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CRAMPTONS ROAD, SEVENOAKS, KENT, TN14 5ES
PLANNING APPLICATION - MARCH 2021

SGN Place

whitby wood

Sevenoaks Gasholder Site

Drainage Strategy

Project No: P450483

P450483-REP-006 rev 02

19/03/21

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PREFACE

The following report has been prepared by our partner organisation Cube for the use of Kin Developments.

This report should be read in conjunction with the Architect's, Building Services Engineer's and all other consultant reports, who are engaged in the project. This report is for the exclusive use of Kin Developments and should not be used in whole or in part by any 3rd parties without the express permission in writing of Whitby Wood.

CUBE
CONSULTING ENGINEERS

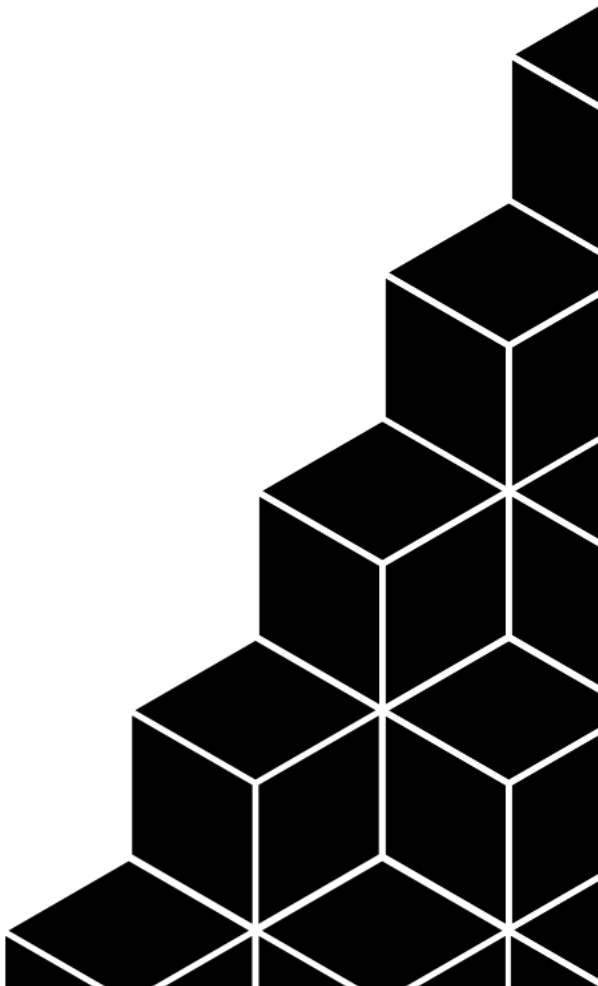
Sevenoaks Gas Holders

Drainage Strategy

Project No.: 1020
Document Ref: 1020-C-RP-0100
Issue: P02
Date: 19/03/2021

Prepared in partnership with

whitby wood



Sevenoaks Gas Holders
Drainage Strategy

QUALITY CONTROL

ISSUE:	DATE:	PREPARED:	CHECKED:	APPROVED:	COMMENTS:
P01	12/03/21	AOR	AP	AP	
P02	19/03/21	AOR	AOR	AP	

CONTENTS

EXECUTIVE SUMMARY

This report has been prepared for Kin Developments and outlines the proposed drainage strategy for the development the Sevenoaks Gas Holders. This document has been prepared to support the planning application for the development.

An existing surface water field drain has been located to the north west of the site which connects to the River Darent downstream. It is proposed to discharge the surface water at a restricted Qbar greenfield rate into this watercourse via gravity. There is evidence of a historic headwall at the head of the drainage ditch, from the evidence available this has been recently removed (before 2018). The ownership of the drainage ditch is yet to be confirmed and therefore the feasibility of this connection is to be confirmed. Should connection to this watercourse be shown not to be feasible then the next acceptable solution would be a connection to adjacent public sewerage.

The TW asset records for the area show that there is a 225mm diameter surface water sewer located in Crampton's Road to the east of the site. It would therefore be proposed to discharge the surface water to the Crampton's Road Surface water sewer at a restricted rate.

The onsite drainage network has been designed to manage all surface water runoff up to and including the 100year plus 40% climate change on site with no flooding. The surface water management system will include Greenroofs, permeable paving and below ground cellular attenuation tanks providing water quality and biodiversity benefits as well as water quantity management.

INTRODUCTION

Cube Consulting Engineers on behalf of Whitby Wood have been appointed to undertake this Drainage Strategy for the Sevenoaks Gas Holders development on behalf of Kin Developments. The purpose of this document is to support the planning application for the Sevenoaks Gas Holders.

This Drainage Strategy has been produced in line with the requirements of the National Planning Policy Framework (NPPF) and the London Plan. In addition to these the following documents, polices and resources have been used to inform this document:

- The Kent County Council (KCC) Strategic Flood Risk Assessment;
- The Kent County Council (KCC) Drainage and Planning Policy; and
- The Sevenoaks Surface Water Management Plan.

This Drainage Strategy makes partial use of third party information and may contain Google maps, Environment Agency, BGS and Defra copyright information.

EXISTING SITE

OVERVIEW

The site is known as the Sevenoaks Gas Holders and is a Brownfield site at the location of the former Gas Holders north of the town centre in Sevenoaks, Kent. The site area is approximately 0.91ha, historically it was occupied by 2no. gas holders (which have now been demolished), several existing buildings and hard paved car parks. The extent of the site boundary in red can be seen in the figure below. The site is bounded to the east by Crampton's Road, to the west by Otford Road and to the south by large commercial units.

The site is situated at:

- National Grid Reference: TQ528571
- OS Grid Reference: E552850, N157150
- Nearest Postcode: TN14 5DY

The existing site topography slopes relatively steeply from the South East to the North West with levels between 68 to 72.5m above ordinance datum. This would equate to an average slope of 1:28 across the site.

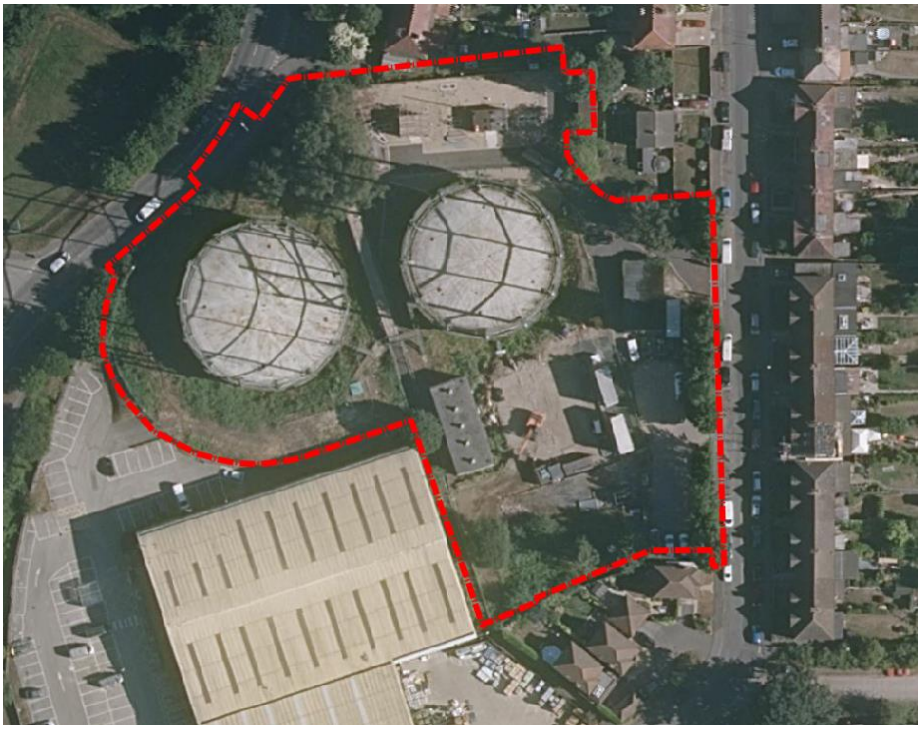


Figure 1 - Proposed Site

GEOLOGY AND HYDROGEOLOGY

The geology and hydrogeology of the site has been informed by mapping from the British Geological Survey (BGS) and historic site investigations. The BGS indicates that for the site the bedrock geology is Folkstone Sandstone Formation with no data on the superficial deposits.

Several historical site investigation reports have also been reviewed which indicate that the site has the following soil strata. Made Ground has been identified at variable depths across the site up to 4.2m below ground level comprising sandy, gravelly clay or clayey sand. This made ground is underlain by Gault Clay

which overlies the Folkestone Beds. The southern part of the site is directly underlain by the Folkestone Beds.

EXISTING FOUL WATER DRAINAGE

The site has been historically used as a gas holder site with ancillary buildings. The underground utility services layout survey undertaken by Intersect surveys in September '20 indicates some existing foul water on site. The survey shows an existing foul water manhole and connection to the Thames Water sewer in Crampton's Road. There is limited information on this connection however it is assumed that this is related to toilet(s) on the historic gas holders site. It is therefore expected that the existing foul water flows from the site are negligible.

The Thames Water (TW) asset records, extracted in Figure 2, indicate that there are public foul water sewers located in Crampton's Road and Otford Road (300mm diameter). The asset records indicate that the 225mm diameter sewer in Crampton's Road has an invert level of 69.54mAOD (1.82mbgl) and the 300mm diameter sewer in Otford Road has an invert level of 66.55mAOD (1.4mbgl).

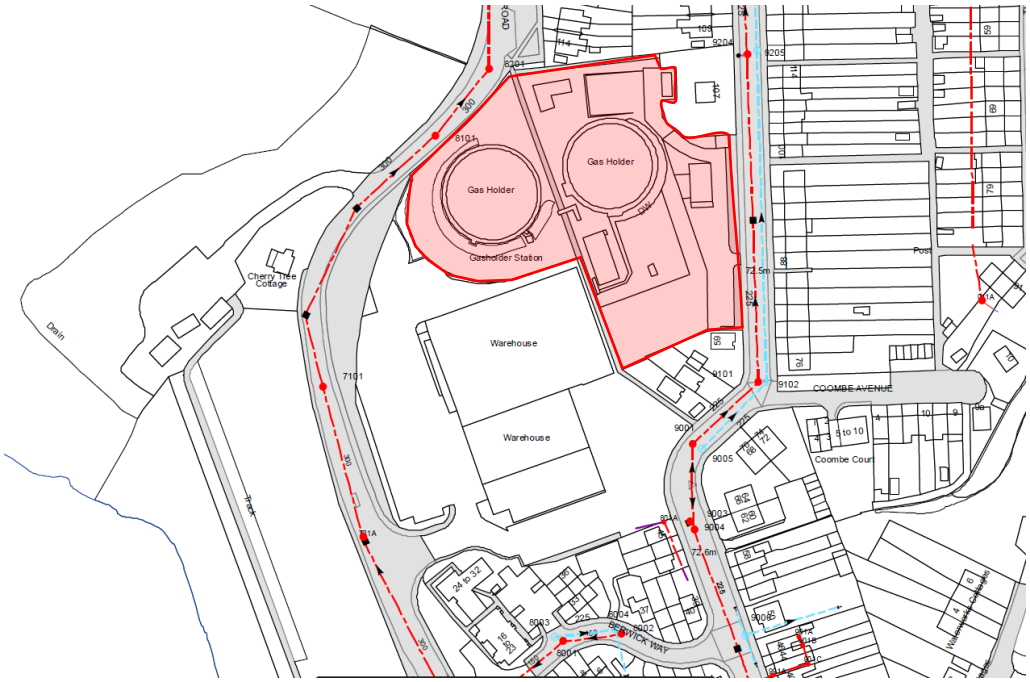


Figure 2: Extract of Thames Water Asset Records

EXISTING SURFACE WATER DRAINAGE

Existing Surface Water Network

While there is limited information available there is evidence of piped surface water drainage on site and therefore it is assumed that the site is drained by an existing surface water drainage system, prior to discharging to the Thames Water foul water public sewer system in Otford Road (based on site levels). This understanding is based on the GPR survey provided by Intersect surveys dated September 2020. The GPR survey indicates that there is an existing soakaway on site however this is shown serving an offsite highway gully only and subject to confirmation.

Existing Surface Water Discharge Rates

The existing surface water discharge rates have been calculated using MicroDrainage and are shown in Table 1. The existing site appears to be circa 80% hardstanding and so the existing discharge rates have been calculated on this basis.

RETURN PERIOD	HARDSTANDING AREA	PEAK DISCHARGE RATE
1 in 1 year	7,800m^2	100l/s
1 in 30 year	7,800m^2	270l/s
1 in 100 year	7,800m^2	351l/s

Table 1: Existing Surface Water Discharge Rates

PROPOSED DRAINAGE STRATEGY

DEVELOPMENT PROPOSALS

The proposed development includes 136no. 1-3 bed residential units in a mix of townhouses and low-rise apartment blocks. The site includes approximately 7,120m^2 of building and hardstanding areas, this represents approximate 78% of the total site area, a reduction on the existing.

FOUL WATER DRAINAGE

Drainage Design Parameters

The below ground foul water drainage system will be designed in accordance with Design and Construction Guidance for foul and surface water sewers or "the Code", BS EN 752 Parts 3 & 4, and Building Regulations Approved Document H.

Proposed Foul Water Discharge

The proposed development includes 136no. 1-3 bed residential properties with associated hardstanding areas. The foul water discharge rate has been calculated assuming a peak residential discharge rate of 4000l/unit/day in accordance with "the Code".

DISCHARGE POINT	NO. OF UNITS	PEAK DISCHARGE RATE
Crampton's Rd	10	0.46l/s
Otford Rd	121	5.60l/s
Total	136	6.06l/s

Table 2: Proposed Foul Water Discharge Rate

A pre-planning enquiry has been submitted to Thames Water; TW have confirmed that there is sufficient capacity within the public sewerage network to accommodate the discharge from development with the split indicated.

Proposed Foul Water Drainage Strategy

The foul water drainage strategy is to collect foul water in the internal landscaped area in a piped system and convey it to two connections to Thames Water sewer. It is currently proposed to discharge foul water under gravity however this is subject to confirmation by a CCTV drainage survey. The proposed connection to Otford road will be with a new junction connection and with the Crampton's Road connection reusing the existing if feasible, this is subject to a connection agreement with Thames Water.

The proposed foul water discharge rate is 6.06l/s as per the calculations outlined in the section above.

SURFACE WATER DRAINAGE

Drainage Design Parameters

The below ground surface water drainage system will be designed in accordance with local policy, local Sustainable Drainage System (SuDS) guidance, national standards and best practice. Industry standards along with the Environment Agency and Design and Construction Guidance for foul and surface water sewers or "the Code" dictate that for below ground surface water systems:

- The system should not surcharge for a 1 in 2 year storm event;
- The system should not flood any part of the site in a 1 in 30 year storm event; and
- Controlled flooding of the site is permitted in a 1 in 100 year storm event including a climate change allowance provided the flood water is contained within the site and does not affect the safe ingress and egress from the site.

The Environment Agency have completed an assessment of the impacts of Climate Change on peak rainfall intensity for small catchments (less than 5km^2). These are summarised in Table 3 extracted from EA guidance 'Flood Risk Assessments: Climate Change allowances' issued on 19th February 2016 with subsequent revisions.

APPLIES ACROSS ALL OF ENGLAND	TOTAL POTENTIAL CHANGE FOR '2020S' (2015 TO 2039)	TOTAL POTENTIAL CHANGE FOR '2050S' (2040 TO 2069)	TOTAL POTENTIAL CHANGE FOR '2080S' (2070 TO 2115)
Upper End	10%	20%	40%
Central	5%	10%	20%

Table 3: Peak rainfall intensity climate change allowances

A typical lifespan for a new development is 100years, under national and local policy this development will be assessed against a 1 in 100year storm event including a 40% climate change allowance using FEH rainfall.

Surface Water Disposal Hierarchy

In accordance with Building Regulations part H, all drainage strategies should manage surface water discharge based on the following hierarchy:

1. Infiltration or a soakaway on site;
2. Discharge to a watercourse; or
3. Discharge to a sewer.

Infiltration

There is some evidence on the GPR survey that there is an existing soakaway on site, this soakaway apparently serves an offsite highway gully only, this is subject to confirmation. This indicates that infiltration may be feasible on site, however an assessment of the pollution risks posed by infiltration suggests that this is not a viable solution. The site has historically been used as a gas storage depot and has large areas of made ground which has been shown to include contaminated soil posing a contamination risk. The site is underlain by the Folkstone formation indicating that infiltration may be feasible however the site is located within a Source Protection Zone 1 with multiple abstraction points within 500m of the site. On the basis of a sensitive receptor and high risk of water contamination at source it is deemed that infiltration is not a suitable approach for the development.

Watercourse

The nearest watercourse to the development is the River Darent which is situated circa 1km north west of the site. Some localised mapping does however indicate that there is a surface water field drain which connects to this watercourse on the opposite side of Otford Road. A review of historic site photos indicate that a brick headwall was previously located at the head of this watercourse suggesting that the watercourse received surface water flows from the surrounding area. It does however appear that this headwall has subsequently been removed as shown in Figure 4.

Figure 3: Google Streetview image dated October 2009

Figure 4: Google Streetview image dated June 2018

Unfortunately, it has not been possible to capture any more recent images and therefore the current status of the watercourse and headwall is unknown. Should it be practicable to make a new connection to this drain then this would be the preferred discharge point. This drain is not identified as a major watercourse and therefore is not managed by the EA, it is expected to fall within the Lead Local Flood Authority (LLFA) remit with various riparian owners. Assuming that the LLFA confirm that a connection can be made to this watercourse this will be the proposed outfall location and is shown on the attached drawing 1020-C-DR-0100. Should a new outfall to this drain not be feasible then a new outfall would be required into the River Darent, this would require a large amount of new public infrastructure in the public highway and on third party land. This is unlikely to be commercially viable location to discharge surface water for the development and therefore is deemed not feasible.

Sewer

Should the proposed water course be deemed not feasible then the next acceptable solution would be a connection to adjacent public sewerage. It is understood that the site currently discharges into the Thames Water (TW) combined sewer in Otford Road. The TW asset records for the area show that there is a 225mm diameter surface water sewer located in Crampton's Road to the east of the site. Due to the topography of the area the invert level of this sewer is higher than the low point of the site. On this basis a gravity connection is not possible should the discharge rate be restricted to a very low rate. On this basis should a sewer connection be required then the surface water runoff from the site will be collected and pumped at a restricted rate to a demarcation chamber before gravity discharge into the TW surface water sewer.

A pre-planning enquiry has been submitted to Thames Water to confirm that the proposed discharge to the public sewer is acceptable at a restricted rate should other alternative disposal methods such as infiltration and discharge to a watercourse be shown not to be feasible. Refer to Appendix B for correspondence.

Proposed Surface Water Discharge

In accordance with the NPPF, London Plan and the local planning policy it is proposed to restrict the surface water discharge rate for the development to greenfield run-off rates. The greenfield runoff rates have been calculated using the HR Wallingford UKSuDS greenfield runoff rate tool, these are summarised in

Table 4.

RETURN PERIOD	HARDSTANDING AREA	GREENFIELD RUNOFF
1 in 1 year	9,100m^2	4.03l/s
Qbar	9,100m^2	4.74l/s
1 in 30 year	9,100m^2	10.9l/s
1 in 100 year	9,100m^2	15.12/s

Table 4: Greenfield Runoff Rates

In accordance with the KCC Drainage and Planning Policy as the site is previously developed 'brownfield' land the peak runoff rate from the development must be as close to the greenfield runoff rate as reasonably practicable for the same rainfall event. As it is not possible to restrict the volume of run off the outflow for the site should be restricted to Qbar for all rainfall events. To achieve a significant betterment for the area, should a gravity connection be feasible to the adjacent water course, it is proposed to control all storms to the Qbar Greenfield runoff rate of 4.7l/s via a hydrobrake flow control device. Due to the capacity of the Thames Water sewer should a sewer connection be required then the surface water will be discharged at a restricted rate via a pump flow control into the TW surface water sewer.

Proposed Surface Water Drainage Strategy

A detailed hydraulic model of the development has been produced using the Microdrainage modelling software, this model indicates that approximately 650m^3 for a restricted discharge rate of 4.7l/s for an impermeable area of 7120m^2.

Due to the significant level change and building density of the development the options for SuDS are limited. Due to the high volume of attenuation required the majority of attenuation will be provided using below ground cellular attenuation tanks. However, the development will also include extensive use of Greenroofs and permeable paving which will provide ecological and water quality benefits as well as providing interception and retention of surface water. The existing site is primarily hardstanding with limited landscaping, the proposals include areas of high quality landscape which will reduce the total runoff volume as well as providing biodiversity and amenity benefits.

The proposed below ground surface water drainage will be designed to accommodate a 1 in 100-year storm event + 40% climate change and therefore will protect the proposed development from the risk of surface water flooding. All surface water runoff will be managed onsite and stored in attenuation before being discharged into the nearby watercourse at a reduced rate via a new connection.

OVERLAND FLOW AND EXCEEDANCE

The hardstanding landscaped areas of the site will be constructed of permeable paving and therefore any overland flows which may occur on the site due to failure or blockage of the drainage system will enter the network in a different location by percolating through the surface. In an exceedance event or offsite infrastructure block surface water will surcharge at the low point of the site. This is located to the north west of the development, any exceedance flows will then drain into Otford Road away from the habitable areas of the site.

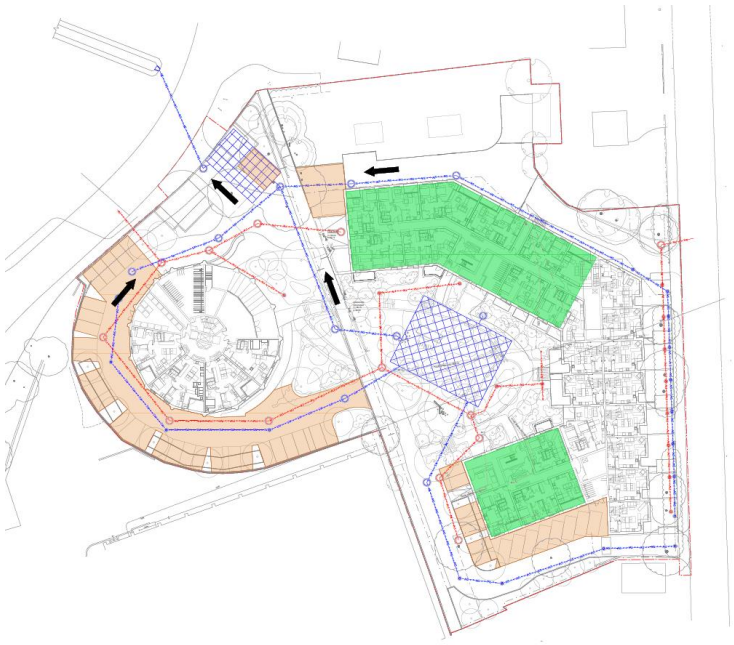


Figure 5: Overland Flow Paths

OFFSITE IMPACT

The proposed surface water drainage strategy outlined in this document demonstrates that the proposed drainage network included in the development will manage all surface water run off during events up to and including the 100 year return period storm including the upper end allowance for climate change. This represents an improvement in surface water management on the site. The discharge from site will be restricted to greenfield runoff rates for all storms up to and including the 100year plus climate change storm. It is understood that the site currently discharges at an unrestricted rate imparting significant hydraulic load to the surrounding infrastructure. As such, it is expected that the proposed development will have a positive impact on surface water flooding offsite reducing the surface water flood risk to downstream properties.

SUSTAINABLE DRAINAGE SOLUTIONS

CELLULAR ATTENUATION TANK

Cellular attenuation storage tanks are used to create a below ground void space for the temporary storage of surface water. These are comprised of structural plastics, usually polypropylene, and have a void ration of 95-96%. Various products are available on the market which can accommodate various vertical and lateral loading which are suitable for under vehicular loaded areas, public realm areas or landscaped areas. The inherent flexibility in size and shape means that they can be tailored to suit specific site characteristics and constraints. Tanks can be wrapped in geomembrane to create a sealed storage only system or can be wrapped in geotextile to allow for infiltration into the ground. Cellular attenuation tanks can be used below pervious surfacing systems to increase the storage volume ratio of these SuDS.

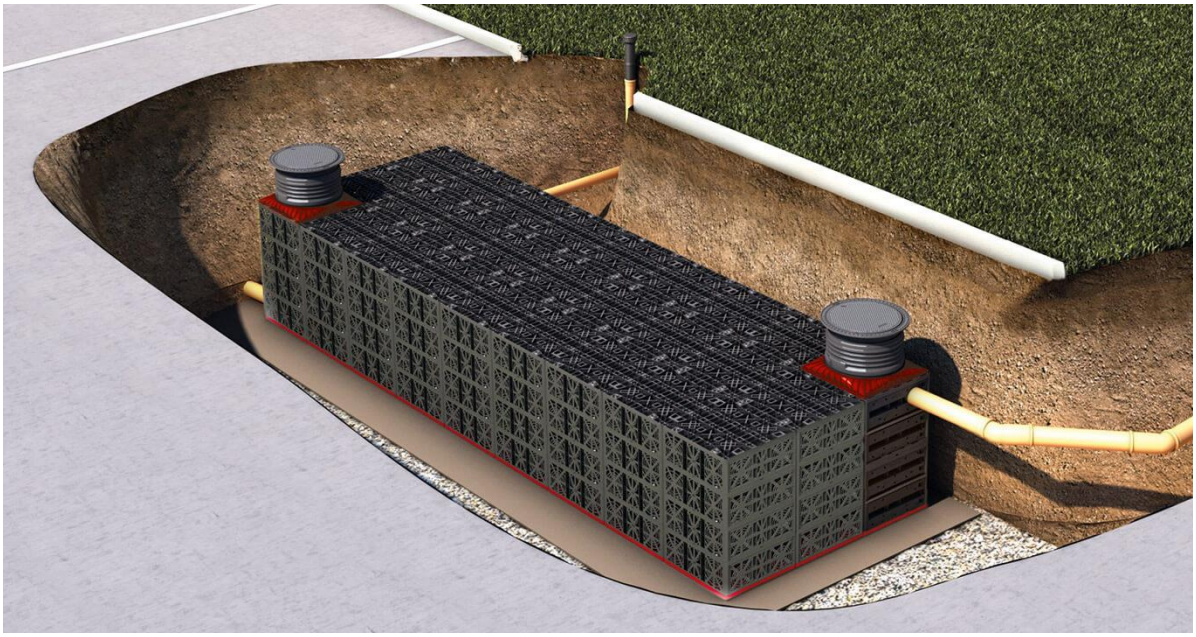


Image courtesy of graf-water.co.uk

ADVANTAGES:	High storage volume ratio, can be used under public realm areas, can be used below traffic areas, minimal maintenance.
DISADVANTAGES:	Cost of excavation, limited water quality treatment.
WATER QUALITY:	Low removal of suspended solids.

PERMEABLE PAVING

Pervious pavements provide a hardstanding area suitable for pedestrian and/or vehicular traffic. The surface allows rainwater to percolate down between the paving block units which have been designed with nibs to provide a rigid finish while providing adequate gaps for infiltration. The sub-base of the permeable paving is graded to include no fines which provides a void ratio for temporary water storage. Permeable paving can be be provide with a geomembrane below the system to create a sealed storage volume or a permeable geotextile can be used below the system to allow for infiltration into the ground.

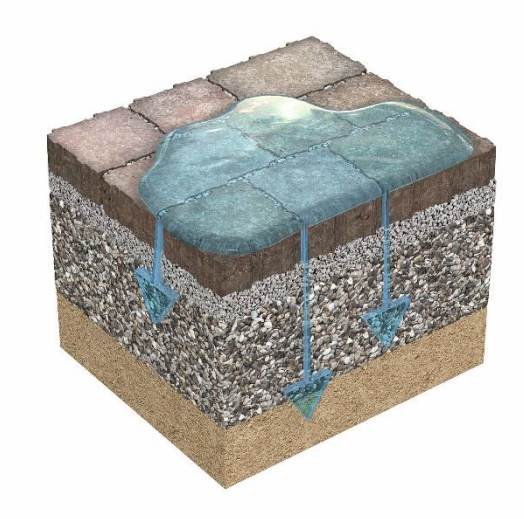


Image courtesy of Marshalls

ADVANTAGES:	Good storage volume ratio, can be used under public realm areas, can be used below traffic areas, can be used for infiltration or as a lined storage only system, reduction of piped drainage network required, suitable for high density development, high pollutant removal
DISADVANTAGES:	High cost, not efficient on steep slopes, may be damaged by heavy vehicle loads or channelised traffic, risk of long term clogging due to poor maintenance.
WATER QUALITY:	High removal of suspended solids, heavy metals and hydrocarbons.

DRAINAGE MAINTENANCE STRATEGY

The following drainage maintenance and management strategy has been produced in accordance with the SuDS Manual, best practice and manufactures guidance. This is not intended to be an exhaustive list but outline guidance for the recommended requirements which are to be reviewed and updated based on the specific site requirements. It is expected that the maintenance for the drainage of the proposed development will be undertaken by the residential management company and will be suitably qualified to undertake the required maintenance.

This schedule should be read in accordance with the manufacturer's guidance and the SuDS Manual.

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

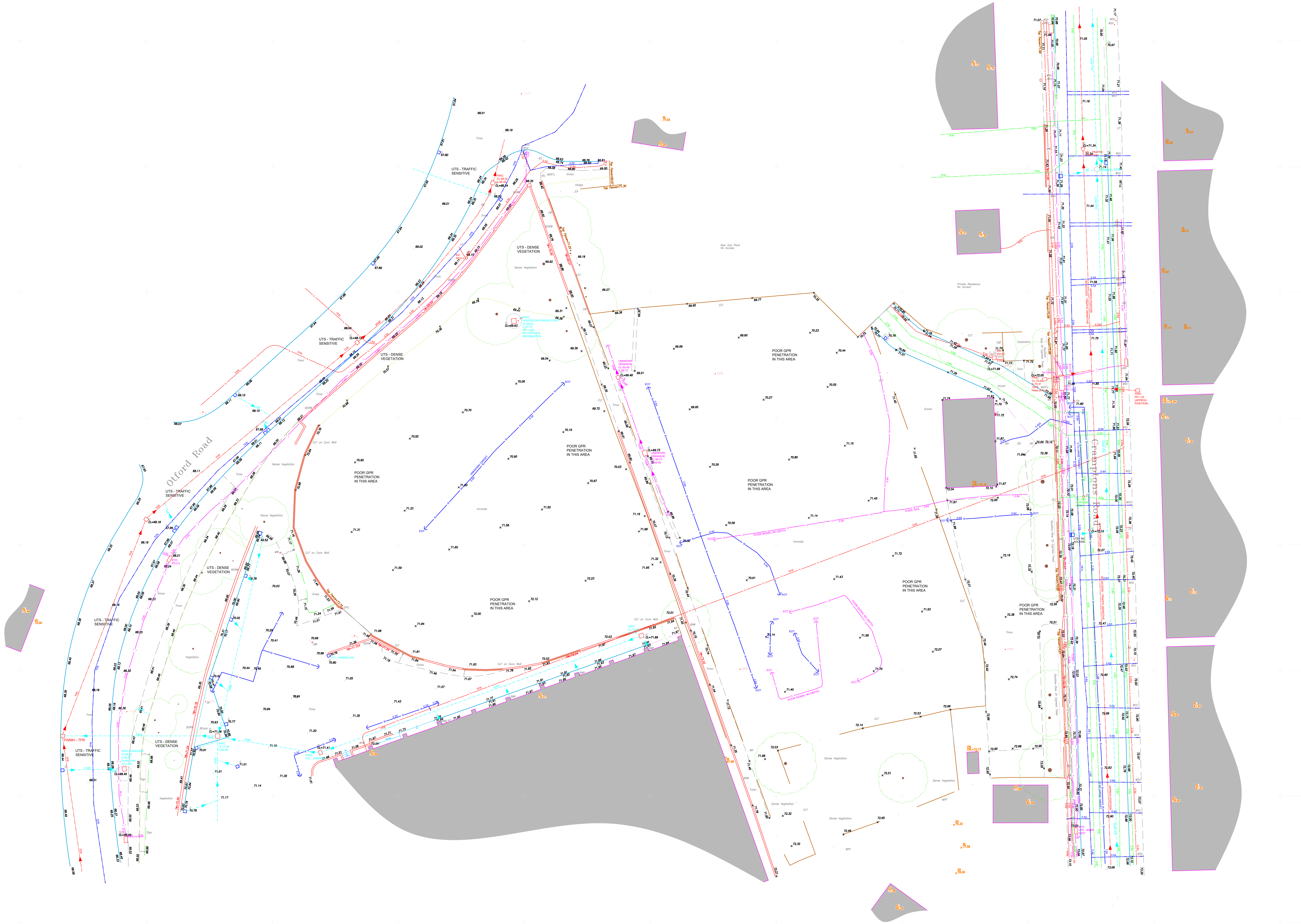
Table 5: Operation and maintenance requirements for attenuation storage tanks (from the SuDS Manual)

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 observation of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this is the most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphospate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm 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, are 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, 48h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Table 6: Operation and maintenance requirements for pervious pavements (from the SuDS Manual)

Appendix A
GPR Survey



ABBREVIATIONS (Land & Utilities)

AR	ASSUMED ROUTE
AV	AIR VALVE
BB	BELISHA BEACON
BD	BACKDROP
Bdl	BED LEVEL
BH	BOREHOLE
BHch	BASEMENT HATCH COVER
Bin	LITTER / GRIT SALT BIN
BL	BASEMENT LIGHT
Bol	BOLLARD
BP	BOUNDARY POST
BS	BUS STOP
BTIC	BRITISH TELECOM CHAMBER
CatL	CATENARY LEVEL
CATV	CABLE TV COVER
CB	CONTROL BOX
CBlt	CONVEYOR BELT
CC	COAL CHUTE
CGrd	CATTLE GRID
ChL	CHANNEL LEVEL
Chy	CHIMNEY
CI	CAST IRON
CL	COVER LEVEL
CO	CONCRETE
CP	CABLE PIT
CpL	COPING LEVEL
Cpsn	CAPSTAN
Cpst	CAMERA POST
CR	CABLE RISER
CrL	CROWN LEVEL
CulP	CULVERT PIPE
CWM	CABLE WINDING MACHINERY
d	DEPTH
Dia.	DIAMETER
DS	DIRECTION SIGN
EIC	ELECTRIC INSPECTION COVER
EoC	EDGE OF CANOPY
EOR	END OF RECORDS
EOT	END OF TRACE
EP	ELECTRICITY POLE
ER	EARTH ROD
EShwr	EMERGENCY SHOWER
ESP	ELECTRICITY SUPPLY POINT
Esw	ELECTRICAL SWITCH
FB	FOOTBRIDGE
FH	FIRE HYDRANT
FL	FLOOR LEVEL
FS	FLAG STAFF / POLE
G	GULLY
G=	GIRTH
GIP	GAS INLET PIPE
GP	GUIDE POST
GPR	TRACED BY G.P.R
Grl	GRILLE
GV	GAS VALVE
Hgt	HEIGHT
Hrl	HANDRAIL
HV	HIGH VOLTAGE
IC	INSPECTION CHAMBER
IL	INVERT LEVEL
IP	INLET PIPE
JN	JUNCTION

KO	KERB OUTLET
Lby	LIFEBOUY
Lck	LOCK GATE
Ldr	LADDER
LH	LAMP HOLE
LP	LAMP POST
LV	LOW VOLTAGE
MgP	MOORING POST
mH	METERS HIGH
Mhcy	MACHINERY
MH	MANHOLE
Mkr	MARKER POST
MkrE	MARKER POST (ELECTRIC)
MkrG	MARKER POST (GAS)
MkrR	MARKER POST (RAILWAY)
MkrT	MARKER POST (TELECOM)
MkrW	MARKER POST (WATER)
MP	MILE POST
MS	MILE STONE
NL	NOT LOCATED
NP	NAME PLATE
OSA	OUTSIDE SURVEY AREA
OSBM	O.S BENCH MARK
OGP	OVERGROUND PIPE
OHCu	O/H CABLE (UNIDENTIFIED)
OHE	OVERHEAD CABLE (ELECTRIC)
OHG	OVERHEAD GANTRY
OHP	OVERHEAD PIPE
OHT	OVERHEAD CABLE (TELECOM)
OP	OUTLET PIPE
P	POST
Pb	PARK BENCH
PB	POST BOX
PCsg	PEDESTRIAN CROSSING
PE	POLYETHALINE
PF	PITCH FIBER
Pl	PILE
Pir	MOVEMENT DETECTOR
Pmd	PLANT MOTOR DRIVE
PP	PETROL / DIESEL PUMP
PR	PIPE RISER
Psk	PENSTOCK
PU	PUMP
PV	PIPE (VERTICAL)
PVC	POLYVINYL CHLORIDE
Pyl	PYLON
Pz	PIEZOMETER
RE	RODDING EYE
RG	RAIN GAUGE
RMP	RESERVOIR MONITORING PNT
RP	REFLECTOR POST
RS	ROAD SIGN
RSP	RAILWAY SIGNAL POST
RWP	RAIN WATER PIPE
S	SPREAD
SA	SURVEY ABANDONED
SB	SIGN BOARD
Shlt	SHELTER (BUS / TRAM)
SI	SPUN IRON
SL	SOFFIT LEVEL
SltL	SILT LEVEL (TOP)
SMP	SETTLEMENT MONITORING PNT

SiL	SIGNAL LOST
SP	SIGN POST
SPil	SHEET PILING
Spr	SPRING
SPt	SAMPLING POINT
ST	STOP TAP
Sti	STILE
Stl	STRUCTURE TOP LEVEL
Stp	STUMP (TREE)
StP	STAND PIPE
StPo	STAY POST
StW	STAY WIRE
SV	STOP VALVE
SVP	SOIL VENT PIPE
TBM	TEMPORARY BENCH MARK
TCB	TELEPHONE CALL BOX
TEL	TELECOM CHAMBER COVER
TFR	TAKEN FROM RECORDS
Thl	THRESHOLD LEVEL
TL	TRAFFIC LIGHT
TP	TELEGRAPH POLE
Tpt	TRIAL PIT
Tr	TROUGH
UTF	UNABLE TO FIND
UTGA	UNABLE TO GAIN ACCESS
UTL	UNABLE TO LIFT
UTR	UNABLE TO ROD
UTS	UNABLE TO SURVEY
UTT	UNABLE TO TRACE
VC	VITREOUS CLAY
VP	VENT PIPE
VR	VAPOUR RECOVERY
VS	VENTILATION SHAFT
VW	VALVE / SLUICE WHEEL
WB	WEIGHBRIDGE
WL	WATER LEVEL
WM	WATER METER
WO	WASH OUT VALVE
Wr	WEIR
WrL	WEIR LEVEL
WrPl	WEIR PLATE (TOP)
WWP	WASTE WATER PIPE

FENCE TYPES:

AMF	ARMCO
BWF	BARBED WIRE
CBF	CLOSE BOARDED
CIF	CORRUGATED IRON
CLF	CHAIN LINK
CPF	CHESTNUT PALING
IRF	IRON RAILING
IWF	INTERWOVEN
PCF	POST & CHAIN
PIF	POST & IRON RAIL
PRF	POST & RAIL
PWF	POST & WIRE
SPF	STEEL PALLISADE
WMF	WIRE MESH

KEY

Symbol	Meaning
TV — TV	CCTV / CABLE TELEVISION
450	COMBINED DRAINAGE
COM	COMMUNICATIONS CABLE
A — A	COMPRESSED AIR
	DUCTING
E — E	EARTH CABLE
	ELECTRIC CABLE
EOT	END OF TRACE
150	FOUL DRAINAGE
F — F	FUEL PIPE
	GAS PIPE
G	GAUGE LINE
H	HEATING
O — O	OFFSET FILL PIPE
	PUMPING MAIN
R — R	RADAR AREA ANOMALY
R — R	RADAR UTILITY TRACE
300	SURFACE DRAINAGE
	SURVEY BOUNDARY
	TELECOM CABLE
TL — TL	TRAFFIC LIGHTS
U — U	UNIDENTIFIED
VR — VR	VAPOUR RECOVERY
V — V	VENT PIPE
	WATER PIPE
	O.S BENCH MARK
	SURVEY CONTROL STATION

Revision	Description	Date

Drawing Status:

INFORMATION

T: 0208 399 3851 M: 07535 236 812
www.intersectsurveys.co.uk

Client: KIN DEVELOPMENTS

Project: SEVENOAKS

Title: UNDERGROUND UTILITY SERVICES LAYOUT

Drawn A.J.O.	Surveyed: A.S.	Date SEPT'20
Cad File: 64801–001		Scale 1:200@A0
Drawing Number 64801-001		Revision

Appendix B

Thames Water Asset records and Pre-Application Response

Asset Location Search

Ashley Gaughan
WorleyParsons
1st Floor Parkview
Great west Road
BRENTFORD
TW8 9AZ

Search address supplied 552850 157150
Former Gasworks
Old Crampton Road
Sevenoaks
TN14 5DY

Your reference Sevenoaks

Our reference ALS/ALS Standard/2014_2775617

Search date 28 May 2014

You are now able to order your Asset Location Search requests online by visiting
www.thameswater-propertysearches.co.uk

Asset Location Search

Search address supplied: 552850 157150, Former Gasworks, Old Crampton Road, Sevenoaks, TN14 5DY

Dear Sir / Madam

An Asset Location Search is recommended when undertaking a site development. It is essential to obtain information on the size and location of clean water and sewerage assets to safeguard against expensive damage and allow cost-effective service design.

The following records were searched in compiling this report: - the map of public sewers & the map of waterworks. Thames Water Utilities Ltd (TWUL) holds all of these.

This searchprovides maps showing the position, size of Thames Water assets close to the proposed development and also manhole cover and invert levels, where available.

Please note that none of the charges made for this report relate to the provision of Ordnance Survey mapping information. The replies contained in this letter are given following inspection of the public service records available to this company. No responsibility can be accepted for any error or omission in the replies.

You should be aware that the information contained on these plans is current only on the day that the plans are issued. The plans should only be used for the duration of the work that is being carried out at the present time. Under no circumstances should this data be copied or transmitted to parties other than those for whom the current work is being carried out.

Thames Water do update these service plans on a regular basis and failure to observe the above conditions could lead to damage arising to new or diverted services at a later date.

Contact Us

If you have any further queries regarding this enquiry please feel free to contact a member of the team on 0845 070 9148, or use the address below:

Thames Water Utilities Ltd
Property Searches
PO Box 3189
Slough
SL1 4WW

Email: searches@thameswater.co.uk
Web: www.thameswater-propertysearches.co.uk

Asset Location Search

Waste Water Services

Please provide a copy extract from the public sewer map.

Enclosed is a map showing the approximate lines of our sewers. Our plans do not show sewer connections from individual properties or any sewers not owned by Thames Water unless specifically annotated otherwise. Records such as "private" pipework are in some cases available from the Building Control Department of the relevant Local Authority.

Where the Local Authority does not hold such plans it might be advisable to consult the property deeds for the site or contact neighbouring landowners.

This report relates only to sewerage apparatus of Thames Water Utilities Ltd, it does not disclose details of cables and or communications equipment that may be running through or around such apparatus.

The sewer level information contained in this response represents all of the level data available in our existing records. Should you require any further Information, please refer to the relevant section within the 'Further Contacts' page found later in this document.

For your guidance:

- The Company is not generally responsible for rivers, watercourses, ponds, culverts or highway drains. If any of these are shown on the copy extract they are shown for information only.
- Any private sewers or lateral drains which are indicated on the extract of the public sewer map as being subject to an agreement under Section 104 of the Water Industry Act 1991 are not an ‘as constructed’ record. It is recommended these details be checked with the developer.

Clean Water Services

Please provide a copy extract from the public water main map.

With regard to the fresh water supply, this site falls within the boundary of another water company. For more information, please redirect your enquiry to the following address:

South East Water Ltd
3 Church Road

Asset Location Search

Haywards Heath
West Sussex
RH16 3NY

Tel: 0845 301 0845

For your guidance:

- Assets other than vested water mains may be shown on the plan, for information only.
- If an extract of the public water main record is enclosed, this will show known public water mains in the vicinity of the property. It should be possible to estimate the likely length and route of any private water supply pipe connecting the property to the public water network.

Payment for this Search

An invoice is enclosed. Please send remittance to Thames Water Utilities Ltd., PO Box 3189, Slough, SL1 4WW.

Asset Location Search

Further contacts:

Waste Water queries

Should you require verification of the invert levels of public sewers, by site measurement, you will need to approach the relevant Thames Water Area Network Office for permission to lift the appropriate covers. This permission will usually involve you completing a TWOSA form. For further information please contact our Customer Centre on Tel: 0845 920 0800. Alternatively, a survey can be arranged, for a fee, through our Customer Centre on the above number.

If you have any questions regarding sewer connections, budget estimates, diversions, building over issues or any other questions regarding operational issues please direct them to our service desk. Which can be contacted by writing to:

Developer Services (Waste Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0845 850 2777
Email: developer.services@thameswater.co.uk

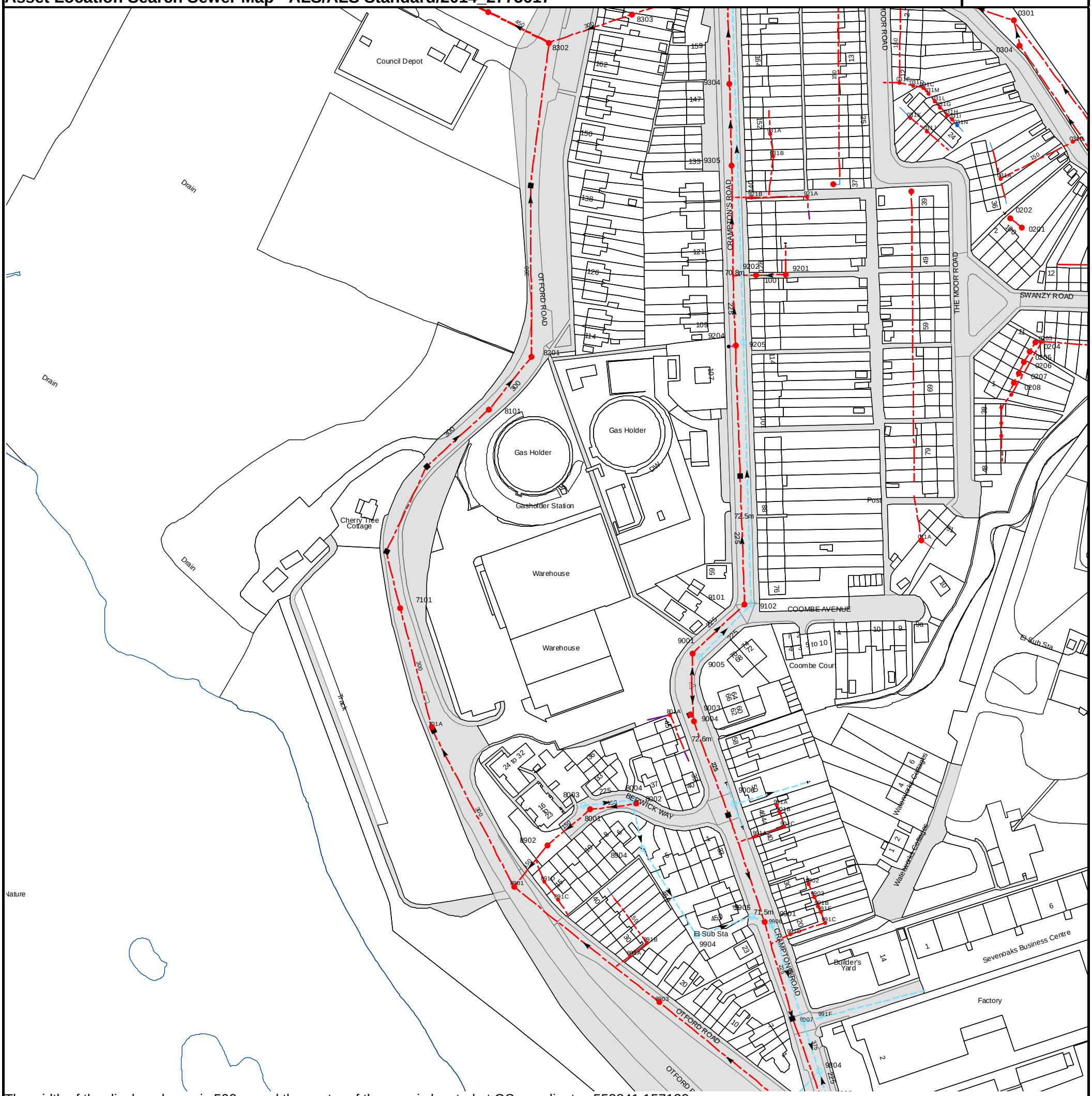
Clean Water queries

Should you require any advice concerning clean water operational issues or clean water connections, please contact:

Developer Services (Clean Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0845 850 2777
Email: developer.services@thameswater.co.uk

Asset Location Search Sewer Map - ALS/ALS Standard/2014_2775617



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 552841,157129

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
0205	n/a	n/a
0204	n/a	n/a
0203	n/a	n/a
9804	71.01	68.87
9907	71.23	69.05
991F	n/a	n/a
701A	n/a	n/a
8901	70.04	68.07
891D	n/a	n/a
8902	70.48	68.74
891C	n/a	n/a
8003	71.24	69.97
8001	71.32	69.52
891A	n/a	n/a
8004	71.74	69.61
8002	71.74	70.27
8904	71.26	69.51
891B	n/a	n/a
8903	n/a	n/a
9003	72.78	n/a
9004	72.75	71
9904	70.79	69.24
9006	72.1	68.96
9905	71.53	69.22
991A	n/a	n/a
9901	71.74	70.14
9906	71.77	69.29
901A	n/a	n/a
901B	n/a	n/a
901C	n/a	n/a
991D	n/a	n/a
9902	n/a	n/a
9903	n/a	n/a
991B	n/a	n/a
991E	n/a	n/a
991C	n/a	n/a
7101	68.52	67.31
8101	69.03	67.65
8201	67.94	66.5
801A	n/a	n/a
9001	72.88	70.85
9005	72.81	71.67
9305	70.02	68.13
9204	71.36	69.54
9205	n/a	n/a
9101	73.12	70.74
9102	73.15	71.5
921B	n/a	n/a
9202	n/a	n/a
9201	n/a	n/a
921A	n/a	n/a
9306	n/a	n/a
9207	n/a	n/a
011A	n/a	n/a
031A	n/a	n/a
0101	n/a	n/a
0103	n/a	n/a
0102	n/a	n/a
0202	n/a	n/a
0209	n/a	n/a
0208	n/a	n/a
0207	n/a	n/a
0201	n/a	n/a
0206	n/a	n/a
8301	65.96	63.79
8302	67.489	63.859
8303	n/a	n/a
9304	69.38	67.45
931A	n/a	n/a
931B	n/a	n/a
031E	n/a	n/a
031K	n/a	n/a
031D	n/a	n/a
031C	n/a	n/a
031J	n/a	n/a
031M	n/a	n/a
031L	n/a	n/a
031G	n/a	n/a
031H	n/a	n/a
031I	n/a	n/a
031N	n/a	n/a
0301	66.83	64.77
0304	67.59	65
031B	n/a	n/a

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

Foul: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.

Surface Water: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.

Combined: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.

Trunk Surface Water

Trunk Foul

Storm Relief

Trunk Combined

Vent Pipe

Bio-solids (Sludge)

Proposed Thames Surface Water Sewer

Proposed Thames Water Foul Sewer

Gallery

Foul Rising Main

Surface Water Rising Main

Combined Rising Main

Sludge Rising Main

Proposed Thames Water Rising Main

Vacuum

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

Air Valve

Dam Chase

Fitting

Meter

Vent Column

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

Control Valve

Drop Pipe

Ancillary

Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol, Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

Outfall

Undefined End

Inlet

Other Symbols

Symbols used on maps which do not fall under other general categories

Public/Private Pumping Station

Change of characteristic indicator (C.O.C.I.)

Invert Level

Summit

Areas

Lines denoting areas of underground surveys, etc.

Agreement

Operational Site

Chamber

Tunnel

Conduit Bridge

Other Sewer Types (Not Operated or Maintained by Thames Water)

Foul Sewer

Surface Water Sewer

Combined Sewer

Gulley

Culverted Watercourse

Proposed

Abandoned Sewer

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.

2) All measurements on the plans are metric.

3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.

4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.

5) 'na' or '0' on a manhole level indicates that data is unavailable.

6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Insight on 0845 070 9148.

Terms and Conditions

All sales are made in accordance with Thames Water Utilities Limited (TWUL) standard terms and conditions unless previously agreed in writing.

1. All goods remain in the property of Thames Water Utilities Ltd until full payment is received.
2. Provision of service will be in accordance with all legal requirements and published TWUL policies.
3. All invoices are strictly due for payment 14 days from due date of the invoice. Any other terms must be accepted/agreed in writing prior to provision of goods or service, or will be held to be invalid.
4. Thames Water does not accept post-dated cheques-any cheques received will be processed for payment on date of receipt.
5. In case of dispute TWUL`s terms and conditions shall apply.
6. Penalty interest may be invoked by TWUL in the event of unjustifiable payment delay. Interest charges will be in line with UK Statute Law 'The Late Payment of Commercial Debts (Interest) Act 1998'.
7. Interest will be charged in line with current Court Interest Charges, if legal action is taken.
8. A charge may be made at the discretion of the company for increased administration costs.

A copy of Thames Water's standard terms and conditions are available from the Commercial Billing Team (cashoperations@thameswater.co.uk).

We publish several Codes of Practice including a guaranteed standards scheme. You can obtain copies of these leaflets by calling us on 0845 9200 800.

If you are unhappy with our service you can speak to your original goods or customer service provider. If you are not satisfied with the response, your complaint will be reviewed by the Customer Services Director. You can write to him at: Thames Water Utilities Ltd. PO Box 492, Swindon, SN38 8TU.

If the Goods or Services covered by this invoice falls under the regulation of the 1991 Water Industry Act, and you remain dissatisfied you can refer your complaint to Consumer Council for Water on 0121 345 1000 or write to them at Consumer Council for Water, 1st Floor, Victoria Square House, Victoria Square, Birmingham, B2 4AJ.

Ways to pay your bill

Credit Card	**BACS Payment**	**Telephone Banking**	**Cheque**
Call **0845 070 9148** quoting your invoice number starting CBA or ADS.	Account number **90478703** Sort code **60-00-01** A remittance advice must be sent to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW.** or email **ps.billing@thameswater.co.uk**	By calling your bank and quoting: Account number **90478703** Sort code **60-00-01** and your invoice number	Made payable to '**Thames Water Utilities Ltd**' Write your Thames Water account number on the back. Send to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW** or by DX to **151280 Slough 13**

Thames Water Utilities Ltd Registered in England & Wales No. 2366661 Registered Office Clearwater Court, Vastern Rd, Reading, Berks, RG1 8DB.

Cube Consulting Engineers
24 Carronade Court
London
N7 8EP

Wastewater pre-planning
Our ref DS6078371

17th November 2020

Pre-planning enquiry: Confirmation of sufficient capacity

Site Address: The Gas Holders Sevenoaks, Crampton's Road, Sevenoaks, Kent, TN14 5DQ

Dear Mr Ryan,

Thank you for providing information on the proposals to construct 15 houses and 124 flats to replace the existing gas holder facility and associated office and workshop at the above location.

We have completed the assessment of the foul water flows and surface water run-off based on the information submitted in your application with the purpose of assessing sewer capacity within the existing Thames Water sewer network.

Foul Water

If your proposals progress in line with the details you've provided, we're pleased to confirm that there will be sufficient sewerage capacity in the adjacent foul water sewer networks to serve your development.

This is based on the foul water flows from the 15 houses gravitating from the site and being connected to the existing connection from the site to the East draining to the 225mm dia. foul water sewer in Crampton's Road and the foul water flows from the 124 flats gravitating from the site and being connected via a new connection onto the 300mm dia. foul water sewer in Otford Road to the West.

This confirmation is valid for 12 months or for the life of any planning approval that this information is used to support, to a maximum of three years.

Please note that you must keep us informed of any changes to your design – for example, an increase in the number or density of homes. Such changes could mean there is no longer sufficient sewerage capacity.

Surface Water

Please note that discharging surface water to the public sewer network should only be considered after all other methods of disposal have been investigated and proven to not be viable. In accordance with the Building Act 2000 Clause H3.3, positive connection to a public sewer will only be consented when it can be demonstrated that the hierarchy of disposal methods have been examined and proven to be impracticable. The disposal hierarchy being: 1st Soakaways; 2nd Watercourses; 3rd Sewers.

Only when it can be proven that soakage into the ground or a connection into an adjacent watercourse is not possible would we consider a restricted discharge into the public surface water sewer network in Crampton's Road.

If the peak surface water run-off discharge is then restricted to a maximum of 2l/s via the proposed private pumping station on the site as your drainage strategy indicates, then we would have no objections to the proposals.

We would encourage techniques such as green roofs and/or permeable paving that restricts surface water discharge from your site.

Please note that the Local Planning authority may comment on surface water discharge under the planning process.

Source Protection Zone

The development site boundary falls within a Source Protection Zone for groundwater abstraction. These zones may be at particular risk from polluting activities on or below the land surface. To prevent pollution, the Environment Agency and Thames Water (or other local water undertaker) will use a tiered, risk-based approach to regulate activities that may impact groundwater resources, this may potentially affect your drainage or surface water strategies where infiltration systems are proposed. The applicant is encouraged to read the Environment Agency's approach to groundwater protection (available at https://www.gov.uk/government/publications/groundwater-protection-position-statements) and may wish to discuss the implications for their development with a suitably qualified environmental consultant.

Therefore, although we would encourage the use of soakaways, the proximity of the site to the abstraction zone may preclude their use in this case depending upon the Environment Agency's assessment of the risk involved.

Please Note

All connection requests are subject to a full Section 106 (Water Industry Act 1991) application before the Company can confirm approval to the connection itself. Please also note that capacity in the public sewerage system cannot be reserved. Please make sure you submit your connection application giving us at least 21 days' notice of the date you wish to make your new connection/s.

The discharge of non-domestic effluent is not permitted until a valid trade effluent consent has been issued by Thames Water. If anything other than domestic sewage is discharged into the

public sewers without the above agreement an offence is committed and the applicant will be liable to the penalties contained in Section 109(1) (WIA 1991).

Applicants should contact Trade Effluent prior to seeking a connection approval, to discuss trade effluent consent and conditions of discharge. A Trade Effluent reference number should be obtained and included in the relevant box of the attached application form. The address for Trade Effluent is - Thames Water Utilities Limited, Waste Water Quality, Crossness Sewage Treatment Works, Belvedere Road, Abbeywood, London. SE2 9AQ. Alternatively you can telephone them on 020 8507 4321.

The views expressed by Thames Water in this letter are in response to this pre-planning enquiry at this time and do not represent our final views on any future planning applications made in relation to this site.

Yours sincerely,

Jonathan Shildrick BSc
Development Engineer
Developer Services

Appendix C
Existing Greenfield Runoff Rates

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Andrew O'Rourke
Site name:	Sevenoaks Gas Holders
Site location:	Sevenoaks

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	51.29317° N
Longitude:	0.19059° E
Reference:	2886646139
Date:	Mar 11 2021 17:04

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 0.91

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	747	747
Hydrological region:	7	7
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	4.74	4.74
1 in 1 year (l/s):	4.03	4.03
1 in 30 years (l/s):	10.9	10.9
1 in 100 year (l/s):	15.12	15.12
1 in 200 years (l/s):	17.73	17.73

Appendix D
Existing Brownfield Runoff Rates

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	21.000	Add Flow / Climate Change (%)	0
Ratio R	0.350	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	550	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.649	4-8	0.131

Total Area Contributing (ha) = 0.780

Total Pipe Volume (m^3) = 10.099

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.390	0.390	0.390
1.001	-	-	100	0.390	0.390	0.390
1.002	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.780	0.780	0.780

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	21.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm) 200.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	1	+0%					70.120
S1.001	S2	15 Winter	1	+0%	100/15 Summer				69.176
S1.002	S3	15 Winter	1	+0%					68.872

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.255	0.000	0.22			53.6	OK	
S1.001	S2	-0.268	0.000	0.34			100.2	OK	
S1.002	S3	-0.296	0.000	0.25			100.8	OK	

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	21.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm) 200.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	30	+0%					70.200
S1.001	S2	15 Winter	30	+0%	100/15 Summer				69.338
S1.002	S3	15 Winter	30	+0%					68.995

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.175	0.000	0.54			131.4	OK	
S1.001	S2	-0.106	0.000	0.92			272.2	OK	
S1.002	S3	-0.173	0.000	0.68			269.6	OK	

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	21.000	Cv (Winter)	0.840

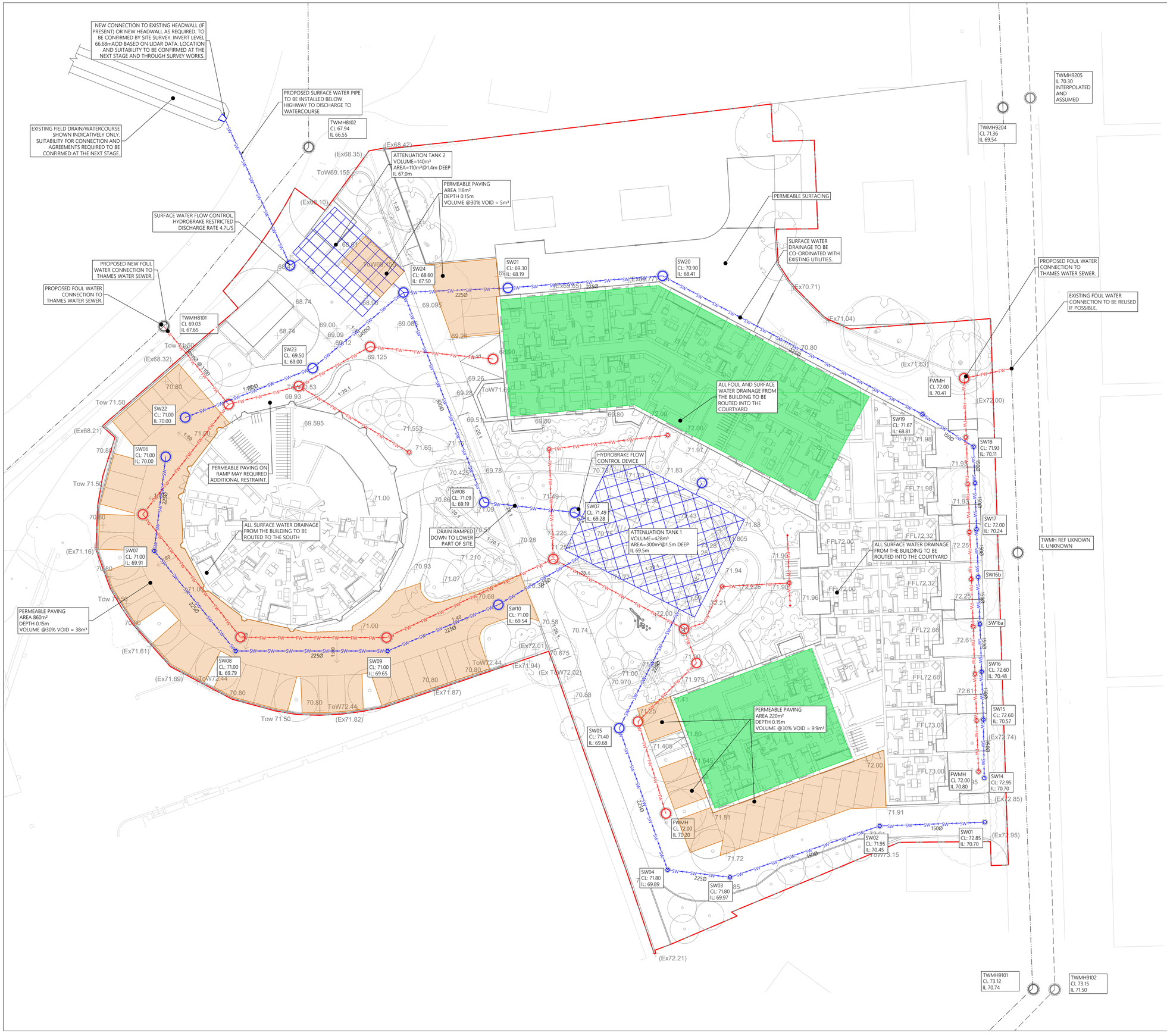
Margin for Flood Risk Warning (mm) 200.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	100	+0%					70.236
S1.001	S2	15 Winter	100	+0%	100/15 Summer				69.552
S1.002	S3	15 Winter	100	+0%					69.050

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.139	0.000	0.70			170.5	OK	
S1.001	S2	0.108	0.000	1.17			346.3	SURCHARGED	
S1.002	S3	-0.118	0.000	0.88			350.7	OK	

Appendix E
Proposed Drainage Layout



NOTES:

1. DO NOT SCALE FROM THIS DRAWING. ONLY FIGURED DIMENSIONS ARE TO BE USED.
2. ALL DIMENSIONS ARE IN MILLIMETRES U.N.O.
3. ALL LEVELS ARE IN METRES ABOVE ORDNANCE DATUM U.N.O.
4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
5. DRAINAGE CHANNELS AND GULLIES, DRAIN POINT CONNECTIONS ETC ARE NOT SHOWN AT THIS STAGE, AN ALLOWANCE SHOULD BE MADE FOR THESE.
6. FOUL AND SURFACE WATER DISCHARGE LOCATIONS AND RATES ARE SUBJECT TO APPROVAL BY THE SEWERAGE UNDERTAKER AND THE LEAD LOCAL FLOOD AUTHORITY.
7. ALL EXISTING DRAINAGE INVERT LEVELS ARE TO BE CONFIRMED ONSITE PRIOR TO CONSTRUCTION. IF LEVELS ARE DIFFERENT TO THAT ASSUMED THEN THE DRAINAGE MAY NEED TO BE UPDATED OR PUMPING STATIONS PROVIDED.
8. THE FEASIBILITY OF THE CONNECTION TO THE EXISTING SURFACE WATER FIELD DRAIN/ WATERCOURSE IS TO BE CONFIRMED THROUGH FURTHER INVESTIGATION. IF CONNECTION IS NOT FEASIBLE SURFACE WATER IS TO BE PUMPED TO THE THAMES WATER SEWER IN CRAMPTON'S ROAD.
9. CELLULAR ATTENUATION TANK SIZE AND DEPTHS SUBJECT TO CHANGE BASED ON FURTHER CO-ORDINATION WITH SOFT LANDSCAPING AND LEVELS.
10. ALL FOUL AND SURFACE WATER DRAIN POINTS ARE TO BE RODDABLE FROM ABOVE GROUND.
11. EXTENT AND DEPTHS OF PERMEABLE PAVING ARE TO BE CONFIRMED BY THE LANDSCAPE ARCHITECT.
12. EXTENT OF GREENROOFS INDICATIVE TO BE CONFIRMED BY ARCHITECT.

KEY

- SITE BOUNDARY
- EXISTING FOUL WATER PUBLIC SEWER
- EXISTING SURFACE WATER PUBLIC SEWER
- PROPOSED FOUL WATER SEWER
- PROPOSED FOUL WATER INSPECTION CHAMBER
- PROPOSED FOUL WATER MANHOLE
- PROPOSED FOUL WATER RODDING EYE
- PROPOSED FOUL WATER DRAIN POINT
- PROPOSED SURFACE WATER SEWER
- PROPOSED SURFACE WATER INSPECTION CHAMBER
- PROPOSED SURFACE WATER MANHOLE
- PROPOSED SURFACE WATER RODDING EYE
- PROPOSED RAIN WATER PIPE
- PROPOSED GREEN ROOF AREA
- PROPOSED ATTENUATION TANK
- PROPOSED PERMEABLE PAVING

REV	DATE	DESCRIPTION	DRN	APP
P02	19/03/2021	PARKING LAYOUT UPDATED	AOR	AP
P01	12/03/2021	ISSUED FOR PLANNING	AOR	AP

STATUS

PRELIMINARY ISSUE

PREPARED IN PARTNERSHIP WITH
whitby wood
91-94 LOWER MARSH
LONDON SE1 7AB, UNITED KINGDOM
+44 (0)20 7442 2216 www.whitbywood.com

PREPARED BY
CUBE CONSULTING ENGINEERS
WWW.CONSULTTHECUBE.CO.UK

CLIENT
KIN DEVELOPMENTS

PROJECT
SEVENOAKS GAS HOLDERS SITE

DRAWING TITLE
BELOW GROUND DRAINAGE LAYOUT

JOB NO.	DATE	SCALE
1020	30/09/2020	1:250

DRN	DES	CHK	APP
CR	CR	AOR	AOR

DRAWING NUMBER
1020-C-DR-0100

REV
P02

Appendix F
Proposed Surface Water Calculations

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 552836 157170 TQ 52836 57170
Data Type	Point
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.485	4-8	0.227

Total Area Contributing (ha) = 0.712

Total Pipe Volume (m^3) = 18.019

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.030	0.030	0.030
1.001	User	-	100	0.031	0.031	0.031
1.002	User	-	100	0.036	0.036	0.036
1.003	-	-	100	0.000	0.000	0.000
1.004	User	-	100	0.036	0.036	0.036
	User	-	100	0.010	0.010	0.046
2.000	User	-	100	0.047	0.047	0.047
2.001	User	-	100	0.077	0.077	0.077
2.002	-	-	100	0.000	0.000	0.000
2.003	-	-	100	0.000	0.000	0.000
2.004	User	-	100	0.025	0.025	0.025
1.005	User	-	100	0.031	0.031	0.031
	User	-	100	0.112	0.112	0.143
	User	-	100	0.012	0.012	0.155
	User	-	100	0.030	0.030	0.185
1.006	-	-	100	0.000	0.000	0.000
1.007	User	-	100	0.054	0.054	0.054
	User	-	100	0.003	0.003	0.057
3.000	User	-	100	0.029	0.029	0.029
3.001	-	-	100	0.000	0.000	0.000
3.002	-	-	100	0.000	0.000	0.000
3.003	-	-	100	0.000	0.000	0.000
3.004	-	-	100	0.000	0.000	0.000
4.000	-	-	100	0.000	0.000	0.000
4.001	User	-	100	0.015	0.015	0.015
3.005	-	-	100	0.000	0.000	0.000
3.006	User	-	100	0.030	0.030	0.030
	User	-	100	0.045	0.045	0.075
3.007	-	-	100	0.000	0.000	0.000
5.000	User	-	100	0.023	0.023	0.023
5.001	-	-	100	0.000	0.000	0.000
5.002	User	-	100	0.038	0.038	0.038
1.008	-	-	100	0.000	0.000	0.000
1.009	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.712	0.712	0.712

Online Controls for Storm

Hydro-Brake® Optimum Manhole: 7, DS/PN: 1.006, Volume (m³): 3.0

Unit Reference	MD-SHE-0054-2000-2500-2000
Design Head (m)	2.500
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	54
Invert Level (m)	69.278
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.500	2.0	Kick-Flo®	0.484	1.0
Flush-Flo™	0.239	1.2	Mean Flow over Head Range	-	1.4

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)
0.100	1.0	1.200	1.4	3.000	2.2	7.000	3.2
0.200	1.2	1.400	1.5	3.500	2.3	7.500	3.3
0.300	1.2	1.600	1.6	4.000	2.5	8.000	3.4
0.400	1.1	1.800	1.7	4.500	2.6	8.500	3.5
0.500	1.0	2.000	1.8	5.000	2.8	9.000	3.6
0.600	1.1	2.200	1.9	5.500	2.9	9.500	3.7
0.800	1.2	2.400	2.0	6.000	3.0		
1.000	1.3	2.600	2.0	6.500	3.1		

Hydro-Brake® Optimum Manhole: 28, DS/PN: 1.009, Volume (m³): 2.1

Unit Reference	MD-SHE-0097-4700-1400-4700
Design Head (m)	1.400
Design Flow (l/s)	4.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	97
Invert Level (m)	66.940
Minimum Outlet Pipe Diameter (mm)	150

Hydro-Brake® Optimum Manhole: 28, DS/PN: 1.009, Volume (m³): 2.1

Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.400	4.7	Kick-Flo®	0.859	3.8
Flush-Flo™	0.421	4.7	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)
0.100	3.1	1.200	4.4	3.000	6.7	7.000	10.0
0.200	4.3	1.400	4.7	3.500	7.2	7.500	10.4
0.300	4.6	1.600	5.0	4.000	7.7	8.000	10.7
0.400	4.7	1.800	5.3	4.500	8.1	8.500	11.0
0.500	4.7	2.000	5.5	5.000	8.5	9.000	11.3
0.600	4.6	2.200	5.8	5.500	8.9	9.500	11.6
0.800	4.1	2.400	6.0	6.000	9.3		
1.000	4.0	2.600	6.3	6.500	9.7		

Storage Structures for Storm

Porous Car Park Manhole: 2, DS/PN: 1.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	22.0
Max Percolation (l/s)	61.1	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	71.650	Cap Volume Depth (m)	0.150

Porous Car Park Manhole: 7, DS/PN: 2.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	86.0
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	238.9	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	70.620	Cap Volume Depth (m)	0.150

Cellular Storage Manhole: 6, DS/PN: 1.005

Invert Level (m)	69.500	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	300.0	0.0	1.501	0.0	0.0
1.500	300.0	0.0			

Porous Car Park Manhole: 24, DS/PN: 5.002

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	18.0
Max Percolation (l/s)	50.0	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	68.830	Cap Volume Depth (m)	0.150

Cellular Storage Manhole: 9, DS/PN: 1.008

Invert Level (m)	67.000	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Cellular Storage Manhole: 9, DS/PN: 1.008

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	110.0	0.0	1.401	0.0	0.0
1.400	110.0	0.0			

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 5 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 552836 157170 TQ 52836 57170
Data Type	Point
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	200.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 20, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	2	+0%	30/15 Summer				70.749
1.001	2	15 Winter	2	+0%	30/15 Summer				70.518
1.002	3	15 Winter	2	+0%	30/15 Summer				70.065
1.003	4	15 Winter	2	+0%	30/15 Summer				69.972
1.004	5	480 Winter	2	+0%	30/15 Summer				69.795
2.000	6	15 Winter	2	+0%	30/15 Summer				70.070
2.001	7	30 Winter	2	+0%	30/15 Summer				70.010
2.002	8	30 Winter	2	+0%	30/15 Summer				69.889
2.003	9	480 Winter	2	+0%	30/15 Summer				69.796
2.004	10	480 Winter	2	+0%	2/360 Winter				69.795
1.005	6	480 Winter	2	+0%	2/30 Winter				69.794
1.006	7	480 Winter	2	+0%	2/15 Summer				69.802

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.101	0.000	0.23			5.0	OK	
1.001	2	-0.085	0.000	0.38		6	8.6	OK	
1.002	3	-0.136	0.000	0.31			13.0	OK	
1.003	4	-0.142	0.000	0.28			13.4	OK	
1.004	5	-0.112	0.000	0.07			3.3	OK	
2.000	6	-0.155	0.000	0.21			7.7	OK	
2.001	7	-0.128	0.000	0.37		9	13.8	OK	
2.002	8	-0.131	0.000	0.35			13.7	OK	
2.003	9	-0.085	0.000	0.08			2.8	OK	
2.004	10	0.024	0.000	0.09			3.3	SURCHARGED	
1.005	6	0.162	0.000	0.02			1.3	SURCHARGED	
1.006	7	0.224	0.000	0.02			1.2	SURCHARGED	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.007	8	15 Winter	2	+0%					69.239
3.000	14	15 Winter	2	+0%	100/15 Summer				70.753
3.001	15	15 Winter	2	+0%	100/15 Summer				70.622
3.002	16	15 Winter	2	+0%	100/15 Summer				70.539
3.003	17	15 Winter	2	+0%	100/15 Summer				70.296
3.004	18	15 Winter	2	+0%	100/15 Summer				70.167
4.000	19	15 Summer	2	+0%					69.600
4.001	20	15 Winter	2	+0%	100/15 Summer				69.155
3.005	19	15 Winter	2	+0%	100/15 Summer				68.867
3.006	20	15 Winter	2	+0%	30/15 Summer				68.501
3.007	21	15 Winter	2	+0%	30/15 Summer				68.288
5.000	22	15 Winter	2	+0%					70.031
5.001	23	15 Winter	2	+0%					69.039
5.002	24	15 Winter	2	+0%	100/15 Winter				68.730
1.008	9	120 Winter	2	+0%	30/15 Summer				67.235
1.009	28	120 Winter	2	+0%	30/15 Summer				67.232

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.007	8	-0.256	0.000	0.05			9.2	OK	
3.000	14	-0.097	0.000	0.27			4.9	OK	
3.001	15	-0.095	0.000	0.29			4.8	OK	
3.002	16	-0.098	0.000	0.26			4.8	OK	
3.003	17	-0.097	0.000	0.27			4.9	OK	
3.004	18	-0.096	0.000	0.28			4.9	OK	
4.000	19	-0.150	0.000	0.00			0.0	OK	
4.001	20	-0.118	0.000	0.10			2.1	OK	
3.005	19	-0.169	0.000	0.14			6.8	OK	
3.006	20	-0.131	0.000	0.36			17.1	OK	
3.007	21	-0.131	0.000	0.36			17.0	OK	
5.000	22	-0.119	0.000	0.10			3.7	OK	
5.001	23	-0.111	0.000	0.15			3.7	OK	
5.002	24	-0.141	0.000	0.30		8	9.0	OK	
1.008	9	-0.065	0.000	0.08		85	4.7	OK	
1.009	28	-0.008	0.000	0.06			4.6	OK	

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 5 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 552836 157170 TQ 52836 57170
Data Type	Point
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	200.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 20, 40

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	30	+20%	30/15 Summer				71.060
1.001	2	15 Winter	30	+20%	30/15 Summer				70.961
1.002	3	15 Winter	30	+20%	30/15 Summer				70.396
1.003	4	960 Winter	30	+20%	30/15 Summer				70.351
1.004	5	960 Winter	30	+20%	30/15 Summer				70.350
2.000	6	15 Winter	30	+20%	30/15 Summer				70.644
2.001	7	15 Winter	30	+20%	30/15 Summer				70.594
2.002	8	15 Winter	30	+20%	30/15 Summer				70.394
2.003	9	960 Winter	30	+20%	30/15 Summer				70.351

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.210	0.000	0.64			13.7	SURCHARGED	
1.001	2	0.358	0.000	1.19		3	27.4	SURCHARGED	
1.002	3	0.195	0.000	1.02			42.6	SURCHARGED	
1.003	4	0.237	0.000	0.06			2.9	SURCHARGED	
1.004	5	0.443	0.000	0.08			4.1	SURCHARGED	
2.000	6	0.419	0.000	0.54			19.7	SURCHARGED	
2.001	7	0.456	0.000	1.35		6	51.2	SURCHARGED	
2.002	8	0.373	0.000	1.25			48.1	SURCHARGED	
2.003	9	0.470	0.000	0.09			3.5	SURCHARGED	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
2.004	10	960 Winter	30	+20%	2/360 Winter				70.350
1.005	6	960 Winter	30	+20%	2/30 Winter				70.349
1.006	7	960 Winter	30	+20%	2/15 Summer				70.360
1.007	8	15 Winter	30	+20%					69.279
3.000	14	15 Winter	30	+20%	100/15 Summer				70.803
3.001	15	15 Winter	30	+20%	100/15 Summer				70.674
3.002	16	15 Winter	30	+20%	100/15 Summer				70.586
3.003	17	15 Winter	30	+20%	100/15 Summer				70.345
3.004	18	15 Winter	30	+20%	100/15 Summer				70.216
4.000	19	15 Summer	30	+20%					69.600
4.001	20	15 Winter	30	+20%	100/15 Summer				69.186
3.005	19	15 Winter	30	+20%	100/15 Summer				68.915
3.006	20	15 Winter	30	+20%	30/15 Summer				68.738
3.007	21	15 Winter	30	+20%	30/15 Summer				68.466
5.000	22	15 Winter	30	+20%					70.055
5.001	23	15 Winter	30	+20%					69.071
5.002	24	15 Winter	30	+20%	100/15 Winter				68.826
1.008	9	120 Winter	30	+20%	30/15 Summer				67.816
1.009	28	240 Winter	30	+20%	30/15 Summer				67.827

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
2.004	10	0.579	0.000	0.11			4.2	SURCHARGED	
1.005	6	0.717	0.000	0.03			1.5	SURCHARGED	
1.006	7	0.781	0.000	0.02			1.4	SURCHARGED	
1.007	8	-0.216	0.000	0.17			30.8	OK	
3.000	14	-0.047	0.000	0.80			14.2	OK	
3.001	15	-0.043	0.000	0.84			14.0	OK	
3.002	16	-0.051	0.000	0.76			14.1	OK	
3.003	17	-0.048	0.000	0.80			14.2	OK	
3.004	18	-0.047	0.000	0.82			14.2	OK	
4.000	19	-0.150	0.000	0.00			0.0	OK	
4.001	20	-0.087	0.000	0.38			7.9	OK	
3.005	19	-0.121	0.000	0.43			21.2	OK	
3.006	20	0.106	0.000	1.13			53.3	SURCHARGED	
3.007	21	0.047	0.000	1.13			53.1	SURCHARGED	
5.000	22	-0.095	0.000	0.28			11.0	OK	
5.001	23	-0.079	0.000	0.44			10.8	OK	
5.002	24	-0.045	0.000	0.98		5	29.9	FLOOD RISK	
1.008	9	0.516	0.000	0.09			5.5	SURCHARGED	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.009	28	0.587	0.000	0.06			4.7	SURCHARGED	

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 5 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 552836 157170 TQ 52836 57170
Data Type	Point
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	200.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 20, 40

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	100	+40%	30/15 Summer				71.929
1.001	2	15 Winter	100	+40%	30/15 Summer				71.678
1.002	3	15 Winter	100	+40%	30/15 Summer				71.066
1.003	4	15 Winter	100	+40%	30/15 Summer				70.912
1.004	5	1440 Winter	100	+40%	30/15 Summer				70.800
2.000	6	1440 Winter	100	+40%	30/15 Summer				70.803
2.001	7	1440 Winter	100	+40%	30/15 Summer				70.803
2.002	8	1440 Winter	100	+40%	30/15 Summer				70.802
2.003	9	1440 Winter	100	+40%	30/15 Summer				70.801

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	1.079	0.000	0.99			21.3	SURCHARGED	
1.001	2	1.075	0.000	1.60		3	36.6	SURCHARGED	
1.002	3	0.865	0.000	1.35			56.3	SURCHARGED	
1.003	4	0.798	0.000	1.16			55.0	SURCHARGED	
1.004	5	0.893	0.000	0.09			4.6	SURCHARGED	
2.000	6	0.578	0.000	0.04			1.5	FLOOD RISK	
2.001	7	0.665	0.000	0.10		602	4.0	FLOOD RISK	
2.002	8	0.782	0.000	0.10			3.9	FLOOD RISK	
2.003	9	0.920	0.000	0.10			3.9	FLOOD RISK	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
2.004	10	1440 Winter	100	+40%	2/360 Winter				70.800
1.005	6	1440 Winter	100	+40%	2/30 Winter				70.799
1.006	7	1440 Winter	100	+40%	2/15 Summer				70.810
1.007	8	15 Summer	100	+40%					69.298
3.000	14	15 Winter	100	+40%	100/15 Summer				71.005
3.001	15	15 Winter	100	+40%	100/15 Summer				70.834
3.002	16	15 Winter	100	+40%	100/15 Summer				70.720
3.003	17	15 Winter	100	+40%	100/15 Summer				70.443
3.004	18	15 Winter	100	+40%	100/15 Summer				70.287
4.000	19	15 Summer	100	+40%					69.600
4.001	20	15 Winter	100	+40%	100/15 Summer				69.431
3.005	19	15 Winter	100	+40%	100/15 Summer				69.378
3.006	20	15 Winter	100	+40%	30/15 Summer				69.281
3.007	21	15 Winter	100	+40%	30/15 Summer				68.724
5.000	22	15 Winter	100	+40%					70.069
5.001	23	15 Winter	100	+40%					69.091
5.002	24	15 Winter	100	+40%	100/15 Winter				68.874
1.008	9	240 Winter	100	+40%	30/15 Summer				68.330
1.009	28	240 Winter	100	+40%	30/15 Summer				68.340

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
2.004	10	1.029	0.000	0.12			4.7	SURCHARGED	
1.005	6	1.166	0.000	0.03			1.8	SURCHARGED	
1.006	7	1.231	0.000	0.02			1.6	SURCHARGED	
1.007	8	-0.197	0.000	0.26			45.7	OK	
3.000	14	0.155	0.000	1.18			21.0	SURCHARGED	
3.001	15	0.117	0.000	1.21			20.3	SURCHARGED	
3.002	16	0.083	0.000	1.07			20.0	SURCHARGED	
3.003	17	0.050	0.000	1.11			19.7	SURCHARGED	
3.004	18	0.024	0.000	1.13			19.6	SURCHARGED	
4.000	19	-0.150	0.000	0.00			0.0	OK	
4.001	20	0.158	0.000	0.54			11.5	SURCHARGED	
3.005	19	0.342	0.000	0.65			32.2	SURCHARGED	
3.006	20	0.649	0.000	1.58			74.6	SURCHARGED	
3.007	21	0.305	0.000	1.59			74.7	SURCHARGED	
5.000	22	-0.081	0.000	0.43			16.5	OK	
5.001	23	-0.059	0.000	0.67			16.3	OK	
5.002	24	0.003	0.000	1.12		5	34.3	FLOOD RISK	
1.008	9	1.030	0.000	0.09			5.3	SURCHARGED	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.009	28	1.100	0.000	0.06			4.7	FLOOD RISK	

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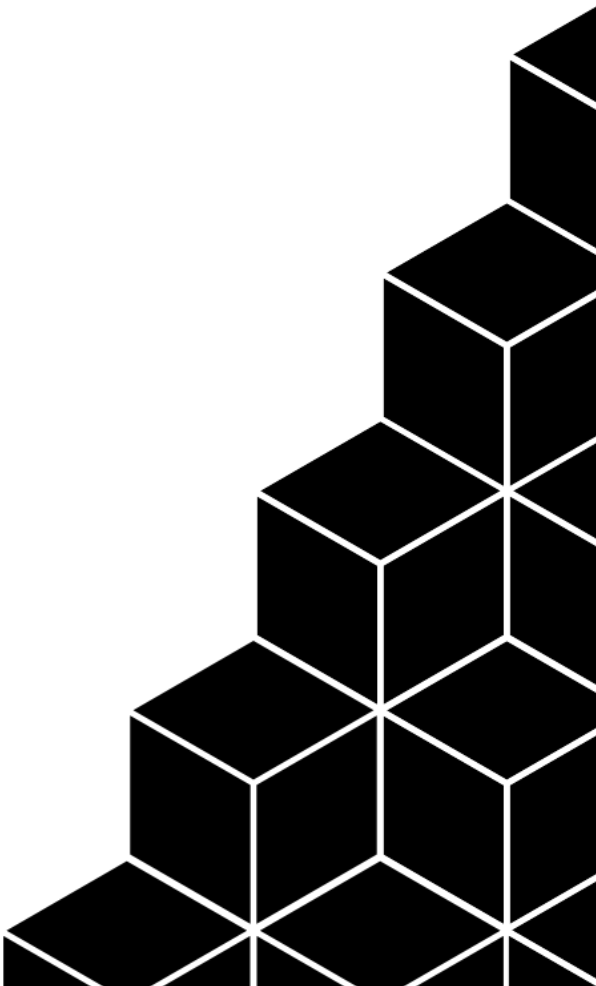

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