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DRAINAGE STRATEGY REPORT
FOR
Green Walk Garages, Ruislip HA4 8NL

DATE: NOV 2023

OUR REF: PK105/DS Rev/

Director: Pawel Kukiela MEng
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REPORT DETAILS

Reference/Rev	Report Type	Author	Issue Date
PK105/DS Rev/	DRAINAGE STRATEGY	PK	NOV 2023
Revision	**Details of Revision**	**Initials**	**Date**

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1.0 INTRODUCTION

1.1 TERMS OF REFERENCE

1.1.1 This Surface and Foul Water Drainage Strategy has been prepared by STAAC Ltd in respect of a Planning Application for proposed development of land at Green Walk Garages, Ruislip HA4 8NL

1.1.2 DEVELOPMENT PROPOSALS

The new application is to comprise 2 residential units with associated access, additional parking areas and landscaping.

1.1.3 This study is based on drawings as provided by STAAC Ltd.

1.1.4 NEED FOR STUDY

The purpose of this valuation is to prove that the development proposal outlined above can be satisfactorily used without affecting flood risk for the neighbourhood and without exposing the development itself at risk of flooding, in accordance with National guidance provided within the National Planning Policy Framework document (NPPF).

1.1.5 A topographical survey of the site (referenced to Ordnance Datum) has been provided to MKSurveys Ltd and has been reviewed as part of this assessment.

1.1.6 The following abbreviations are used in this report:

- AOD – Above Ordnance Datum;
- BGL – Below Ground Level;
- EA – Environment Agency;
- FZM – Flood Zone Map prepared by the EA;
- NPPF – National Planning Policy Framework;
- FRA – Flood Risk Assessment
- SFRA – Strategic Flood Risk Assessment; and
- SUDS – Sustainable Urban Drainage Systems.

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2.0 THE EXISTING SITE

2.1 The proposed development site is circa 0.047ha area of brownfield land located at Green Walk Garages, Ruislip HA4 8NL. The proposed development will consist of 2 residential units with associated drives and landscaped areas. The site eastern boundaries are formed by residential plots at Windmill Lane, Ruislip. There are residential dwellings to the east and north of the site. The southern boundaries are formed by the fence of green areas most likely being part of residential properties at Pembroke Road. There is an unnamed watercourse circa 400m to the south of site.
The site location is shown in the Figure 1 below.

The site is situated within Flood Zone 1 as indicated in Flood Map for Planning in Appendix E. The site is not affected by flooding at any event. Flood Risk Assessment is not required for sites situated within Flood Zone 1 with less than 1ha area.

Figure 1 – SITE LOCATION PLAN (https://flood-map-for-planning.service.gov.uk/)

2.2 Land use near the site is generally residential along Green Walk with green areas located to the south of the site. The figure below shows aerial photo of the site and surroundings.

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Figure 2 - AERIAL PHOTO (source www.google.pl/maps)

2.3 The topographical survey shows that the site is generally flat but falls from 51.24 AOD in the south west to about 50.25 AOD in the north east.

2.4 Topographical survey provided by MKSurveys show the presence of (most likely) combined water sewer located at connection to Green Walk turning head to the north east which flows most likely in a northern direction.

The summary of existing site location features is presented in the Table 1 below.

Table 1 – Site Summary

Project Name	Green Walk
Address	Green Walk Garages, Ruislip HA4 8NL
OS NGR	OSNGR 509706 E, 187276 N.
Site Area	0.047ha
Development Type	Residential
EA Development Control Area	North West
Local Planning Authority	London Borough of Hillingdon

2.5 NEARBY WATER COURSES/ DRAINAGE FEATURES

There is an unknown name watercourse 500m to the south of Green Walk. This ordinary watercourse is assumed to flow in a south east direction. However, there is no option to connect to this water course without crossing 3rd party land.

2.6 EXISTING DRAINAGE

The site is a brownfield land. There is an existing brownfield runoff. For this reason it is advised in line with NPPF and other guidance that the existing runoff rate is identified. This has been done and the following brownfield rates have been calculated: 6.3l/s discharge for the 1 year event, 15.5l/s discharge for the 1:30 year event and 19.9l/s for the 1:100 year event. Refer to Appendix B.

2.7 EXISTING GROUND CONDITIONS

Reading publications of the British Geological Survey (BGS) it can be cited that the soil consists of " vertically and laterally variable sequences mainly of clay, some silty or sandy, with some sands and gravels, minor limestones and lignites and occasional sandstone and conglomerate. The Lambeth Group was deposited in fluvial, estuarine, lagoonal or proximal marine environments. Late Paleocene to Early Eocene (late Thanetian to early Ypresian)" The borehole log shows made ground underlined by "stiff fissured brown and grey mottled silty clay" then "stiff fissured grey sitly clay" (source:BGS)

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3.0 SURFACE WATER DRAINAGE STRATEGY

3.1 Suitable control measures will be essential within the site to mitigate flood risk posed by post development runoff. This will be via surface water discharge limit from site.

3.2 INFILTRATION POTENTIAL

As mentioned in point 2.7 British Geological Survey (BGS) shows little or no potential for infiltration. Therefore, at this stage infiltration rate testing has not been undertaken.

3.3 CALCULATIONS

The proposed development has the area of approximately 0.047 ha. The total impermeable area, which is 330m2, accounts for impermeable surfacing (roofs, access and driveways). Preliminary calculations show that sufficient storage required to attenuate runoff from the proposed impermeable areas arising from the critical 1:100 year + 40% climate change event can be provided within SUDS feature –attenuation storage crate. For information about the design storm period and intensity and calculations refer to Appendix C. Please, refer to PK105-140DS Preliminary Drainage Strategy (see Appendix A).

3.4 Due to site characteristic is it proposed that surface drainage system will consist of storage SUDS elements and piped system.

3.5. From BGS (as per point 3.2) the rate of permeability of the ground would be low and/or unreliable. Therefore soakaways are precluded in the development as the primary means of surface water disposal/drainage for the site.

3.6 Based on surface geology across the site (BGS) it is advised that an alternative comprehensive drainage scheme is developed at detailed design stage to accommodate the discharge of surface water from the proposed impermeable areas.

3.7 The development should be drained to the private sewer to the north at a controlled rate of discharge. The existing runoff regime from the 0.047ha development site area has been evaluated. The Brownfield runoff - rate preexisting rate of discharge for 100year storm was evaluated as 19.9 l/s.
It should be noted that 5l/s rate is commonly minimum rate to avoid blockages not just for Flow Control, but the whole system downstream from Flow Control. Therefore, although Brownfield runoff - rate preexisting has been evaluated as 100year storm rate of 19.9 l/s, the range between 3.6l/s to 7.7l/s rate which will be close to average value of 5l/s should be considered by Authorities as more suitable option, which excludes flood risk from blocked pipe and provides substantial reduction (43-66% depending on the event). Therefore, it is expected Thames Water Utilities will accept the range between 3.6l/s to 7.7l/s for events from 1yr to 100yr+40%cc for the connections from the site.

3.8 An initial surface water drainage design has been carried out to satisfy a question of the feasibility of the new development. The anticipated attenuation storage balances the surface water runoff from the proposed impermeable development areas back to the brownfield runoff rate with reduction discussed above. It is proposed the surface drainage from the whole site will discharge to private sewer to the north of site.

3.9 The total volume of the storage crates, based on a proposed 330m2 - the total impermeable site area at average 5l/s restriction rate at connection point - is circa 3 m3. Please refer to the surface water calculations in Appendix C.

3.10 A preliminary drainage strategy layout comprising the system of pipes, catchpits, manholes and a storage crates is presented in Appendix A. It needs to be taken into account, this is a preliminary outline solution at planning stage and it will be required to re-design it once detailed layout design has been completed.

3.11 The private areas design is to be confirmed at the detailed stage, but it is likely that properties on the site would drain into the private combined or storm water sewers to the north of site. The development can drain to this sewers if it is feasible, but also other manholes of Thames Water Utilities Surface Water system as well as other points of discharge can be taken into consideration, depending on proposal in the detailed design.

3.12 WATER QUALITY

Introduction of catchpits and gullies with sumps will improve the quality of water leaving the site outside extreme storm events. So, this will be beneficial from the treatment train point of view.

3.13 DESIGN EXCEEDANCE

In the event of a blockage of the outfall pipework, which is unlikely although possible at or lower than 3.6/s discharge rate (the rate preventing blockage should be set as 5l/s as average for various events) - an overflow path exists towards the north-east boundary then within channels of Green Walk turning head using gullies or on the surface towards main Green Walk and along it to the east towards and further along Green Walk without affecting any onsite or adjacent properties due to FFLs or back footway levels being higher than road channels where water will drain via gullies and drains or if this fails, along the road channels towards Pembroke Road to the south and then towards east following the topography of the road.

MAINTANANCE AND ADOPTION

3.14 It is proposed that the SUDS feature in the scheme will be attenuation storage under the car park south east of site. The piped system may be offered for adoption separately as well. Adoptable sewers could be designed to Sewerage Sector Guidance or Sewers for Adoption if agreed with Thames Water Utilities in this case. The maintenance regime is as described below.

3.15 CELLULAR SOAKAWAY

Cellular soakaway or storage could be considered only in the private areas, as they normally are not adopted by Highways or Water Authority. Soakaways are unsuitable for this development due to no infiltration on site and additionally limited space in the front of and back the buildings, difficult access in the garden areas with limited functionality (head of the run). There is a potential for cover issues with shallow pipes, potential for clash with tree root protection areas, services, etc.
It is to be noted the tanked cellular storage is to be used on site as attenuation feature in the private but open access car park which highly contributes to lowering discharge rates (significant reduction of brownfield) rates using 3m3 of storage.

3.16 PIPEWORK AND CATCHPITS

Catchpits could be used in the manholes where drainage from private areas connects to the main run. The catchpits within the road are not discussed at this stage, as their use will depend on adoption authority if the developer is willing to offer the scheme for adoption

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and the main run may be moved to the road in this case. The debris and silt protection measures will be discussed at detail design stage.
The pipes network will need a robust maintenance regime. The debris and silt are to be removed from the system regularly. It is recommended the whole drainage system will undergo routine inspection (every three months) and is cleaned of silt and debris if found.
If the scheme is offered for adoption, the maintenance regime by the owning Authority will apply.

3.17 WATER RECYCLING BY WATERBUTTS

The water butts will be used as water recycling, and discharged to the ground by watering the garden.

3.18 SUMMARY OF SUDS OPTIONS

Summary of SUDS options applicable on site and their maintenance regime is shown in the table 3.

Table 3 – SITE SUMMARY OF SUDS OPTION AND MAINTENANCE REGIME

SUDS Element	Applicability	Maintenance Regime
Cellular Soakaway	x	Not applicable – only tanked cellular storage – some jet-washing may be required every 5 years or if need be.
Catchpits& inspection chambers	v	Will require a robust maintenance regime. The debris and silt are to be removed from the system regularly. Routine inspection (every three months) and cleaning of silt and debris if found.
Water Butts	x	No special maintenance required

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4.0 FOUL DRAINAGE PROPOSAL

4.1 Foul water is proposed to discharge to the existing private foul combined water sewer most likely located within front of neighboring property to the north east at Green Walk turning head from the north of site connecting to an existing Manhole with Cover Level and Invert Level yet to be confirmed. The Location of the private foul sewer manhole is indicatively shown on google maps arial photo– see figure 3 below.

Figure 3 – LOCATION OF THE PRIVATE FOUL SEWER MANHOLE (source google maps)

4.2 The proposed site topography allows connection of 100mm diameter pipes at 1 in 80 gradients. This is in accordance with Building Regulations part H, which requires minimum 5 toilets to use 150mm pipes, which is not the case here. The site with 2 dwellings will be connected via 100mm diameter pipes at 1 in 80. The 100mm is normally acceptable for

Thames Water Utilities in case of adoption, if less than 10 building are connected to such a pipe. This is the case within this site, then in case of offering for adoption 100mm pipes would need to be used. The adoption details can be discussed and agreed with Water Authority at further stage if required.

4.3 Internal simple grey water recycling system for WC use only is to be installed. The details are yet to be confirmed, but will be to manufacturers information, and consulted with architect. The example systems may found at:

https://www.aqua-lity.co.uk/greywater-recycling
https://vareoblu.com/domestic-grey-water-recycling/

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5.0 SUMMARY

5.1 The purpose of this Drainage Strategy was to form description and explanation to the design shown in Drainage Strategy drawing as per Appendix A.

5.2 The existing site is mainly brownfield. The proposed development consists of buildings, footways, drives and landscaped areas.

5.3 The preliminary drainage design has been undertaken for proposed development to check feasibility and satisfy planning criteria formulated within NPPF.

5.4 The surface water strategy indicated that soakaways are not feasible. The proposed drainage system will be a mix of piped network, catchpits and crate storages to provide maximum attenuation, filtration and recycling (water butts), to form efficient treatment train.

5.5 The discharge rate for Surface Water has been limited to 7.7l/s for all events including 100year + 40% Climate Change. The pre-existing brownfield rate for 100year event is evaluated as 19.9 l/s, then 7.7l/s is 61% reduction, and an average 5l/s rate should be permitted, due to potential risk of blockage for connection point.

5.6 The Surface Drainage has been also checked for exceedance, and suitable flood pathways have been identified.

5.7 The SUDS of various type were discussed, and it was explained why some of the SUDS features are not suitable. Additionally, a maintenance regime has been proposed for the SUDS used on site.

5.8 Foul Water network has also been proposed and discussed. An internal greywater recycling system for WC use was also proposed.

5.9 To conclude it has been proven within this Drainage Strategy Report that the design is compliant with the requirements of NPPF and Environmental Agency regulations, and the planning permission should not be refused on this ground.

5.10. The site is situated within Flood Zone 1 as indicated on Flood Map for Planning in Appendix G. The site is not affected by flooding at any event and the Flood Risk Assessment is not required for this site located in Flood Zone 1 with less than 1ha area.

Signed:  Date: 06/11/2023
Pawel Kukiela
Civil and Structural Engineer MEng

Appendix A

LOCATION OF EXISTING SEWERS ARE ASSUMED. THE CONTRACTOR SHALL CONFIRM THE LOCATIONS, LEVELS, DIAMATER AND CONDITION OF THE SEWERS PRIOR TO COMMENCING CONSTRUCTION WORKS ON SITE.

CONTRACTOR TO COMPLETE S106 APPLICATIONS AND OBTAIN APPROVAL PRIOR TO CONNECTING TO THE PUBLIC SEWER.

Contractor to check for any existing 3rd party sewers crossing the site and all disused sewers are sealed.

Design subject to planning conditions

Built to public sewer permission to be obtained

Design subject to change when internal layouts are available

Design is provisional and subject to changes when building internal layouts are available – Final RWP points from house to be confirmed by Architect.

All excavation in proximity of trees to be by hand, with no tree roots >25mm diameter severed. Only horticultural grade loppers or pruners to be used for root severance. All exposed roots will immediately be wrapped or covered to prevent desiccation; prior to backfilling exposed roots shall be covered with good quality topsoil or sharp sand (not builders due to high salt content).

Advise from geotechnical engineer to be sought to check ground stability associated with chalk bedrock if encountered.

Notes:

1. DO NOT SCALE.
2. This drawing should be read in conjunction with all other relevant drawings and details.
3. If there is any conflict between the information on this drawing and that indicated on other drawings the Engineer should be informed BEFORE commencement of construction on site.
4. It should be understood that all drawings issued are Preliminary and NOT for construction until technical approval has been obtained from the relevant Authority and changing drawing to Construction status. If the contractor commences site work prior to such approval being given or status changed, it is solely at his own risk.
5. All dimensions are given in millimetres unless noted otherwise.
6. The Risk Assessment and Hazard Identification and information for this project must be reviewed and understood by the contractor BEFORE the commencement of any works on site.
7. The Contractor is responsible for checking all tie-ins for line and level with existing prior commencement of any works. If any errors are found The Engineer, should be notified immediately in writing.
8. The positions of soil & vent pipes & rainwater pipes etc and level information on this drawing are indicative only. Refer to current Architects Plans' for location(s). The drainage design may require the change after all those locations have been confirmed. All rainwater and soil and vent pipes shall be completed with rodding access.
9. The Building Regulations Part H apply to all private drainage to be constructed.
10. All private drains/sewers to be 100 mm diameter unless noted otherwise.
11. For details of pipes penetrating walls and pipe runs near buildings refer to Building Regulations Part 'H'.
12. All workmanship should be in accordance with the most current British Standards.
13. The drainage is designed for the permanent case. Should additional loads over & above those designed for may arise during the construction process, the Contractor shall ensure any necessary temporary protection is in place for pipelines, manholes etc. so nothing is damaged as a result of his method of working.
14. Pipe gradients shown are indicative only and are not be used for setting out purposes.
15. Internal drainage indicative only. Architects or M&E engineers drawings should be referred to for in-house connections.
16. Contractor to liaise with Statutory Undertakers and Services Owners to agree services diversions if necessary.
17. Design subject to change when foundation type confirmed.
18. Cover levels may need adjustment to suit the surface

	Existing Brownfield rates l/s	Storm	Proposed rates l/s	Reduction
1 year	6.3	1 year	3.6	43%
30 years	15.5	30 years	5.2	66%
100 years	19.9	100 years+40%	7.7	61%

Key:

- Proposed Private Foul Water Sewer
- Proposed Private Surface Water Sewer
- Proposed Rain Water Pipe (RWP)
- Proposed Private Surface Water PPIC (Inspection Chamber)
- Proposed Private Surface Water Manhole
- Yard Gulley (Yg)
- Proposed Private Surface Water Rodding Eye (RE)
- Site Boundary
- Linear Drain

Rev	Date	Description	By	Ckd

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Client: STAAC Ltd

Project: Green Walk Garages, Ruislip HA4 8NL

Title: Outline Drainage Layout

Drawing Status: PRELIMINARY

Job No.: PK105

Drawn	Checked	Scale at A1	Date	Issue Date
PK	PK	1:100	05.11.2023	05.11.2023

Drawing No.: PK105-140DS

Revision: P0

Appendix B

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1			51.000	600	509712.519	187281.239	27.021
2			50.750	600	509713.935	187285.018	26.650
3	0.047	5.00	50.250	600	509724.990	187287.036	26.271
out			50.610	600	509724.882	187288.257	26.645
0		5.00	51.000	100	509709.679	187272.707	26.500

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
0 1	0	1	8.992	0.600	24.500	23.979	0.521	17.3	100	5.08	50.0
1 2	1	2	4.036	0.600	24.500	24.100	0.400	10.1	100	5.11	50.0
2 3	2	3	11.238	0.600	24.100	23.979	0.121	92.9	100	5.34	50.0
3 out	3	out	1.226	0.600	23.979	23.965	0.014	87.6	100	5.37	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
0 1	1.868	14.7	0.0	26.400	26.921	0.000	0.0	0	0.000
1 2	2.447	19.2	0.0	26.400	26.550	0.000	0.0	0	0.000
2 3	0.798	6.3	0.0	26.550	26.171	0.000	0.0	0	0.000
3 out	0.822	6.5	6.4	26.171	26.545	0.047	0.0	81	0.937

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
0 1	8.992	17.3	100	Circular_Default Sewer Type	51.000	24.500	26.400	51.000	23.979	26.921
1 2	4.036	10.1	100	Circular_Default Sewer Type	51.000	24.500	26.400	50.750	24.100	26.550
2 3	11.238	92.9	100	Circular_Default Sewer Type	50.750	24.100	26.550	50.250	23.979	26.171
3 out	1.226	87.6	100	Circular_Default Sewer Type	50.250	23.979	26.171	50.610	23.965	26.545

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
0 1	0	100	Manhole	Adoptable	1	600	Manhole	Adoptable
1 2	1	600	Manhole	Adoptable	2	600	Manhole	Adoptable
2 3	2	600	Manhole	Adoptable	3	600	Manhole	Adoptable
3 out	3	600	Manhole	Adoptable	out	600	Manhole	Adoptable

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	20.000	Drain Down Time (mins)	240
Ratio-R	0.400	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

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

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	0	0	0
100	0	0	0
100	30	0	0

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.39%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	1	23.979	0.000	0.0	0.0000	0.0000	OK
15 minute summer	2	1	24.100	0.000	0.0	0.0000	0.0000	OK
15 minute winter	3	10	24.083	0.104	6.6	0.0332	0.0000	SURCHARGED
15 minute winter	out	10	24.046	0.081	6.3	0.0000	0.0000	OK
15 minute summer	0	1	24.500	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	1 2	2	0.0	0.000	0.000	0.0000	
15 minute summer	2	2 3	3	0.0	0.000	0.000	0.0436	
15 minute winter	3	3 out	out	6.3	0.843	0.982	0.0090	3.1
15 minute summer	0	0 1	1	0.0	0.000	0.000	0.0000	

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.39%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	1	23.979	0.000	0.0	0.0000	0.0000	OK
15 minute winter	2	11	24.251	0.151	1.4	0.0428	0.0000	SURCHARGED
15 minute winter	3	11	24.251	0.272	16.3	0.0869	0.0000	SURCHARGED
15 minute summer	out	9	24.060	0.095	14.9	0.0000	0.0000	OK
15 minute summer	0	1	24.500	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	1 2	2	0.0	0.000	0.000	0.0158	
15 minute winter	2	2 3	3	-1.4	-0.224	-0.223	0.0879	
15 minute winter	3	3 out	out	15.5	1.986	2.405	0.0095	7.5
15 minute summer	0	0 1	1	0.0	0.000	0.000	0.0000	

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.39%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	1	23.979	0.000	0.0	0.0000	0.0000	OK
15 minute winter	2	11	24.376	0.276	2.1	0.0780	0.0000	SURCHARGED
15 minute winter	3	11	24.375	0.396	21.1	0.1263	0.0000	SURCHARGED
15 minute summer	out	8	24.060	0.095	19.1	0.0000	0.0000	OK
15 minute summer	0	1	24.500	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	1 2	2	0.0	0.000	0.000	0.0158	
15 minute winter	2	2 3	3	-2.1	-0.266	-0.330	0.0879	
15 minute winter	3	3 out	out	19.9	2.545	3.083	0.0095	9.7
15 minute summer	0	0 1	1	0.0	0.000	0.000	0.0000	

Results for 100 year +30% CC Critical Storm Duration. Lowest mass balance: 99.39%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	13	24.076	0.097	1.5	0.0274	0.0000	OK
15 minute winter	2	11	24.538	0.438	2.4	0.1241	0.0000	SURCHARGED
15 minute winter	3	11	24.543	0.564	27.4	0.1800	0.0000	SURCHARGED
15 minute summer	out	8	24.060	0.095	24.1	0.0000	0.0000	OK
15 minute summer	0	1	24.500	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1 2	2	-1.5	-0.275	-0.076	0.0178	
15 minute winter	2	2 3	3	2.5	0.319	0.399	0.0879	
15 minute winter	3	3 out	out	24.7	3.153	3.819	0.0095	12.5
15 minute summer	0	0 1	1	0.0	0.000	0.000	0.0099	

Appendix C

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.010	5.00	51.000	600	509712.519	187281.239	1.257
2	0.008	5.00	50.750	600	509713.935	187285.018	1.047
3	0.008	5.00	50.250	600	509724.990	187287.036	0.660
out			50.610	600	509724.882	187288.257	1.035
0	0.007	5.00	51.000	100	509709.679	187272.707	1.167

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
0 1	0	1	8.992	0.600	49.833	49.743	0.090	99.9	100	5.19	50.0
1 2	1	2	4.036	0.600	49.743	49.703	0.040	100.9	100	5.28	50.0
2 3	2	3	11.238	0.600	49.703	49.590	0.113	99.4	100	5.53	50.0
3 out	3	out	1.226	0.600	49.590	49.575	0.015	81.7	100	5.55	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
0 1	0.769	6.0	0.9	1.067	1.157	0.007	0.0	27	0.560
1 2	0.765	6.0	2.3	1.157	0.947	0.017	0.0	43	0.712
2 3	0.771	6.1	3.4	0.947	0.560	0.025	0.0	54	0.793
3 out	0.852	6.7	4.5	0.560	0.935	0.033	0.0	60	0.912

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
0 1	8.992	99.9	100	Circular_Default Sewer Type	51.000	49.833	1.067	51.000	49.743	1.157
1 2	4.036	100.9	100	Circular_Default Sewer Type	51.000	49.743	1.157	50.750	49.703	0.947
2 3	11.238	99.4	100	Circular_Default Sewer Type	50.750	49.703	0.947	50.250	49.590	0.560
3 out	1.226	81.7	100	Circular_Default Sewer Type	50.250	49.590	0.560	50.610	49.575	0.935

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
0 1	0	100	Manhole	Adoptable	1	600	Manhole	Adoptable
1 2	1	600	Manhole	Adoptable	2	600	Manhole	Adoptable
2 3	2	600	Manhole	Adoptable	3	600	Manhole	Adoptable
3 out	3	600	Manhole	Adoptable	out	600	Manhole	Adoptable

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	20.000	Drain Down Time (mins)	240
Ratio-R	0.400	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

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

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	0	0	0
100	40	0	0

Node 3 Online Orifice Control

Flap Valve	✓	Design Depth (m)	0.500	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	7.0		
Invert Level (m)	49.590	Diameter (m)	0.070		

Node 1 Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	49.743	Depth (m)	0.400
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	17	Inf Depth (m)	
Safety Factor	2.0	Pit Width (m)	4.000	Number Required	1
Porosity	0.95	Pit Length (m)	2.000		

Results for 1 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	12	49.786	0.043	2.4	0.3422	0.0000	OK
15 minute winter	2	12	49.768	0.065	3.0	0.0281	0.0000	OK
15 minute winter	3	12	49.747	0.157	3.7	0.0825	0.0000	SURCHARGED
15 minute summer	out	1	49.575	0.000	3.4	0.0000	0.0000	OK
15 minute winter	0	10	49.860	0.027	1.0	0.0035	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1 2	2	2.0	0.535	0.339	0.0172	
15 minute winter	2	2 3	3	2.8	0.394	0.459	0.0740	
15 minute winter	3	Orifice	out	3.6				2.1
15 minute winter	0	0 1	1	1.0	0.503	0.160	0.0214	

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	14	49.944	0.201	5.9	1.6153	0.0000	SURCHARGED
15 minute winter	2	13	49.933	0.230	4.6	0.1001	0.0000	SURCHARGED
15 minute winter	3	13	49.885	0.295	5.4	0.1550	0.0000	SURCHARGED
15 minute summer	out	1	49.575	0.000	5.0	0.0000	0.0000	OK
15 minute winter	0	14	49.947	0.114	2.4	0.0146	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1 2	2	3.4	0.548	0.574	0.0316	
15 minute winter	2	2 3	3	4.0	0.517	0.668	0.0879	
15 minute winter	3	Orifice	out	5.2				5.3
15 minute winter	0	0 1	1	2.4	0.550	0.393	0.0704	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	1	23	50.343	0.600	7.4	3.3088	0.0000	SURCHARGED
30 minute winter	2	23	50.318	0.615	6.8	0.2683	0.0000	SURCHARGED
30 minute winter	3	23	50.194	0.604	8.2	0.3169	0.0000	FLOOD RISK
15 minute summer	out	1	49.575	0.000	6.8	0.0000	0.0000	OK
30 minute winter	0	23	50.350	0.517	3.4	0.0662	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute winter	1	1 2	2	4.4	0.560	0.728	0.0316	
30 minute winter	2	2 3	3	5.8	0.737	0.952	0.0879	
30 minute winter	3	Orifice	out	7.7				12.6
30 minute winter	0	0 1	1	2.5	0.538	0.414	0.0704	

Calculated by:	Pawel Rukiela
Site name:	Green Walk
Site location:	Ruislip

This is an estimation of the storage volume requirements that are needed 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). It is not to be used for detailed design of drainage systems. It is recommended that hydraulic modelling software is used to calculate volume requirements and design details before finalising the design of the drainage scheme.

Site Details

Latitude:	51.57380° N
Longitude:	0.41772° W
Reference:	3523905681
Date:	Nov 03 2023 14:54

Site characteristics

Total site area (ha):	0.0330603
Significant public open space (ha):	0
Area positively drained (ha):	0.0330603
Impermeable area (ha):	00.0330603
Percentage of drained area that is impermeable (%):	100
Impervious area drained via infiltration (ha):	0
Return period for infiltration system design (year):	100
Impervious area drained to rainwater harvesting (ha):	0
Return period for rainwater harvesting system (year):	10
Compliance factor for rainwater harvesting system (%):	66
Net site area for storage volume design (ha):	0.03
Net impermable area for storage volume design (ha):	0.03
Pervious area contribution to runoff (%):	30

Methodology

esti	IH124
Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	4	4
SPR:	0.47	0.47

Hydrological characteristics

	Default	Edited
Rainfall 100 yrs 6 hrs:	--	63
Rainfall 100 yrs 12 hrs:	--	89.32
FEH / FSR conversion factor:	1.16	1.16
SAAR (mm):	647	647
M5-60 Rainfall Depth (mm):	20	20
'r' Ratio M5-60/M5-2 day:	0.4	0.4

* where rainwater harvesting or infiltration has been used for managing surface water runoff such that the effective impermeable area is less than 50% of the 'area positively drained', the 'net site area' and the estimates of Q_{BAR} and other flow rates will have been reduced accordingly.

Hydological region:	6	6
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 10 year:	1.62	1.62
Growth curve factor 30 year:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Q_{BAR} for total site area (l/s):	0.15	0.15
Q_{BAR} for net site area (l/s):	0.15	0.15

Design criteria

Climate change allowance factor:	1.4
Urban creep allowance factor:	1.1
Volume control approach	Use long term storage
Interception rainfall depth (mm):	5
Minimum flow rate (l/s):	2

Site discharge rates

	Default	Edited
1 in 1 year (l/s):	2	2
1 in 30 years (l/s):	2	2
1 in 100 year (l/s):	2	2

Estimated storage volumes

	Default	Edited
Attenuation storage 1/100 years (m^3):	9	9
Long term storage 1/100 years (m^3):	0	0
Total storage 1/100 years (m^3):	9	9

This report was produced using the storage estimation tool developed by HRWallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at http://uksuds.com/terms-and-conditions.htm. The outputs from this tool have been used to

estimate storage volume requirements. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of these data in the design or operational characteristics of any drainage scheme.

Appendix D

CG2, 8 TQ08NE 118

Contract Name RUISLIP

Borehole No. 1

Sheet 1 of 1

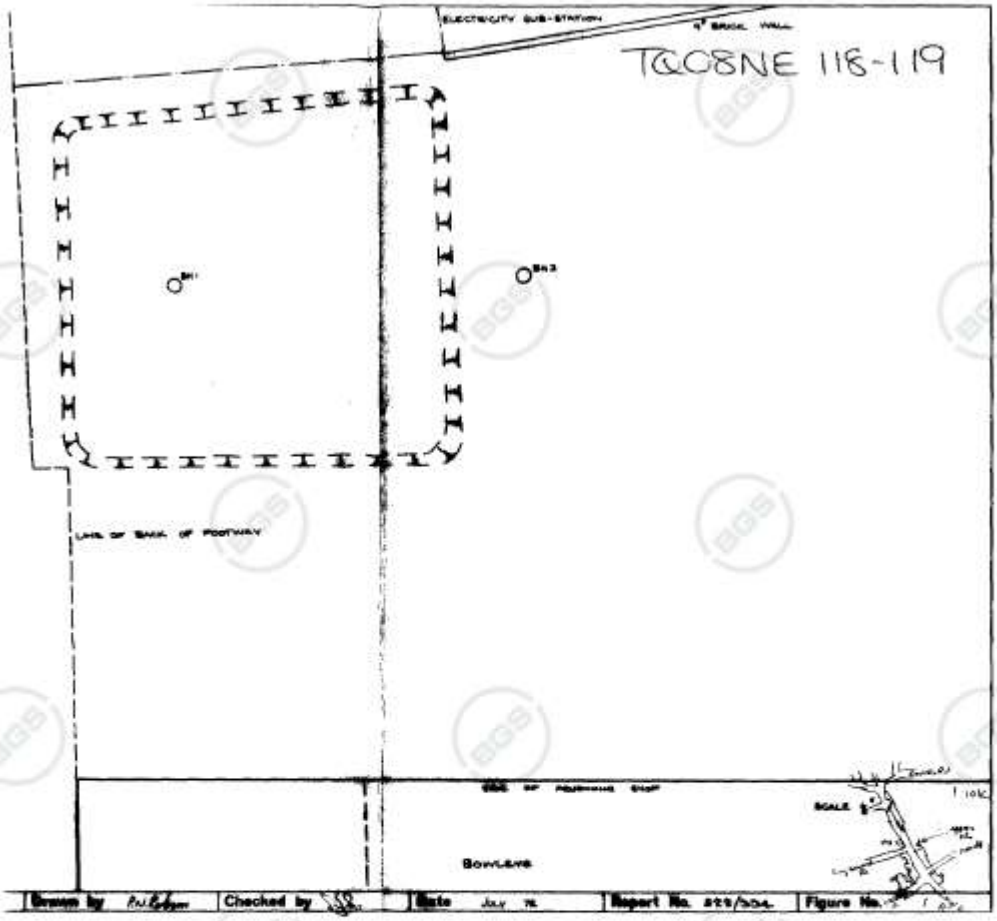
Method of boring Shell and Auger
Diameter 6"

Ground level
Start 21.6.72
Finish 21.6.72

Daily progress	Water levels	In-situ tests	Samples	Depth (ft)	Reduced level (ft OD)	Thickness (ft)	Description of Strata	
21/6				1'6"		1'6"	Bricks and brick dust	Made Ground
				2'0"		0'6"	Concrete	
			U					
			J					
			U					
			J					
			U					
			J					
			J			20'0"	Stiff fissured brown and grey mottled silty clay	
			U					
			J					
				22'0"				
			U					
			J			8'0"	Stiff fissured grey silty clay	
			U					
21/6				30'0"			Bottom of Borehole	

Notes ⧖ Water struck, ⧗ Morning water level, —— Casing depth, ---- Borehole depth

Terresearch Limited | Report No. S.21/554 | Appendix 1 Sheet 1


TQ08NE 118-119
Bowling
Drawn by
Checked by
Date
Report No.
Figure No.

Appendix E

Flood map for planning

Your reference	Location (easting/northing)	Created
<Unspecified>	**509715/187277**	**3 Nov 2023 15:34**

Your selected location is in flood zone 1, an area with a low probability of flooding.

You will need to do a flood risk assessment if your site is **any of the following:**

- bigger that 1 hectare (ha)
- In an area with critical drainage problems as notified by the Environment Agency
- identified as being at increased flood risk in future by the local authority's strategic flood risk assessment
- at risk from other sources of flooding (such as surface water or reservoirs) and its development would increase the vulnerability of its use (such as constructing an office on an undeveloped site or converting a shop to a dwelling)

Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.

Environment Agency

Flood map for planning

Your reference
<Unspecified>

Location (easting/northing)
509715/187277

Scale
1:2500

Created
3 Nov 2023 15:34

- Selected area
- Flood zone 3
- Flood zone 2
- Flood zone 1
- Flood defence
- Main river
- Water storage area

0 20 40 60m

Appendix F

Notes:

1. GRID AND LEVELS BASED ON ORDNANCE DATUM, DERIVED FROM THE NATIONAL GNSS NETWORK. LOCAL SCALE FACTOR REMOVED.
2. TREE AND HEDGE SPECIES HAVE BEEN IDENTIFIED AS ACCURATELY AS POSSIBLE BUT SHOULD BE CROSS CHECKED IN CRITICAL AREAS.

Coordinate Table

Station	Description	Easting	Northing	Level
S1	Road Nail	509747.167	187327.633	49.691
S2	Road Nail	509735.325	187290.926	50.213
S3	Road Nail	509716.035	187283.736	50.788
S4	Road Nail	509680.295	187350.432	50.906
S5	Hilti Nail	509663.388	187275.475	51.269
S6	Hilti Nail	509677.739	187316.616	51.080
J12	Hilti Nail	509668.872	187291.479	51.146

Revision	Description	Surv. by	Appr. by	Date
1	Back gardens of houses 17-23 Windmill Lane added	JB	AJ / ??	July 2019

0m 2 4 6 8 10 12 14 16 18

mksurveys

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Ruislip Manor Cottage Society Ltd

Green Walk
Ruislip
London

Topographical Survey

Scale	Sheet Size:	Sheet Number:	Date:
1:200	A2	1	July 2018

Project Number:	Rev:	Surveyed By:	Approved By:
25751	1	TC	AJ