE INSPECTION REPORT
- B. COPIES OF SITE HAND WRITTEN DAILY RECORD SHEETS
- C. ANNOTATED SITE DRAWINGS

UTILITY SURVEYS LTD

5 SUFFOLK ROAD
MALDON
ESSEX
CM9 6AX

LOCATION: WOODVILLE PLACE GRAVESEND KENT

JOB REF: 071416

CLIENT: CHURCHILL RETIREMENT LIVING

DATE: 24/11/2021

MH No. S1 DEPTH. 1.84 COVER. RH CONSTRUCTION. Co Seg REMARKS. ROOTS IN MANHOLE		MH No. F4 DEPTH. COVER. CONSTRUCTION. REMARKS.	COVER BROKEN FULL OF RUBBLE
MH No. S2 DEPTH. 1.01 COVER. RH CONSTRUCTION. Co REMARKS. ROOTS IN MANHOLE		MH No. F5 DEPTH. COVER. CONSTRUCTION. REMARKS.	UNABLE TO LIFT COVER STUCK IN FRAME
MH No. S3 DEPTH. COVER. CONSTRUCTION. REMARKS.	UNABLE TO LIFT COVER STUCK IN FRAME	MH No. F6 DEPTH. 1.24 COVER. RH CONSTRUCTION. Co REMARKS.	
MH No. F1 DEPTH. 0.90 COVER. RH CONSTRUCTION. Co REMARKS. ROOTS IN MANHOLE		MH No. F7 DEPTH. COVER. CONSTRUCTION. REMARKS.	UNABLE TO LIFT COVER STUCK IN FRAME
MH No. F2 DEPTH. 1.37 COVER. RH CONSTRUCTION. Co REMARKS. ROOTS IN MANHOLE		MH No. 6801 DEPTH. 0.60 COVER. SH CONSTRUCTION. Br REMARKS.	SUSPENDED OUTFALL FROM SITE 150Ø SHARP BEND DOWN
MH No. F3 DEPTH. 0.50 COVER. RH CONSTRUCTION. Br REMARKS. ROOTS IN MANHOLE			
KEY: C - Circular S - Square T - Triangular L - Light Duty M - Medium Duty H - Heavy Duty Co - Concrete Br - Brick R - Rectangular			



SITE PHOTO 01



SITE PHOTO 02



SITE PHOTO 03



SITE PHOTO 04



SITE PHOTO 05



SITE PHOTO 06



SITE PHOTO 07



SITE PHOTO 08



SITE PHOTO 09



OUTFALL TO WOODVILLE PLACE MH 6801



POSSIBLE 3 CHAMBER INTERCEPTOR (COVERS BROKEN)



ASSUMED FOUL OUTFALL ROUTE

CCTV Sewer Survey – Daily Record Sheet

Date	24/11/2021	Job No	071416
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Client CHURCHILL RETIREMENT LIVING

Site Address WOODVILLE PLACE

GRAVESEND

KENT

Rig Manager	S. GARDINER	Operative	M. CAMPBELL
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Utility Surveys Ltd

5 Suffolk Road

Maldon

Essex

CM9 6AX

Tel: 07971910370

Manhole		Sewer dia.	Recorded Metreage	Survey Abandoned	Remarks
Start	Finish				
S1	MAD	150	9-64		Soils MAD
TOTAL					

Standing Time	
0	0.00
1	0.00
2	0.00
3	0.00
4	0.00
5	0.00
6	0.00
7	0.00
8	0.00
9	0.00
10	0.00
11	0.00
12	0.00
13	0.00
14	0.00
15	0.00
16	0.00
17	0.00
18	0.00
19	0.00
20	0.00
21	0.00
22	0.00
23	0.00
24	0.00
25	0.00
26	0.00
27	0.00
28	0.00
29	0.00
30	0.00
31	0.00
32	0.00
33	0.00
34	0.00
35	0.00
36	0.00
37	0.00
38	0.00
39	0.00
40	0.00
41	0.00
42	0.00
43	0.00
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45	0.00
46	0.00
47	0.00
48	0.00
49	0.00
50	0.00
51	0.00
52	0.00
53	0.00
54	0.00
55	0.00
56	0.00
57	0.00
58	0.00
59	0.00
60	0.00
61	0.00
62	0.00
63	0.00
64	0.00
65	0.00
66	0.00
67	0.00
68	0.00
69	0.00
70	0.00
71	0.00
72	0.00
73	0.00
74	0.00
75	0.00
76	0.00
77	0.00
78	0.00
79	0.00
80	0.00
81	0.00
82	0.00
83	0.00
84	0.00
85	0.00
86	0.00
87	0.00
88	0.00
89	0.00
90	0.00
91	0.00
92	0.00
93	0.00
94	0.00
95	0.00
96	0.00
97	0.00
98	0.00
99	0.00

Metreage check	X
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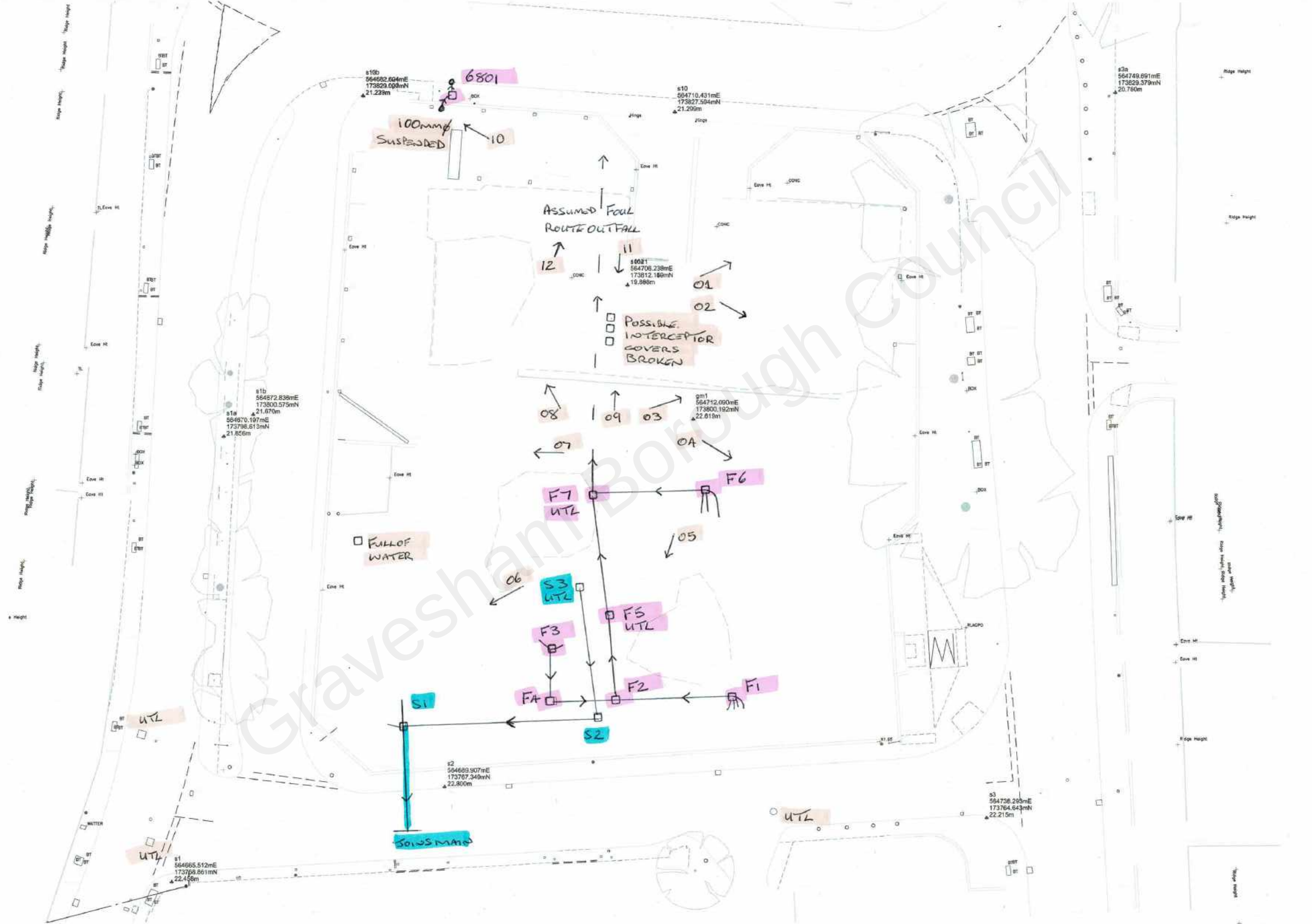
Length	OK
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Reason for standing time

Remarks ASSUMED FOUL SURFACE WATER SYSTEMS PLOTTED
ON DRAWING
SQUATTERS ON SITE IN CABINS
SITE PHOTO'S 1-12 MARKED ON DRAWING
FOUL OUTFALL NOT FOUND

Special Instructions; Site Contact -

Checked





Upper Roof
Catchment:
437m²

Lower Roof
Catchment:
567m²

A	14.07.2022	INITIAL ISSUE	VS	JB	JB
REV	DATE	DESCRIPTION	BY	CHK	APD
DRAWING STATUS:					
FOR INFORMATION ONLY					
CLIENT:					
CHURCHILL RETIREMENT LIVING					
PROJECT:					
WINDMILL STREET, GRAVESEND					
TITLE:					
PRELIMINARY DRAINAGE LAYOUT					
PROJECT No:		DRAWING No:		REV:	
1305		01-SK-1001		A	
SCALE @ A1:					
0 1:100 5 metres					

Colebrook-White Pipe Capacity Analysis

Project No.	1305	
Project Title	Windmill Street, Gravesend	
Client	Planning Issues Ltd	
Sheet Ref	P:\1305 Windmill Street, Gravesend\D Design and Analysis\SPREADSHEETS\01 Drainage\03 Sewer Design\[Colebrook White Equation (pipe velocity & capacity).xlsx]Colebrook-White	

Calcs by	JB
Checked by	CPY
Approved by	CPY
Date	25.02.2022
Revision	DRAFT

Pipe capacity calculation based on the Colebrook White Equation (HR Wallingford, 1990);

$$V = -2\sqrt{(2gDS)} \log_{10} \left(\frac{k_s}{3.7D} + \frac{2.51\nu}{D\sqrt{(2gDS)}} \right)$$

Fluid type:

Surface

Where:

D Pipe diameter
S Hydraulic gradient
k_s Effective pipe roughness
g Gravitational acceleration
ν kinematic viscosity
A Cross-sectional flow area
Q Discharge
V Velocity

1 in

150	mm
100	m/m
0.6	mm
9.81	m/s ²
1.01E-06	m ² /s
0.018	m ²
17.754	l/s
1.00	m/s

Catchment area analysis based on Modified Rational Method equation (HR Wallingford, 1990);

$$Q_{BAR} = 2.78 \cdot i \cdot A$$

Hydrological Region:

7

*see map

Where:

Q_{BAR} Average discharge (l/s)
i Rainfall intensity (mm/hr)
A Catchment area (m²)

i

50.4 mm/hr

*see map

Return Period	2yr	30yr	100yr
Growth Factor (Q/QBAR)	0.88	2.4	3.19
Critical Area (ha)	0.1440	0.0528	0.0397

(area that can freely drain)

Brownfield flow rate analysis based on Modified Rational Method (HR Wallingford, 1990);

	2yr	30yr	100yr	QBAR
Area (ha):	0.100			
BF flow (l/s):	12.33	33.63	44.70	14.01

Foul capacity analysis for dwellings based on Sewers for Adoption (6th Edition);

l/dwelling/day	0.046
No. dwellings served	383
No. dwellings served +10% infiltration	349

Awcock Ward Partnership Consulting Ltd		Page 1
Kensington Court Woodwater Park Pynes Hill Exeter EX2 5TY	1305 - Windmill St, Gravesend CELLULAR TANK lin2yr+40%CC	
Date 21/07/2022 09:21	Designed by JB	
File 1305-SW-101-CELLULAR STRORAGE ...	Checked by CPY	
XP Solutions		Source Control 2018.1

Summary of Results for 2 year Return Period (+40%)

Half Drain Time : 81 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	98.076	0.076	0.0	2.7	2.7	18.3	O K
30 min Summer	98.092	0.092	0.0	3.5	3.5	22.0	O K
60 min Summer	98.100	0.100	0.0	3.9	3.9	24.1	O K
120 min Summer	98.119	0.119	0.0	4.7	4.7	28.5	O K
180 min Summer	98.124	0.124	0.0	4.9	4.9	29.7	O K
240 min Summer	98.124	0.124	0.0	4.9	4.9	29.7	O K
360 min Summer	98.118	0.118	0.0	4.6	4.6	28.3	O K
480 min Summer	98.111	0.111	0.0	4.4	4.4	26.6	O K
600 min Summer	98.104	0.104	0.0	4.1	4.1	24.9	O K
720 min Summer	98.098	0.098	0.0	3.8	3.8	23.5	O K
960 min Summer	98.089	0.089	0.0	3.4	3.4	21.3	O K
1440 min Summer	98.076	0.076	0.0	2.7	2.7	18.4	O K
2160 min Summer	98.066	0.066	0.0	2.1	2.1	15.8	O K
2880 min Summer	98.059	0.059	0.0	1.8	1.8	14.2	O K
4320 min Summer	98.052	0.052	0.0	1.4	1.4	12.4	O K
5760 min Summer	98.047	0.047	0.0	1.2	1.2	11.3	O K
7200 min Summer	98.044	0.044	0.0	1.0	1.0	10.6	O K
8640 min Summer	98.042	0.042	0.0	0.9	0.9	10.0	O K
10080 min Summer	98.040	0.040	0.0	0.9	0.9	9.6	O K
15 min Winter	98.085	0.085	0.0	3.1	3.1	20.4	O K
30 min Winter	98.103	0.103	0.0	4.0	4.0	24.7	O K
60 min Winter	98.112	0.112	0.0	4.4	4.4	26.9	O K
120 min Winter	98.131	0.131	0.0	4.9	4.9	31.4	O K
180 min Winter	98.133	0.133	0.0	4.9	4.9	32.0	O K
240 min Winter	98.130	0.130	0.0	4.9	4.9	31.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	51.827	0.0	18.5	18
30 min Summer	33.269	0.0	24.0	31
60 min Summer	20.383	0.0	30.2	50
120 min Summer	13.832	0.0	41.1	82
180 min Summer	10.636	0.0	47.5	116
240 min Summer	8.699	0.0	51.9	150
360 min Summer	6.423	0.0	57.5	216
480 min Summer	5.120	0.0	61.1	280
600 min Summer	4.278	0.0	63.8	342
720 min Summer	3.687	0.0	66.0	404
960 min Summer	2.909	0.0	69.4	522
1440 min Summer	2.092	0.0	74.8	766
2160 min Summer	1.518	0.0	82.0	1128
2880 min Summer	1.219	0.0	87.7	1500
4320 min Summer	0.913	0.0	98.3	2208
5760 min Summer	0.756	0.0	109.1	2944
7200 min Summer	0.659	0.0	118.9	3680
8640 min Summer	0.593	0.0	128.3	4408
10080 min Summer	0.546	0.0	137.5	5136
15 min Winter	51.827	0.0	20.8	17
30 min Winter	33.269	0.0	27.0	31
60 min Winter	20.383	0.0	33.9	52
120 min Winter	13.832	0.0	46.1	90
180 min Winter	10.636	0.0	53.3	126
240 min Winter	8.699	0.0	58.2	162

Summary of Results for 2 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
360 min Winter	98.119	0.119	0.0	4.7	4.7	28.6	O K
480 min Winter	98.109	0.109	0.0	4.3	4.3	26.1	O K
600 min Winter	98.100	0.100	0.0	3.9	3.9	24.0	O K
720 min Winter	98.093	0.093	0.0	3.6	3.6	22.2	O K
960 min Winter	98.082	0.082	0.0	3.0	3.0	19.7	O K
1440 min Winter	98.069	0.069	0.0	2.3	2.3	16.5	O K
2160 min Winter	98.058	0.058	0.0	1.7	1.7	14.0	O K
2880 min Winter	98.052	0.052	0.0	1.4	1.4	12.4	O K
4320 min Winter	98.044	0.044	0.0	1.1	1.1	10.7	O K
5760 min Winter	98.040	0.040	0.0	0.9	0.9	9.6	O K
7200 min Winter	98.037	0.037	0.0	0.8	0.8	9.0	O K
8640 min Winter	98.035	0.035	0.0	0.7	0.7	8.5	O K
10080 min Winter	98.034	0.034	0.0	0.6	0.6	8.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
360 min Winter	6.423	0.0	64.5	228
480 min Winter	5.120	0.0	68.5	292
600 min Winter	4.278	0.0	71.6	356
720 min Winter	3.687	0.0	74.0	416
960 min Winter	2.909	0.0	77.8	540
1440 min Winter	2.092	0.0	83.8	782
2160 min Winter	1.518	0.0	91.8	1148
2880 min Winter	1.219	0.0	98.3	1504
4320 min Winter	0.913	0.0	110.2	2248
5760 min Winter	0.756	0.0	122.2	2944
7200 min Winter	0.659	0.0	133.2	3744
8640 min Winter	0.593	0.0	143.8	4488
10080 min Winter	0.546	0.0	154.1	5152

Awcock Ward Partnership Consulting Ltd		Page 3
Kensington Court	1305 - Windmill St, Gravesend	
Woodwater Park Pynes Hill	CELLULAR TANK	
Exeter EX2 5TY	1in2yr+40%CC	
Date 21/07/2022 09:21	Designed by JB	
File 1305-SW-101-CELLULAR STRORAGE ...	Checked by CPY	
XP Solutions	Source Control 2018.1	

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	2	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 564711 173793 TQ 64711 73793	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.201

Time (mins)	Area
From:	To: (ha)

0	4 0.201
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Awcock Ward Partnership Consulting Ltd		Page 4
Kensington Court	1305 - Windmill St, Gravesend	
Woodwater Park Pynes Hill	CELLULAR TANK	
Exeter EX2 5TY	1in2yr+40%CC	
Date 21/07/2022 09:21	Designed by JB	
File 1305-SW-101-CELLULAR STRORAGE ...	Checked by CPY	
XP Solutions	Source Control 2018.1	

Model Details

Storage is Online Cover Level (m) 100.000

Cellular Storage Structure

Invert Level (m) 98.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	253.0	0.0	0.500	253.0	0.0	0.501	0.0	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0113-5000-0500-5000
Design Head (m) 0.500
Design Flow (l/s) 5.0
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 113
Invert Level (m) 98.000
Minimum Outlet Pipe Diameter (mm) 150
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.500	5.0	Kick-Flo®	0.372	4.4
Flush-Flo™	0.179	5.0	Mean Flow over Head Range	-	4.1

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)
0.100	3.9	0.800	6.2	2.000	9.6	4.000	13.3	7.000	17.4
0.200	5.0	1.000	6.9	2.200	10.0	4.500	14.1	7.500	18.1
0.300	4.8	1.200	7.5	2.400	10.4	5.000	14.8	8.000	18.7
0.400	4.5	1.400	8.1	2.600	10.8	5.500	15.4	8.500	19.2
0.500	5.0	1.600	8.6	3.000	11.6	6.000	16.1	9.000	19.8
0.600	5.4	1.800	9.1	3.500	12.5	6.500	16.8	9.500	20.3

Awcock Ward Partnership Consulting Ltd		Page 1
Kensington Court	1305 - Windmill St, Gravesend	
Woodwater Park Pynes Hill	CELLULAR TANK	
Exeter EX2 5TY	lin30yr+40%CC	
Date 21/07/2022 09:21	Designed by JB	
File 1305-SW-101-CELLULAR STRORAGE ...	Checked by CPY	
XP Solutions	Source Control 2018.1	

Summary of Results for 30 year Return Period (+40%)

Half Drain Time : 142 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	98.186	0.186	0.0	5.0	5.0	44.8	O K
30 min Summer	98.234	0.234	0.0	5.0	5.0	56.2	O K
60 min Summer	98.270	0.270	0.0	5.0	5.0	65.0	O K
120 min Summer	98.297	0.297	0.0	5.0	5.0	71.4	O K
180 min Summer	98.302	0.302	0.0	5.0	5.0	72.5	O K
240 min Summer	98.299	0.299	0.0	5.0	5.0	71.9	O K
360 min Summer	98.283	0.283	0.0	5.0	5.0	68.0	O K
480 min Summer	98.262	0.262	0.0	5.0	5.0	62.9	O K
600 min Summer	98.240	0.240	0.0	5.0	5.0	57.6	O K
720 min Summer	98.219	0.219	0.0	5.0	5.0	52.6	O K
960 min Summer	98.182	0.182	0.0	5.0	5.0	43.7	O K
1440 min Summer	98.134	0.134	0.0	4.9	4.9	32.1	O K
2160 min Summer	98.105	0.105	0.0	4.1	4.1	25.2	O K
2880 min Summer	98.090	0.090	0.0	3.4	3.4	21.7	O K
4320 min Summer	98.075	0.075	0.0	2.6	2.6	18.0	O K
5760 min Summer	98.066	0.066	0.0	2.1	2.1	15.9	O K
7200 min Summer	98.060	0.060	0.0	1.8	1.8	14.5	O K
8640 min Summer	98.056	0.056	0.0	1.6	1.6	13.5	O K
10080 min Summer	98.053	0.053	0.0	1.5	1.5	12.7	O K
15 min Winter	98.210	0.210	0.0	5.0	5.0	50.4	O K
30 min Winter	98.264	0.264	0.0	5.0	5.0	63.5	O K
60 min Winter	98.307	0.307	0.0	5.0	5.0	73.9	O K
120 min Winter	98.342	0.342	0.0	5.0	5.0	82.2	O K
180 min Winter	98.344	0.344	0.0	5.0	5.0	82.8	O K
240 min Winter	98.338	0.338	0.0	5.0	5.0	81.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	126.825	0.0	46.6	18
30 min Summer	82.092	0.0	60.7	32
60 min Summer	50.579	0.0	75.7	62
120 min Summer	31.133	0.0	93.3	110
180 min Summer	23.098	0.0	103.8	142
240 min Summer	18.544	0.0	111.2	172
360 min Summer	13.437	0.0	120.9	240
480 min Summer	10.611	0.0	127.3	306
600 min Summer	8.805	0.0	132.1	372
720 min Summer	7.546	0.0	135.8	434
960 min Summer	5.896	0.0	141.4	558
1440 min Summer	4.166	0.0	149.8	780
2160 min Summer	2.959	0.0	160.2	1128
2880 min Summer	2.331	0.0	168.2	1496
4320 min Summer	1.680	0.0	181.5	2208
5760 min Summer	1.344	0.0	194.2	2944
7200 min Summer	1.139	0.0	205.7	3672
8640 min Summer	1.001	0.0	216.8	4408
10080 min Summer	0.901	0.0	227.5	5136
15 min Winter	126.825	0.0	52.4	18
30 min Winter	82.092	0.0	68.1	32
60 min Winter	50.579	0.0	84.8	60
120 min Winter	31.133	0.0	104.5	116
180 min Winter	23.098	0.0	116.4	168
240 min Winter	18.544	0.0	124.6	188

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Woodwater Park Pynes Hill	CELLULAR TANK	
Exeter EX2 5TY	1in30yr+40%CC	
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File 1305-SW-101-CELLULAR STRORAGE ...	Checked by CPY	
XP Solutions	Source Control 2018.1	

Summary of Results for 30 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
360 min Winter	98.312	0.312	0.0	5.0	5.0	75.1	O K
480 min Winter	98.280	0.280	0.0	5.0	5.0	67.3	O K
600 min Winter	98.247	0.247	0.0	5.0	5.0	59.3	O K
720 min Winter	98.216	0.216	0.0	5.0	5.0	51.8	O K
960 min Winter	98.164	0.164	0.0	5.0	5.0	39.4	O K
1440 min Winter	98.114	0.114	0.0	4.5	4.5	27.3	O K
2160 min Winter	98.089	0.089	0.0	3.4	3.4	21.3	O K
2880 min Winter	98.076	0.076	0.0	2.7	2.7	18.4	O K
4320 min Winter	98.063	0.063	0.0	2.0	2.0	15.1	O K
5760 min Winter	98.055	0.055	0.0	1.6	1.6	13.3	O K
7200 min Winter	98.051	0.051	0.0	1.4	1.4	12.1	O K
8640 min Winter	98.047	0.047	0.0	1.2	1.2	11.3	O K
10080 min Winter	98.045	0.045	0.0	1.1	1.1	10.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
360 min Winter	13.437	0.0	135.5	264
480 min Winter	10.611	0.0	142.6	334
600 min Winter	8.805	0.0	148.0	402
720 min Winter	7.546	0.0	152.2	464
960 min Winter	5.896	0.0	158.5	580
1440 min Winter	4.166	0.0	167.9	794
2160 min Winter	2.959	0.0	179.4	1144
2880 min Winter	2.331	0.0	188.4	1500
4320 min Winter	1.680	0.0	203.4	2248
5760 min Winter	1.344	0.0	217.5	2992
7200 min Winter	1.139	0.0	230.4	3640
8640 min Winter	1.001	0.0	242.9	4368
10080 min Winter	0.901	0.0	254.9	5096

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XP Solutions	Source Control 2018.1	

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 564711 173793 TQ 64711 73793	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.201

Time (mins)	Area
From:	To: (ha)

0	4 0.201
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XP Solutions	Source Control 2018.1	

Model Details

Storage is Online Cover Level (m) 100.000

Cellular Storage Structure

Invert Level (m) 98.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	253.0	0.0	0.500	253.0	0.0	0.501	0.0	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0113-5000-0500-5000
Design Head (m) 0.500
Design Flow (l/s) 5.0
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 113
Invert Level (m) 98.000
Minimum Outlet Pipe Diameter (mm) 150
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.500	5.0	Kick-Flo®	0.372	4.4
Flush-Flo™	0.179	5.0	Mean Flow over Head Range	-	4.1

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)
0.100	3.9	0.800	6.2	2.000	9.6	4.000	13.3	7.000	17.4
0.200	5.0	1.000	6.9	2.200	10.0	4.500	14.1	7.500	18.1
0.300	4.8	1.200	7.5	2.400	10.4	5.000	14.8	8.000	18.7
0.400	4.5	1.400	8.1	2.600	10.8	5.500	15.4	8.500	19.2
0.500	5.0	1.600	8.6	3.000	11.6	6.000	16.1	9.000	19.8
0.600	5.4	1.800	9.1	3.500	12.5	6.500	16.8	9.500	20.3

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XP Solutions		Source Control 2018.1

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

Half Drain Time : 205 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	98.247	0.247	0.0	5.0	5.0	59.3	O K
30 min Summer	98.314	0.314	0.0	5.0	5.0	75.5	O K
60 min Summer	98.373	0.373	0.0	5.0	5.0	89.7	O K
120 min Summer	98.421	0.421	0.0	5.0	5.0	101.2	O K
180 min Summer	98.433	0.433	0.0	5.0	5.0	104.1	O K
240 min Summer	98.436	0.436	0.0	5.0	5.0	104.8	O K
360 min Summer	98.428	0.428	0.0	5.0	5.0	102.8	O K
480 min Summer	98.409	0.409	0.0	5.0	5.0	98.4	O K
600 min Summer	98.387	0.387	0.0	5.0	5.0	93.0	O K
720 min Summer	98.361	0.361	0.0	5.0	5.0	86.7	O K
960 min Summer	98.309	0.309	0.0	5.0	5.0	74.3	O K
1440 min Summer	98.226	0.226	0.0	5.0	5.0	54.4	O K
2160 min Summer	98.150	0.150	0.0	5.0	5.0	36.0	O K
2880 min Summer	98.117	0.117	0.0	4.6	4.6	28.1	O K
4320 min Summer	98.092	0.092	0.0	3.5	3.5	22.0	O K
5760 min Summer	98.079	0.079	0.0	2.8	2.8	19.0	O K
7200 min Summer	98.071	0.071	0.0	2.4	2.4	17.1	O K
8640 min Summer	98.065	0.065	0.0	2.1	2.1	15.7	O K
10080 min Summer	98.061	0.061	0.0	1.9	1.9	14.7	O K
15 min Winter	98.277	0.277	0.0	5.0	5.0	66.7	O K
30 min Winter	98.355	0.355	0.0	5.0	5.0	85.2	O K
60 min Winter	98.422	0.422	0.0	5.0	5.0	101.4	O K
120 min Winter	98.478	0.478	0.0	5.0	5.0	115.0	O K
180 min Winter	98.496	0.496	0.0	5.0	5.0	119.1	O K
240 min Winter	98.496	0.496	0.0	5.0	5.0	119.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	165.812	0.0	61.3	18
30 min Summer	108.215	0.0	80.3	33
60 min Summer	67.184	0.0	100.7	62
120 min Summer	41.353	0.0	124.1	120
180 min Summer	30.929	0.0	139.2	168
240 min Summer	25.051	0.0	150.4	196
360 min Summer	18.438	0.0	166.1	260
480 min Summer	14.682	0.0	176.4	328
600 min Summer	12.243	0.0	183.8	398
720 min Summer	10.523	0.0	189.6	464
960 min Summer	8.245	0.0	198.1	590
1440 min Summer	5.818	0.0	209.5	836
2160 min Summer	4.102	0.0	222.2	1168
2880 min Summer	3.206	0.0	231.4	1500
4320 min Summer	2.269	0.0	245.4	2208
5760 min Summer	1.786	0.0	258.2	2944
7200 min Summer	1.493	0.0	269.7	3672
8640 min Summer	1.296	0.0	280.8	4408
10080 min Summer	1.154	0.0	291.4	5136
15 min Winter	165.812	0.0	68.8	18
30 min Winter	108.215	0.0	90.1	32
60 min Winter	67.184	0.0	112.8	62
120 min Winter	41.353	0.0	139.0	118
180 min Winter	30.929	0.0	156.0	172
240 min Winter	25.051	0.0	168.5	222

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XP Solutions	Source Control 2018.1	

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
360 min Winter	98.483	0.483	0.0	5.0	5.0	116.1	O K
480 min Winter	98.457	0.457	0.0	5.0	5.0	109.9	O K
600 min Winter	98.426	0.426	0.0	5.0	5.0	102.3	O K
720 min Winter	98.391	0.391	0.0	5.0	5.0	94.0	O K
960 min Winter	98.312	0.312	0.0	5.0	5.0	75.1	O K
1440 min Winter	98.193	0.193	0.0	5.0	5.0	46.4	O K
2160 min Winter	98.116	0.116	0.0	4.6	4.6	28.0	O K
2880 min Winter	98.095	0.095	0.0	3.7	3.7	22.9	O K
4320 min Winter	98.076	0.076	0.0	2.7	2.7	18.2	O K
5760 min Winter	98.066	0.066	0.0	2.1	2.1	15.7	O K
7200 min Winter	98.059	0.059	0.0	1.8	1.8	14.2	O K
8640 min Winter	98.055	0.055	0.0	1.5	1.5	13.1	O K
10080 min Winter	98.051	0.051	0.0	1.4	1.4	12.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
360 min Winter	18.438	0.0	186.1	278
480 min Winter	14.682	0.0	197.6	354
600 min Winter	12.243	0.0	206.0	432
720 min Winter	10.523	0.0	212.4	506
960 min Winter	8.245	0.0	221.9	636
1440 min Winter	5.818	0.0	234.8	866
2160 min Winter	4.102	0.0	248.9	1164
2880 min Winter	3.206	0.0	259.3	1504
4320 min Winter	2.269	0.0	275.0	2208
5760 min Winter	1.786	0.0	289.2	2936
7200 min Winter	1.493	0.0	302.1	3648
8640 min Winter	1.296	0.0	314.6	4408
10080 min Winter	1.154	0.0	326.5	5096

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File 1305-SW-101-CELLULAR STRORAGE ...	Checked by CPY	
XP Solutions	Source Control 2018.1	

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 564711 173793 TQ 64711 73793	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.201

Time (mins)	Area
From:	To: (ha)

0	4 0.201
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XP Solutions	Source Control 2018.1	

Model Details

Storage is Online Cover Level (m) 100.000

Cellular Storage Structure

Invert Level (m) 98.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	253.0	0.0	0.500	253.0	0.0	0.501	0.0	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0113-5000-0500-5000
Design Head (m) 0.500
Design Flow (l/s) 5.0
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 113
Invert Level (m) 98.000
Minimum Outlet Pipe Diameter (mm) 150
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.500	5.0	Kick-Flo®	0.372	4.4
Flush-Flo™	0.179	5.0	Mean Flow over Head Range	-	4.1

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)
0.100	3.9	0.800	6.2	2.000	9.6	4.000	13.3	7.000	17.4
0.200	5.0	1.000	6.9	2.200	10.0	4.500	14.1	7.500	18.1
0.300	4.8	1.200	7.5	2.400	10.4	5.000	14.8	8.000	18.7
0.400	4.5	1.400	8.1	2.600	10.8	5.500	15.4	8.500	19.2
0.500	5.0	1.600	8.6	3.000	11.6	6.000	16.1	9.000	19.8
0.600	5.4	1.800	9.1	3.500	12.5	6.500	16.8	9.500	20.3



Surface Water Strategy:

1. Surface Water Discharge

Proposed private surface water to discharge to a new manhole connection on Southern Water Storm Sewer beneath Wrotham Road at peak flow rate of 5.0 l/s. Subject to capacity check.

2. Flow Control

Gravity vortex flow control to discharge at 5.00 l/s. Controlled flows are to Southern Water adapted surface water network in Wrotham Road.

3. Cellular Attenuation

Cellular tank to receive flows from external hard paving and roof catchments. Chambers immediately upstream of tank to include silt traps.

4. Maintenance

Geocellular Attenuation Tank to be fitted with access turrets for maintenance of feature. Minimum 1no. cover to be vented in accordance with manufacturer recommendations.

5. Exceedance flows

Beyond the capacity of the proposed surface water network and attenuation, exceedance flows would be directed away from the proposed building and towards areas of landscaping, and/or car parking, wherever possible. Beyond the capacity of the site, flows would continue north on to Woodville Place as per existing conditions.

6. Access and Parking Areas

Parking spaces 4-8: 42.50m² 0.5m depth
Parking spaces 9-15: 87.50m² 0.5m depth
Parking spaces 16-21: 74.50m² 0.5m depth
Parking spaces 22-24: 37.50m² 0.5m depth
Permeable access: 33.86m² 0.5m depth
Impermeable area: 281.77m²

Foul flows generated by the proposed site to connect to the existing adopted foul sewer network in Woodville Place, via on-site connection. If necessary a new connection at an appropriate invert could be required. Position and invert the existing on-site foul connection to be confirmed.
Alternative foul connection to existing public foul network to east may be possible.
Connections subject to capacity checks with Southern Water.

Key:

Existing drainage:

- Site Boundary
- Surface Water Sewer
- Foul Water Sewer
- Foul Water Chamber
- Surface Water Chamber

Proposed drainage:

- Building Impermeable Catchment
- Hardstanding Impermeable Catchment
- Cellular Storage Tank
- Surface Water Sewer
- Foul Water Sewer
- Private Surface Inspection Chamber
- Private Foul Inspection Chamber
- Flow Control Chamber
- Private Surface Water Manhole
- Overland Flood Flow Route

Area Summary Schedule

Net Developable Area	0.362 ha
Impermeable Catchment	0.201 ha

Pre-Development Runoff

The greenfield runoff rates have been assessed for the 'net developable area' using the CP-SuS3 Method. The calculation excludes large areas of open space which will remain undeveloped.

The brownfield runoff rates have been assessed, using the Modified Rational Method, for a contributing area (0.1ha) that is considered likely to discharge to the existing drainage network on site. Figure in brackets indicate limit of terminal discharge from site connection to adopted off-site network.

Return Period	Greenfield Rate	Brownfield Rate
1yr	0.7 l/s	12.33 l/s
30yr	1.8 l/s	33.43 l/s (17.75 l/s)
100yr	2.6 l/s	40.70 l/s (17.75 l/s)

Attenuation Summary

Cellular Storage Tank

Catchment	0.201 ha
Hydrobroke limited to 5.0 l/s @ 0.5m head	
Ref: MD-SHE-0113-5000-0500-5000	
Porosity	92%
Dimension	Tank 22m X 11.5m X 0.5m deep

Total 100yr+40% Volume 119.1m³

Total 100yr+40%CC Discharge: 5.0 l/s

Notes:

- The proposed development has been assessed in line with the National Planning Policy Framework, to allow the planning application to be progressed and to show that the development can be undertaken in an acceptable manner from a flood risk perspective.
- The proposed development is located within Flood Zone 1 and is not known to be susceptible to flooding from pluvial, groundwater, infrastructure or artificial sources.
- To ensure the development is safe throughout its lifetime, the surface water strategy accounts for runoff in up to the 1 in 100 year return period.
- The strategy also safeguards against climate change (40%), providing betterment over existing conditions, where the rate and volume of runoff would continue to increase due to climate change.
- The existing ground conditions may be susceptible to solution features and therefore advice indicates drainage strategies should consider discharges other than by infiltration.
- Storm water runoff will be attenuated on-site and will discharge via a new connection to the existing Southern Water surface water sewer beneath Wrotham Road.
- The impermeable drained catchment is not being increased by the development, meaning Long Term Storage is not required.
- The proposed surface water outfall is to discharge into the SW public surface water beneath Wrotham Road, given no practicable alternatives are nearby.
- Surface water flows will be stored in an attenuation tank upstream of a gravity vortex control limited to 5.0 l/s. This provides 72% betterment compared to existing 1 in 1 year brownfield conditions and thereby exceeds the 50% requirement, outlined within the KCC design guidance.
- The attenuation tank will be provided with upstream silt traps to mitigate against siltation.
- Beyond the 100-year critical storm, exceedance runoff will be directed towards any residual areas of open space and/or car parking, where any above ground storage can be utilised.
- Foul flows generated by the proposed development will be served by a new private gravity network, with existing connections to the Southern Water foul sewer to be prioritised for re-use.
- All on-site proposed drainage will remain private and will be designed in accordance with Building Regulations Part H and CIRIA C753 and will become the responsibility of the building operator or appointed management company.
- As the development will be safe from flooding throughout its lifetime and will actively reduce the flood risk to properties within the downstream catchment, it is recommended that the Local Planning Authority confirm they have no objections to the proposed development.

C	12.08.2022	UPDATED TO INCLUDE PERMEABLE PAVING AND TANK BASED ON FEH RAINFALL	VS	JB	CPY
B	12.04.2022	UPDATED TO SUIT CLIENTS LATEST LAYOUT	RF	JB	CPY
A	15.03.2022	INITIAL ISSUE	VS	JB	CPY
REV	DATE	DESCRIPTION	BY	CHK	APD

DRAWING STATUS: **PLANNING APPLICATION**

CLIENT: **CHURCHILL RETIREMENT LIVING**

PROJECT: **WINDMILL STREET, GRAVESEND**

TITLE: **PRELIMINARY DRAINAGE LAYOUT**

PROJECT No:	DRAWING No:	REV:
1305	01-PDL-1001	C

SCALE @ A1: 0 1:200 10 metres

DESIGN BY:

Awcock Ward Partnership, Ada House, Pynes Hill, Exeter, EX2 3TU
Tel: 01392 409007 Web: www.awpexeter.com