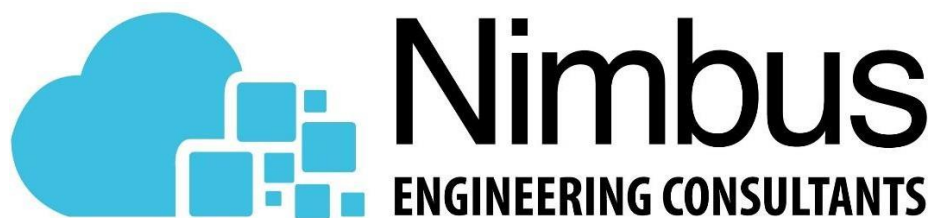


SUDS REPORT FOR
LAND ADJ 38 FINCHAMPSTEAD ROAD, WOKINGHAM,
RG40 2NN

DOCUMENT NUMBER.: C3310-R1-REV-B

PREPARED BY



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1. INTRODUCTION

1.1 Appointment

Nimbus Engineering have been appointed to provide a solution on the management of surface water run-off and to ensure that there is no risk of flooding caused by the proposed construction of a four bedroom house.

The existing and proposed site plans, can be found in Appendix A.

1.2 Objectives

This report will address the concerns raised by the Borough and provide details on a suitable Sustainable Urban Drainage System (SuDS) in order to reduce the surface water run-off leaving the site and show that the proposed development will not increase Flood Risk at the site or elsewhere.

1.3 Limitations

The general limitations of this report are:

- A number of data and information sources have been used to prepare this report. Whilst Nimbus Engineering believes them to be trustworthy, Nimbus Engineering is unable to guarantee the accuracy of data and information that has been provided by others.

- This report has been prepared using the best data and information that was available at the time of writing. There is the potential for further information or data to become available, leading to changes in the conclusions drawn by this report, for which Nimbus Engineering cannot be held responsible.

2. GEOLOGY OF THE AREA

According to, the British Geological Survey, the superficial deposits at site are unknown. However, the bedrock in the area is of the London Clay Formation, consisting of clay, silt, and sand, as shown in Figure 2, overleaf.

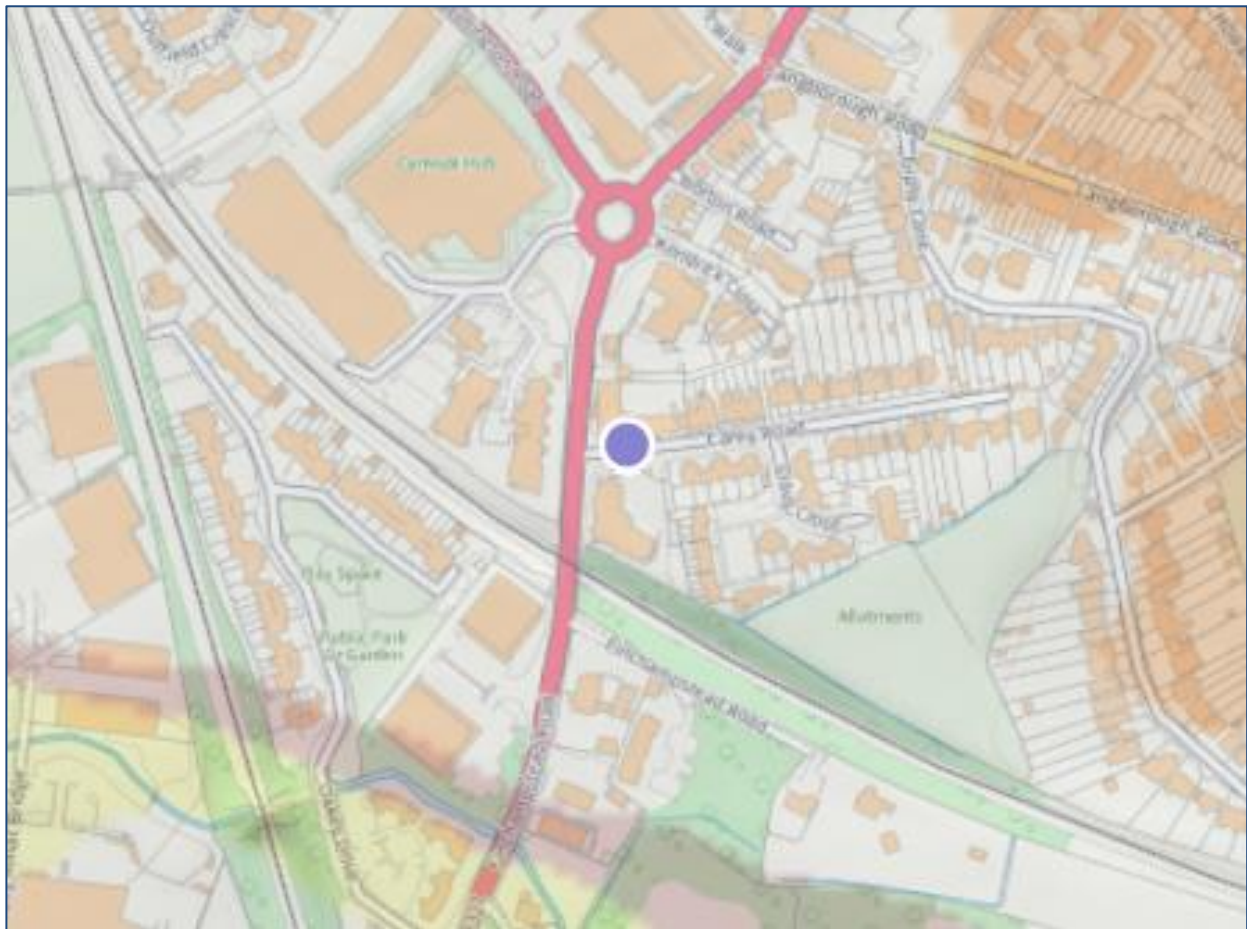


Figure 1 - Superficial Deposits at the site. (Source: British Geological Survey website (contains British Geological Survey materials © NERC2024)).



Figure 2- Bedrock at the site. (Source: British Geological Society Website (Contains British Geological Survey materials © URKI [2024]. Base mapping is provided by ESRI)

3. SUSTAINABLE URBAN DRAINAGE SYSTEMS

Surface water arising from a developed site should, as far as is practicable, be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the proposed development, while reducing the flood risk to the site itself and elsewhere, taking climate change into account.

Reducing the rate of surface water discharge from urban sites is one of the most effective ways of reducing and managing flood risk.

Traditional piped surface water systems work by removing surface water from our developments as quickly as possible, however this can cause various adverse impacts:

- Increased downstream flooding, and sudden rises in flow rates and water levels in local water courses.
- Reduction in groundwater levels and dry weather flows in watercourses.
- Reduce amenity and adversely affect biodiversity due to the surface water run-off containing contaminants such as oil, organic matter, and toxic materials

SuDS are defined as a sequence of management principles and control structures designed to drain surface water in a more sustainable fashion than conventional piped drainage techniques. SuDS should utilise the natural landscape of an area which as well as slowing down the rate of runoff provides a number of environmental, ecological and social benefits.

These include:

- Protection and enhancement of water quality. As well as providing on-site attenuation, SuDS treat the water, resulting in an improved quality of water leaving the site. This is achieved when the water passes through fine soils and the roots of specially selected plants. Pollutants washed off the hard landscaping by rainfall will be safely removed before the water reaches the natural receiving water course.
- A sympathetic approach to the environmental setting by providing opportunities to create habitats for flora and fauna in urban watercourses and open spaces.
- Meeting the amenity and social needs of the local community and residents in the creation of attractive green spaces.

The various types of SuDS include:

Permeable paving	
Soakaways.	
Swales and basins.	
Bioretention/ rain gardens.	
Green roofs and rainwater re-use.	

Preferably a combination of these techniques should be used as part of the surface water management train, and it is important for all stakeholders, such as developers, architects, landscape architects and engineers to work in order to determine a feasible solution.

The SuDS management train is shown below, and this has been followed when proposing the proposed Sustainable Urban Drainage Systems for this site.

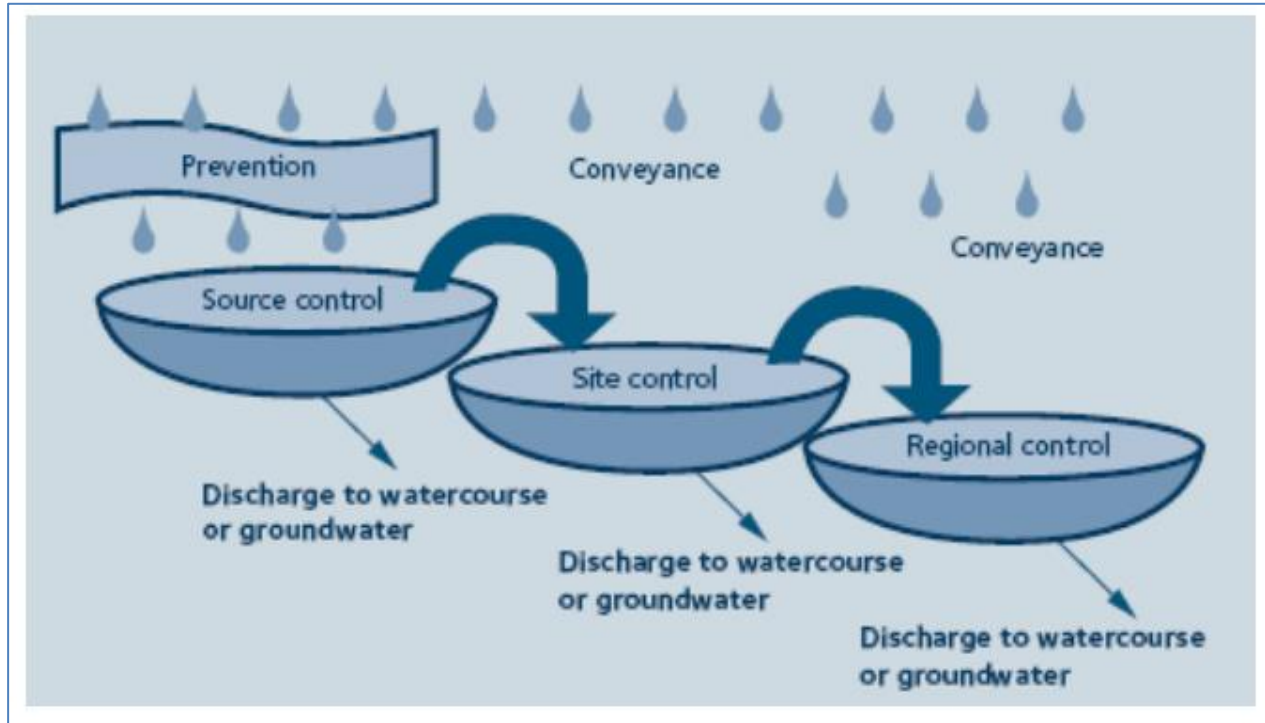


Figure 3 – SuDS Management Train

4. PROPOSED SOLUTION

The total site area for this proposed dwelling is 140m², with the existing areas at the site being 100% impermeable. Following the development proposals the impermeable areas at the site will decrease to 112.38 m², consisting of the roof areas of the proposed dwelling and the associated hardstanding areas.

Pre and post development surface water run off calculations prior to the inclusion of SuDS have been provided in Appendix B.

The underlying geology consists of clay; therefore, infiltration is unsuitable at this site. The water authority asset plans provided in Appendix C, shows that there is a surface water sewer adjacent to the site for restricted surface water discharges.

In order to follow the SuDS management train, two wall mounted rainwater harvesting tanks will be provided. However, there are no flat roof areas to provide green or sedum roofs.

All proposed hardstanding areas will be formed of permeable surfacing .

The remaining surface water runoff will be conveyed into a crate system attenuation tank, with restricted flow to be discharged to the existing surface water sewer adjacent to the site, at a rate of 1 l/s. The attenuation tank has been sized for the 1 in 100 years plus 45% climate change event and requires 1.9m³ of storage.

This proposed SuDS solution is proportionate to the nature and scale of the development and ensures that there is an 88.76 % reduction in surface water run off leaving the site for the 1 in 100 years plus climate change event.

5. SuDS PROPOSALS FOR DEVELOPMENT

In accordance with the CIRIA SuDS Manual C753, the SuDS hierarchy has been considered in relation to the site-specific constraints and its surroundings. Table 1 below outlines the hierarchical approach considered for the development at Land Adj 38 Finchampstead Road, Wokingham, RG40 2NN.

Sustainable Drainage Proposal	Description	Constraints/Comments	Appropriate
Rainwater Use as a Resource	Use of rainwater runoff for reuse, e.g. Rainwater harvesting tanks, Blue Roofs for irrigation	Two wall mounted rainwater harvesting tanks	Yes
Rainwater Full Infiltration to Ground (Source Control)	Infiltration devices and/or soakaways. Surface water runoff stored on site and gradually percolating into receiving ground	The underlying geology consists of clay, therefore, has no infiltration potential	No
Rainwater Partial Infiltration to Ground (Source Control)	Installation of permeable/porous surfacing	All new hardstanding areas will be formed of porous surfacing	Yes
Rainwater attenuation in green infrastructure features for gradual release	The onsite storage of all surface water runoff which can then be gradually conveyed to a nearby watercourse, sewer, or infiltration into the ground. Forms of green infrastructure features: Green Roofs, Raingardens, Ponds, Swales, Detention basins, Infiltration	There are no areas of flat roof therefore sedum or green roofing, is not feasible, and there is no available space for any other above ground SuDS features	No

	Trenches, and raingarden planters		
Rainwater discharge direct to a watercourse	All surface water runoff on site discharged at a restricted rate to a nearby watercourse	N/A	N/A
Controlled rainwater discharge to a surface water sewer or drain	All surface water runoff on site discharged at a restricted rate to a nearby surface water sewer or drain, all rainwater runoff stored in below ground attenuation features. E.g. oversized pipes or geo-cellular tanks	Remaining surface water is restricted to 1 l/s and discharged to an existing surface water sewer adjacent to the site	Yes
Controlled rainwater discharge to a combined sewer	All surface water runoff on site discharged at a restricted rate to a nearby combined sewer all rainwater runoff stored in below ground attenuation features. E.g. oversized pipes or geo- cellular tanks	N/A	N/A

Table 1: SuDS Control Measures for Development

6. TIMESCALE AND MAINTENANCE OF WORKS

All drainage works shall be completed prior to first occupation and there shall be no adoption of any of the drainage works within the site, the homeowner will be responsible to oversee the long-term maintenance of the drains. The following outline maintenance strategy sets out recommended timescales for maintenance of the proposed drainage works, in line with CIRIA SuDS Design Guide:

- Regular inspection will comprise the inspection and cleaning of catchment, gutters, filters and tanks to reduce the likelihood of contamination, this is recommended to be carried out every 3 to 6 months.

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations or 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 glyphosate applied directly into the weeds by an applicator rather than spraying	As required
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving.	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material.	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48hr after large storms in six months
	Inspect slit accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Table 2: Operation and maintenance requirements for pervious pavements.

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Inspection of the tank for debris and sediment build-up, inlets/outlets/withdraw devices, overflow areas, pumps, filters.	Annually (and following poor performance)
	Cleaning of tank, inlets, outlets, gutters. Withdrawal devices and roof drain filters of silts and other debris	Annually (and following poor performance)
Occasional maintenance	Cleaning and/ or replacement of any filters	Three monthly (or as required)
Remedial actions	Repair of overflow erosion damage or damage to tank	As required
	Pump repairs	As required

Table 3: Operation and maintenance requirement for RWH systems.

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 blockages 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 4: Operation and maintenance requirements for attenuation storage tanks.

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Inspect from surface and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then 6 monthly intervals
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	Orifice plates within plastic chambers or vortex controls to be jetted from the surface after heavy rainfall events to remove any debris or silt	As required
	Empty catchpits upstream of SuDS features to ensure no debris is passed downstream	3 months or as required
Remedial actions*	In the event of a blockage, a vortex flow control can be removed from the chamber via the lifting cabled located at the access, this will be cleaned at surface level and reinstalled into its original location	As required
	In the event of a blockage, the orifice plate should be jetted from surface, and if blockage is not cleared the orifice plate can be removed by removing fixing bolts. These fixing bolts should be checked and replaced if needed.	As required
Monitoring	Following installation, it is important that any extraneous materials i.e. building materials: granular backfill, in-situ pour concrete etc are removed from the unit and the new flow control chamber is fully jetted down	Upon installation
	Inspect/check chamber channel for any debris or silt build-up. Upstream chambers should be checked at the same time as these monitoring works to ensure network is operating at full capacity.	Annually

Table 5: Operation and maintenance requirements for flow control chambers

7. CONCLUSIONS

The purpose of this report is to provide a suitable SuDS strategy to the Lead Local Flooding Authority relating to surface water flows arising due to the proposed development.

As requested, SuDS have been incorporated into this design, in the form of two wall mounted rainwater harvesting tank, porous surfacing, with the remaining surface water runoff be attenuated and the site and conveyed to the existing surface water network adjacent to the site at a rate of 1 l/s.

This proposed SuDS solution is proportionate to the nature and scale of the development and ensures that there is an 88.76 % reduction in surface water run off leaving the site for the 1 in 100 years plus climate change event.

APPENDIX A – DRAWINGS



PROPOSED FRONT ELEVATION [WEST]
SCALE: 1:100 @ A1



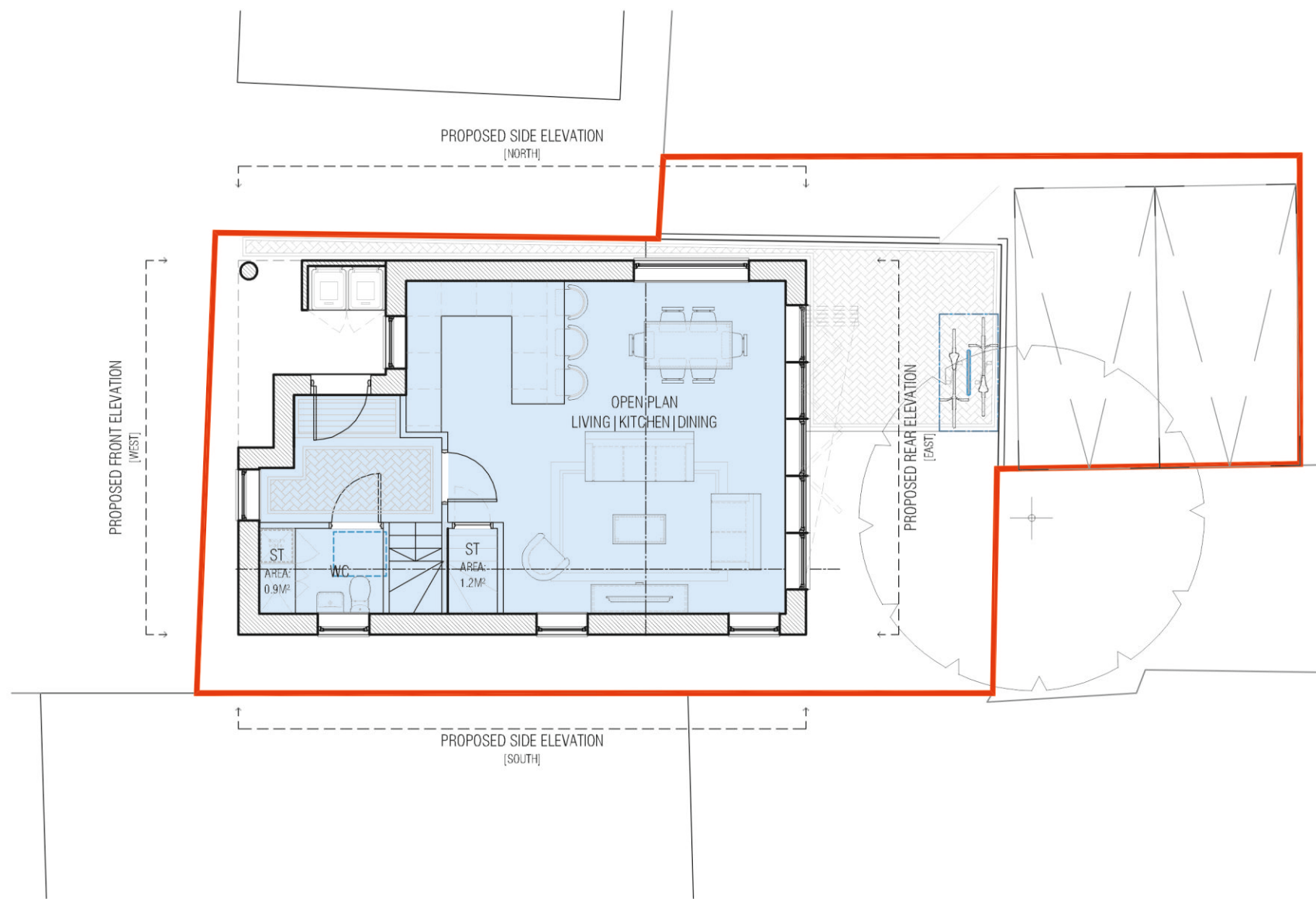
PROPOSED SIDE ELEVATION [SOUTH]
SCALE: 1:100 @ A1



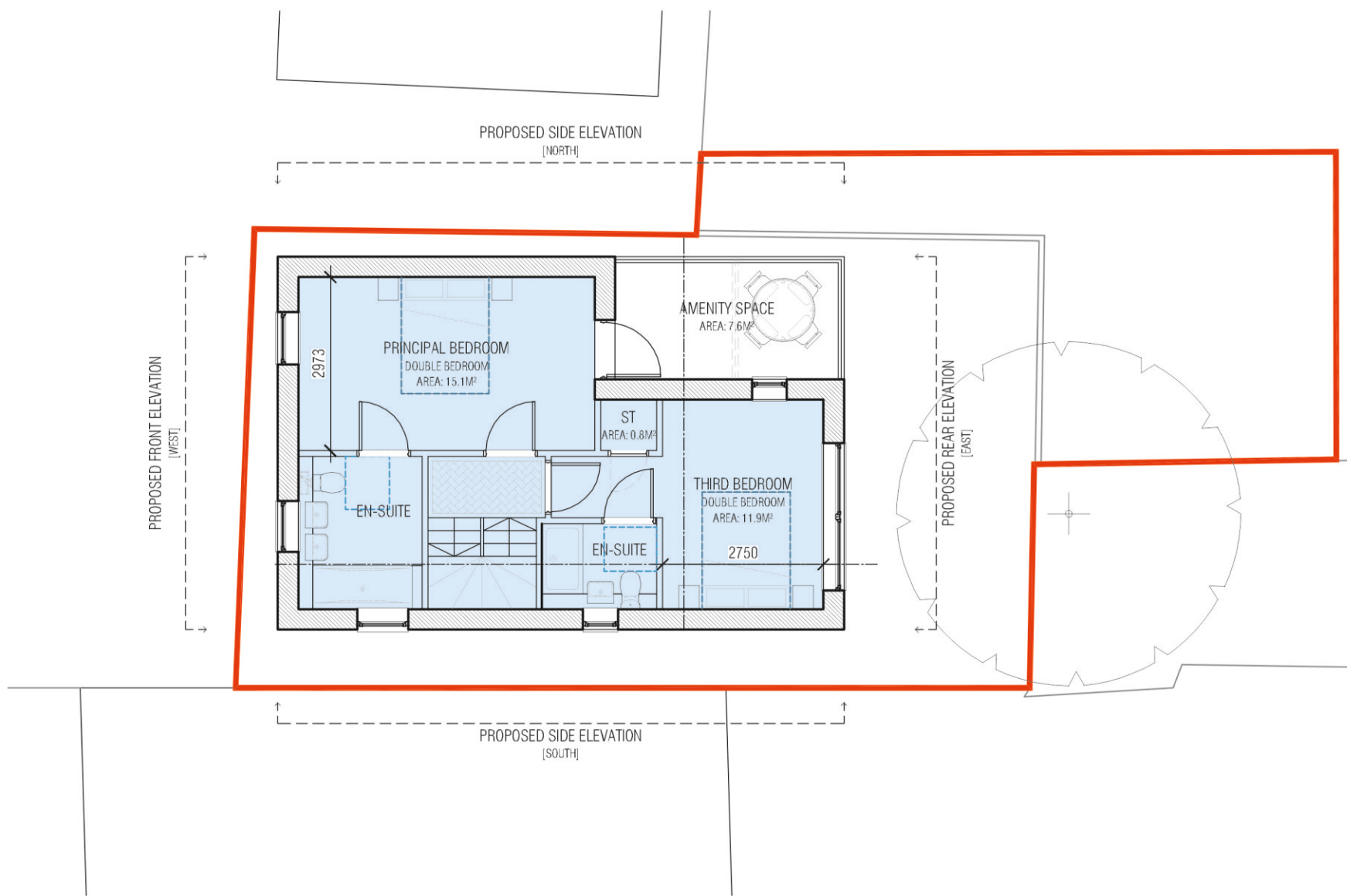
PROPOSED REAR ELEVATION [EAST]
SCALE: 1:100 @ A1



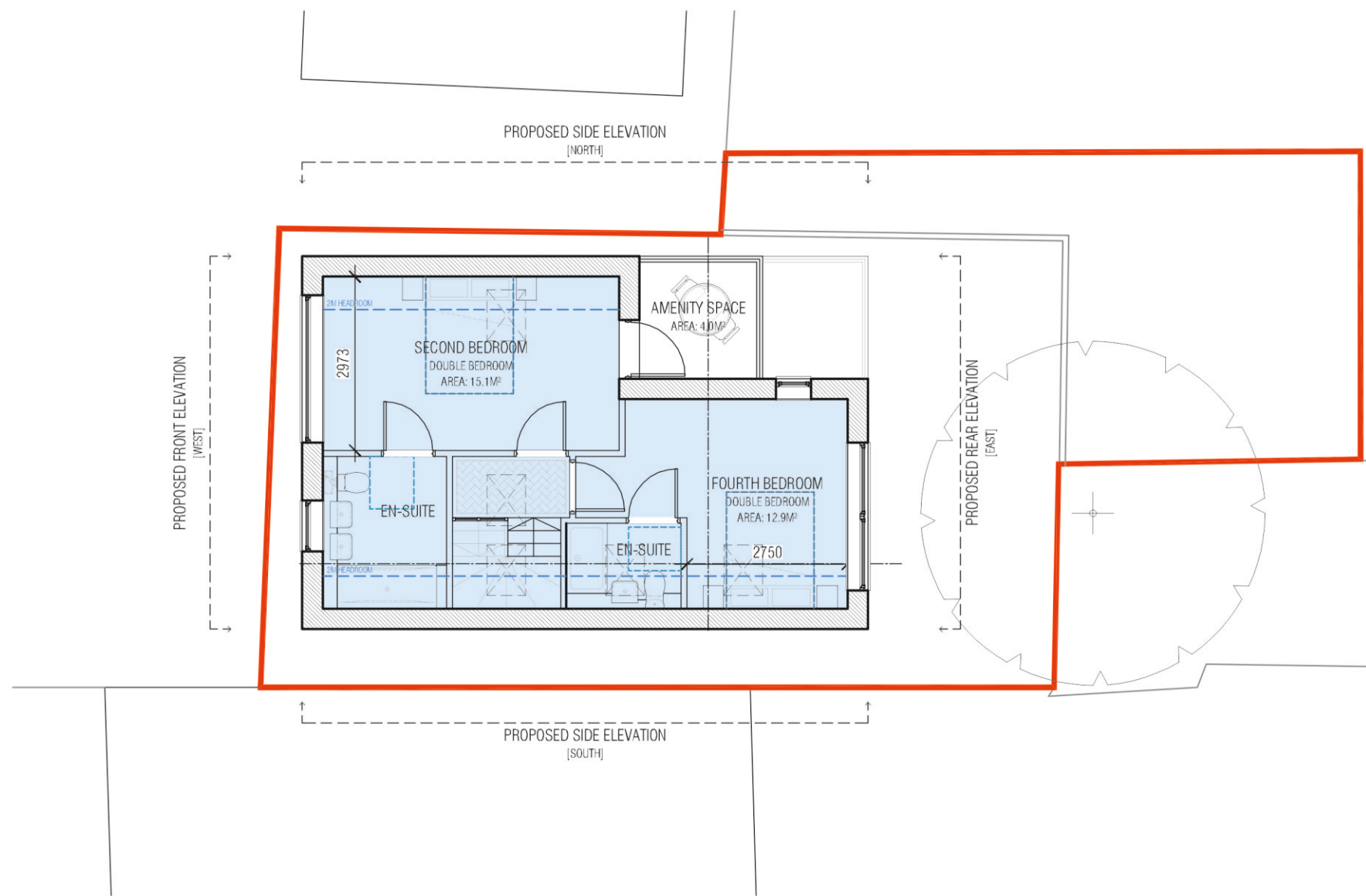
PROPOSED SIDE ELEVATION [NORTH]
SCALE: 1:100 @ A1



PROPOSED GROUND FLOOR PLAN
SCALE: 1:100 @ A1



PROPOSED FIRST FLOOR PLAN
SCALE: 1:100 @ A1



PROPOSED SECOND FLOOR PLAN
SCALE: 1:100 @ A1



PROPOSED SITE PLAN
SCALE: 1:200 @ A1

PS	01/04/2024	CLIENT'S COMMENTS	PP
PP	04/04/2024	CLIENT'S COMMENTS	PP
REV.	DATE	AMENDMENT	DRAWN

PROJECT:
RESIDENTIAL DEVELOPMENT
LND ADJOINING 38 FINCHAMPSTEAD RD,
WOKINGHAM
RG40 2NN

DRAWING TITLE:
PROPOSED FLOOR PLANS
AND ELEVATIONS

CLIENT:
KLARA HOMES

DRAWN:	PROJECT NO:	DRAWING NO:
GR.	24.570	201
CHECKED:	SCALE:	REVISION:
--	1:100	

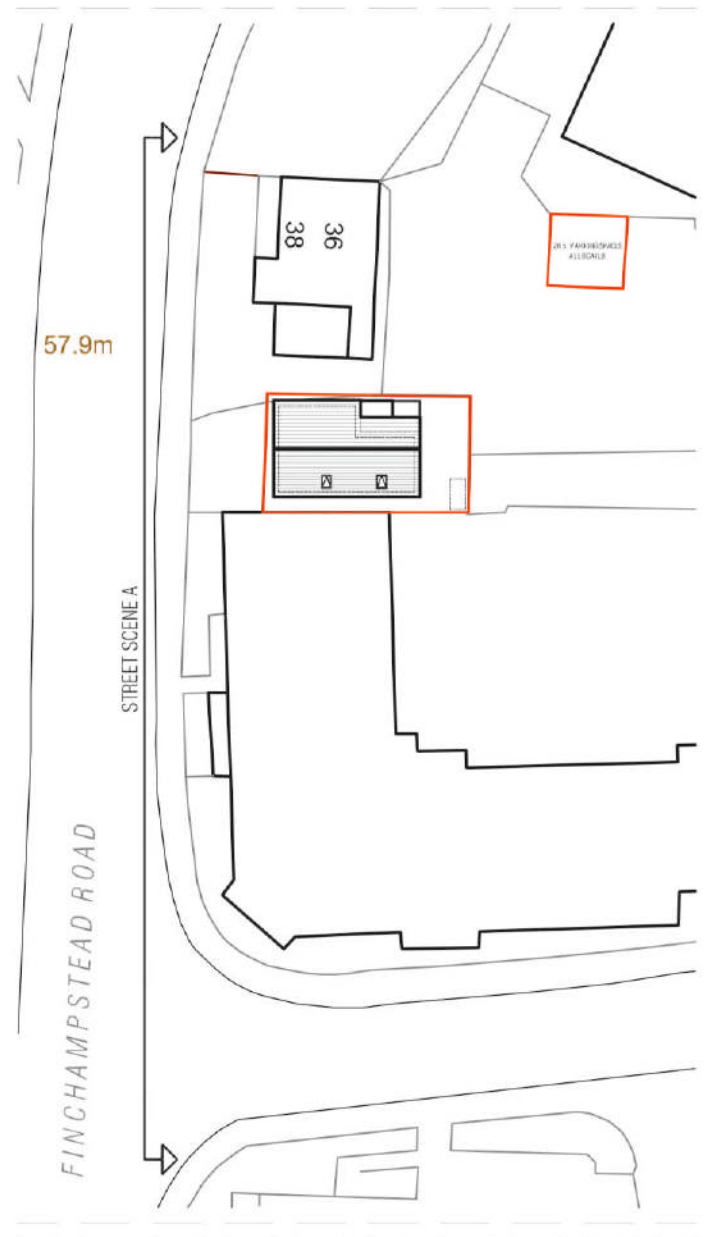
DATE: APRIL' 24

171 HIGH STREET, RAYLEIGH, ESSEX, SS6 7QA
TEL: +44 (0)202 851 4161 EMAIL: HELLO@FRONT-ARCHITECTURE.CO.UK

FRONT.

CONTRACTORS ARE TO CHECK ALL LEVELS AND DIMENSIONS BEFORE WORK COMMENCES ON SITE AND ANY DISCREPANCIES ARE TO BE REFERRED TO FRONT ARCHITECTURE.

DO NOT SCALE, WORK TO FIGURED DIMENSIONS ONLY.



SITE PLAN KEY
SCALE: 1/500 @ A1



PROPOSED SECTION BB
SCALE:1:100@A1

DATE:	REFERENCE:	DRAWN:
PROJECT:		
RESIDENTIAL DEVELOPMENT LND ADOKINGHAM RD, WOKINGHAM RG40 2NN		
DRAWING TITLE:		
EXISTING AND PROPOSED STREET SCENES		
CLIENT:		
KLARA HOMES		
DRAWN:	PROJECT NO:	DRAWING NO:
GR.	24.570	202
CHECKED:	SCALE:	
--	1:100	
DATE	REVISION:	
APRIL' 24		P01

APPENDIX B – SURFACE WATER RUN OFF CALCULATIONS



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Job No. C3310	
Sheet no. 1	
Date 09/06/24	
By SL	Checked Reviewed

MasterDrain
HY 10.01

Project **Land Adj 38 Finchampstead Road**
Title **Pre & Post SW Calcs Prior to SuDS Mitigation**

Data:-

Hydrology (FSR):-

Location = WOKINGHAM

Long reference = 480168

M5-60 (mm) = 18.6

r = 0.41

Hyd. area = 6

Hydrograph = Winter

WRAP = 4

Grid reference = SU8068

SAAR (mm/yr) = 650

Soil = 0.47

Hyd. zone = 8

Area = England & Wales

Site values used in design:-

Total site area = 0.0140 ha

Pre-dev area drained = 0.0140 ha

Imperm runoff factor = 100%

Climate change factor = 45%

Post-dev area drained = 0.0112 ha

Perm runoff factor = 20%

Pre-development

Area to soakaways = 0.0000 ha

Perv. area to SU DS = 0.0000 ha

Area to other SU DS = 0.0000 ha

Pre-dev flow to drain = 0.00 l/s

Post-development

Area to soakaways = 0.0000 ha

Perv. area to SU DS = 0.0000 ha

Area to other SU DS = 0.0000 ha

Post-dev flow to drain = 0.00 l/s

Calculations:-

Revised Post-dev Imperm. area = 0.011 ha

Equiv. Post-dev Imperm. area = 0.011 ha

Equiv. Post-dev Perm. area = 0.001 ha

Total Pre-dev equiv. area ha = 0.014 ha

Total Post-dev equiv. area ha = 0.012 ha

100 yr 6 hour mean intensity = 9.70mm/hr

Results:-

Pre-dev peakflow runoff (l/s) (m^3/s)

R.P.	15	30	60	120	240	360	480	600	Max	CCF	Final	R.P.
1	2.8	1.9	1.2	0.7	0.4	0.3	0.3	0.2	2.8	N/A	2.8	1
30	6.9	4.5	2.8	1.7	1.0	0.7	0.6	0.5	6.9	N/A	6.9	30
100	8.9	5.9	3.7	2.2	1.3	0.9	0.8	0.6	8.9	N/A	8.9	100

Post-dev peakflow runoff (l/s)

R.P.	15	30	60	120	240	360	480	600	Max	CCF	Final	R.P.
1	2.4	1.6	1.0	0.6	0.4	0.3	0.2	0.2	2.4	45	3.5	1
30	5.8	3.8	2.3	1.4	0.8	0.6	0.5	0.4	5.8	45	8.4	30
100	7.5	4.9	3.1	1.9	1.1	0.8	0.6	0.5	7.5	45	10.9	100

100 year 6 hour (x Climate Change Factor) storm gives:-

Pre-dev runoff volume m^3 = 8.1 m^3

Post-dev rainfall volume = 9.9 m^3

Post-dev volume m^3 (excess above SU DS) = 9.9 m^3

100 yr 6 hour mean intensity = 9.70mm/hr

Pre-dev volume to drain at 0 l/s = 0.0 m^3

Post-dev volume to drain at 0 l/s = 0.0 m^3

Post-dev storage volume = 9.9 m^3

Post-dev 5mm imperm volume = 0.6 m^3

Post-dev 5mm perm volume = 0.1 m^3

$Q_{BAR(rural)}$ = 0.062 l/s or 4.427 l/s/ha or 0.000 cumecs - from IoH 124.

The rainfall rates are calculated using the location specific values above in accordance with the Wallingford procedure.



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Job No. C3310		
Sheet no. 2		
Date 09/06/24		
By SL	Checked	Reviewed

Project	Land Adj 38 Finchampstead Road
Title	Pre & Post SW Calcs Prior to SuDS Mitigation

Data summary.

Use the data below for the SUR1 form

Site areas:-

Total site area	=	0.0140 ha ;140.0 m ² [3A]
Pre-development impermeable area	=	0.0140 ha [3B]
Pre-development permeable area	=	0.0000 ha
Post-development impermeable area	=	0.0112 ha [3C]
Post-development permeable area	=	0.0028 ha

Peak runoff:-

Pre-development 1 year storm (15min)	=	2.8 l/s [6A]
Pre-development 100 year storm (15min)	=	8.9 l/s [6C]
Post-development 1 year storm (15min)	=	2.4 l/s [6B]
Post-development 100 year storm (15min)=		7.53 l/s [6D]

Greenfield runoff:-

$Q_{BAR(rural)} = 0.062 \text{ l/s}$ or 4.427 l/s/ha or 0.000 cumecs - from IoH 124.

Climate change factor:-

CCF = 45%

Volumes:-

Pre-development 100 yr/6hr storm [12A]	=	11.8m ³
Post-development 100 yr/6hr storm (add. volume with no SUDS) [12B]	=	9.9m ³
Post-development 100 yr/6hr storm (add. volume with SUDS)	=	9.9m ³
Post-development add. predicted volume (No SUDS) [12C]	=	-1.9m ³

You may also require

Data relating to the infiltration test calculations (if applicable)
Evidence to show runoff reduction (if applicable)
Information on calculation methods (if applicable see next sheet)

Note

Numbers in square brackets relate to the
Nov. 2010 v1.1 / issued 11/02/10 copy of SUR1



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Job No. C3310		
Sheet no. 3		
Date 09/06/24		
By SL	Checked	Reviewed

Project **Land Adj 38 Finchampstead Road**

Title **Pre & Post SW Calcs Prior to SuDS Mitigation**

Definitions and methods

Hydrology

The hydrological constants are derived from the Wallingford maps. They are used to calculate location specific rainfall figures.

Site values and factors

Areas of the site should be entered in hectares (10000 m²). If the Pre-development site is a green field, this box is blank.

Climate Change Factor is initially set at 20% - this may be changed as required.

Greenfield runoff is calculated using the method described in loH 124.

Runoff factors

The impermeable runoff factor is initially set at 98%

The permeable runoff factor is initially set at 20%

Note: the CCF and the runoff factors may be changed by the user to suit the development

The areas draining to soakaways and other SUDS are entered in the appropriate box (in hectares)

Calculations

The post-development area is reduced by subtracting the areas that drain to soakaways or other SUDS, to give a revised figure.

All areas are then multiplied by the appropriate runoff factor to give an equivalent area with 100% runoff.

These are then summated.

This gives a total pre-development equivalent area, and a similar figure for the post-development area.

The 'Post-dev volume to drain (no SUDS)' gives the total runoff to drain if no SUDS were used.

Results

The pre- and post-development areas are subjected to 1,30 and 100 year return period storms with a duration of 15 to 600 minutes.

The Revised Post-dev Imperm. area is the area (in ha) that is not going to SUDS x impervious runoff factor.

The runoff rates are calculated for the chosen hydrograph (Summer or Winter) as l/s. Figures in red indicate m³/s

The peak value is measured, multiplied by the CCF and the total maximum rate is shown.

The pre- and post-development volumes for a 100 year / 6 hour storm are calculated from the area under the hydrograph curve.

Post-dev volume (i.e. excess above SUDS) is that volume produced by the drained area that does not go to SUDS.

Qbar(rural) is calculated in accordance with the procedure laid down in loH 124



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Job No. C3310		
Sheet no. 1		
Date 14/06/24		
By SL	Checked	Reviewed

Project **Land Adj 38 Finchampstead Road, Wokingham, RG40 2NN**

Title **Hydrograph storage calcs with 1 l/s discharge**

Data:-

Location = WOKINGHAM
M5-60 (mm) = 18.6
Soil index = 0.45
Return period = 100
UCWI = 0.0

Grid reference = SU8068
r = 0.41
SAAR (mm/yr) = 650
WRAP = 4
Climate change = 45%

Clayey, or loamy over clayey soils with an impermeable layer at shallow depth.

Pipeline storage = 0.0 m³
Offline storage = 0.0 m³

Available MH storage = 0.0 m³

Percentage runoff = 100.0% (manual setting)

Imperv. area = 76 m²
Total area = 76 m²
Total runoff = 3.3 m³
Storage (m³) = 1.9 m³ (Sum of all balance quantities)
Total rainfall depth = 43.6 mm

Pervious area = 0 m²
Equiv area = 76 m² (Tot. area x % runoff).
Discharge rate = 1.000 l/s

Calculations :-

Time (hrs)	%Mean intens	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)	Cumulative (m3)
0.005	20.0	17.5	0.007	0.018	0.000	0.000
0.010	20.0	17.5	0.007	0.018	0.000	0.000
0.015	21.0	18.3	0.007	0.018	0.000	0.000
0.020	21.0	18.3	0.007	0.018	0.000	0.000
0.025	22.0	19.2	0.007	0.018	0.000	0.000
0.030	23.0	20.1	0.008	0.018	0.000	0.000
0.035	24.0	20.9	0.008	0.018	0.000	0.000
0.040	26.0	22.7	0.009	0.018	0.000	0.000
0.045	27.0	23.6	0.009	0.018	0.000	0.000
0.050	29.0	25.3	0.010	0.018	0.000	0.000
0.055	31.0	27.0	0.010	0.018	0.000	0.000
0.060	32.0	27.9	0.011	0.018	0.000	0.000
0.065	33.0	28.8	0.011	0.018	0.000	0.000
0.070	34.0	29.7	0.011	0.018	0.000	0.000
0.075	36.0	31.4	0.012	0.018	0.000	0.000
0.080	38.0	33.2	0.013	0.018	0.000	0.000
0.085	39.0	34.0	0.013	0.018	0.000	0.000
0.090	40.0	34.9	0.013	0.018	0.000	0.000
0.095	42.0	36.6	0.014	0.018	0.000	0.000
0.100	45.0	39.3	0.015	0.018	0.000	0.000
0.105	49.0	42.8	0.016	0.018	0.000	0.000
0.110	53.0	46.2	0.018	0.018	0.000	0.000
0.115	57.0	49.7	0.019	0.018	0.001	0.001
0.120	62.0	54.1	0.021	0.018	0.003	0.003
0.125	66.0	57.6	0.022	0.018	0.004	0.007
0.130	71.0	61.9	0.024	0.018	0.006	0.013
0.135	77.0	67.2	0.026	0.018	0.008	0.020
0.140	84.0	73.3	0.028	0.018	0.010	0.030
0.145	91.0	79.4	0.030	0.018	0.012	0.042
0.150	98.0	85.5	0.032	0.018	0.014	0.057
0.155	105.0	91.6	0.035	0.018	0.017	0.074
0.160	114.0	99.5	0.038	0.018	0.020	0.094
0.165	125.0	109.1	0.041	0.018	0.023	0.117
0.170	135.0	117.8	0.045	0.018	0.027	0.144
0.175	143.0	124.8	0.047	0.018	0.029	0.173
0.180	154.0	134.4	0.051	0.018	0.033	0.206
0.185	164.0	143.1	0.054	0.018	0.036	0.243
0.190	173.0	150.9	0.057	0.018	0.039	0.282
0.195	183.0	159.7	0.061	0.018	0.043	0.325
0.200	194.0	169.3	0.064	0.018	0.046	0.371



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Project **Land Adj 38 Finchampstead Road, Wokingham, RG40 2NN**

Title **Hydrograph storage calcs with 1 l/s discharge**

Calculations (cont.) :-

Time (hrs)	%Mean intens	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)	Cumulative (m3)
0.205	204.0	178.0	0.068	0.018	0.050	0.421
0.210	212.0	185.0	0.070	0.018	0.052	0.473
0.215	219.0	191.1	0.073	0.018	0.055	0.527
0.220	226.0	197.2	0.075	0.018	0.057	0.584
0.225	233.0	203.3	0.077	0.018	0.059	0.644
0.230	239.0	208.5	0.079	0.018	0.061	0.705
0.235	244.0	212.9	0.081	0.018	0.063	0.768
0.240	248.0	216.4	0.082	0.018	0.064	0.832
0.245	249.0	217.3	0.083	0.018	0.065	0.897
0.250	250.0	218.1	0.083	0.018	0.065	0.962
0.255	250.0	218.1	0.083	0.018	0.065	1.026
0.260	249.0	217.3	0.083	0.018	0.065	1.091
0.265	248.0	216.4	0.082	0.018	0.064	1.155
0.270	244.0	212.9	0.081	0.018	0.063	1.218
0.275	239.0	208.5	0.079	0.018	0.061	1.279
0.280	233.0	203.3	0.077	0.018	0.059	1.339
0.285	226.0	197.2	0.075	0.018	0.057	1.396
0.290	219.0	191.1	0.073	0.018	0.055	1.450
0.295	212.0	185.0	0.070	0.018	0.052	1.502
0.300	204.0	178.0	0.068	0.018	0.050	1.552
0.305	194.0	169.3	0.064	0.018	0.046	1.598
0.310	183.0	159.7	0.061	0.018	0.043	1.641
0.315	173.0	150.9	0.057	0.018	0.039	1.680
0.320	164.0	143.1	0.054	0.018	0.036	1.717
0.325	154.0	134.4	0.051	0.018	0.033	1.750
0.330	143.0	124.8	0.047	0.018	0.029	1.779
0.335	135.0	117.8	0.045	0.018	0.027	1.806
0.340	125.0	109.1	0.041	0.018	0.023	1.829
0.345	114.0	99.5	0.038	0.018	0.020	1.849
0.350	105.0	91.6	0.035	0.018	0.017	1.866
0.355	98.0	85.5	0.032	0.018	0.014	1.881
0.360	91.0	79.4	0.030	0.018	0.012	1.893
0.365	84.0	73.3	0.028	0.018	0.010	1.903
0.370	77.0	67.2	0.026	0.018	0.008	1.910
0.375	71.0	61.9	0.024	0.018	0.006	1.916
0.380	66.0	57.6	0.022	0.018	0.004	1.920
0.385	62.0	54.1	0.021	0.018	0.003	1.922
0.390	57.0	49.7	0.019	0.018	0.001	1.923
0.395	53.0	46.2	0.018	0.018	0.000	1.923
0.400	49.0	42.8	0.016	0.018	0.000	1.921
0.405	45.0	39.3	0.015	0.018	0.000	1.918
0.410	42.0	36.6	0.014	0.018	0.000	1.914
0.415	40.0	34.9	0.013	0.018	0.000	1.909
0.420	39.0	34.0	0.013	0.018	0.000	1.904
0.425	38.0	33.2	0.013	0.018	0.000	1.898
0.430	36.0	31.4	0.012	0.018	0.000	1.892
0.435	34.0	29.7	0.011	0.018	0.000	1.886
0.440	33.0	28.8	0.011	0.018	0.000	1.879
0.445	32.0	27.9	0.011	0.018	0.000	1.871
0.450	31.0	27.0	0.010	0.018	0.000	1.864
0.455	29.0	25.3	0.010	0.018	0.000	1.855
0.460	27.0	23.6	0.009	0.018	0.000	1.846
0.465	26.0	22.7	0.009	0.018	0.000	1.837
0.470	24.0	20.9	0.008	0.018	0.000	1.827
0.475	23.0	20.1	0.008	0.018	0.000	1.816
0.480	22.0	19.2	0.007	0.018	0.000	1.806
0.485	21.0	18.3	0.007	0.018	0.000	1.795
0.490	21.0	18.3	0.007	0.018	0.000	1.784
0.495	20.0	17.5	0.007	0.018	0.000	1.772
0.500	20.0	17.5	0.007	0.018	0.000	1.761

Storage volume (m³) = 1.9 m³ (Sum of all balance quantities)



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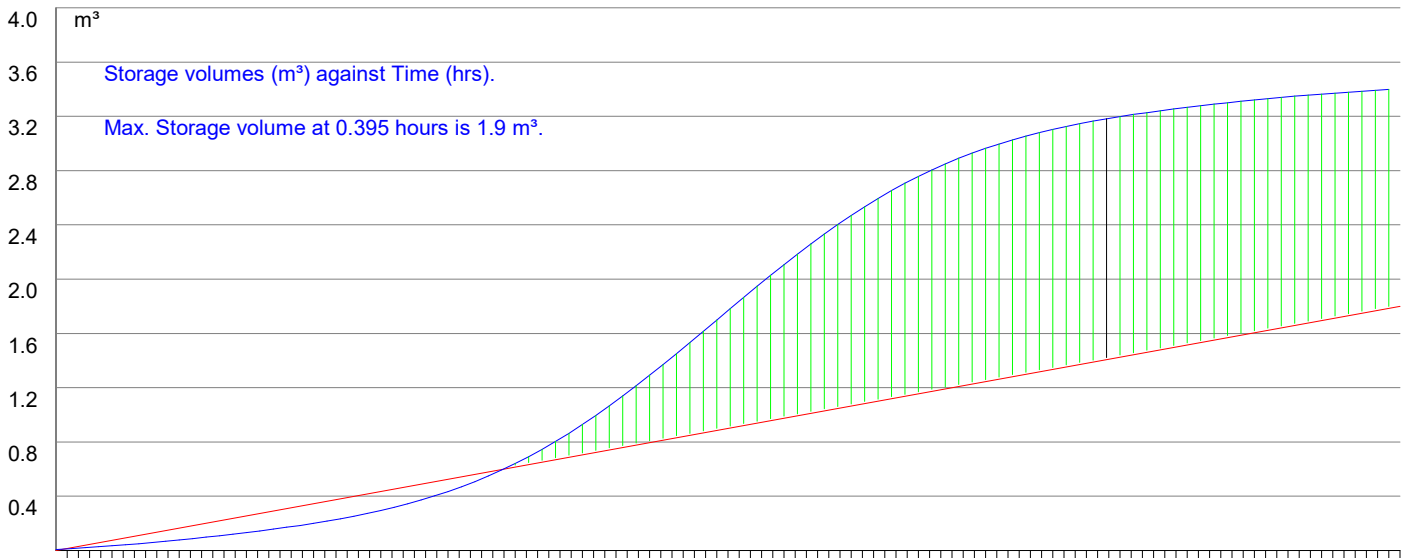
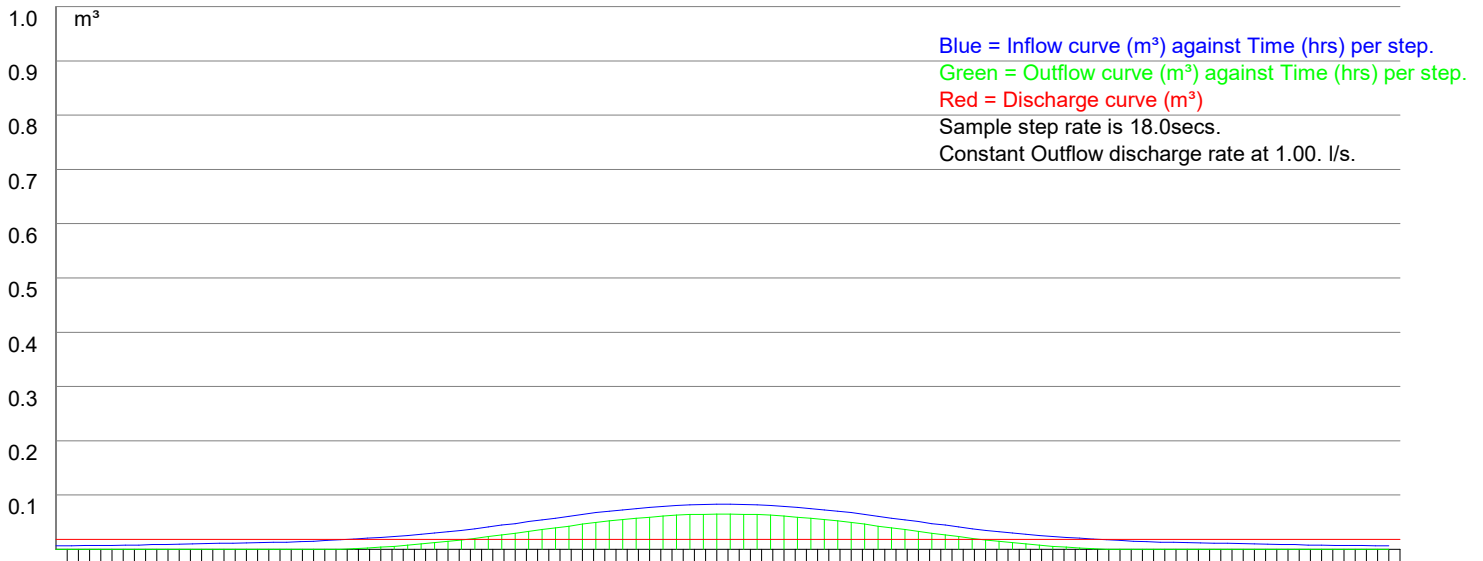
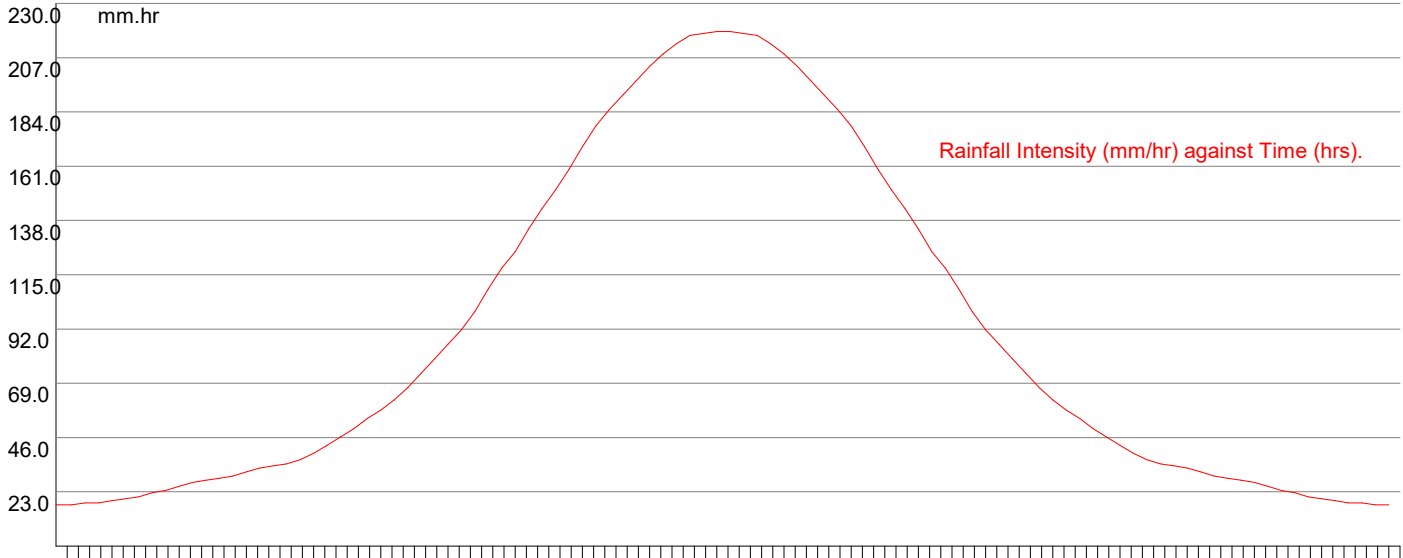
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Title **Hydrograph storage calcs with 1 l/s discharge**

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Project **Land Adj 38 Finchampstead Road, Wokingham, RG40 2NN**

Title **Hydrograph storage calcs with 1 l/s discharge**

Maximum storage volumes for varying duration storms.

Storm length (hrs)	Max. Vol (m ³)	Max. Vol time	Mean intens (mm/hr)	Step time. (mins)	Peak found
0.25	1.76	0.25	133.29	0.2	
0.5	1.92	0.50	87.25	0.3	Peak found
1	1.73	---	54.47	0.6	
2	1.03	---	32.92	1.2	
3	0.41	---	24.23	1.8	
4	0.02	---	19.39	2.4	
5	0.00	---	16.27	3.0	
6	0.00	---	14.06	3.6	
7	0.00	---	12.44	4.2	
8	0.00	---	11.19	4.8	
9	0.00	---	10.19	5.4	
10	0.00	---	9.37	6.0	
12	0.00	---	8.10	7.2	
15	0.00	---	6.78	9.0	
18	0.00	---	5.85	10.8	
20	0.00	---	5.38	12.0	
24	0.00	---	4.64	14.4	
30	0.00	---	3.88	18.0	
36	0.00	---	3.35	21.6	
42	0.00	---	2.95	25.2	
48	0.00	---	2.65	28.8	
54	0.00	---	2.41	32.4	
60	0.00	---	2.21	36.0	
66	0.00	---	2.05	39.6	
72	0.00	---	1.91	43.2	
84	0.00	---	1.68	50.4	
96	0.00	---	1.51	57.6	
120	0.00	---	1.25	72.0	
150	0.00	---	1.04	90.0	
175	0.00	---	0.92	105.0	
200	0.00	---	0.82	120.0	
250	0.00	---	0.69	150.0	
300	0.00	---	0.59	180.0	
375	0.00	---	0.49	225.0	
500	0.00	---	0.39	300.0	
750	0.00	---	0.28	450.0	
1000	0.00	---	0.22	600.0	
1250	0.00	---	0.18	750.0	
1500	0.00	---	0.16	900.0	
1570	0.00	---	0.15	942.0	
2000	0.00	---	0.12	1200.0	
2500	0.00	---	0.10	1500.0	
3000	0.00	---	0.09	1800.0	
3500	0.00	---	0.08	2100.0	
4000	0.00	---	0.07	2400.0	



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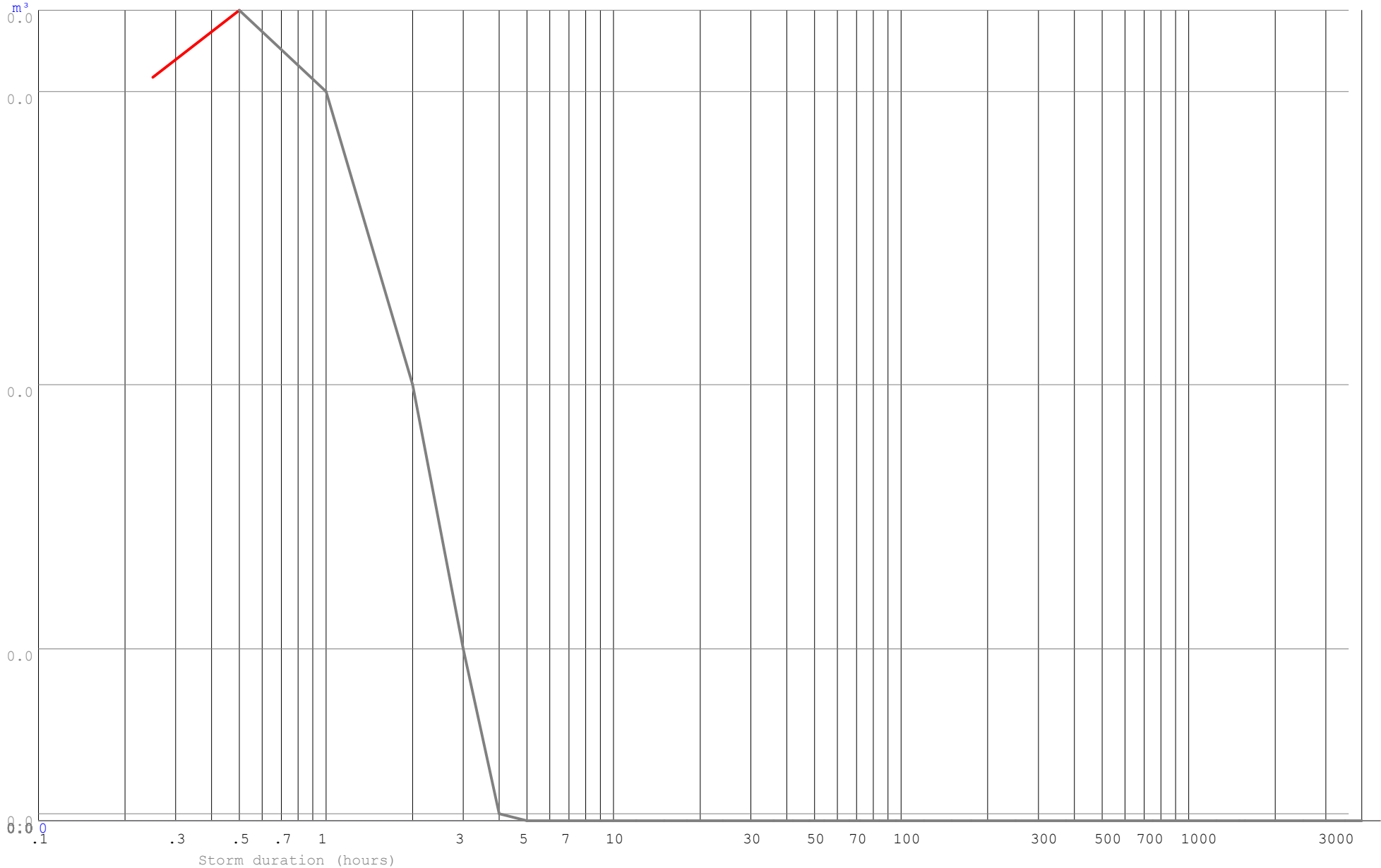
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Title **Hydrograph storage calcs with 1 l/s discharge**

Sequential storage volume at specific storm durations.





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Project **Land Adj 38 Finchampstead Road, Wokingham, RG40 2NN**

Title **Hydrograph storage calcs with 1 l/s discharge**

Explanatory notes for Peak Flow Storage

- 1) This system uses the rainfall intensity/ duration curve calculated using either the Wallingford or FEH method as selected.
- 2) The balance is calculated from the inflow minus the outflow.
- 3) The storage volume is the maximum value of the balance curve.
- 4) This method was described by Davis (1963) - see Butler & Davies, 2nd edition, p294
- 5) References to 'storm duration' relate only to the hydrograph method (qv).
- 6) There are always 600 steps in the calculation process, thus a 'run' time of 10 hours will be sampled every minute,

Explanatory notes for Hydrograph Storage

- 1) The user has the choice of Summer or Winter curves
- 2) The mean intensity varies with the duration of the storm curve
- 3) There are always 120 steps in the calculation process, irrespective of storm duration.
- 4) The balance is calculated from the inflow minus the outflow.
- 5) The storage volume is the sum of the balance values for each step.
- 6) Varying durations should be tried to find the maximum storage value - this can be narrowed down very closely.

*Modelling using the flow characteristics of the restrictor is available using Vortex Control modelling function. Please be aware that this function needs the full design data file to function.

Why do the two methods give different results?

The rainfall characteristics for each method are very different.

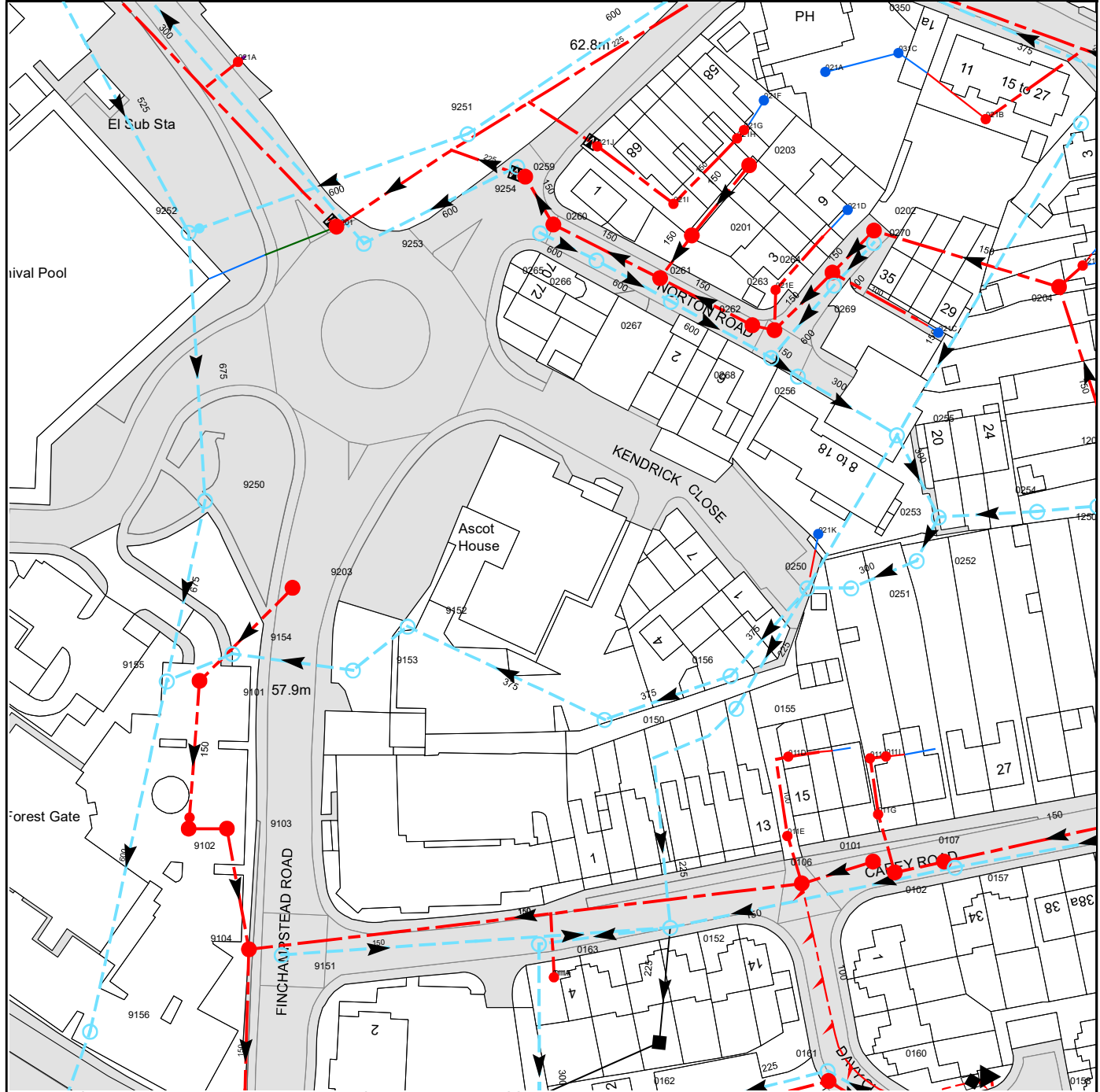
The Peak flow (using the Intensity/Duration/Frequency curve) does not model the actual rainfall. This curve is joined points which represent the mean intensity of a storm at a given duration i.e. a value of 19.5 mm/hr for a 60 minute storm indicates that over the sixty minute period, the mean intensity was 19.5 mm/hr. The calculation method samples the IDF curve for a given location and frequency (Return Period) and calculates the storage for that rate and duration less the outflow volume. The maximum value is displayed as the 'worst case' storage.

The hydrograph method uses a standard curve for either Winter or Summer storms. Traditionally these are symmetrical about the central peak. UK rainfall does not fit into this convenient curve, so the calculations are dealing with a stylised set of data. The mean intensity for the storm is calculated from the IDF curve and applied to the curve data, calculating the storage for that step less the outflow volume. The final storage volume is the sum of the storage for all the steps.

It can be seen that these two methods are very different, and the user may have the choice of which result to use. This is not an exact science, though is often treated as such by those that do not understand the principles of the calculations.

APPENDIX C – WATER AUTHORITY ASSET PLANS

Asset Location Search Sewer Map - ALS/ALS Standard/2021 4386107



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 481006,168211

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.

Based on the Ordnance Survey Map with the Sanction of the controller of H.M. Stationery Office, License no. 100019345 Crown Copyright Reserved.

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
021J	n/a	n/a
031C	n/a	n/a
021B	n/a	n/a
1257	n/a	n/a
0254	60.43	59.08
1250	61.5	59.45
0204	n/a	n/a
121F	n/a	n/a
0262	61.6	60.85
0268	61.49	59.89
0263	61.55	60.89
021E	n/a	n/a
011E	n/a	n/a
011D	n/a	n/a
0256	61.38	59.85
0106	56.01	54.41
0250	58.95	55.85
021K	n/a	n/a
0264	61.82	60.98
0269	61.9	59.96
021D	n/a	n/a
0251	58	56.5
011H	n/a	n/a
0101	56.37	54.59
0270	62.29	60.06
0202	62.4	61.05
011G	n/a	n/a
011I	n/a	n/a
0102	56.48	55.4
0255	60.99	58.74
0252	59.26	57.06
0253	60.79	58.27
021C	n/a	n/a
0107	56.81	55.72
0157	56.84	55.2
0161	53.67	51.49
0104	53.43	50.5
921A	n/a	n/a
9251	62.01	59.56
9254	62.03	59.48
0259	61.84	60.53
021H	n/a	n/a
021G	n/a	n/a
0203	n/a	n/a
021F	n/a	n/a
021A	n/a	n/a
9155	59.32	55.23
9252	62	57.45
9102	57.61	54.74
9101	58.95	56.05
9250	60.9	56.1
9103	56.52	54.16
9154	57.94	55.49
9104	55.56	52.95
9151	55.59	54.44
9203	58.91	56.45
9201	61.61	59.78
9153	59.21	55.66
9253	61.63	n/a
9152	59.18	55.71
0163	55.41	53.33
0265	61.85	60.1
0260	61.92	60.58
011F	n/a	n/a
0266	61.96	60.06
0150	58.96	55.8
0261	61.96	60.73
0152	55.43	53.56
0267	61.91	60.01
021I	n/a	n/a
0201	62.34	60.78
0156	58.77	55.87
0155	n/a	n/a
9156	56.28	53.18

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