Surface Water Strategy

For the Approved development to r/o

8 Dunheved Road North, Thornton heath, CR7 6AH

Prepared by

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INNERVISION design

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Disclaimer

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Scope

Note: this report can only be assessed under the scope it is intended for as set out below:

Town and Country Planning Act 1990

The scope of this report includes the provision of supplementary information in relation to a planning application set under the provision of this Act and is intended to meet the requirements for "particulars" under Section 62; (3) & (4 A) of same.

The Town and Country Planning (Development Management Procedure) (England) Order 2015

The scope of this report includes the provision of supplementary information in relation to any related planning Condition set under the provision of this Order and is intended to meet the requirements for "particulars" under Section 27(b) of same.

Building Act 1984

Building Regulations 2010 and Statute control

This report **is not** provided in support of any application made under the Building Act 1984 or related Regulations.

Statement of conformity

While this report cannot therefore be lawfully assessed by any persons, in any capacity, for compliance with the above Building Regulations all drainage on this private site, both foul and SW will be subject to full compliance with Part H of the Building Regulations 2010 (as amended 2013).

Hence all construction details, SW runs, pipe diameters etc. as detailed in this report are designed to comply in full with the "Adequate provision" Requirement of Part H and are to be checked, inspected, tested and approved by the Building Control Body of the clients choice at the time of detailed design and construction.

SuDS design additional standards

All SuDS (Sustainable drainage system) on site will also be designed and installed in accordance with CIRIA 753 & CIRIA 768, para 169 of the NPPF, its supporting technical guidance and the DEFRA Non-Statutory Technical standards for sustainable drainage systems (2015).

1 Executive Summary

A All surface water arising from the roof is attenuated and discharged at no greater that 1.0 ls^{-1} to the existing network.

B All areas of hard standing on the site will be constructed using a permeable medium.

C The project team have detailed “off line” rainwater butt(s) to collect water for external use.

D All SuDS on site will be installed with full consideration to long term maintenance.

2 Introduction

2.1 Site location

The project is on land to the rear of 8 Dunheved Road North, Thornton Heath, CR7 6AH (see Figure 1).

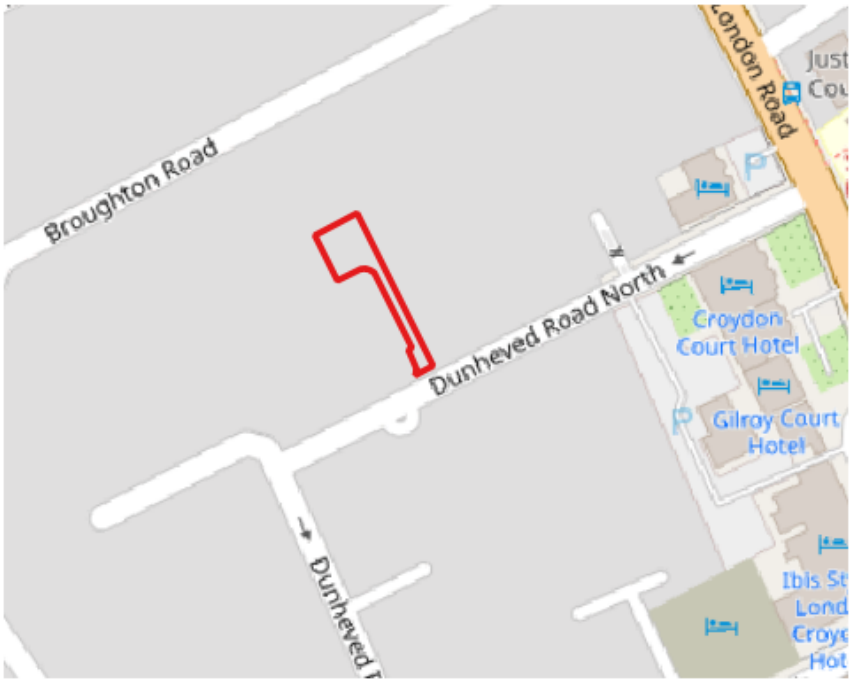


Figure 1: Site location plan, as indicated in red with North topmost. (source: Open streetmap)

2.2 Development description

The Approval (23/00679/FUL) is for the "Erection of a pair of semi-detached dwellings and provision of associated parking, landscaping, and cycle and refuse stores".

All plans as those Approved.

2.2.1 Condition 9

> "Prior to the commencement of above ground works, a detailed surface water drainage scheme incorporating the following measures shall be submitted to and approved in writing by the Local Planning Authority:
>
> a) Calculation of the existing and proposed run-off rate (which should achieve greenfield run-off rates unless an alternative rate is adequately justified and achieved);

b) Confirmation of the impermeable and permeable site areas used for the infiltration calculations;

c) Details of the on-site infiltration drainage;

d) Details of the on-site attenuation tank;

e) Details of further sustainable drainage measures;

f) An updated layout plan (to scale) of the proposed drainage scheme;

g) Details of the ownership and / or maintenance agreement for the SUDS on the site.

The approved scheme shall be implemented prior to the first occupation of the development and maintained thereafter."

2.3 Site geology

Refer to Geo insight report at Appendix A.

The site is on Lynch Hill Gravel Member - Sand And Gravel.

2.3.1 Infiltration potential

The Geo insight report classes the minimum infiltration potential as "High" increasing to a maximum of "Very High".

For pavement design a conservative "medium" value of 100mm.hr^{-1} is used (2.78 x 10^{-5}ms^{-1}) with a further facto of safety of 3 applied within the design.

2.4 Existing surface water disposal strategy

The site is, other than for a section of concreted driveway, considered greenfield for the purpose of this report with all water lost via natural process.

The curtilage of the entire site encloses an area of approximately 425m^2 of which, pre-development, 45m^2 is classed as being impermeable (0m^2 roofs, 45m^2 impermeable hard-standing and paths), with the remaining 380m^2 classed as permeable planting. The new development increases the impermeable area from 45m^2 to 90m^2 (90m^2 roof area).

2.5 Estimation of existing run-off rates

The Wallingford Procedure[3] is used as the basis for the following calculation by using a site specific IDF curve to establish i_1 and i_{100} rainfall intensities. Hence for the upper limit on flow from the site:

2.5.1 Variables

i_1 = 67.8[1] mm hr^{-1}

i_{100} = 111.5 mm hr^{-1}

A = 45 m^2

Cr = 1

Cv = 0.9

2.5.2 Impermeable area run-off rate for pre-developed site

$$Q_{BF1} = \frac{0.9 * 67.8 * 45}{3600} = 0.8ls^{-1}$$

$$Q_{BF100} = \frac{0.9 * 111.5 * 45}{3600} = 1.3ls^{-1}$$

Existing runoff rates from the impermeable areas of the site are calculated as 0.76ls^{-1} (based on 67.8mm hr^{-1}, 1 in 1 yr summer storm).

2.6 Greenfield estimation of peak rate of run-off

2.6.1 Methodology

To assess the minimum outfall rates then as a greenfield site and is less than 50 ha therefore run-off rate calculations have been carried out in accordance with the IH Report 124 'Flood estimation for small catchments'[1]. The pro rata method on the size of catchment has been used.

[1] 67.8mm hr^{-1} is the mean intensity of a 1 in 1yr 6min duration summer storm, calculated to be the worst case, using standard IDF formula.

2.6.2 Formula

For catchments less than 50ha:

$$Q_{BAR50ha} = 1.08\,(50/100)^{0.89} * SAAR^{1.17} * SPR^{2.17} \tag{1}$$

$$Q_{BAR} = Q_{BAR50ha} * \frac{A}{50} \tag{2}$$

$$Q_{1yr} = Q_{BAR} * 0.85 \tag{3}$$

$$Q_{100yr} = Q_{BAR} * GC_{100} \tag{4}$$

2.6.3 Variables

Qbar/Qmed =0.85

SAAR = 649mm

Hydrological Region 6

Growth curve factors: 30 yr = 2.3; 100 yr = 3.19

SPR = 0.47

2.6.4 Calculations

$$\begin{aligned} Q_{BAR50ha} =& 1.08 * 0.5^{0.89} * 649^{1.17} * 0.47^{2.17} \\ =& 0.58 * 1951.31 * 0.19 \\ =& 220.95 \end{aligned}$$

Using Equation 2:

$$\begin{aligned} Q_{BAR} =& \frac{220.95 * 0.04}{50} \\ =& 0.19 ls^{-1} \end{aligned}$$

Using Equation 3:

$$\begin{aligned} Q_{1} =& 0.19 * 0.85 \\ =& 0.16 ls^{-1} \end{aligned}$$

Using Equation 4:

$$\begin{aligned} Q_{100} &= 0.19 * 3.19 \\ &= 0.60 ls^{-1} \end{aligned}$$

2.6.5 Peak run-off rates

For the 1 year Return Period event the peak runoff calculates to 0.16 ls^{-1}
For the 30 year Return Period event the peak runoff calculates to 0.43 ls^{-1}
For the 100 year Return Period event the peak runoff calculates to 0.60 ls^{-1}

3 SuDS Principles

3.1 SuDS design philosophy

The CIRIA SuDS[2] manual provides the design philosophy:

> "SuDS design should, as much as possible, be based around the following:
>
> - using surface water run-off as a resource
> - managing rainwater close to where it falls
> - managing run-off at the surface
> - allowing rainwater to soak into the ground
> - promoting evapotranspiration
> - slowing and storing run-off to mimic natural run-off characteristics
> - reducing contamination of run-off through pollution prevention and controlling the run-off at source
> - treating run-off to reduce the risk of urban contaminants causing environmental pollution."

3.2 Source control

- Sedum roofing.
- Infiltration devices. Typically soakaways.
- Rainwater harvesting.
- Bio-retention planting, rain gardens.
- Permeable paving, porous asphalt. These provide both infiltration and short term storage volumes thus reducing overall un-mitigated run-off volumes.

3.3 "End of pipe" solutions

To be considered only after implementation of the above options.

- Retention tanks with outfall controlled by hydraulic means to limiting discharge rates and volumes to discharge to existing SW flow pathways.

Sections 4.2 to 4.7 consider the viability of a range of these SuDS devices.

4 Appraisal of SuDS options

4.1 Site constraints impacting on SuDS

- Very low GF rate due to small size of site.
- Approved site layout with no areas on site greater than 5m from the proposed dwellings.
- Approved pitched roofs.
- No access to water courses or ditches.

4.2 Infiltration devices

Due to site constraints, as per Section 4.1, soakaways are not possible.

4.3 Bio-retention

Due to site constraints, bio-retention devices are not suited to this site.

4.4 Permeable hard standing

With reference to Section 3.1, permeable paving promotes the following SuDS design criteria:

- manages rainwater close to where it falls
- manages run-off at the surface
- allows rainwater to soak into the ground
- slows and stores run-off to mimic natural run-off characteristics
- treats run-off to reduce the risk of urban contaminants causing environmental pollution.

4.4.1 Permeable paving

A 30% void ratio is assumed through a 350mm sub-base. This is appropriate for a DOT Type 3 Sub-base hence the storage capacity equates to circa 105mm per 1m^2 therefore based on a M6 100hr + cc storm of 87mm rainfall the paving offers, without any allowance for infiltration, a circa 1:1.2 drained volume:storage volume capacity. Hence there is no anticipated exceedance flow from the areas of permeable paving.

TSS 0.7, Metals 0.6, Hydrocarbons 0.7 = suitable for trafficked areas

All permeable paving offers sufficient storage volume to accommodate the 5mm event.

4.5 Rainwater harvesting

With reference to Section 3.1, Rainwater harvesting promotes the following SuDS design criteria:

- uses surface water runoff as a resource
- manages rainwater close to where it falls

and:

- stores rainwater for later use

4.5.1 For external use

Rain water harvesting / water butts: These provide additional, "off line[2]" SuDS, and are deemed a suitable SuDS component for small plots[2], extract at Figure 2. The image shows a water butt in "off-line" configuration using a standard diverter.

[2]The term "off-line" refers to the fact that a water butt is a harvesting device that is not "in-line" in the same manner that a pipe is in-line. Water is collected (harvested) until the water butt is full. When full, the rainwater continues down the rainwater pipe. Outflow from the tank is not "automatic" since this would negate the reason to harvest rainwater. Instead, manual drawdown occurs with the harvested water being used for external uses. Since a water butt may be full, the useful volume is not accounted for in storage and run-off calculations.

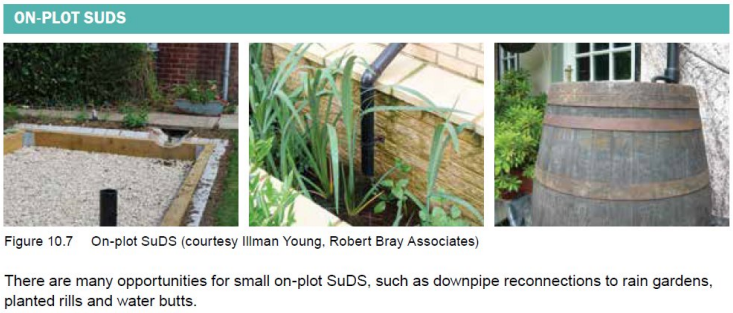


Figure 2: Use of water butts as provided in the SuDS manual

The collection and re-use of water can reduce run off volumes arising from roofs. The collected water, via readily available diverters (e.g. Web link: Standard diverter example, as per Figure 3), being used for external uses.

Figure 3: Standard rainwater diverter

Rainwater butts can, in part, accommodate the 5mm event dependent on manual drawdown and evaporation.

4.6 Sedum/green/blue roofs.

Due to site constraints, as per Section 4.1, these are not viable.

4.7 "End of pipe" solutions

To be considered only after implementation of the above options.

- Retention tanks with outfall controlled by hydraulic means (e.g. hydrobrakes, pipe sizing, orifice plate etc.) to limiting rates and volumes to discharge to existing flow pathways.

5 Proposed Surface water disposal strategy

5.1 Outfall control

5.1.1 Pitched roof area

Surface water from the roofed areas (90m^2 + 20m^2 over the crates themselves) will be directed to the existing SW network under hydraulic control with outfall rates limited to a 1 in 100 yr discharge rate of 1.0 ls^{-1}(Copy of Thames Water ALS at Appendix B).

5.1.2 Method to restrict discharge rate

Designed to accommodate all surface water arising from a design drained area of 121m^2 requires a minimum attenuation volume of 5 m^3. This can be achieved using an overall storage volume of 5 m^3 formed with a 0.3m overall unit depth. See Table 1.

Drained area	$110m^2$	
Urban Creep	1.1	
Designed drained area	$121m^2$	
Return periods considered	1yr, 30yr, 100yr	
Storm profiles used	50% Summer	75% Winter
Storm coeffs	a = 0.1, b = 0.815	a = 0.06, b = 1.026
Storm range, storm increments	From 5 minutes duration in further 2 min. intervals until critical storm reached	
Rainfall model	FEH 2022	
Critical design storm	76 mins, Winter	
Climate change	1.4	
Storm mean intensity	$38.3mm.hr^{-1}$	
Design mean intensity	$53.6mm.hr^{-1}$	
Storm peak intensity	$100.5mm.hr^{-1}$	
Design peak intensity	$140.7mm.hr^{-1}$	
Design maximum head	0.25m	
Calculated maximum head	0.25m	
Minimum attenuation volume required	$4.66m^3$	
Void ratio	95%	
Design attenuation volume	$4.8m^3$	($0.25m \times 19m^2$)
Provided attenuation volume	$5.7m^3$	($0.95 \times 20m^2 \times 0.3m$)
Factor of Safety	1.20	
1 in 1yr maximum outfall rate	$0.54ls^{-1}$	(See Figure 9.)
1 in 30yr maximum outfall rate	$0.82ls^{-1}$	(See Figure 10.)
1 in 100yr maximum outfall rate	$0.96ls^{-1}$	(See Figure 11.)
1 in 100yr Time to peak	59 mins	
1 in 100yr Max head: Time to drop to 50%	0.79 hrs	
Outfall control method	30mm Orifice	CD = 0.62

Table 1: Storage volume design summary

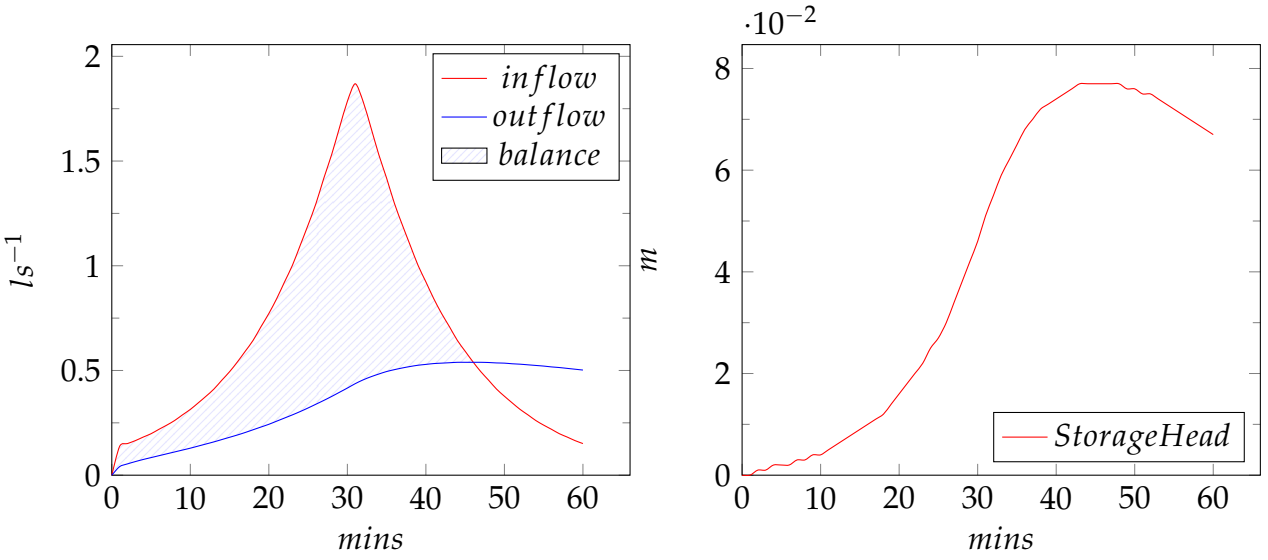


Figure 4: 1 in 1 year critical storm event

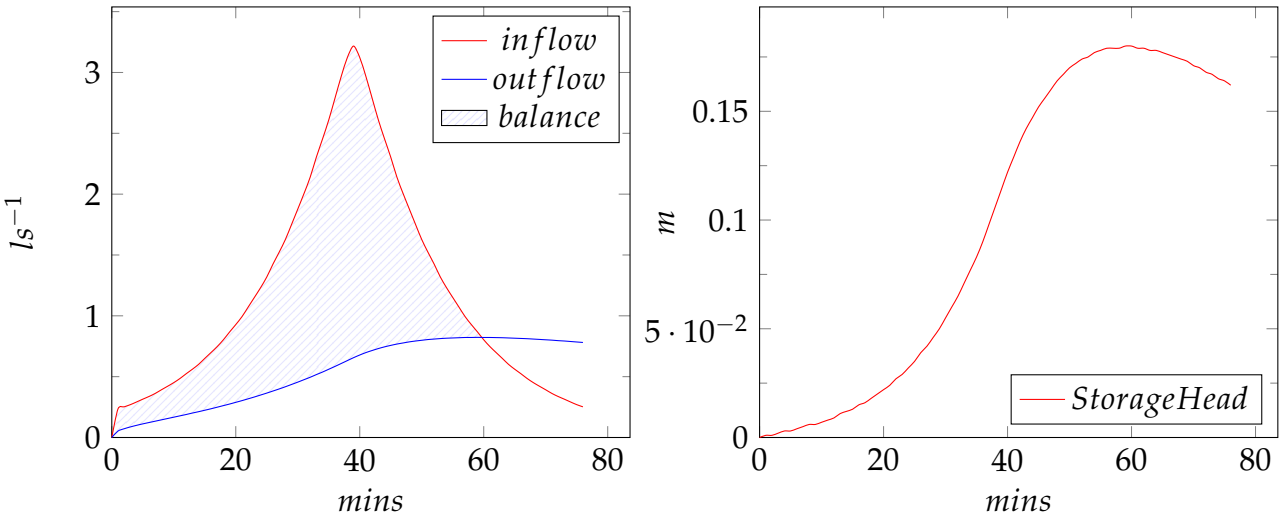


Figure 5: 1 in 30 year critical storm event

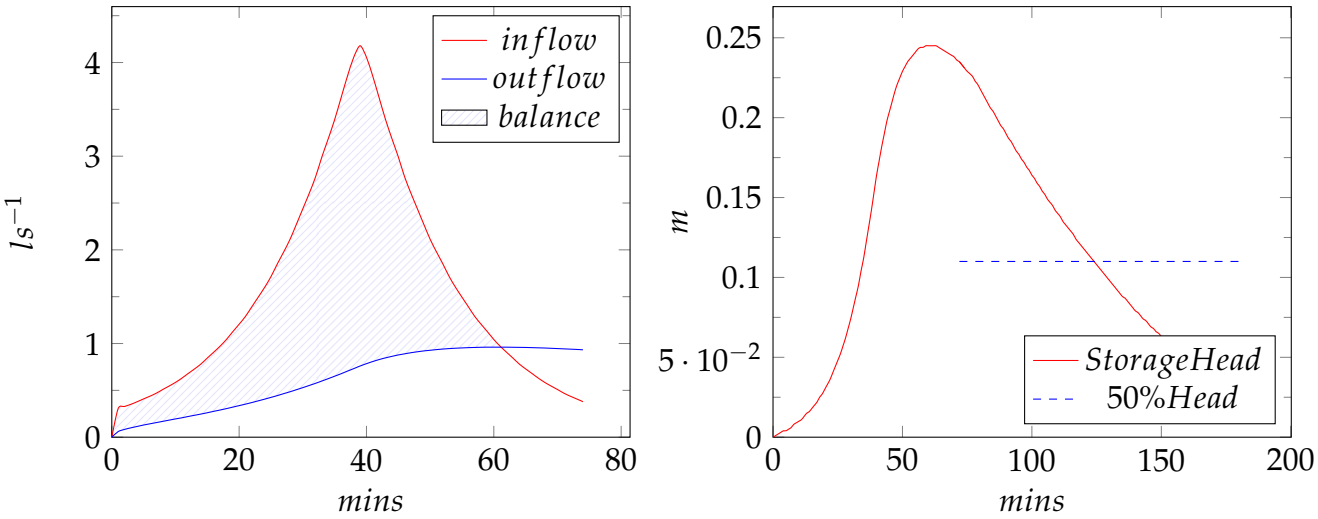


Figure 6: 1 in 100 year critical storm event

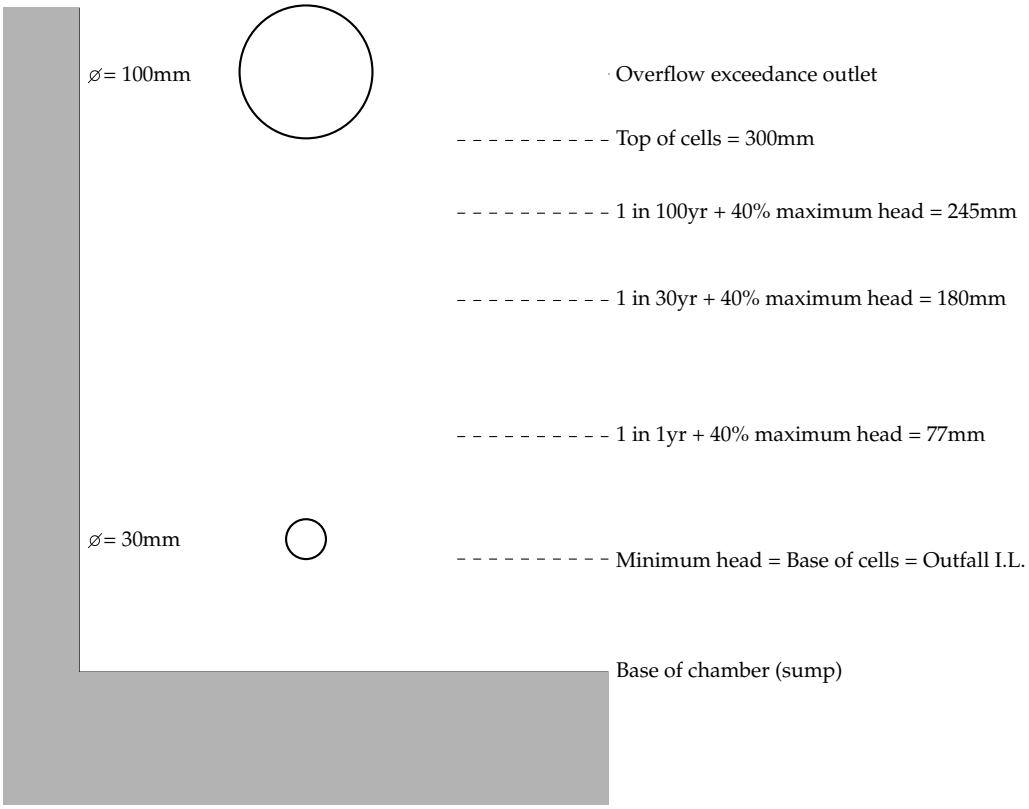


Figure 7: Orifice arrangement in control chamber

This can be achieved using a commercially available sub-base replacement attenuation cells and protected orifice control device - see Appendix C. This unit incorporates a higher level 100mm diameter overflow pipe to route exceedance flows under system failure events.

The attenuation cells will be fully tanked to the sides and base and installed in on-line configuration as per the typical detail at Figure 8.

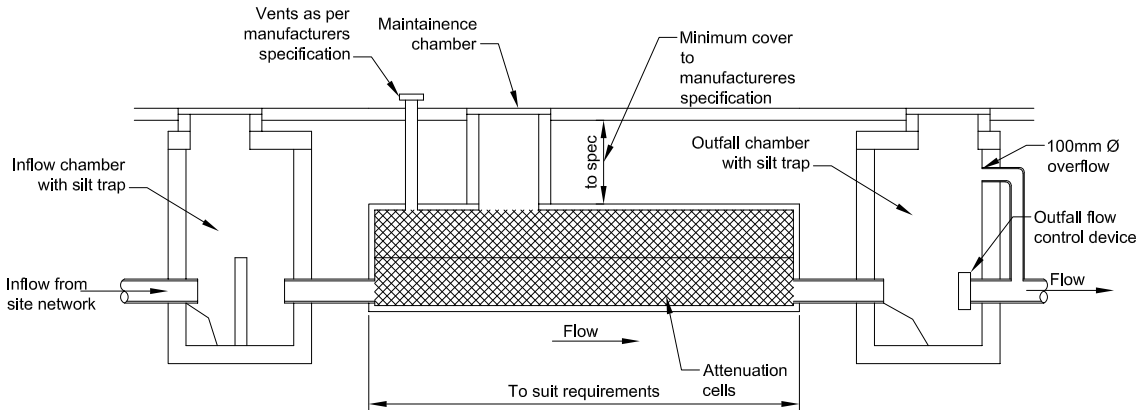


Figure 8: Typical on-line attenuation layout

5.2 Permeable hard standing

5.2.1 Permeable paving

All areas of hard standing on the site will be constructed using a permeable medium on a DOT/MOT 3 sub-base (refer to Section 4.4.1).

For a check on the capacity of the permeable paving to function an infiltration rate of 33mm.hr^{-1} has been used below (FoS = 3).

Over 170m^2 plan area, 33mm.hr^{-1} equates to a total outflow rate of 1.57ls^{-1}

Calculation based on CIRIA C753: Eq.25.1 where h_{max} = D(Ri-q)/n.

Designed to accommodate all surface water arising requires a sub-base with an attenuation capacity of 5.5 m^3 per 170m^2 drained area.

Duration (mins)	Intensity ($mmhr^{-1}$) + 40% CC	Inflow, m^3 (A)	Outflow, m^3 (B)	Balance volume required (A-B), m^3
5	156.07	2.21	0.47	1.7
10	156.07	4.42	0.94	3.5
15	156.07	6.63	1.42	5.2
30	101.84	8.66	2.84	5.8
60	63.39	10.78	5.67	5.1
120	38.57	13.11	11.34	1.8
240	23.12	15.72	22.68	0.0
360	16.93	17.27	34.02	0.0
600	11.29	19.19	56.70	0.0
700	9.96	19.76	66.15	0.0
1440	5.49	22.38	136.08	0.0

Table 2: Balance volume required within sub-base for a range of 1 in 100yr + 1.4% CC storm durations based on an outfall rate of $1.575ls^{-1}$ per $170m^2$ drained area.

This can be achieved by using a 0.35m deep, 30% void ratio, DoT Type 3 sub-base (see Table 3).

Unit area	$170m^2$	
R	1	CIRIA C753: $R = A_D/A_P$
Return periods considered	1yr, 30yr, 100yr	
Storm profiles used	50% Summer	75% Winter
Storm coeffs	a = 0.1, b = 0.815	a = 0.06, b = 1.026
Storm range, storm increments	From 5 minutes duration in further 2 min. intervals until critical storm reached	
Rainfall model	FEH 2022	
Critical design storm	44 mins, Winter	
Climate change	1.4	
Storm mean intensity	$56.2mm.hr^{-1}$	
Design mean intensity	$78.6mm.hr^{-1}$	CIRIA C753: i
Calculated maximum head	0.11m	CIIRA C753: h_{max}
Sub-base attenuation volume required per $170m^2$	$5.45m^3$	
Void ratio	30%	CIRIA C753: n
Sub-base attenuation volume provided per $170m^2$	$18m^3$	(0.3 x $170m^2$ x 0.35m)
Based on a minimum infiltration rate of 33 $mmhr^{-1}$		CIRIA C753: q
1 in 1yr min. outfall rate per $170m^2$	$1.575ls^{-1}$	(See Figure 9.)
1 in 30yr min. outfall rate per $170m^2$	$1.575ls^{-1}$	(See Figure 10.)
1 in 100yr min. outfall rate per $170m^2$	$1.575ls^{-1}$	(See Figure 11.)
1 in 100yr Time to peak	37 mins	
1 in 100yr Max head: Time to drop to 50%	0.28 hrs	
Outfall control method	Base Infiltration - Type A	

Table 3: Summary of sub-base attenuation capacity

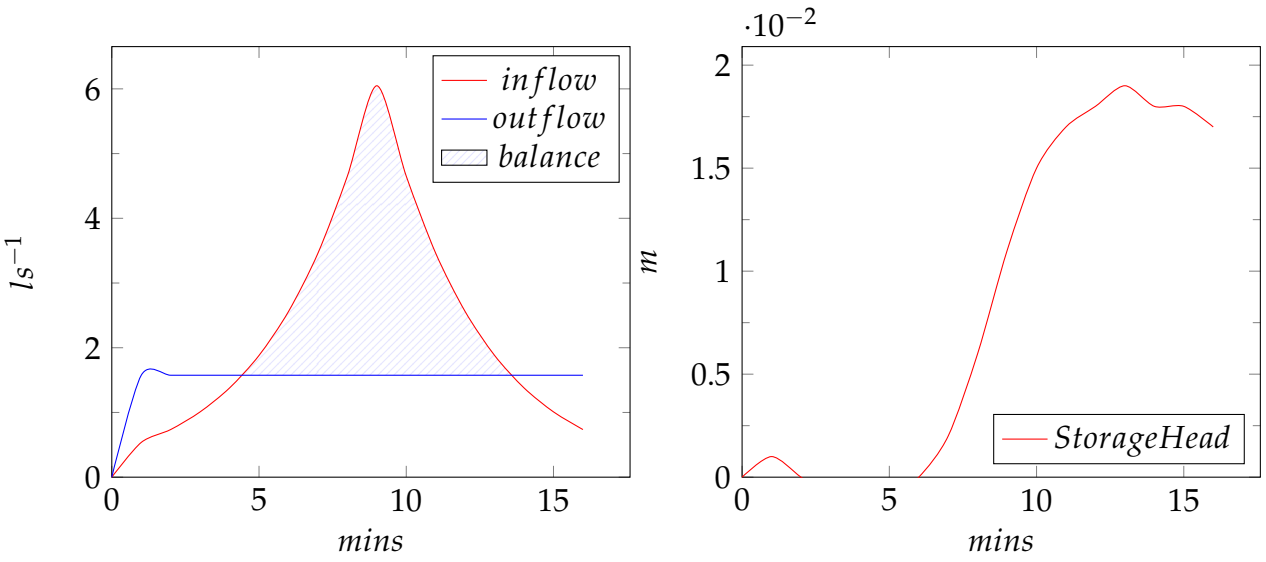


Figure 9: 1 in 1 year critical storm event

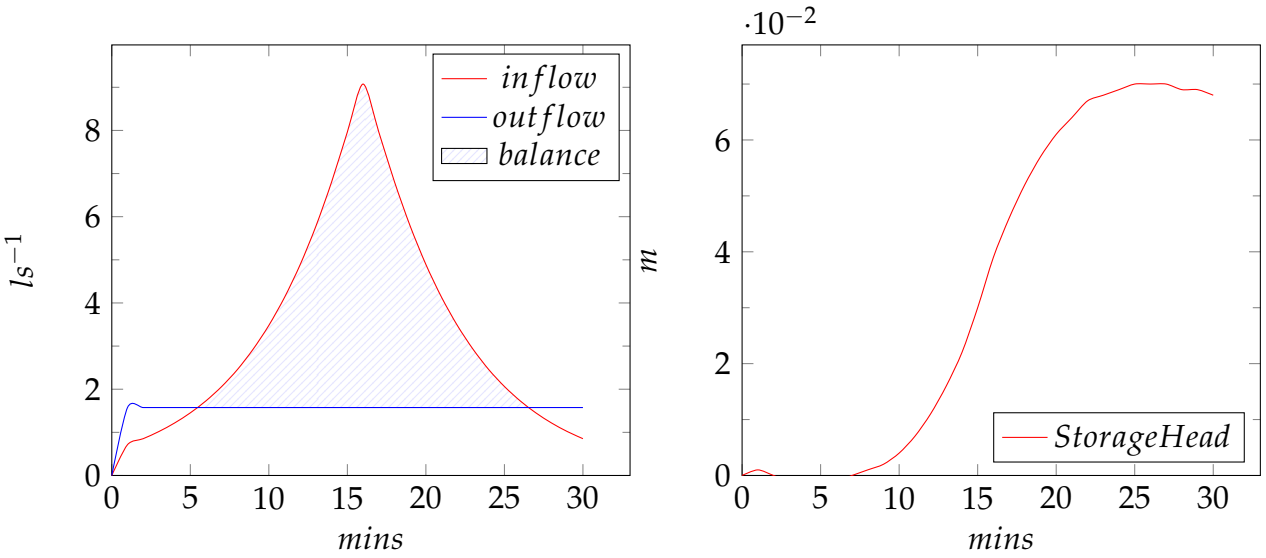


Figure 10: 1 in 30 year critical storm event

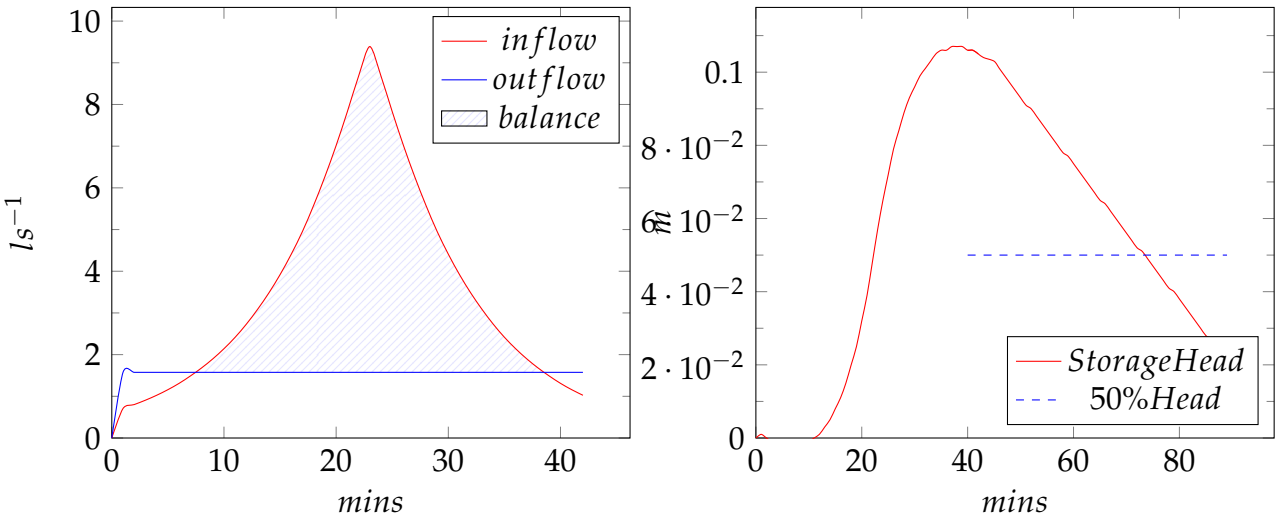
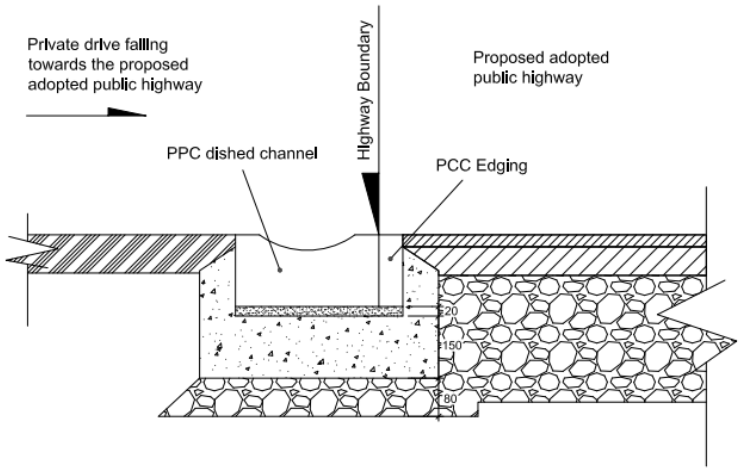


Figure 11: 1 in 100 year critical storm event

The areas of permeable paving are primarily disconnected from the proposed SW network on site, i.e. they are not primarily designed to drain to the network. Surface water retained in the sub-base matrix is lost through evaporation and infiltration at shallow depths, into the surrounding naturally fissured sub-soils (due to action of freeze-thaw, roots, earthworms and the proposed local re-grading following any site clearance). In doing so it mimics as close as possible the natural hydrological process of water falling onto the ground and finding natural flow paths for dispersion.

Exceedance flows (flows over the 1.2 x M1006hr + CC event) will be conveyed at the surface via channels to the proposed SW drains. A channel drain will also be placed across the entrance as per detail at Figure 12.



Notes:

1. Dished channels shall be installed between any areas of private land that fall towards the proposed adopted highway

2. The precast concrete dished channel shall fall to a soakaway or piped connexion to the private system on the site, no private water will be permitted into or on to the proposed adopted public highway.

3. The dished channel shall be laid on 20mm of class 1 mortar to allow a suitable fall to be created.

Figure 12: Channel drain at site entrance.

5.3 Rainwater harvesting

5.3.1 For external use

The project team have shown an "off line" rainwater butts to collect water for external use and to reduce potable water demand.

5.4 Vegetation Expansion

All landscaping will be colonised with greater and more expansive vegetation such as shrubs and trees, increasing interception and reducing run-off rates, where surface water will be dissipated through evapotranspiration and infiltration.

All domestic planting can accommodate the 5mm event. There is no anticipated exceedance flows from areas of domestic planting.

6 Design

6.1 Indicative layout

Refer to Appendix D.

6.2 Pipe sizing

Flow will be conveyed via 100mm diameter drainage runs laid at no less than 1:80 falls giving a maximum design capacity of 6.6ls^{-1}(Part H design chart, Figure 13).

1 in 100yr max mean intensity storm = 112mmhr^{-1}

Drained area to one pipe = 90m^2

Required pipe capacity = 90 x 0.1115 / 3.6 = 2.8 ls^{-1}

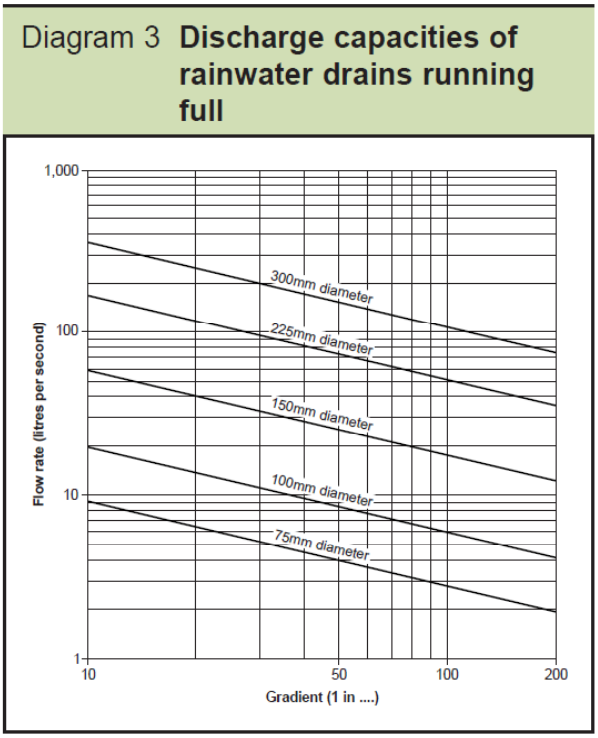


Figure 13: Part H drainage design chart

6.3 Reduction in outfall rates

In providing these solutions the following percentage reductions are achieved:

1 in 1 yr. Reduced from 0.76ls^{-1} to 0.54ls^{-1} which equates to a circa 29% reduction

1 in 30 yr. Reduced from 1.0ls^{-1} to 0.8ls^{-1} which equates to a circa 15% reduction

1 in 100 yr. Reduced from 1.3ls^{-1} to 1.0ls^{-1} which equates to a circa 23% reduction

6.4 Timetable for implementation

6.4.1 Site clearing phase

During the site clearing phase, rainwater will be managed in line with the requirements under the CDM regulations using existing SW gullies with measures in place to prevent contaminants entering the network (sand bag bunds etc).

Any existing redundant SW drains will then be grubbed out and capped off.

6.4.2 Construction phase

The Type 3 sub-base will be laid early in the project and protected with either 50mm wearing course or 100mm sacrificial crushed concrete over a geotextile material so as to allow site access.

Flow control devices and the attenuation cells will be installed early in the project under the remit of the ground-works operations.

Areas of landscaping and boundary planting will be undertaken as the project nears completion.

6.4.3 Post construction phase

Either the 50mm wearing course will be core drilled (100mm diam) at 1m staggered centres with core holes filled with 19mm stone, or the sacrificial layer of crushed concrete and geotextile removed to exposed a clean type 3 prior to local repair and laying of pavement over.

Permeable paving will only be installed when all construction activities are either complete, or near completion so as to minimise blockage of the surface.

Water butts will be installed prior to final completion as part of the final landscaping.

7 Maintenance of SuDS

Ultimate responsibility for the long term maintenance with SuDS in this environment lay with the dwelling owners (as yet unknown).

All SuDS on site will be installed with full consideration to long term maintenance. The following guidance applies:

7.1 Pervious pavements

The maintenance plan for permeable paving will include:

- Monthly litter removal;
- Bi-Annual jet washing/sweeping as/if required.
- Annual inspection and repairs as/if required.

7.2 Inspection/control chambers

The maintenance plan for areas of geocellular systems will include:

- Regular inspection of silt traps, IC's, pipework and pre-treatment devices (safe access provision required)
- Removal of sediments and debris as required.

Access points are required so as to be able to use a suction tanker on an annual basis.

7.3 Vegetation expansion

The maintenance plan for any garden planting will include:

- Monthly inspections until vegetation is established;
- Six monthly inspections after the vegetation has become established;
- Monthly litter removal.

7.4 Water butts

A maintenance plan for water butts should include:

- Regular inspection of silt traps and filters.
- Removal of sediments and debris as required.

8 Summary

All surface water arising can be managed on site. Exceedance flows and flows arising from system failure can be managed on site. Run-off rates are controlled to as low an outfall rate as is currently technically feasible and proportionate to the nature and scale of the development whilst minimising the risk of blockage.

The use of SuDS techniques on site, as detailed above and when installed in line with best practice (I.e. CIRIA 753 & CIRIA 768), will mitigate and treat the run-off volumes in line with the core policies.

Signed: 

Dr Robin Saunders CEng, C. Build E, MCABE, BEng(Hons), PhD

Date: 27th March, 2024

References

[1] DCW Marshall & AC Bayliss. Flood estimation for small catchments. Technical Report No. 124, Institute of Hydrology, June 1994.

[2] CIRIA. The SUDS manual. Technical report, CIRIA, 2015.

[3] H R Wallingford, Howbery Park, Wallingford, Oxfordshire. *The Wallingford Procedure*, volume 1 edition, 1981.

A Geo Insight report

Groundsure LOCATION INTELLIGENCE

Geo Insight

8A, DUNHEVED ROAD NORTH, THORNTON HEATH, CR7 6AH

Order Details

Date: 27/03/2024

Your ref: 242634

Our Ref: GS-5GK-OZ8-4T7-PXT

Site Details

Location: 531259 167443

Area: 0.05 ha

Authority: London Borough of Croydon ↗

Contact us with any questions at:
info@groundsure.com ↗
01273 257 755

Certified B Corporation

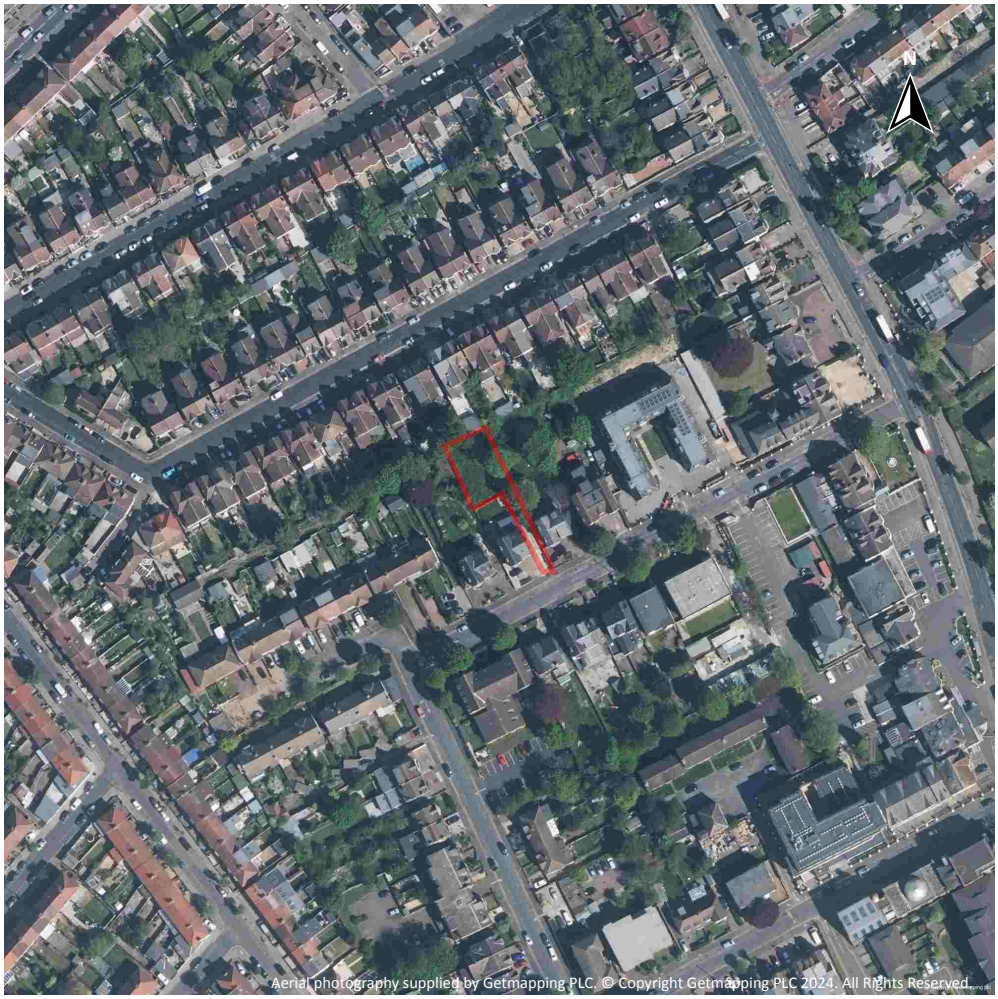
Summary of findings

Page	Section	Geology 1:10,000 scale >	On site	0-50m	50-250m	250-500m	500-2000m
11 >	1.1 >	10k Availability >	Identified (within 500m)				
12 >	1.2 >	Artificial and made ground (10k) >	0	0	1	1	-
13 >	1.3 >	Superficial geology (10k) >	1	0	0	1	-
14	1.4	Landslip (10k)	0	0	0	0	-
15 >	1.5 >	Bedrock geology (10k) >	1	0	0	0	-
16	1.6	Bedrock faults and other linear features (10k)	0	0	0	0	-
Page	Section	Geology 1:50,000 scale >	On site	0-50m	50-250m	250-500m	500-2000m
17 >	2.1 >	50k Availability >	Identified (within 500m)				
18 >	2.2 >	Artificial and made ground (50k) >	0	0	1	1	-
19	2.3	Artificial ground permeability (50k)	0	0	-	-	-
20 >	2.4 >	Superficial geology (50k) >	1	0	0	1	-
21 >	2.5 >	Superficial permeability (50k) >	Identified (within 50m)				
21	2.6	Landslip (50k)	0	0	0	0	-
21	2.7	Landslip permeability (50k)	None (within 50m)				
22 >	2.8 >	Bedrock geology (50k) >	1	0	0	0	-
23 >	2.9 >	Bedrock permeability (50k) >	Identified (within 50m)				
23	2.10	Bedrock faults and other linear features (50k)	0	0	0	0	-
Page	Section	Boreholes >	On site	0-50m	50-250m	250-500m	500-2000m
24 >	3.1 >	BGS Boreholes >	0	0	5	-	-
Page	Section	Natural ground subsidence >					
26 >	4.1 >	Shrink swell clays >	Moderate (within 50m)				
27 >	4.2 >	Running sands >	Very low (within 50m)				
28 >	4.3 >	Compressible deposits >	Negligible (within 50m)				
29 >	4.4 >	Collapsible deposits >	Very low (within 50m)				
30 >	4.5 >	Landslides >	Very low (within 50m)				
31 >	4.6 >	Ground dissolution of soluble rocks >	Negligible (within 50m)				

Page	Section	Mining and ground workings >	On site	0-50m	50-250m	250-500m	500-2000m
33	5.1	BritPits	0	0	0	0	-
34 >	5.2 >	Surface ground workings >	0	0	7	-	-
34	5.3	Underground workings	0	0	0	0	0
34	5.4	Underground mining extents	0	0	0	0	-
35	5.5	Historical Mineral Planning Areas	0	0	0	0	-
35 >	5.6 >	Non-coal mining >	0	0	0	1	1
35	5.7	JPB mining areas	None (within 0m)				
36	5.8	The Coal Authority non-coal mining	0	0	0	0	-
36 >	5.9 >	Researched mining >	0	0	2	1	-
36	5.10	Mining record office plans	0	0	0	0	-
37	5.11	BGS mine plans	0	0	0	0	-
37	5.12	Coal mining	None (within 0m)				
37	5.13	Brine areas	None (within 0m)				
37	5.14	Gypsum areas	None (within 0m)				
37	5.15	Tin mining	None (within 0m)				
38	5.16	Clay mining	None (within 0m)				
Page	Section	Ground cavities and sinkholes	On site	0-50m	50-250m	250-500m	500-2000m
39	6.1	Natural cavities	0	0	0	0	-
39	6.2	Mining cavities	0	0	0	0	0
39	6.3	Reported recent incidents	0	0	0	0	-
39	6.4	Historical incidents	0	0	0	0	-
40	6.5	National karst database	0	0	0	0	-
Page	Section	Radon >					
41 >	7.1 >	Radon >	Less than 1% (within 0m)				
Page	Section	Soil chemistry >	On site	0-50m	50-250m	250-500m	500-2000m
43 >	8.1 >	BGS Estimated Background Soil Chemistry >	1	1	-	-	-
43 >	8.2 >	BGS Estimated Urban Soil Chemistry >	1	5	-	-	-
44	8.3	BGS Measured Urban Soil Chemistry	0	0	-	-	-

Page	Section	Railway infrastructure and projects >	On site	0-50m	50-250m	250-500m	500-2000m
45	9.1	Underground railways (London)	0	0	0	-	-
45	9.2	Underground railways (Non-London)	0	0	0	-	-
46	9.3	Railway tunnels	0	0	0	-	-
46 >	9.4 >	Historical railway and tunnel features >	0	0	8	-	-
46	9.5	Royal Mail tunnels	0	0	0	-	-
47	9.6	Historical railways	0	0	0	-	-
47	9.7	Railways	0	0	0	-	-
47	9.8	Crossrail 1	0	0	0	0	-
47	9.9	Crossrail 2	0	0	0	0	-
47	9.10	HS2	0	0	0	0	-

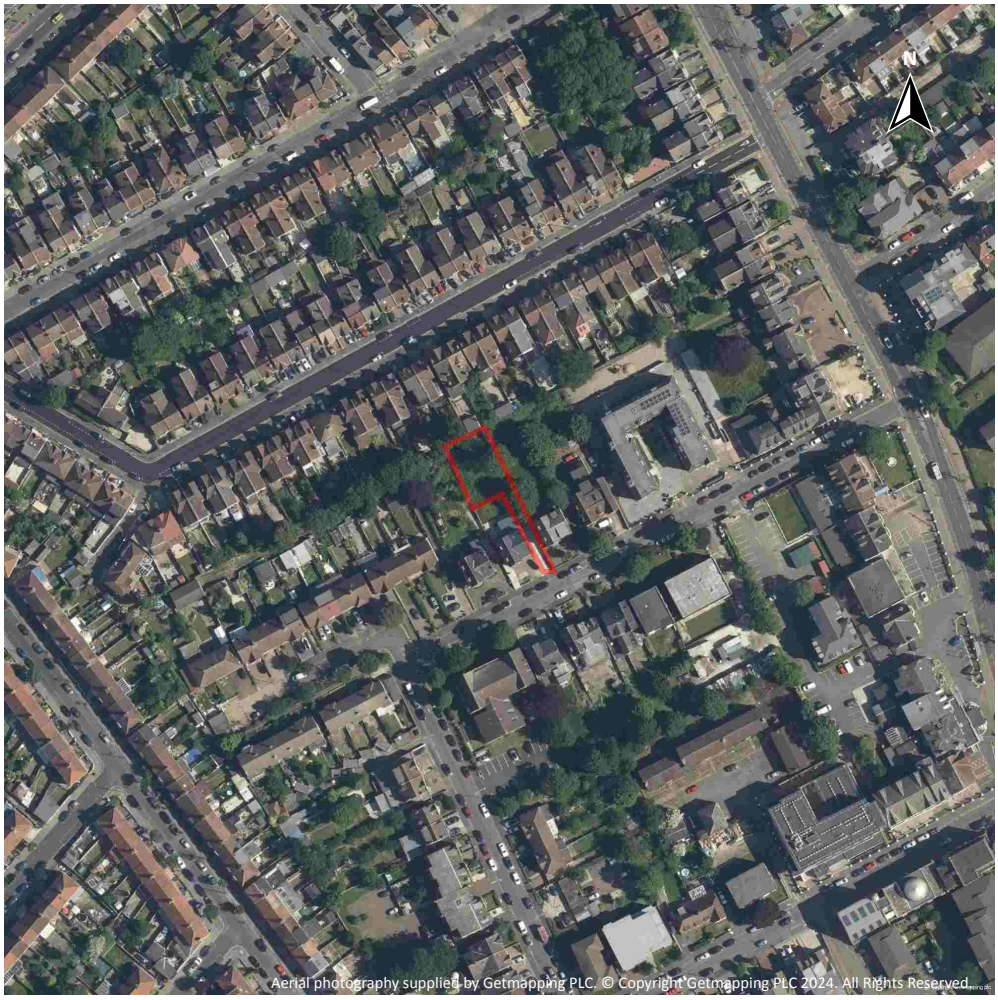
Recent aerial photograph



Capture Date: 30/04/2022

Site Area: 0.05ha

Recent site history - 2021 aerial photograph



Capture Date: 14/06/2021

Site Area: 0.05ha

Recent site history - 2019 aerial photograph

Capture Date: 29/06/2019

Site Area: 0.05ha

Recent site history - 2013 aerial photograph

Capture Date: 20/04/2013

Site Area: 0.05ha

Recent site history - 1999 aerial photograph

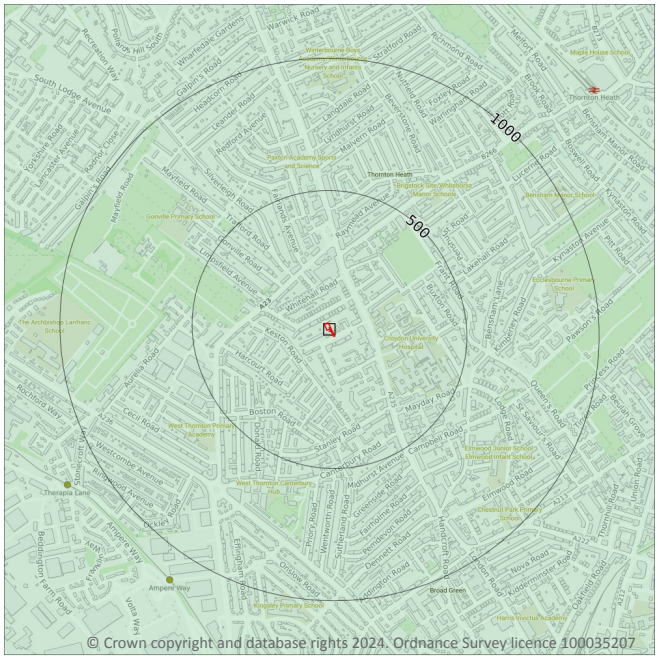
Capture Date: 04/09/1999

Site Area: 0.05ha

OS MasterMap site plan

Site Area: 0.05ha

1 Geology 1:10,000 scale - Availability



Site Outline

Search buffers in metres (m)

Full coverage

Partial coverage

No coverage

1.1 10k Availability

Records within 500m	1

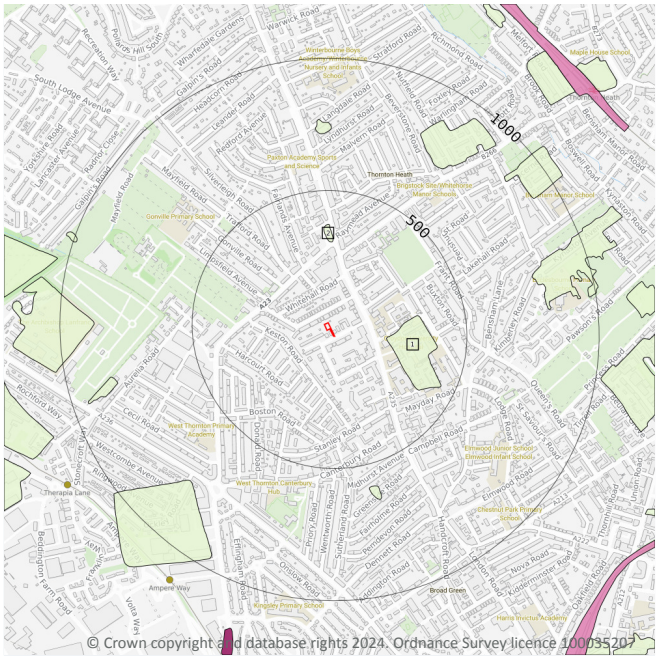
An indication on the coverage of 1:10,000 scale geology data for the site, the most detailed dataset provided by the British Geological Survey. Either 'Full', 'Partial' or 'No coverage' for each geological theme.

Features are displayed on the Geology 1:10,000 scale - Availability map on **page 11 >**

ID	Location	Artificial	Superficial	Bedrock	Mass movement	Sheet No.
1	**On site**	**Full**	**Full**	**Full**	**No coverage**	**TQ36NW**

This data is sourced from the British Geological Survey.

Geology 1:10,000 scale - Artificial and made ground



Site Outline

Search buffers in metres (m)

- Reclaimed ground
- Made ground
- Worked ground
- Infilled ground
- Disturbed ground
- Landscaped ground

1.2 Artificial and made ground (10k)

Records within 500m	2

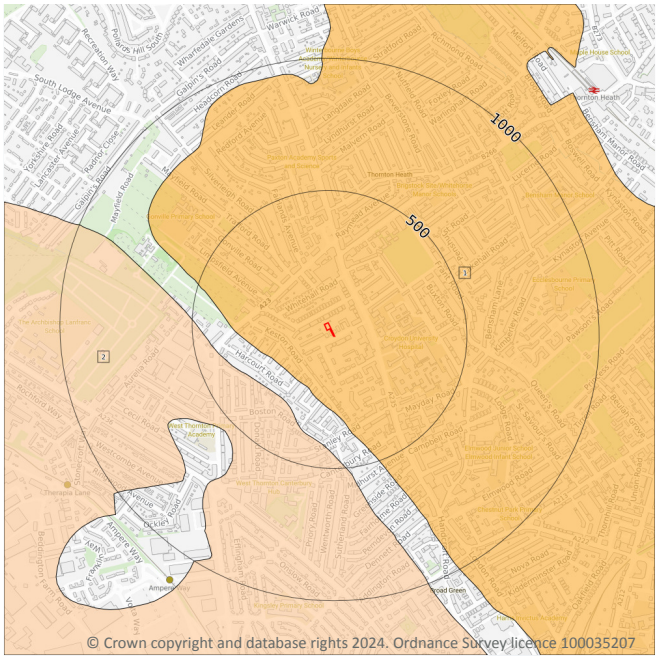
Details of made, worked, infilled, disturbed and landscaped ground at 1:10,000 scale. Artificial ground can be associated with potentially contaminated material, unpredictable engineering conditions and instability.

Features are displayed on the Geology 1:10,000 scale - Artificial and made ground map on **page 12 >**

ID	Location	LEX Code	Description	Rock description
1	196m E	WMGR-ARTDP	Infilled Ground	Artificial Deposit
2	306m N	WMGR-ARTDP	Infilled Ground	Artificial Deposit

This data is sourced from the British Geological Survey.

Geology 1:10,000 scale - Superficial



Site Outline

Search buffers in metres (m)

Landslip (10k)

Superficial geology (10k)
Please see table for more details.

1.3 Superficial geology (10k)

Records within 500m	2

Superficial geological deposits at 1:10,000 scale. Also known as 'drift', these are the youngest geological deposits, formed during the Quaternary. They rest on older deposits or rocks referred to as bedrock.

Features are displayed on the Geology 1:10,000 scale - Superficial map on **page 13 >**

ID	Location	LEX Code	Description	Rock description
1	**On site**	**LHGR-XSV**	**Lynch Hill Gravel Member - Sand And Gravel**	**Sand And Gravel**
2	305m SW	HAGR-XSV	Hackney Gravel Member - Sand And Gravel	Sand And Gravel

This data is sourced from the British Geological Survey.

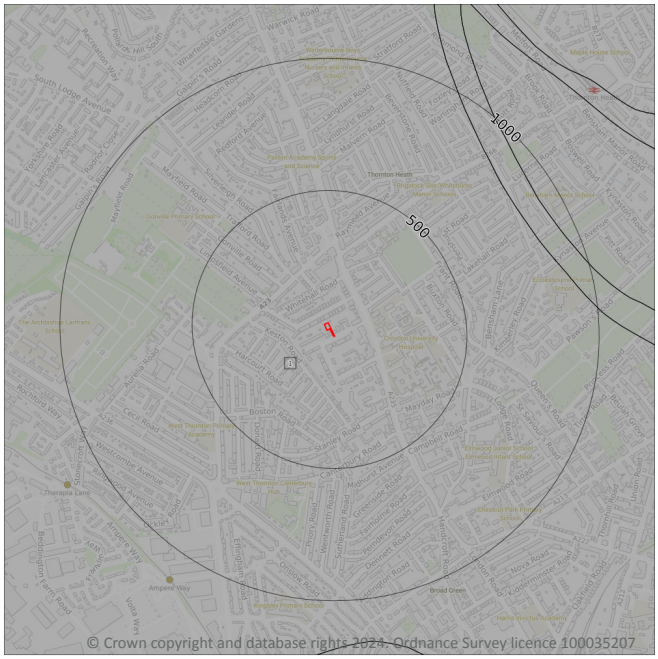
1.4 Landslip (10k)

Records within 500m	0

Mass movement deposits on BGS geological maps at 1:10,000 scale. Primarily superficial deposits that have moved down slope under gravity to form landslips. These affect bedrock, other superficial deposits and artificial ground.

This data is sourced from the British Geological Survey.

Geology 1:10,000 scale - Bedrock



Site Outline

Search buffers in metres (m)

Bedrock faults and other linear features (10k)

Bedrock geology (10k)
Please see table for more details.

1.5 Bedrock geology (10k)

Records within 500m	1

Bedrock geology at 1:10,000 scale. The main mass of rocks forming the Earth and present everywhere, whether exposed at the surface in outcrops or concealed beneath superficial deposits or water.

Features are displayed on the Geology 1:10,000 scale - Bedrock map on **page 15 >**

ID	Location	LEX Code	Description	Rock age
1	**On site**	**LC-CLAY**	**London Clay Formation - Clay**	**Eocene Epoch**

This data is sourced from the British Geological Survey.

1.6 Bedrock faults and other linear features (10k)

Records within 500m	0

Linear features at the ground or bedrock surface at 1:10,000 scale of six main types; rock, fault, fold axis, mineral vein, alteration area or landform. Features are either observed or inferred, and relate primarily to bedrock.

This data is sourced from the British Geological Survey.

2 Geology 1:50,000 scale - Availability

Site Outline

Search buffers in metres (m)

Geological map tile

2.1 50k Availability

Records within 500m	1

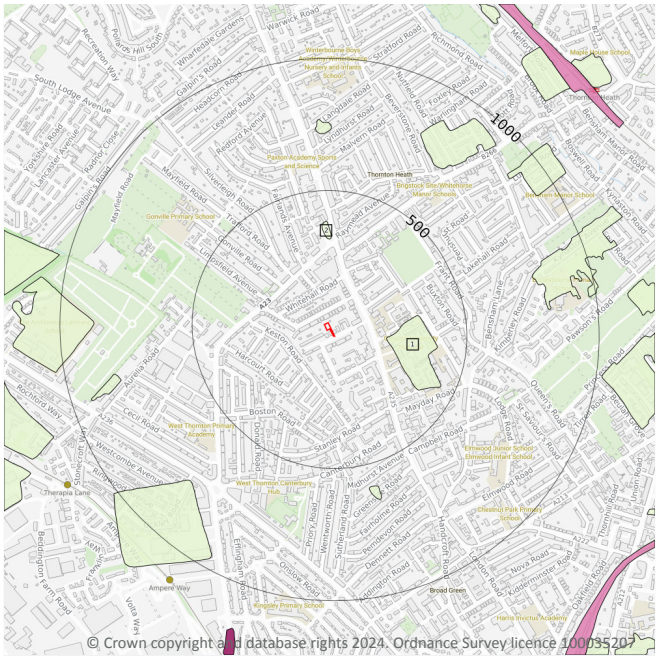
An indication on the coverage of 1:50,000 scale geology data for the site. Either 'Full' or 'No coverage' for each geological theme.

Features are displayed on the Geology 1:50,000 scale - Availability map on **page 17 >**

ID	Location	Artificial	Superficial	Bedrock	Mass movement	Sheet No.
1	**On site**	**Full**	**Full**	**Full**	**Full**	**EW270_south_london_v4**

This data is sourced from the British Geological Survey.

Geology 1:50,000 scale - Artificial and made ground



Site Outline

Search buffers in metres (m)

- Made ground
- Worked ground
- Infilled ground
- Disturbed ground
- Landscaped ground

2.2 Artificial and made ground (50k)

Records within 500m	2

Details of made, worked, infilled, disturbed and landscaped ground at 1:50,000 scale. Artificial ground can be associated with potentially contaminated material, unpredictable engineering conditions and instability.

Features are displayed on the Geology 1:50,000 scale - Artificial and made ground map on **page 18 >**

ID	Location	LEX Code	Description	Rock description
1	196m E	WMGR-ARTDP	INFILLED GROUND	ARTIFICIAL DEPOSIT
2	316m N	WMGR-ARTDP	INFILLED GROUND	ARTIFICIAL DEPOSIT

This data is sourced from the British Geological Survey.

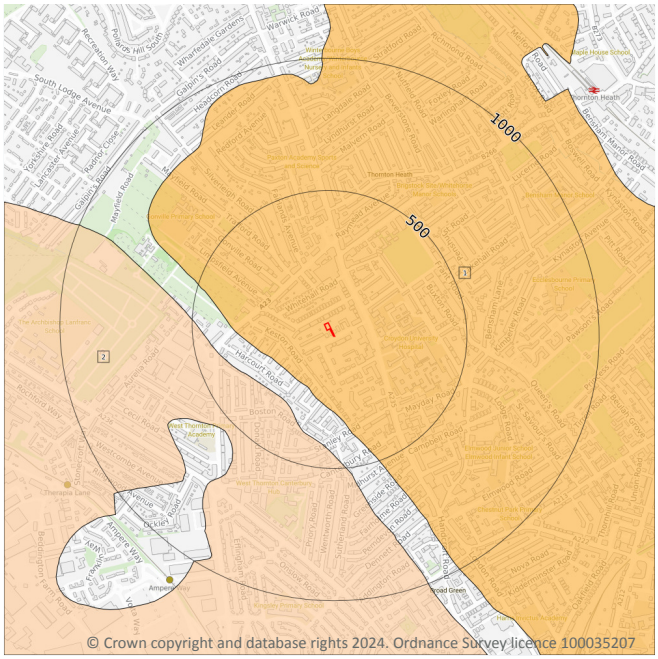
2.3 Artificial ground permeability (50k)

Records within 50m	0

A qualitative classification of estimated rates of vertical movement of water from the ground surface through the unsaturated zone of any artificial deposits (the zone between the land surface and the water table).

This data is sourced from the British Geological Survey.

Geology 1:50,000 scale - Superficial



Site Outline

Search buffers in metres (m)

Landslip (50k)

Superficial geology (50k)
Please see table for more details.

2.4 Superficial geology (50k)

Records within 500m	2

Superficial geological deposits at 1:50,000 scale. Also known as 'drift', these are the youngest geological deposits, formed during the Quaternary. They rest on older deposits or rocks referred to as bedrock.

Features are displayed on the Geology 1:50,000 scale - Superficial map on **page 20 >**

ID	Location	LEX Code	Description	Rock description
1	**On site**	**LHGR-XSV**	**LYNCH HILL GRAVEL MEMBER**	**SAND AND GRAVEL**
2	305m SW	HAGR-XSV	HACKNEY GRAVEL MEMBER	SAND AND GRAVEL

This data is sourced from the British Geological Survey.

2.5 Superficial permeability (50k)

Records within 50m	1

A qualitative classification of estimated rates of vertical movement of water from the ground surface through the unsaturated zone of any superficial deposits (the zone between the land surface and the water table).

Location	Flow type	Maximum permeability	Minimum permeability
On site	**Intergranular**	**Very High**	**High**

This data is sourced from the British Geological Survey.

2.6 Landslip (50k)

Records within 500m	0

Mass movement deposits on BGS geological maps at 1:50,000 scale. Primarily superficial deposits that have moved down slope under gravity to form landslips. These affect bedrock, other superficial deposits and artificial ground.

This data is sourced from the British Geological Survey.

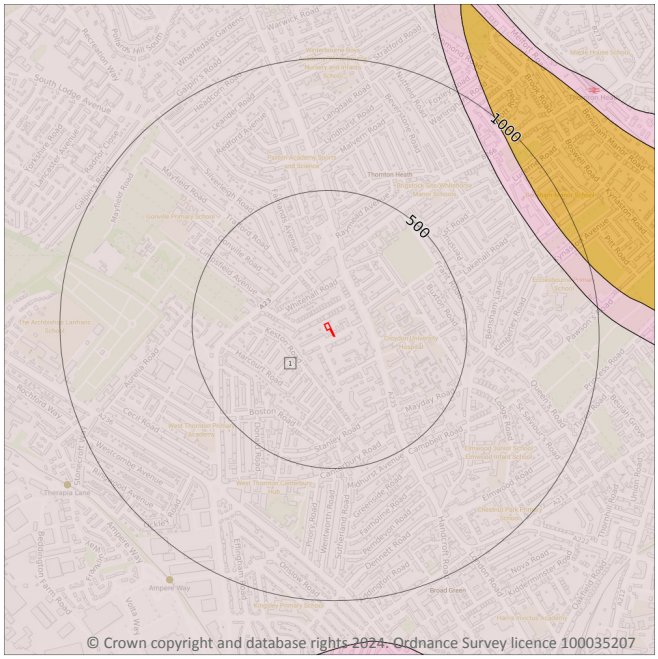
2.7 Landslip permeability (50k)

Records within 50m	0

A qualitative classification of estimated rates of vertical movement of water from the ground surface through the unsaturated zone of any landslip deposits (the zone between the land surface and the water table).

This data is sourced from the British Geological Survey.

Geology 1:50,000 scale - Bedrock



Site Outline

Search buffers in metres (m)

Bedrock faults and other linear features (50k)

Bedrock geology (50k)
Please see table for more details.

2.8 Bedrock geology (50k)

Records within 500m	1

Bedrock geology at 1:50,000 scale. The main mass of rocks forming the Earth and present everywhere, whether exposed at the surface in outcrops or concealed beneath superficial deposits or water.

Features are displayed on the Geology 1:50,000 scale - Bedrock map on **page 22 >**

ID	Location	LEX Code	Description	Rock age
1	On site	LC-XCZ	LONDON CLAY FORMATION - CLAY AND SILT	YPRESIAN

This data is sourced from the British Geological Survey.

2.9 Bedrock permeability (50k)

Records within 50m	1

A qualitative classification of estimated rates of vertical movement of water from the ground surface through the unsaturated zone of bedrock (the zone between the land surface and the water table).

Location	Flow type	Maximum permeability	Minimum permeability
On site	**Mixed**	**Low**	**Very Low**

This data is sourced from the British Geological Survey.

2.10 Bedrock faults and other linear features (50k)

Records within 500m	0

Linear features at the ground or bedrock surface at 1:50,000 scale of six main types; rock, fault, fold axis, mineral vein, alteration area or landform. Features are either observed or inferred, and relate primarily to bedrock.

This data is sourced from the British Geological Survey.

3 Boreholes

Site Outline

Search buffers in metres (m)

- Confidential
- 0 - 10m
- 10 - 30m
- 30m+
- Unknown

3.1 BGS Boreholes

Records within 250m	5

The Single Onshore Boreholes Index (SOBI); an index of over one million records of boreholes, shafts and wells from all forms of drilling and site investigation work held by the British Geological Survey. Covering onshore and nearshore boreholes dating back to at least 1790 and ranging from one to several thousand metres deep.

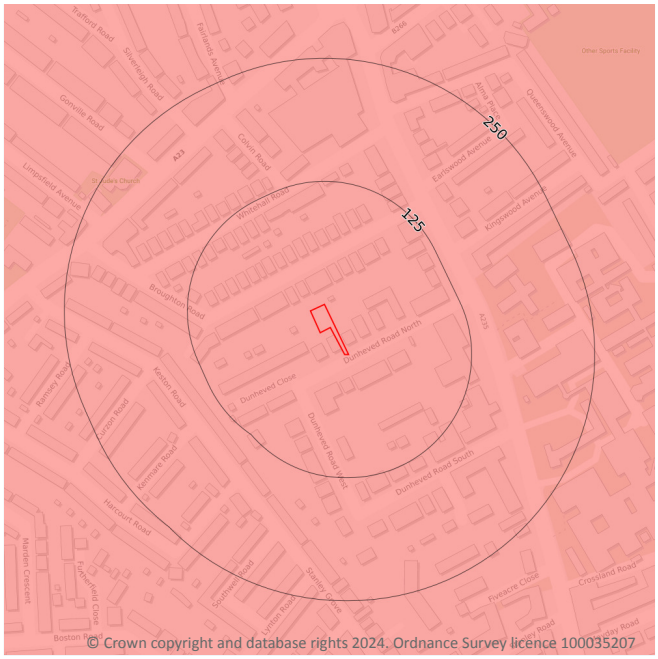
Features are displayed on the Boreholes map on **page 24 >**

ID	Location	Grid reference	Name	Length	Confidential	Web link
A	214m E	531500 167380	MAYDAY HOSPITAL TP 10	1.0	N	596631 ↗
B	219m E	531500 167460	MAYDAY HOSPITAL 16	15.0	N	596623 ↗
B	222m E	531500 167470	MAYDAY HOSPITAL TP 7	1.0	N	596628 ↗

ID	Location	Grid reference	Name	Length	Confidential	Web link
A	224m E	531510 167380	MAYDAY HOSPITAL 15	25.0	N	596622 ↗
1	241m SE	531500 167290	MAYDAY HOSPITAL 1	25.0	N	596610 ↗

This data is sourced from the British Geological Survey.

4 Natural ground subsidence - Shrink swell clays



Site Outline

Search buffers in metres (m)

- No data
- Negligible
- Very low
- Low
- Moderate
- High

4.1 Shrink swell clays

Records within 50m	1

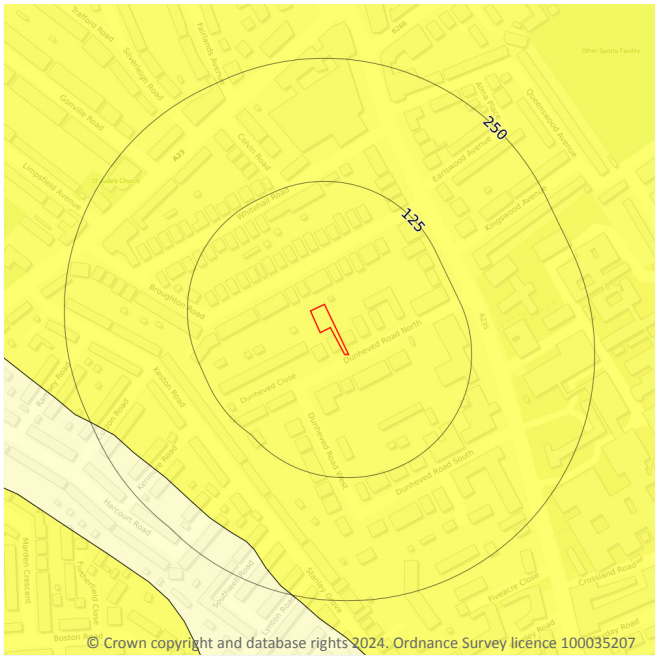
The potential hazard presented by soils that absorb water when wet (making them swell), and lose water as they dry (making them shrink). This shrink-swell behaviour is controlled by the type and amount of clay in the soil, and by seasonal changes in the soil moisture content (related to rainfall and local drainage).

Features are displayed on the Natural ground subsidence - Shrink swell clays map on **page 26 >**

Location	Hazard rating	Details
On site	**Moderate**	**Ground conditions predominantly high plasticity.**

This data is sourced from the British Geological Survey.

Natural ground subsidence - Running sands



Site Outline

Search buffers in metres (m)

- No data
- Negligible
- Very low
- Low
- Moderate
- High

4.2 Running sands

Records within 50m	1

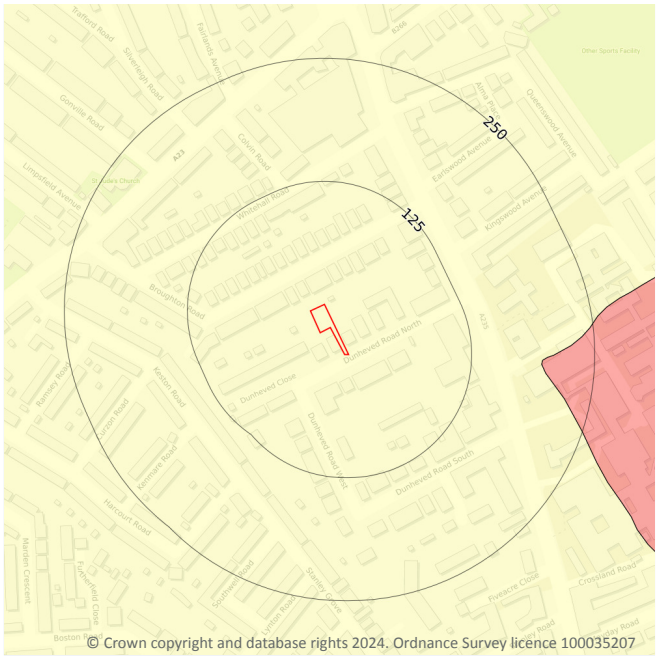
The potential hazard presented by rocks that can contain loosely-packed sandy layers that can become fluidised by water flowing through them. Such sands can 'run', removing support from overlying buildings and causing potential damage.

Features are displayed on the Natural ground subsidence - Running sands map on **page 27 >**

Location	Hazard rating	Details
On site	**Very low**	**Running sand conditions are unlikely. No identified constraints on land use due to running conditions unless water table rises rapidly.**

This data is sourced from the British Geological Survey.

Natural ground subsidence - Compressible deposits



Site Outline

Search buffers in metres (m)

- No data
- Negligible
- Very low
- Low
- Moderate
- High

4.3 Compressible deposits

Records within 50m	1

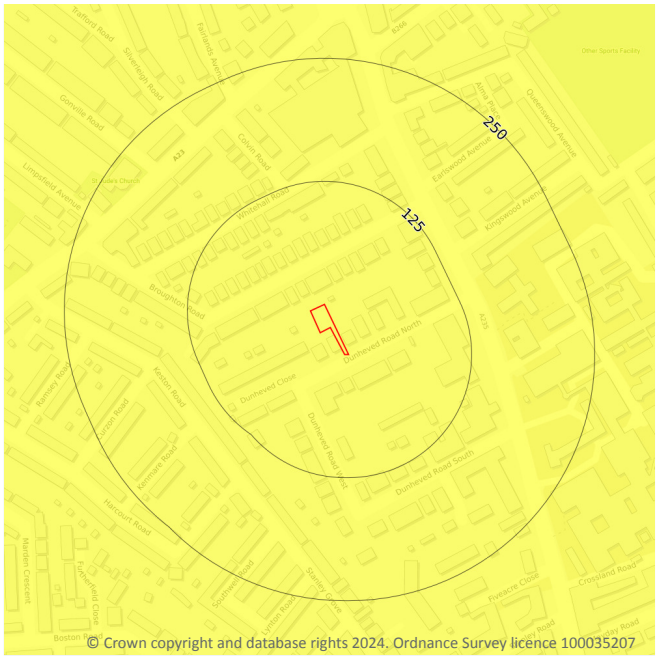
The potential hazard presented by types of ground that may contain layers of very soft materials like clay or peat and may compress if loaded by overlying structures, or if the groundwater level changes, potentially resulting in depression of the ground and disturbance of foundations.

Features are displayed on the Natural ground subsidence - Compressible deposits map on **page 28 >**

Location	Hazard rating	Details
On site	**Negligible**	**Compressible strata are not thought to occur.**

This data is sourced from the British Geological Survey.

Natural ground subsidence - Collapsible deposits



Site Outline

Search buffers in metres (m)

- No data
- Negligible
- Very low
- Low
- Moderate
- High

4.4 Collapsible deposits

Records within 50m	1

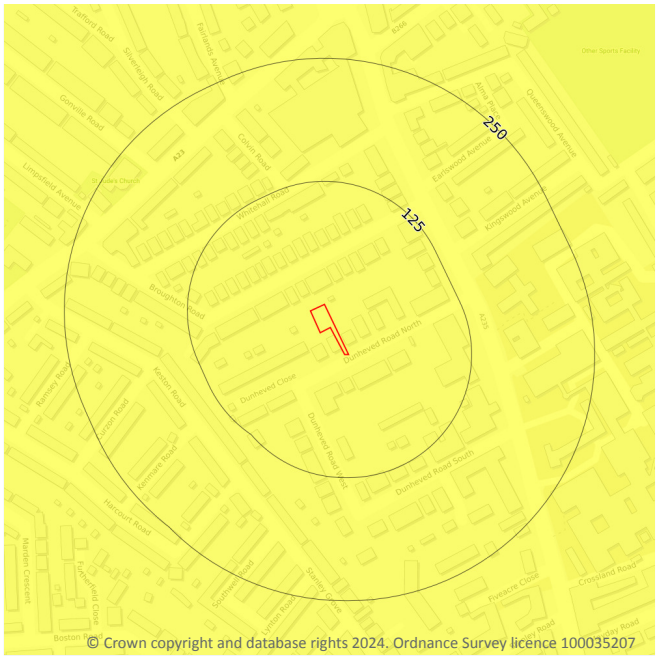
The potential hazard presented by natural deposits that could collapse when a load (such as a building) is placed on them or they become saturated with water.

Features are displayed on the Natural ground subsidence - Collapsible deposits map on **page 29 >**

Location	Hazard rating	Details
On site	**Very low**	**Deposits with potential to collapse when loaded and saturated are unlikely to be present.**

This data is sourced from the British Geological Survey.

Natural ground subsidence - Landslides



Site Outline

Search buffers in metres (m)

- No data
- Negligible
- Very low
- Low
- Moderate
- High

4.5 Landslides

Records within 50m	1

The potential for landsliding (slope instability) to be a hazard assessed using 1:50,000 scale digital maps of superficial and bedrock deposits, combined with information from the BGS National Landslide Database and scientific and engineering reports.

Features are displayed on the Natural ground subsidence - Landslides map on **page 30 >**

Location	Hazard rating	Details
On site	**Very low**	**Slope instability problems are not likely to occur but consideration to potential problems of adjacent areas impacting on the site should always be considered.**

This data is sourced from the British Geological Survey.

Natural ground subsidence - Ground dissolution of soluble rocks

Site Outline

Search buffers in metres (m)

- No data
- Negligible
- Very low
- Low
- Moderate
- High

4.6 Ground dissolution of soluble rocks

Records within 50m	1

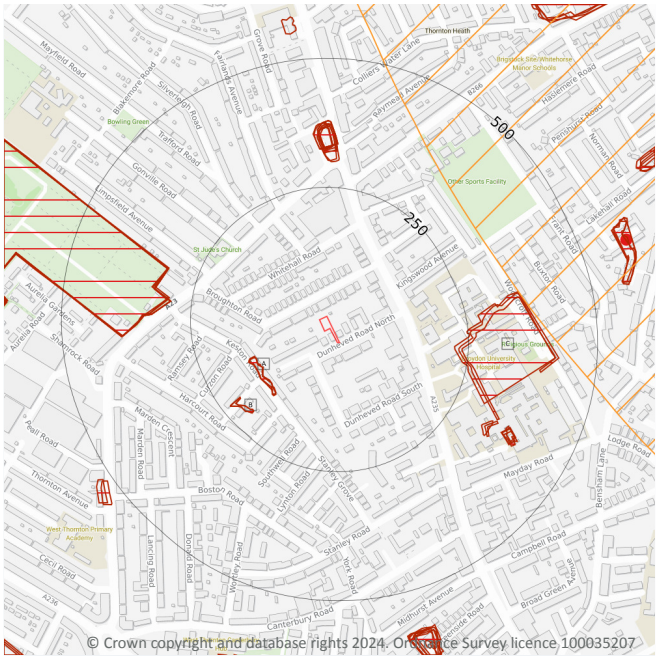
The potential hazard presented by ground dissolution, which occurs when water passing through soluble rocks produces underground cavities and cave systems. These cavities reduce support to the ground above and can cause localised collapse of the overlying rocks and deposits.

Features are displayed on the Natural ground subsidence - Ground dissolution of soluble rocks map on **page 31 >**

Location	Hazard rating	Details
On site	**Negligible**	**Soluble rocks are either not thought to be present within the ground, or not prone to dissolution. Dissolution features are unlikely to be present.**

This data is sourced from the British Geological Survey.

5 Mining and ground workings



Site Outline

Search buffers in metres (m)

- BritPits
- Surface ground workings
- Underground workings
- Underground mining extents
- Historical mineral planning areas
- TCA non-coal mining

Non Coal Mining

- Sporadic underground mining of restricted extent possible
- Localised small scale underground mining possible
- Small scale mining possible
- Underground mining known or likely within or in close proximity
- Underground mining known within or in very close proximity

5.1 BritPits

Records within 500m	0

BritPits (an abbreviation of British Pits) is a database maintained by the British Geological Survey of currently active and closed surface and underground mineral workings. Details of major mineral handling sites, such as wharfs and rail depots are also held in the database.

This data is sourced from the British Geological Survey.

5.2 Surface ground workings

Records within 250m	7

Historical land uses identified from Ordnance Survey mapping that involved ground excavation at the surface. These features may or may not have been subsequently backfilled.

Features are displayed on the Mining and ground workings map on **page 33 >**

ID	Location	Land Use	Year of mapping	Mapping scale
A	139m SW	Pond	1919	1:10560
A	139m SW	Pond	1930	1:10560
A	139m SW	Pond	1910	1:10560
B	206m SW	Pond	1930	1:10560
B	206m SW	Pond	1910	1:10560
C	223m E	Unspecified Pit	1872	1:10560
C	232m E	Unspecified Ground Workings	1871	1:10560

This is data is sourced from Ordnance Survey/Groundsure.

5.3 Underground workings

Records within 1000m	0

Historical land uses identified from Ordnance Survey mapping that indicate the presence of underground workings e.g. mine shafts.

This is data is sourced from Ordnance Survey/Groundsure.

5.4 Underground mining extents

Records within 500m	0

This data identifies underground mine workings that could present a potential risk, including adits and seam workings. These features have been identified from BGS Geological mapping and mine plans sourced from the BGS and various collections and sources.

This data is sourced from Groundsure.

5.5 Historical Mineral Planning Areas

Records within 500m	0

Boundaries of mineral planning permissions for England and Wales. This data was collated between the 1940s (and retrospectively to the 1930s) and the mid 1980s. The data includes permitted, withdrawn and refused permissions.

This data is sourced from the British Geological Survey.

5.6 Non-coal mining

Records within 1000m	2

The potential for historical non-coal mining to have affected an area. The assessment is drawn from expert knowledge and literature in addition to the digital geological map of Britain. Mineral commodities may be divided into seven general categories - vein minerals, chalk, oil shale, building stone, bedded ores, evaporites and 'other' commodities (including ball clay, jet, black marble, graphite and chert).

Features are displayed on the Mining and ground workings map on **page 33 >**

ID	Location	Name	Commodity	Class	Likelihood
1	334m NE	Not available	Chalk	C	Underground mine workings may have occurred in the past, or current mines may be operating to modern engineering standards. Potential for difficult ground conditions should be considered.
-	673m S	Not available	Chalk	C	Underground mine workings may have occurred in the past, or current mines may be operating to modern engineering standards. Potential for difficult ground conditions should be considered.

This data is sourced from the British Geological Survey.

5.7 JPB mining areas

Records on site	0

Areas which could be affected by former coal and other mining. This data includes some mine plans unavailable to the Coal Authority.

This data is sourced from Johnson Poole and Bloomer.

5.8 The Coal Authority non-coal mining

Records within 500m	0

This data provides an indication of the potential zone of influence of recorded underground non-coal mining workings. Any and all analysis and interpretation of Coal Authority Data in this report is made by Groundsure, and is in no way supported, endorsed or authorised by the Coal Authority. The use of the data is restricted to the terms and provisions contained in this report. Data reproduced in this report may be the copyright of the Coal Authority and permission should be sought from Groundsure prior to any re-use.

This data is sourced from The Coal Authority.

5.9 Researched mining

Records within 500m	3

This data indicates areas of potential mining identified from alternative or archival sources, including; BGS Geological paper maps, Lidar data, aerial photographs (from World War II onwards), archaeological data services, websites, Tithe maps, and various text/plans from collected books and reports. Some of this data is approximate and Groundsure have interpreted the resultant risk area and, where possible, specific areas of risk have been captured.

Location	Mineral type
196m E	Stone
227m E	Stone
405m SE	Stone

This data is sourced from Groundsure.

5.10 Mining record office plans

Records within 500m	0

This dataset is representative of Mining Record Office and/or plan extents held by Groundsure and should be considered approximate. Where possible, plans have been located and any specific areas of risk they depict have been captured.

This data is sourced from Groundsure.

5.11 BGS mine plans

Records within 500m	0

This dataset is representative of BGS mine plans held by Groundsure and should be considered approximate. Where possible, plans have been located and any specific areas of risk they depict have been captured.

This data is sourced from Groundsure.

5.12 Coal mining

Records on site	0

Areas which could be affected by past, current or future coal mining.

This data is sourced from the Coal Authority.

5.13 Brine areas

Records on site	0

The Cheshire Brine Compensation District indicates areas that may be affected by salt and brine extraction in Cheshire and where compensation would be available where damage from this mining has occurred. Damage from salt and brine mining can still occur outside this district, but no compensation will be available.

This data is sourced from the Cheshire Brine Subsidence Compensation Board.

5.14 Gypsum areas

Records on site	0

Generalised areas that may be affected by gypsum extraction.

This data is sourced from British Gypsum.

5.15 Tin mining

Records on site	0

Generalised areas that may be affected by historical tin mining.

This data is sourced from Groundsure.

5.16 Clay mining

Records on site	0

Generalised areas that may be affected by kaolin and ball clay extraction.

This data is sourced from the Kaolin and Ball Clay Association (UK).

6 Ground cavities and sinkholes

6.1 Natural cavities

Records within 500m	0

Industry recognised national database of natural cavities. Sinkholes and caves are formed by the dissolution of soluble rock, such as chalk and limestone, gulls and fissures by cambering. Ground instability can result from movement of loose material contained within these cavities, often triggered by water.

This data is sourced from Stantec UK Ltd.

6.2 Mining cavities

Records within 1000m	0

Industry recognised national database of mining cavities. Degraded mines may result in hazardous subsidence (crown holes). Climatic conditions and water escape can also trigger subsidence over mine entrances and workings.

This data is sourced from Stantec UK Ltd.

6.3 Reported recent incidents

Records within 500m	0

This data identifies sinkhole information gathered from media reports and Groundsure's own records. This data goes back to 2014 and includes relative accuracy ratings for each event and links to the original data sources. The data is updated on a regular basis and should not be considered a comprehensive catalogue of all sinkhole events. The absence of data in this database does not mean a sinkhole definitely has not occurred during this time.

This data is sourced from Groundsure.

6.4 Historical incidents

Records within 500m	0

This dataset comprises an extract of 1:10,560, 1:10,000, 1:2,500 and 1:1,250 scale historical Ordnance Survey maps held by Groundsure, dating back to the 1840s. It shows shakeholes, deneholes and other 'holes' as noted on these maps. Dene holes are medieval chalk extraction pits, usually comprising a narrow shaft with a number of chambers at the base of the shaft. Shakeholes are an alternative name for suffusion sinkholes, most commonly found in the limestone landscapes of North Yorkshire but also extensively noted around the Brecon Beacons National Park.

Not all 'holes' noted on Ordnance Survey mapping will necessarily be present within this dataset.

This data is sourced from Groundsure.

6.5 National karst database

Records within 500m	0

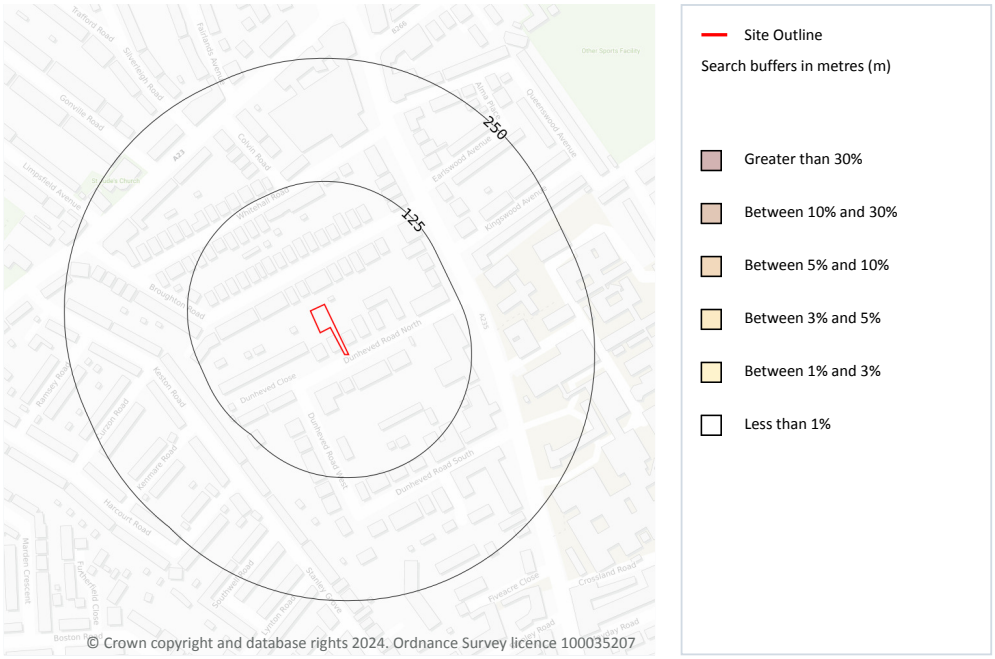
This is a comprehensive database of national karst information gathered from a wide range of sources. BGS have collected data on five main types of karst feature: Sinkholes, stream links, caves, springs, and incidences of associated damage to buildings, roads, bridges and other engineered works.

Since the database was set up in 2002 data covering most of the evaporite karst areas of the UK have now been added, along with data covering about 60% of the Chalk, and 35% of the Carboniferous Limestone outcrops. Many of the classic upland karst areas have yet to be included. Recorded so far are: Over 800 caves, 1300 stream sinks, 5600 springs, 10,000 sinkholes.

The database is not yet complete, and not all records have been verified. The absence of data does not mean that karst features are not present at a site. A reliability rating is included with each record.

This data is sourced from the British Geological Survey.

7 Radon



7.1 Radon

Records on site	1

The Radon Potential data classifies areas based on their likelihood of a property having a radon level at or above the Action Level in Great Britain. The dataset is intended for use at 1:50,000 scale and was derived from both geological assessments and indoor radon measurements (more than 560,000 records). A minimum 50m buffer should be considered when searching the maps, as the smallest detectable feature at this scale is 50m. The findings of this section should supersede any estimations derived from the Indicative Atlas of Radon in Great Britain (1:100,000 scale).

Features are displayed on the Radon map on **page 41 >**

Location	Estimated properties affected	Radon Protection Measures required
On site	**Less than 1%**	**None**

This data is sourced from the British Geological Survey and UK Health Security Agency.

8 Soil chemistry

8.1 BGS Estimated Background Soil Chemistry

Records within 50m	2

The estimated values provide the likely background concentration of the potentially harmful elements Arsenic, Cadmium, Chromium, Lead and Nickel in topsoil. The values are estimated primarily from rural topsoil data collected at a sample density of approximately 1 per 2 km^2. In areas where rural soil samples are not available, estimation is based on stream sediment data collected from small streams at a sampling density of 1 per 2.5 km^2; this is the case for most of Scotland, Wales and southern England. The stream sediment data are converted to soil-equivalent concentrations prior to the estimation.

Location	Arsenic	Bioaccessible Arsenic	Lead	Bioaccessible Lead	Cadmium	Chromium	Nickel
On site	**No data**	**No data**	**No data**	**No data**	**No data**	**No data**	**No data**
44m N	No data	No data	No data	No data	No data	No data	No data

This data is sourced from the British Geological Survey.

8.2 BGS Estimated Urban Soil Chemistry

Records within 50m	6

Estimated topsoil chemistry of Arsenic, Cadmium, Chromium, Copper, Nickel, Lead, Tin and Zinc and bioaccessible Arsenic and Lead in 23 urban centres across Great Britain. These estimates are derived from interpolation of the measured urban topsoil data referred to above and provide information across each city between the measured sample locations (4 per km^2).

Location	Arsenic (mg/kg)	Bioaccessible Arsenic (mg/kg)	Lead (mg/kg)	Bioaccessible Lead (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Nickel (mg/kg)	Tin (mg/kg)
On site	**21**	**3.7**	**256**	**176**	**1.2**	**74**	**85**	**23**	**26**
5m SE	25	4.4	238	164	0.7	67	70	20	20
12m SE	19	3.3	292	201	1.6	78	100	25	32
13m SE	22	3.8	276	190	1.1	72	88	23	28
44m N	15	2.6	247	170	2.6	86	94	24	28
49m W	21	3.7	218	150	1	71	72	21	20

This data is sourced from the British Geological Survey.

8.3 BGS Measured Urban Soil Chemistry

Records within 50m	0

The locations and measured total concentrations (mg/kg) of Arsenic, Cadmium, Chromium, Copper, Nickel, Lead, Tin and Zinc in urban topsoil samples from 23 urban centres across Great Britain. These are collected at a sample density of 4 per km^2.

This data is sourced from the British Geological Survey.

9 Railway infrastructure and projects

Site Outline
Search buffers in metres (m)
Crossrail 1 Stations
Crossrail 1 Route
Crossrail 2 Stations
Crossrail 2 Route
Crossrail 2 Worksites
Crossrail 2 Safeguarding
Crossrail 2 Headhouses
Railway stations
Active railways
Active tunnels
Abandoned railways
Historic railways
Historic tunnels
Underground stations
Underground Lines
Royal Mail tunnels
HS2 optimised route
HS2 Stations
HS2 Depots
HS2 Surface Safeguarding
HS2 Subsurface Safeguarding

9.1 Underground railways (London)

Records within 250m	0

Details of all active London Underground lines, including approximate tunnel roof depth and operational hours.

This data is sourced from publicly available information by Groundsure.

9.2 Underground railways (Non-London)

Records within 250m	0

Details of the Merseyrail system, the Tyne and Wear Metro and the Glasgow Subway. Not all parts of all systems are located underground. The data contains location information only and does not include a depth assessment.

This data is sourced from publicly available information by Groundsure.

9.3 Railway tunnels

Records within 250m	0

Railway tunnels taken from contemporary Ordnance Survey mapping.

This data is sourced from the Ordnance Survey.

9.4 Historical railway and tunnel features

Records within 250m	8

Railways and tunnels digitised from historical Ordnance Survey mapping as scales of 1:1,250, 1:2,500, 1:10,000 and 1:10,560.

Features are displayed on the Railway infrastructure and projects map on **page 45 >**

Location	Land Use	Year of mapping	Mapping scale
185m N	Tramway Sidings	1932	2500
185m N	Tramway Sidings	1913	2500
185m N	Tramway Sidings	1940	2500
227m N	Railway Sidings	1898	2500
229m N	Tramway Sidings	1896	2500
230m N	Tramway Sidings	1912	2500
233m N	Tramway Sidings	1940	2500
233m N	Tramway Sidings	1932	2500

This data is sourced from Ordnance Survey/Groundsure.

9.5 Royal Mail tunnels

Records within 250m	0

The Post Office Railway, otherwise known as the Mail Rail, is an underground railway running through Central London from Paddington Head District Sorting Office to Whitechapel Eastern Head Sorting Office. The line is 10.5km long. The data includes details of the full extent of the tunnels, the depth of the tunnel, and the depth to track level.

This data is sourced from Groundsure/the Postal Museum.

9.6 Historical railways

Records within 250m	0

Former railway lines, including dismantled lines, abandoned lines, disused lines, historic railways and razed lines.

This data is sourced from OpenStreetMap.

9.7 Railways

Records within 250m	0

Currently existing railway lines, including standard railways, narrow gauge, funicular, trams and light railways.

This data is sourced from Ordnance Survey and OpenStreetMap.

9.8 Crossrail 1

Records within 500m	0

The Crossrail railway project links 41 stations over 100 kilometres from Reading and Heathrow in the west, through underground sections in central London, to Shenfield and Abbey Wood in the east.

This data is sourced from publicly available information by Groundsure.

9.9 Crossrail 2

Records within 500m	0

Crossrail 2 is a proposed railway linking the national rail networks in Surrey and Hertfordshire via an underground tunnel through London.

This data is sourced from publicly available information by Groundsure.

9.10 HS2

Records within 500m	0

HS2 is a proposed high speed rail network running from London to Manchester and Leeds via Birmingham. Main civils construction on Phase 1 (London to Birmingham) of the project began in 2019, and it is currently anticipated that this phase will be fully operational by 2026. Construction on Phase 2a (Birmingham to Crewe) is anticipated to commence in 2021, with the service fully operational by 2027. Construction on Phase 2b (Crewe to Manchester and Birmingham to Leeds) is scheduled to begin in 2023 and be operational by 2033.

This data is sourced from HS2 ltd.

Data providers

Groundsure works with respected data providers to bring you the most relevant and accurate information. To find out who they are and their areas of expertise see https://www.groundsure.com/sources-reference ↗.

Terms and conditions

Groundsure's Terms and Conditions can be accessed at this link: www.groundsure.com/terms-and-conditions-april-2023/ ↗.

B Thames Water

B.1 ALS

C Polypipe main components

C.1 Attenuation cells

Permavoid system - components

Permavoid 85 and 150

Product code: PVPP85 and PVPP150

Permavoid is a geocellular interlocking system designed for shallow groundwater storage or infiltration, to be used in place of traditional aggregate sub-base. The system has an exceptionally high compressive and tensile strength and bending resistance with a proprietary jointing system to create a horizontal structural 'raft' within the pavement that is ideal for the shallow attenuation of surface water. The system can also be combined in layers using interlocking shear connectors to increase depth in 85mm and 150mm increments. This is particularly useful in designing infiltration systems, allowing flexibility in balancing the soil permeability/infiltration area of the Permavoid storage units and residual temporary attenuation.

Element	85mm	150mm
Physical Properties		
Weight per unit	2.25kg	3kg
Weight per square metre	9kg	12kg
Length	708mm	708mm
Width	354mm	354mm
Depth	85mm	150mm
Short Term Compressive Strength		
Vertical	715kN/m²	715kN/m²
Lateral	156kN/m²	156kN/m²
Short Term Deflection		
Vertical	1mm per 126kN/m²	1mm per 126kN/m²
Lateral	1mm per 15kN/m²	1mm per 15kN/m²
Tensile Strength		
Of a single joint	42.4kN/m²	42.4kN/m²
Of a single joint at (1% secant modulus)	18.8kN/m²	18.8kN/m²
Bending resistance of unit	0.71kN/m	0.71kN/m
Bending resistance of single joint	0.16kN/m	0.16kN/m
Volumetric void ratio	92%	95%
Average effective perforated surface area	52%	52%
Other Properties		
Intrinsic permeability (k)	1.0×10^{-5}	1.0×10^{-5}
Ancillary	Permavoid Permatie Permavoid Shear Connector	Permavoid Permatie Permavoid Shear Connector
Material	Polypropylene (PP)	Polypropylene (PP)

Hydraulic Performance 85mm			
3 units wide, 1 unit deep (1.06m x 0.15m)			
Free Discharge			
Gradient (%)	0	1	2
Flow Rate (l/m/s)	4	6	7

Hydraulic Performance 150mm						
3 units wide, 1 unit deep (1.06m x 0.15m)						
Free Discharge						
Gradient (%)	0	1	2	3	4	5
Flow Rate (l/m/s)	8	13	15	17	19	21

Applications

The Permavoid units are suitable for use as a stormwater attenuation and/or infiltration system. The system comprises of single, interconnected cells which can be installed in the ground as part of sub-base formation. Permavoid is suitable for use in a range of applications including residential, industrial estates, car parks, sports pitches, roofs, basements, pedestrian areas and rainwater harvesting.

Performance

The structural load bearing capacity of the Permavoid units have been tested in accordance with the following European Standard: BS 7533-13:2009. The system's structural design life expectancy, based upon creep test data (tested in accordance with CIRIA guidelines) is as follows; for lightly loaded areas such as car parks, a design life of 50 years is achievable. For areas with prolonged HGV loading a typical design life may only be 25 years, depending on the design of the pavement surfacing and structural layers over the tank.

Installation standard

All calculations for Permavoid units are based upon site-specific load cases, pavement construction types and thicknesses, soil cover and ground conditions and the suitability must therefore be approved for each project.

Key benefits

- High strength, high capacity, shallow, sub-base replacement system
- Stormwater attenuation and/or infiltration system
- Used as part of a SuDS scheme to offer stormwater storage at shallow construction depths
- Units are manufactured from 90% recycled polypropylene (PP)
- 100% recyclable

Available to download on the website toolbox.

Structural design

Pavement applications

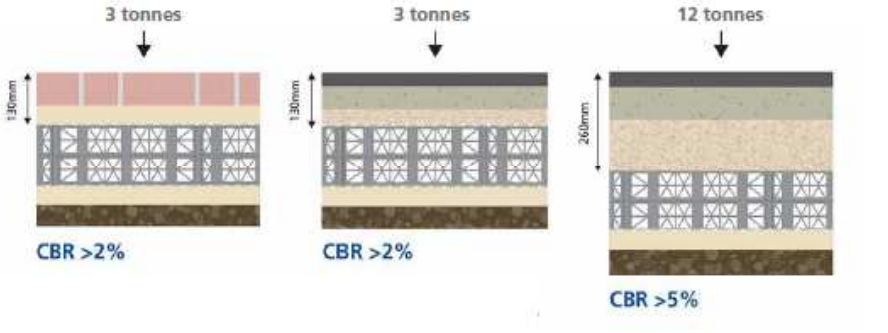
The Permavoid system has undergone numerous laboratory tests and instrumented site trials to validate use in pavement constructions. Permavoid exceeds the minimum unit performance recommended in industry guidance for geocellular units installed within a pavement structure.

Many factors should be considered when designing Permavoid below pavements, including:

- Vehicle types
- Frequency of loading
- Load duration
- Speed
- Pavement construction

Pavement construction examples

Typical minimum recommended pavement construction details, for a number of loading situations, are reproduced below; amended to illustrate how Permavoid would typically be installed within these pavement structures.



80mm block
+ 50mm sand bed
= 130mm

Applications:

- Private drives
- Car parks with height restrictions

30mm asphalt surface
+ 60mm asphalt base
+ 40mm Type 1 sub-base
= 130mm

Applications:

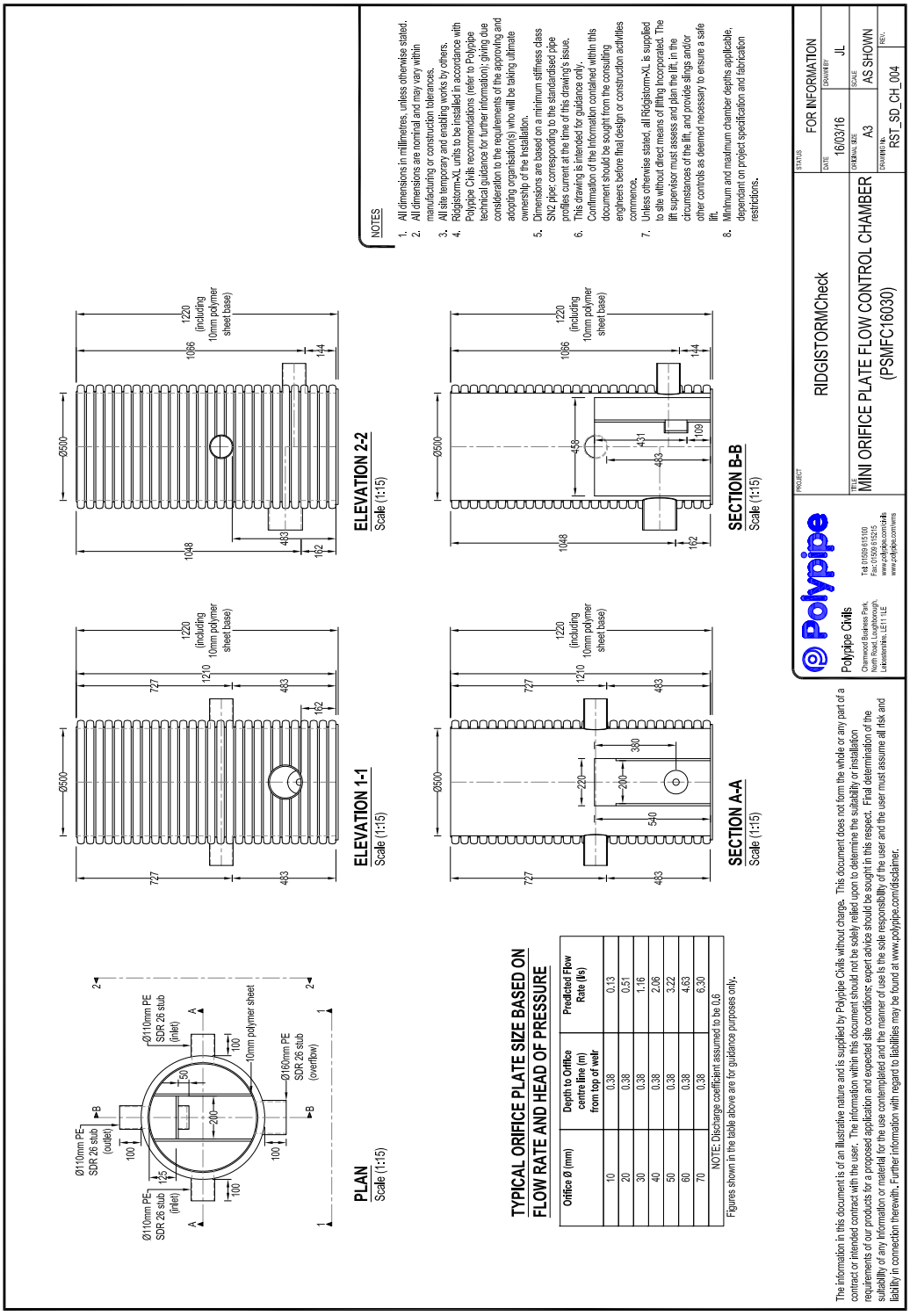
- Private drives
- Car parks with height restrictions
- Includes for occasional/ accidental HGV overrun

30mm asphalt surface
+ 90mm asphalt base
+ 140mm Type 1 sub-base
= 260mm

Applications:

- Car parks without height restrictions
- Includes for occasional/ accidental HGV overrun
- Suitable for access roads

C.2 Protected orifice chamber




Polyethylene wear plate, with chamfered circular orifice & perforated debris guard
Integral hinged stainless steel plate to slide up between guide rails for simple maintenance
Integral polypropylene 2.5kN lockable cover and frame, individually labelled with a unique reference number and orifice size for whole-life relevance
Polyethylene twin-wall chamber complying with BS 7158

D Proposed SuDS layout