SW strategy

For the proposed development on land at

Canada Cottages, Stortford Road, Gt Dunmow, CM6 1SH

Prepared by

Dr Robin Saunders CEng

Innervision Design Ltd

Updated site layout February 2023

INNERVISION
design

Contents

Appendix

List of Figures

List of Tables

Disclaimer

This document has been prepared solely as a conceptual surface water drainage strategy report on behalf of the client in the context of the scope as defined in this document. Innervision Design Ltd maintains that all reasonable care and skill have been used in the compilation of this report. However, Innervision Design Ltd shall not be under any liability for loss or damage (including consequential loss) whatsoever or howsoever arising as a result of the use of this report by the client or his agents. If any un-authorised third party comes into possession of this report they rely on it at their own risk and Innervision Design Ltd owes them no duty, care or skill whatsoever.

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) & (4A) 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 2.1 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 at Canada Cottages, Stortford Road, Great Dunmow CM6 1SH (see Figure 1).

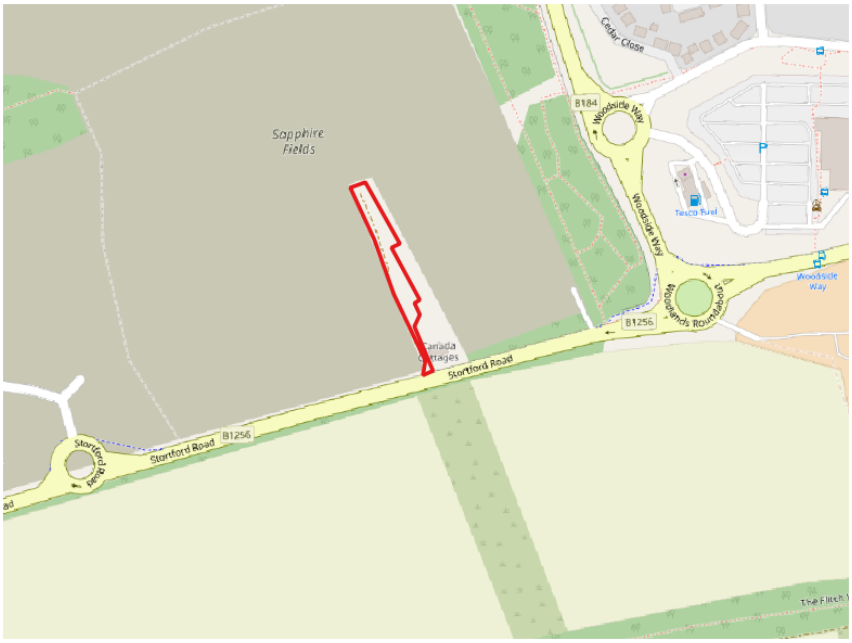


Figure 1: Site location plan, as indicated in red with North topmost. (source: Open streetmap)

2.2 Development description

Proposal is for the erection of a four detached residential dwellings following the demolition of the existing buildings on site.

All plans to be submitted under separate cover.

2.3 Site geology

With reference to BGS mapping the site is located directly on the Lowestoft formation - boulder clay.

See also Geo insight report at Appendix A.

2.3.1 Infiltration rates

A test hole failed to drain down to 75% hence testing was abandoned.

Evidence from the major development surrounding the site to the West, North and East also indicates that infiltration is not a viable option.

2.4 Existing surface water disposal strategy

Survey of the existing drainage shows surface water is currently managed on site via a central drain out-falling to a culvert at the road boundary.

The curtilage of the entire site encloses an area of approximately 2200m^2 of which, pre-development, 1260m^2 is classed as being impermeable (260m^2 roofs, 1000m^2 impermeable hard-standing and paths), with the remaining 940m^2 classed as permeable planting. The new development decreases the impermeable area from 1260m^2 to 355m^2 (293m^2 roof area).

2.5 Estimation of existing run-off rates

For the purpose of this report the site is considered green field.

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.

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 = 616mm

Hydrological Region 6

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

SPR = 0.47

2.6.4 Calculations

$$\begin{aligned} Q_{BAR50ha} &= 1.08 * 0.5^{0.89} * 616^{1.17} * 0.47^{2.17} \\ &= 0.58 * 1835.73 * 0.19 \\ &= 207.86 \end{aligned}$$

Using Equation 2:

$$\begin{aligned} Q_{BAR} &= \frac{207.86 * 0.22}{50} \\ &= 0.91 ls^{-1} \end{aligned}$$

Using Equation 3:

$$\begin{aligned} Q_1 &= 0.91 * 0.85 \\ &= 0.78 ls^{-1} \end{aligned}$$

Using Equation 4:

$$\begin{aligned} Q_{100} &= 0.91 * 3.19 \\ &= 2.92 ls^{-1} \end{aligned}$$

2.6.5 Peak run-off rates

For the 1 year Return Period event the peak runoff calculates to 0.78 ls^{-1}
For the 30 year Return Period event the peak runoff calculates to 2.10 ls^{-1}
For the 100 year Return Period event the peak runoff calculates to 2.92 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

- Sloping site.
- No viable infiltration for soakaways.
- Low pro rata greenfield run-off rate.
- Pitched roofs.
- No direct 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[1]" 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.

[1]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.

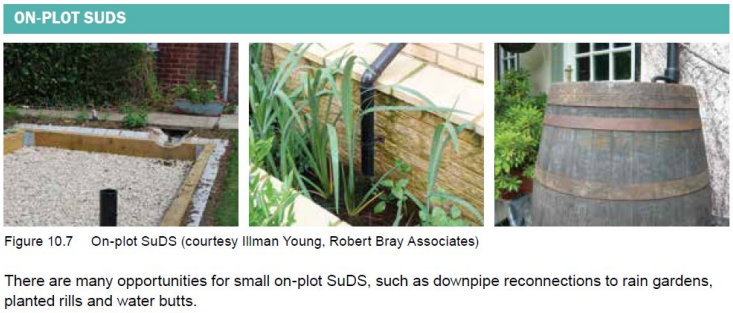


Figure 10.7 On-plot SuDS (courtesy Illman Young, Robert Bray Associates)

There are many opportunities for small on-plot SuDS, such as downpipe reconnections to rain gardens, planted rills and water butts.

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.

Client advised, following their own investigation that these are not suited to size of development.

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 will be directed to the existing SW network under hydraulic control with outfall rates limited to a 1 in 100 yr discharge rate of 2.1 ls^{-1}.

5.1.2 Method to restrict discharge rate

Designed to accomodate all surface water arising from a design drained area of 489.5m^2 requires a minimum attenuation volume of 23 m^3. This can be achieved using an overall storage volume of 24 m^3 formed with a 0.4m overall unit depth. See Table 1.

Drained area	445m^2	
Urban Creep	1.1	
Designed drained area	489.5m^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	
M5-60	20mm	
r	0.4	
Rainfall model	FSR	
Critical design storm	151 mins, Summer	
Climate change	1.4	
Storm mean intensity	20.6mm.hr^{-1}	
Design mean intensity	28.8mm.hr^{-1}	
Storm peak intensity	103.5mm.hr^{-1}	
Design peak intensity	144.9mm.hr^{-1}	
Design maximum head	0.38m	
Calculated maximum head	0.37m	
Minimum attenuation volume required	23.33m^3	
Void ratio	95%	
Design attenuation volume	23.8m^3	(0.38m x 62.7m^2)
Provided attenuation volume	25.1m^3	(0.95 x 66m^2 x 0.4m)
Factor of Safety	1.05	
1 in 1yr maximum outfall rate	1.1ls^{-1}	(See Figure 4.)
1 in 30yr maximum outfall rate	1.8ls^{-1}	(See Figure 5.)
1 in 100yr maximum outfall rate	2.1ls^{-1}	(See Figure 6.)
1 in 100yr Time to peak	118 mins	
1 in 100yr Max head: Time to drop to 50%	1.80 hrs	
Outfall control method	40mm Orifice	CD = 0.62

Table 1: Storage volume design summary

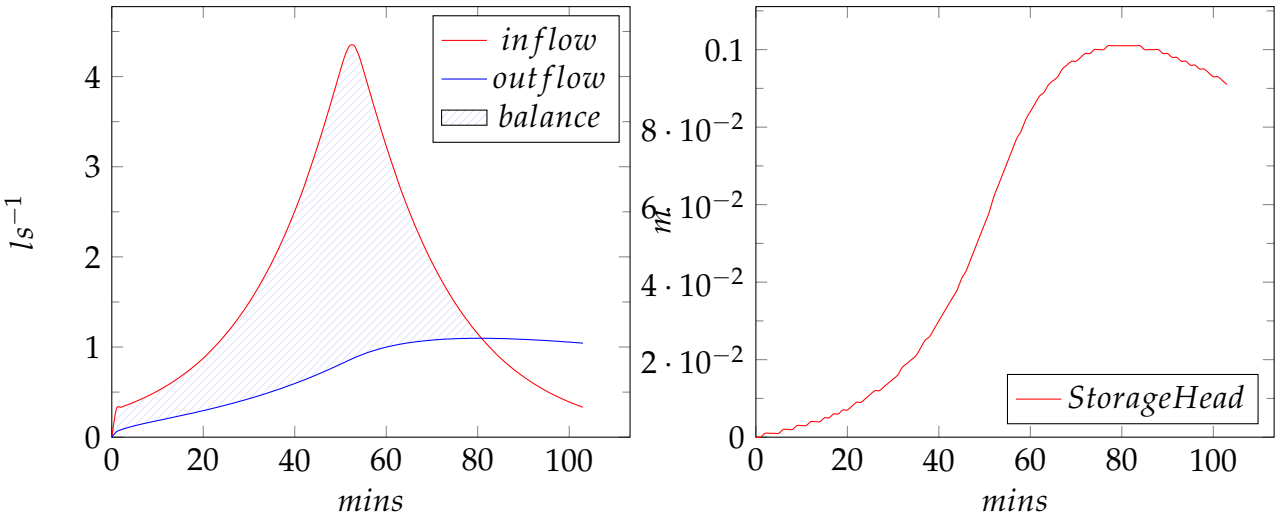


Figure 4: 1 in 1 year critical storm event

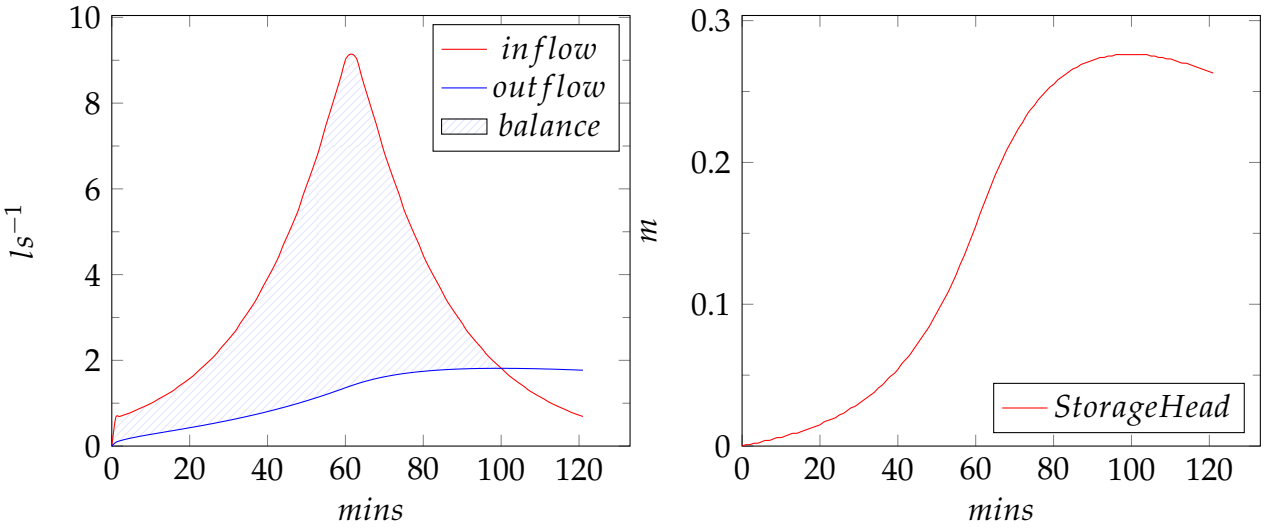


Figure 5: 1 in 30 year critical storm event

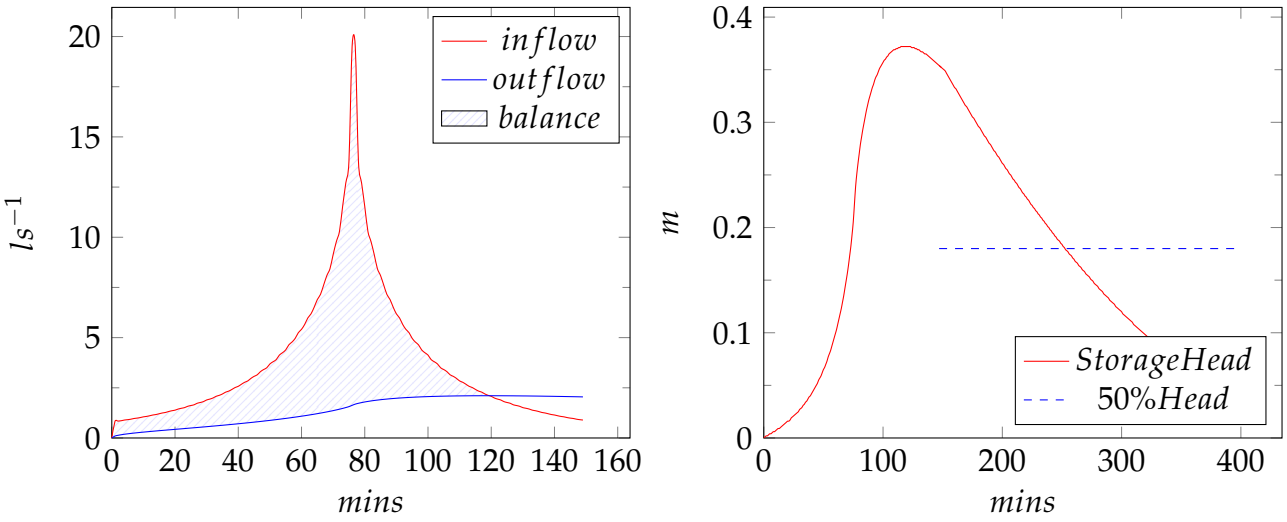


Figure 6: 1 in 100 year critical storm event

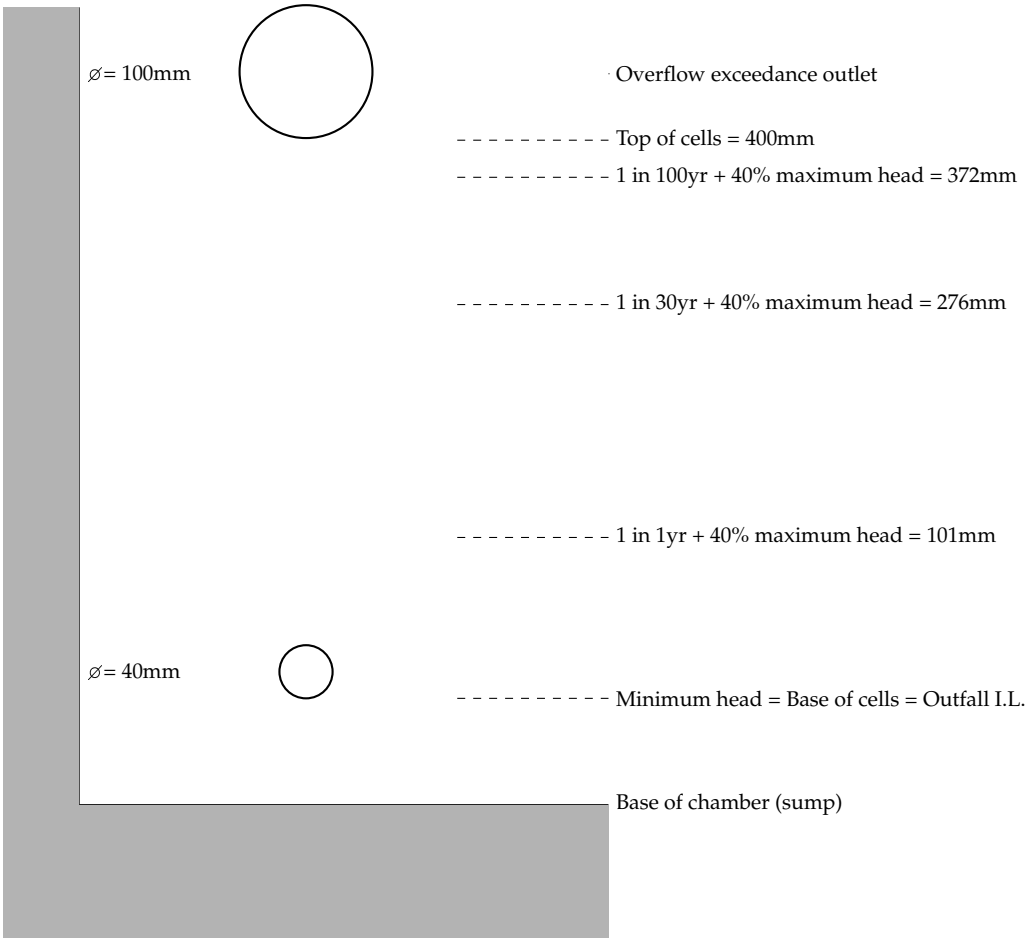


Figure 7: Orifice arrangement in control chamber

This can be achieved using a commercially available attenuation cells and protected orifice control device - see Appendix B. 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 and vented and installed in off-line configuration as per the typical detail at Figure 8.

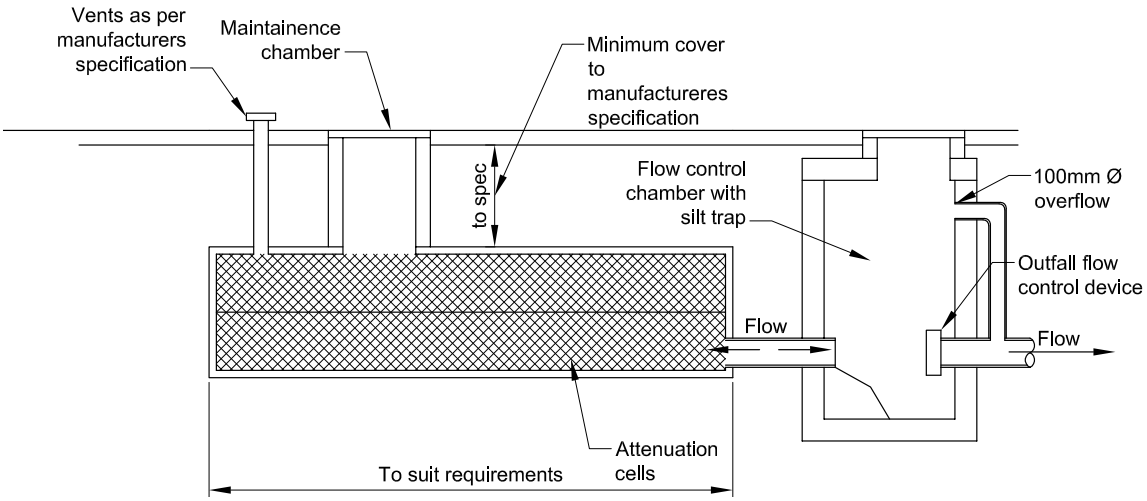


Figure 8: Typical off-line attenuation layout

5.1.3 Consent to discharge

Consent will be required.

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).

The perimeter of these areas will be considered for expansive planting to accommodate any exceedance flows.

Noting the site gradients the formation level will require terracing and sub-base bunding to retain water at the location it falls. Refer to Marshall's detail at Figure 9.

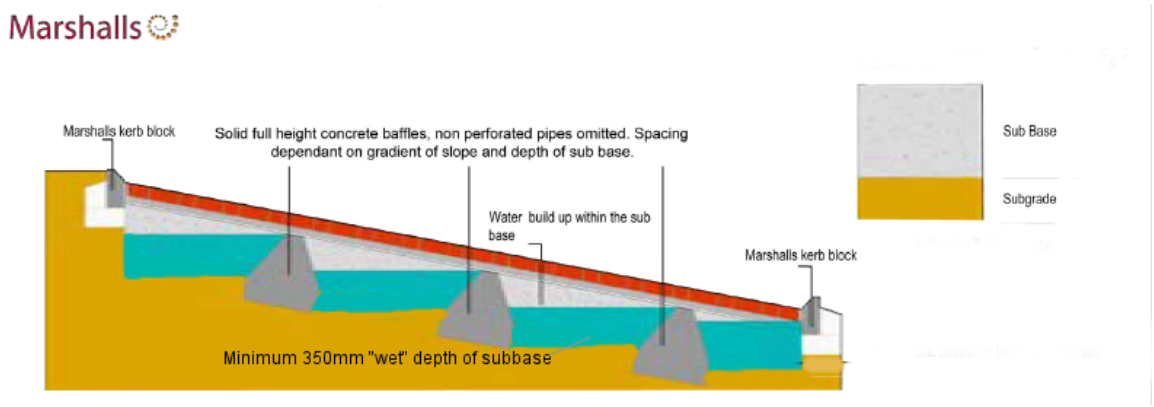


Figure 9: Sub-base formation on sloping site (Adapted from Marshalls paving)

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 soakaway. 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 (e.g. ACO channels) to the proposed SW drains.

5.3 Rainwater harvesting

5.3.1 For external use

The project team have shown an “off line” rainwater butt per dwelling 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

The drainage layout to submitted under separate cover.

Flow will be conveyed to the soakaway via 150mm diameter drainage runs laid at no less than 1:80 falls giving a maximum design capacity of 20ls^{-1}(Part H design chart, Figure 10).

1 in 100yr max mean intensity storm = 153mmhr^{-1}

Drained area to one pipe = 293m^2

Required pipe capacity = 293 x 0.153 / 3.6 = 12.5 ls^{-1}

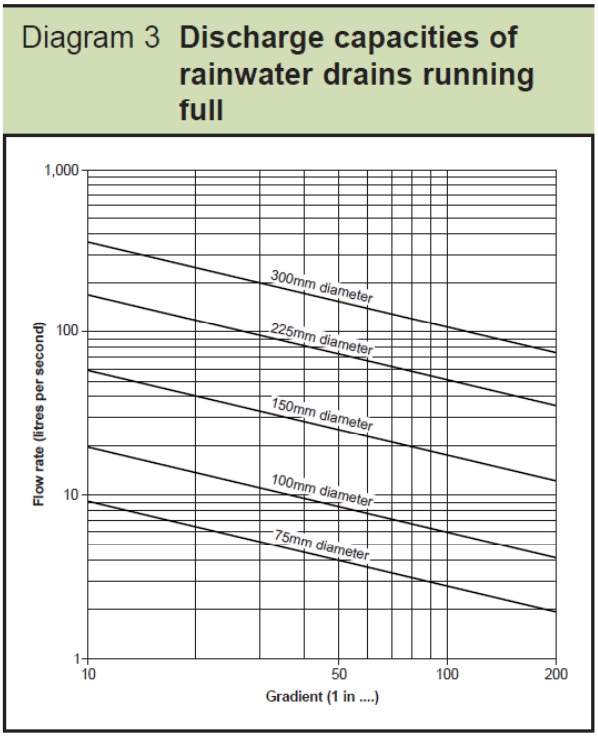


Figure 10: Part H drainage design chart

6.2 Timetable for implementation

6.2.1 Demolition phase

During the demolition phase, rainwater will be managed in line with the requirements under the CDM regulations using existing SW gullies with measures in place to pre-

vent contaminants entering the network.

6.2.2 Construction phase

Type 3 to the driveway is to be placed early in the project to allow site access. This will be protected with either a 50mm wearing course or a 150mm layer of sacrificial crushed concrete placed on a geo-textile layer over the Type 3.

Attenuation cells will be installed early in the project under the remit of the ground-works operations.

Prior to installation of the paved areas either the wearing course will be core drilled, 100m diameter, at 1m staggered centres with core holes filled with granular fill, or, the layer of crushed concrete and geotextile removed with the Type 3 repaired as required prior to new geotextile layer and final paving.

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

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

6.2.3 Post construction phase

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

Inspection chambers pumped and cleaned out.

7 Maintenance of SuDS

Ultimate responsibility for the long term maintenance with SuDS in this environment lay with the land owner/management company.

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 pervious pavements will include:

- Monthly litter removal;
- Bi-Annual (suction, if space allows) sweeping.
- 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 Rainwater harvesting

The maintenance plan for the rainwater harvesting will include:

- Monthly cleaning of pre-filters;
- Monthly checking of high water level warning devices;
- Six monthly/seasonal gutter clearance.

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 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: 28th February, 2023

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.

A Geo Insight report

Groundsure LOCATION INTELLIGENCE

Geo Insight

CANADA COTTAGES, STORTFORD ROAD, GREAT DUNMOW, CM6 1SH

Order Details

Date: 31/07/2022

Your ref: 221852

Our Ref: GS-8944875

Site Details

Location: 561283 221879

Area: 0.21 ha

Authority: Uttlesford District Council

Contact us with any questions at:
info@groundsure.com
08444 159 000

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	0	0	-
13	1.3	Superficial geology (10k)	0	0	0	0	-
13	1.4	Landslip (10k)	0	0	0	0	-
14	1.5	Bedrock geology (10k)	0	0	0	0	-
14	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
15	2.1	50k Availability	Identified (within 500m)				
16	2.2	Artificial and made ground (50k)	0	0	0	0	-
16	2.3	Artificial ground permeability (50k)	0	0	-	-	-
17	2.4	Superficial geology (50k)	1	0	0	1	-
18	2.5	Superficial permeability (50k)	Identified (within 50m)				
18	2.6	Landslip (50k)	0	0	0	0	-
18	2.7	Landslip permeability (50k)	None (within 50m)				
19	2.8	Bedrock geology (50k)	1	0	0	0	-
20	2.9	Bedrock permeability (50k)	Identified (within 50m)				
20	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
21	3.1	BGS Boreholes	0	0	1	-	-
Page	Section	Natural ground subsidence					
22	4.1	Shrink swell clays	Low (within 50m)				
23	4.2	Running sands	Very low (within 50m)				
24	4.3	Compressible deposits	Negligible (within 50m)				
25	4.4	Collapsible deposits	Very low (within 50m)				
26	4.5	Landslides	Very low (within 50m)				
27	4.6	Ground dissolution of soluble rocks	Negligible (within 50m)				

Page	Section	Mining, ground workings and natural cavities	On site	0-50m	50-250m	250-500m	500-2000m
28	5.1	Natural cavities	0	0	0	0	-
29	5.2	BritPits	0	0	0	0	-
29	**5.3**	**Surface ground workings**	0	0	8	-	-
29	5.4	Underground workings	0	0	0	0	0
30	5.5	Historical Mineral Planning Areas	0	0	0	0	-
30	5.6	Non-coal mining	0	0	0	0	0
30	5.7	Mining cavities	0	0	0	0	0
30	5.8	JPB mining areas	None (within 0m)				
30	5.9	Coal mining	None (within 0m)				
31	5.10	Brine areas	None (within 0m)				
31	5.11	Gypsum areas	None (within 0m)				
31	5.12	Tin mining	None (within 0m)				
31	5.13	Clay mining	None (within 0m)				

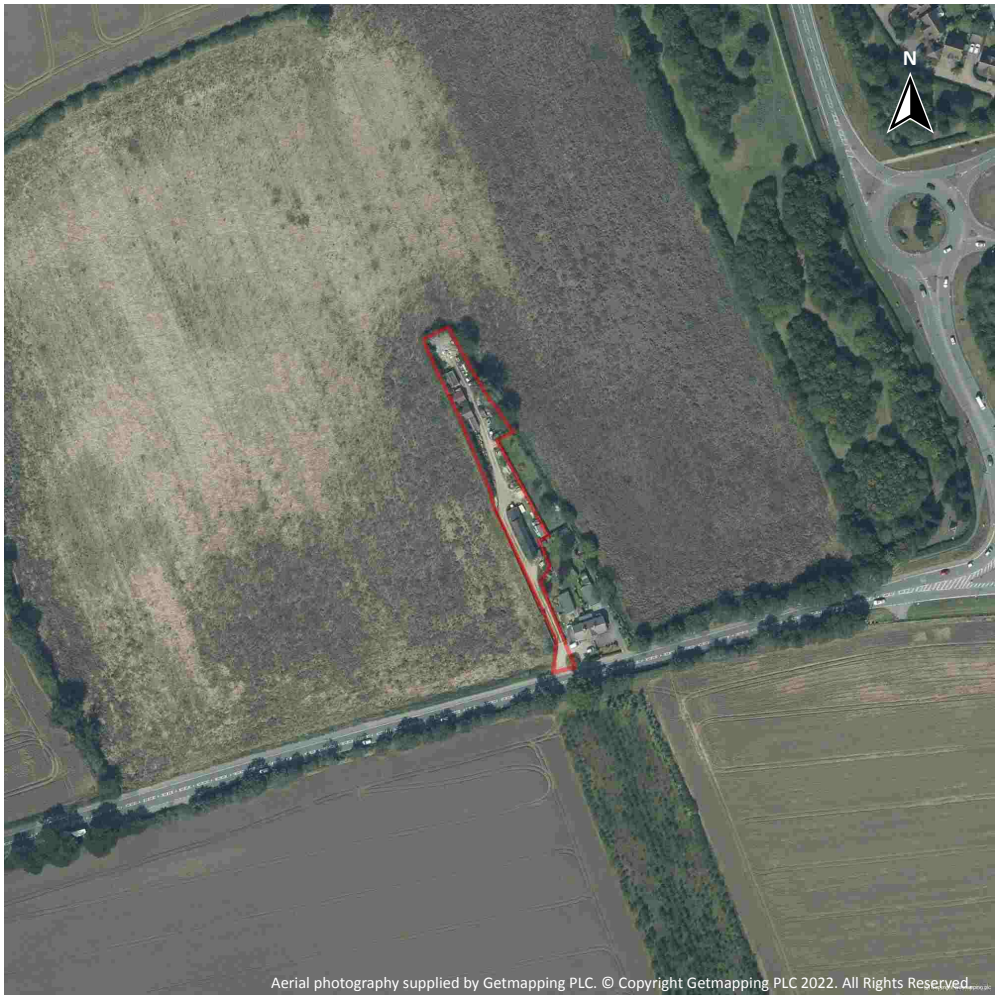
Page	Section	Radon	
32	**6.1**	**Radon**	Less than 1% (within 0m)

Page	Section	Soil chemistry	On site	0-50m	50-250m	250-500m	500-2000m
33	**7.1**	**BGS Estimated Background Soil Chemistry**	1	1	-	-	-
33	7.2	BGS Estimated Urban Soil Chemistry	0	0	-	-	-
33	7.3	BGS Measured Urban Soil Chemistry	0	0	-	-	-

Page	Section	Railway infrastructure and projects	On site	0-50m	50-250m	250-500m	500-2000m
34	8.1	Underground railways (London)	0	0	0	-	-
34	8.2	Underground railways (Non-London)	0	0	0	-	-
34	8.3	Railway tunnels	0	0	0	-	-
34	8.4	Historical railway and tunnel features	0	0	0	-	-
34	8.5	Royal Mail tunnels	0	0	0	-	-
35	8.6	Historical railways	0	0	0	-	-
35	8.7	Railways	0	0	0	-	-
35	8.8	Crossrail 1	0	0	0	0	-

35	8.9	Crossrail 2	0	0	0	0	-
35	8.10	HS2	0	0	0	0	-

Recent aerial photograph



Capture Date: 25/08/2019

Site Area: 0.21ha

Recent site history - 2017 aerial photograph

Capture Date: 13/07/2017

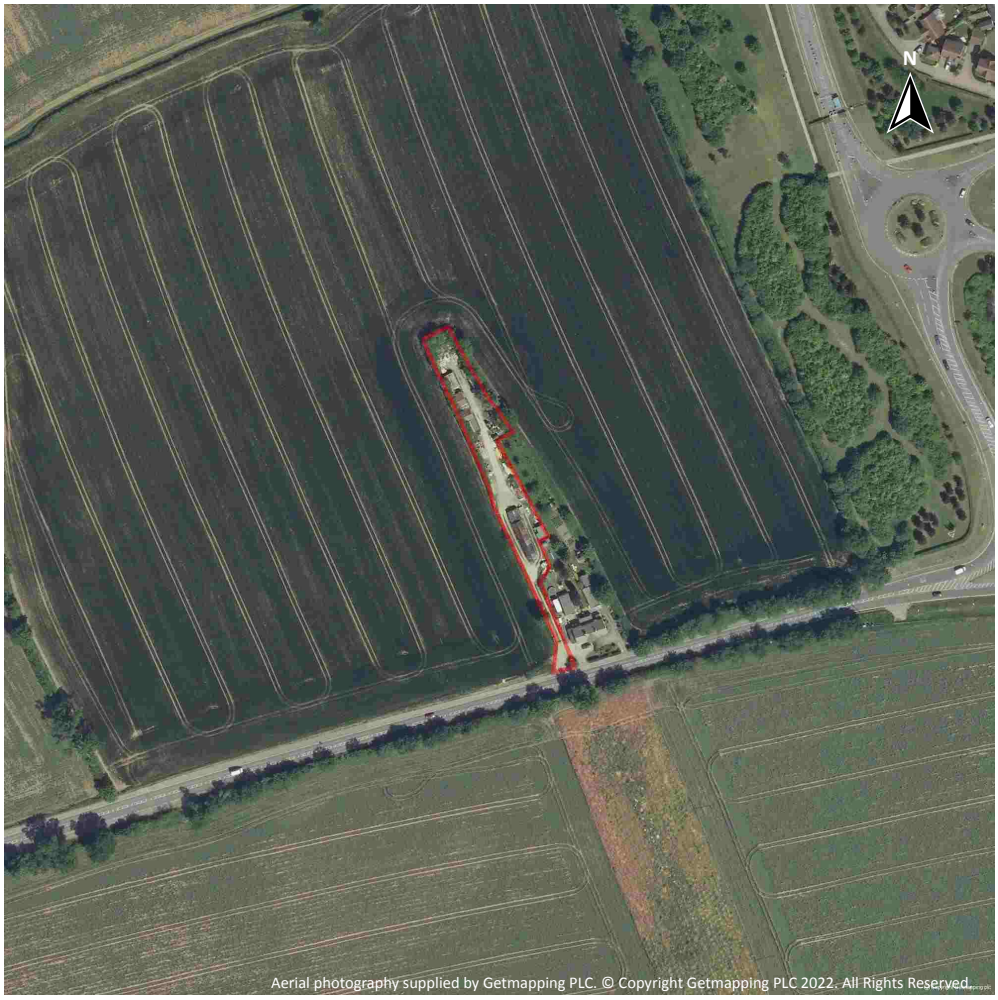
Site Area: 0.21ha

Recent site history - 2014 aerial photograph

Capture Date: 03/07/2014

Site Area: 0.21ha

Recent site history - 2009 aerial photograph



Capture Date: 23/06/2009

Site Area: 0.21ha

Recent site history - 1999 aerial photograph

Capture Date: 18/07/1999

Site Area: 0.21ha

OS MasterMap site plan

Site Area: 0.21ha

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	No coverage	No coverage	No coverage	No coverage	NoCov

This data is sourced from the British Geological Survey.

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

1.2 Artificial and made ground (10k)

Records within 500m	0

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.

This data is sourced from the British Geological Survey.

Geology 1:10,000 scale - Superficial

1.3 Superficial geology (10k)

Records within 500m	0

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.

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

1.5 Bedrock geology (10k)

Records within 500m	0

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.

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 15**

ID	Location	Artificial	Superficial	Bedrock	Mass movement	Sheet No.
1	**On site**	**Full**	**Full**	**Full**	**No coverage**	**EW222_great_dunmow_v4**

This data is sourced from the British Geological Survey.

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

2.2 Artificial and made ground (50k)

Records within 500m	0

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.

This data is sourced from the British Geological Survey.

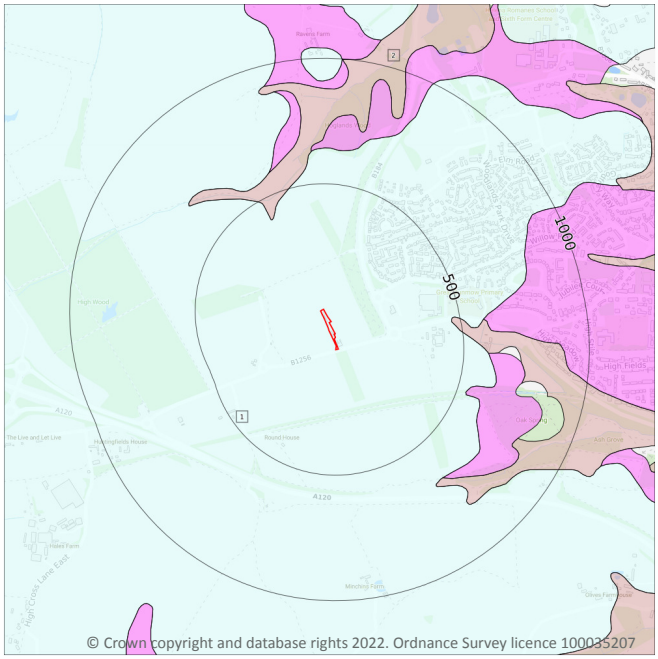
2.3 Artificial ground permeability (50k)

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 17**

ID	Location	LEX Code	Description	Rock description
1	**On site**	**LOFT-DMTN**	**LOWESTOFT FORMATION**	**DIAMICTON**
2	410m NW	HEAD-XCZSV	HEAD	CLAY, SILT, 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	**Mixed**	**Moderate**	**Low**

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 19**

ID	Location	LEX Code	Description	Rock age
1	**On site**	**LC-XCZS**	**LONDON CLAY FORMATION - CLAY, SILT AND SAND**	**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**	**Moderate**	**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	1

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 21**

ID	Location	Grid reference	Name	Length	Confidential	Web link
1	236m N	561330 222190	S OF HOGLANDS WOOD, GREAT DUNMOW	15.2	N	546530

This data is sourced from the British Geological Survey.

4 Natural ground subsidence - Shrink swell clays

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 22**

Location	Hazard rating	Details
On site	**Low**	**Ground conditions predominantly medium 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 23**

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 24**

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 25**

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 26**

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 27**

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, ground workings and natural cavities

Site Outline

Search buffers in metres (m)

- Natural cavities (Area)
- Natural cavities (Point)
- BritPits
- Surface ground workings
- Underground workings
- Historical Mineral Planning Areas
- Mining Cavities

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 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.

5.2 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.

5.3 Surface ground workings

Records within 250m	8

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, ground workings and natural cavities map on **page 28**

ID	Location	Land Use	Year of mapping	Mapping scale
A	242m S	Cuttings	1923	1:10560
A	242m S	Cuttings	1947	1:10560
B	244m S	Cuttings	1896	1:10560
B	244m S	Cuttings	1898	1:10560
B	246m S	Cuttings	1955	1:10560
C	248m S	Cuttings	1988	1:10000
C	248m S	Cuttings	1981	1:10000
B	250m S	Cuttings	1876	1:10560

This is data is sourced from Ordnance Survey/Groundsure.

5.4 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.

5.5 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	0

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).

This data is sourced from the British Geological Survey.

5.7 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.

5.8 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.

5.9 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.

5.10 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.

5.11 Gypsum areas

Records on site	0

Generalised areas that may be affected by gypsum extraction.

This data is sourced from British Gypsum.

5.12 Tin mining

Records on site	0

Generalised areas that may be affected by historical tin mining.

This data is sourced from Groundsure.

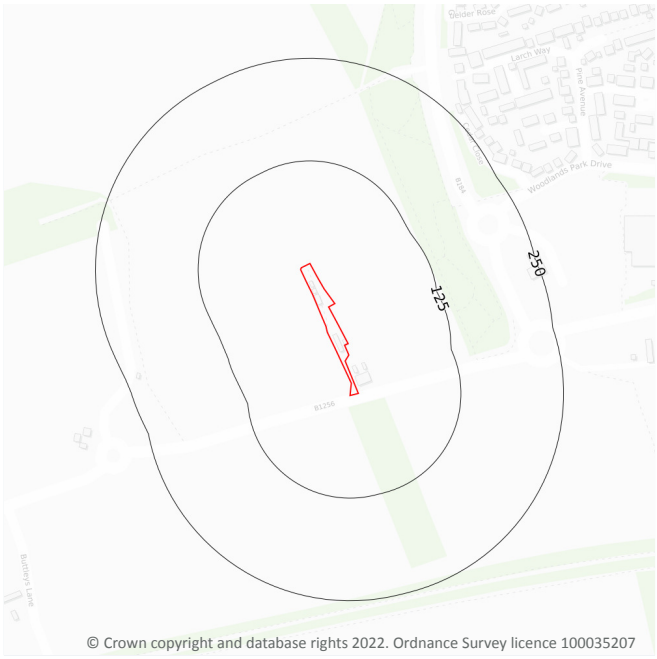
5.13 Clay mining

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 Radon



Site Outline

Search buffers in metres (m)

- Greater than 30%
- Between 10% and 30%
- Between 5% and 10%
- Between 3% and 5%
- Between 1% and 3%
- Less than 1%

6.1 Radon

Records on site	1

Estimated percentage of dwellings exceeding the Radon Action Level. This data is the highest resolution radon dataset available for the UK and is produced to a 75m level of accuracy to allow for geological data accuracy and a 'residential property' buffer. The findings of this section should supersede any estimations derived from the Indicative Atlas of Radon in Great Britain. The data was derived from both geological assessments and long term measurements of radon in more than 479,000 households.

Features are displayed on the Radon map on **page 32**

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

This data is sourced from the British Geological Survey and Public Health England.

7 Soil chemistry

7.1 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	**15 mg/kg**	**No data**	**100 mg/kg**	**60 mg/kg**	**1.8 mg/kg**	**60 - 90 mg/kg**	**15 - 30 mg/kg**
34m N	15 mg/kg	No data	100 mg/kg	60 mg/kg	1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg

This data is sourced from the British Geological Survey.

7.2 BGS Estimated Urban Soil Chemistry

Records within 50m	0

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).

This data is sourced from the British Geological Survey.

7.3 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.

8 Railway infrastructure and projects

8.1 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.

8.2 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.

8.3 Railway tunnels

Records within 250m	0

Railway tunnels taken from contemporary Ordnance Survey mapping.

This data is sourced from the Ordnance Survey.

8.4 Historical railway and tunnel features

Records within 250m	0

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.

This data is sourced from Ordnance Survey/Groundsure.

8.5 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.

8.6 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.

8.7 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.

8.8 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.

8.9 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.

8.10 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: https://www.groundsure.com/terms-and-conditions-jan-2020/.

2.2 Polystorm Lite

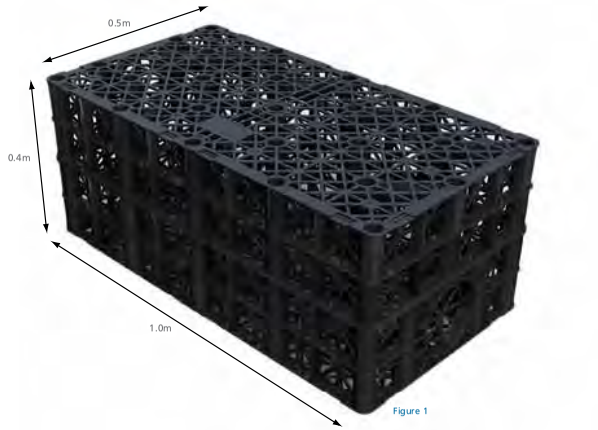


Figure 1

Designed for use in landscaped, pedestrian or other non-loaded applications with a load bearing capacity of:

20 tonnes

Technical specification overview	
Unit type	Polystorm Lite
Product code	PSM2*
Dimensions	1m x 0.5m x 0.4m high
Total volume	0.2m per cube
Unit weight	7kgs**
Cube storage volume	0.19m³ (190 litres)
Surface area	55% perforated
Compressive strength	Maximum 20 tonnes per sq metre
Maximum burial depth	2.5m***

* Each unit includes 4 clips and 2 shear connectors. Please note that brick bond connector may be required at additional cost.

** Pallet weight dependent upon order quantity and transport type.

*** In weak clay soil conditions the maximum burial depth is 1.5 metres. Polystorm Lite should not be installed below the water table.

Table 1

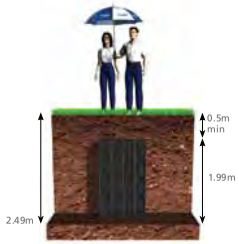


Figure 2

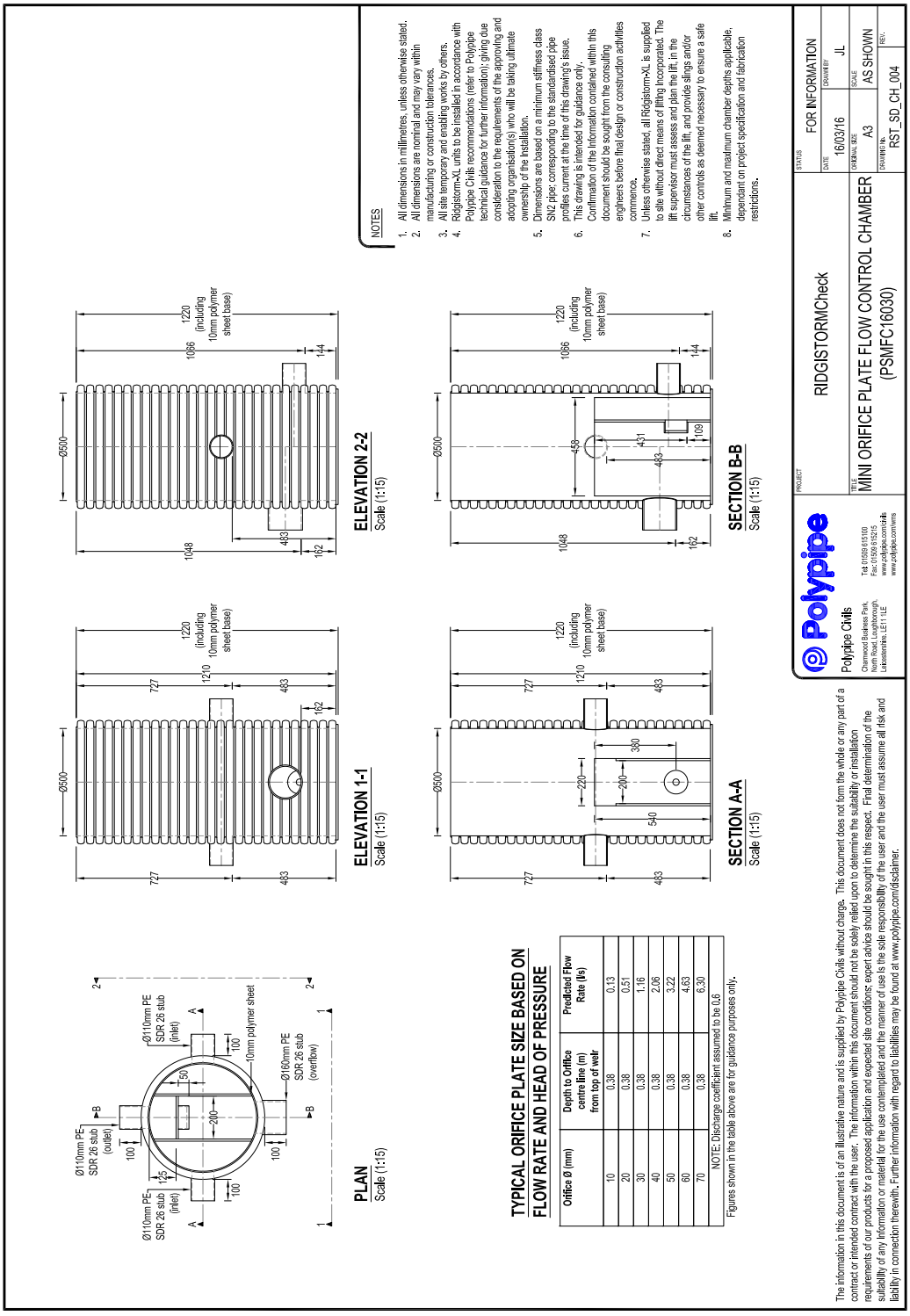
Polystorm Lite has been specifically designed for non-trafficked applications. With a 20 tonne per square metre compressive strength it will however take general maintenance vehicles such as grass cutters. Polystorm Lite can be used for both attenuation and soakaway applications. The modular structure receives rainwater collected from roofs or surface drains ready to release within a set drainage limit. Polystorm Lite can be used typically for landscaped areas, pedestrian or public open spaces such as underneath playgrounds.

Polystorm Lite		
Description	Code	Pack quantity
Polystorm Lite cell 1000 x 500 x 400mm	PSM2	15
Polystorm Lite flow control unit	PSMFC160/30	1
Brick bond shear connector	PSMBBSC	30
Clips	PSMCLIP	60
Shear connector	PSMSC	30
EN1401 flange adaptor - 110mm	PSMFA110	1
Ridgidrain flange adaptor - 150mm	PSMFA150	1
EN1401 flange adaptor - 160mm	PSMFA160	1
Basic silt trap	PSMST160	1
Advanced silt trap - 15 litres/sec	PSMSTA160/15	1
Mini silt trap for Polystorm Lite	PSMST110	1
Cover & frame (round)	UG501	1
Cover & frame (square)	UG502	1
450mm silt trap lid & frame	UG512	1
460mm lockable plastic cover & frame	UG511	1
Polypropylene cover & frame	ICDC1	1
Chamber riser section	ICDR1	1
Silt trap sealing ring	UG488	1

Table 2

Note: Minimum cover and burial depths may vary depending on load and ground conditions. Please contact Polypipe WMS for further information. All grades of Polystorm units may be used in situations outside of those recommended above, through the use of the appropriate protective measures designed to reduce the imposed loading on the proposed Polystorm structures.

B.2 Protected orifice chamber




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

C Proposed SuDS layout

As submitted under separate cover.