GeoSmart Information

SuDSmart Design

Sustainable Drainage Assessment

Site Address

Land to the rear of Orchard Cottage
Main Street
Grendon Underwood
HP18 OSJ

Grid Reference

468646, 220238

Report Prepared for

Adrian Bird

Date

2024-02-02

Report Status

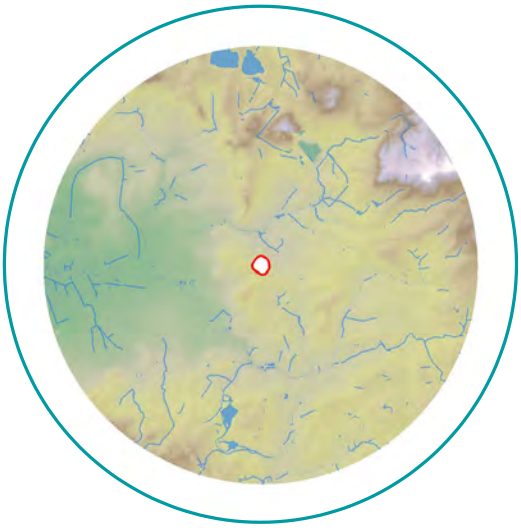
FINAL

Site Area

1.03 ha

Report Reference

81010R1



Discharge to Pond

As infiltration has been proven infeasible, runoff from the proposed development is proposed to be discharged into the existing pond at a controlled rate.

SuDS features such as rainwater harvesting butts, permeable paving and attenuation tanks are proposed to provide attenuation up to the 1 in 100 year + 40% climate change rainfall event.

Report Author

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Report Checker & Reviewer

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1 Executive summary

This report assesses the feasibility of a range of Sustainable Drainage Scheme (SuDS) options in support of the Site development process. A SuDS strategy is proposed to ensure surface water runoff can be managed effectively over the lifetime of the development.

SuDS suitability

Risk	Issue	Result
Discharge Location	What is the infiltration potential at the Site?	Low
	What is the potential to discharge to surface water features?	High
	What is the potential to discharge to sewers?	Low
	What is the potential to discharge to highway drains?	Low
Flooding	What is the fluvial flood risk at the Site?	Very Low
	What is the pluvial flood risk at the Site?	Very Low to High
	What is the groundwater flood risk at the Site?	Negligible
Pollution	Is the groundwater a protected resource?	No
	Is the surface water feature a protected resource?	No

Summary of existing and proposed development

The Site is currently used within a residential and greenfield capacity. At present there is a single building with car park and landscaped areas. Development proposals comprise the demolition of the existing dwelling and the construction of seven dwellings with access road, car parking and associated landscaping.

Summary of discharge routes

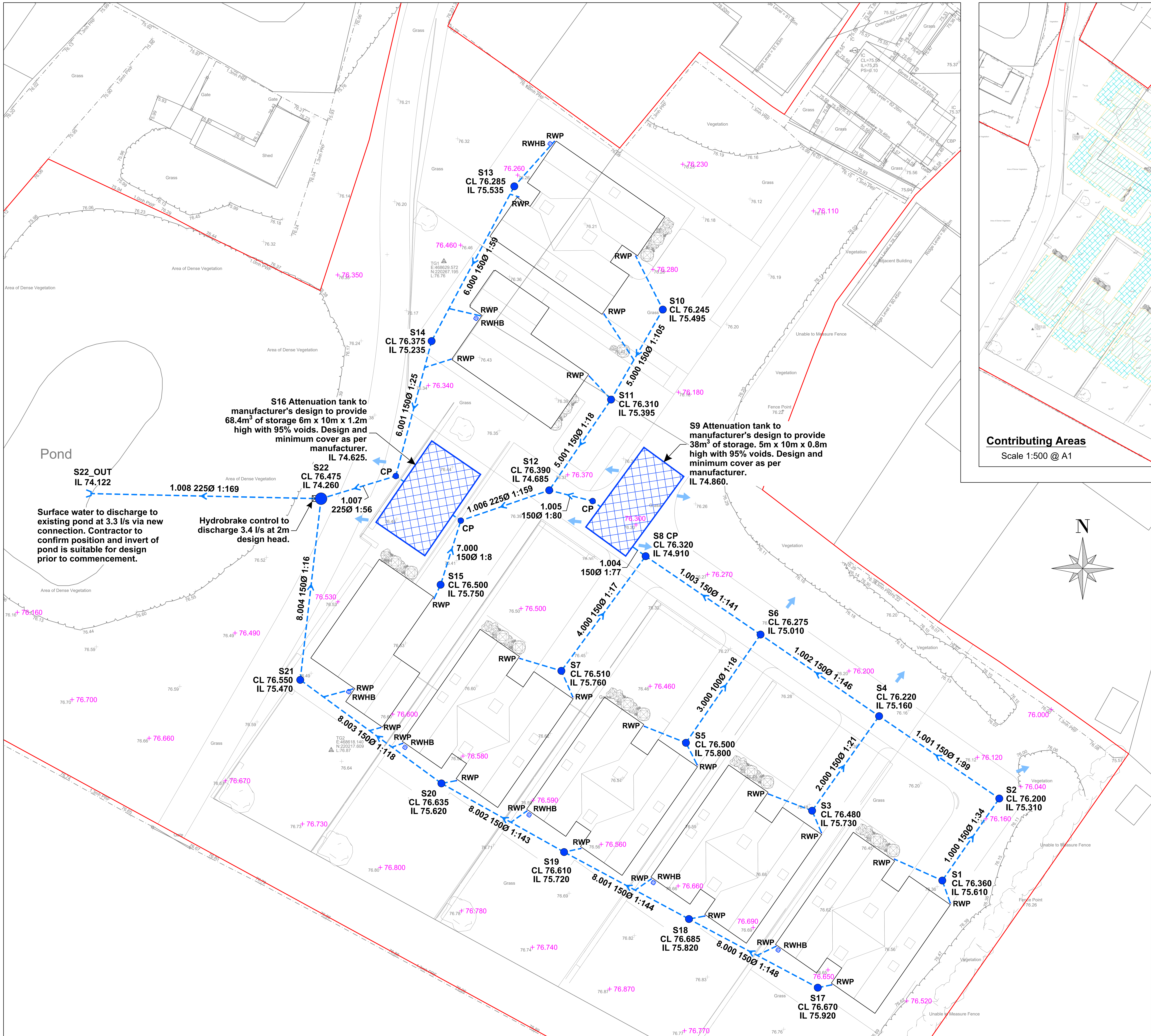
According to GeoSmart's SD50 mapping the Site has Low potential for infiltration, with low permeability underlying Stewartby Member Mudstone. In-situ soil infiltration testing was conducted at the Site (Ref: P1175/R1/V1, EPS Consulting), which indicated that infiltration rates are too low for infiltration SuDS to be feasible at the Site.

OS mapping shows that there are no surface water features within 100 m of the Site. However, aerial mapping and a topographic survey by Total Geomatics (2023) have confirmed the presence of a pond located within the west of the Site.

According to a Thames Water asset plan there are no surface water or combined sewers within close proximity to the Site.

Runoff rate and attenuation requirements

Discharging off-Site requires 128.4 m^3 of attenuation to be provided to ensure there is no flooding within the development in all storm events up to and including the 1 in 100 year including a 40% allowance for climate change. This volume is subject to the discharge rate being restricted to 3.3 l/s. This is equivalent to the 100 year Greenfield runoff rate (see Appendix B for full calculations)



Proposed Surface Water Drainage Layout

Scale 1:200 @ A1

Contributing Areas

Scale 1:500 @ A1

Contributing Areas Legend:

- Permeable paving (Type C non infiltrating) 1585m² (100%)
- Building roof 983m² (100%)

Legend:

- Attenuation tank
- RWP — Rain water pipe
- RWHB — Rain water harvesting butt
- Surface water drain
- Surface manhole with: S1 Reference number; CL 76.360 Cover level; IL 75.610 Invert level
- Flow control at manhole
- CP — Catchpit chamber
- Outfall
- Overland flow routes
- + 76.460 — Spot level, assumed

0 4m 8m 12m 16m 20m

10mm = 2m (1:200 @ A1)

Notes.
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Drainage Strategy:

- Drainage strategy consists of rain water harvesting butts, permeable paving, attenuation tanks and controlled discharge to the existing pond.
- Permeable paving will discharge via perforated pick up drains or top hat type outlets. Base of storage sub-base to fall towards pick up / discharge points. All as manufacturer's design.
- Surface water will discharge to the pond at 3.3 l/s, less than the greenfield runoff rate of 3.4 l/s.

Rev	Date	Detail	Drwn	Chkd
P01	02.02.24	Initial issue	DS	MG

Client: Adrian Bird

Project: Land to the rear of Orchard Cottage, Main Street, Grendon Underwood, HP18 0SJ

Drawing Title: Proposed Surface Water Drainage Layout

GeoSmart Information
Suite 9-11, 1st Floor, Old Bank Buildings, Bellstone, Shrewsbury, SY1 1HU

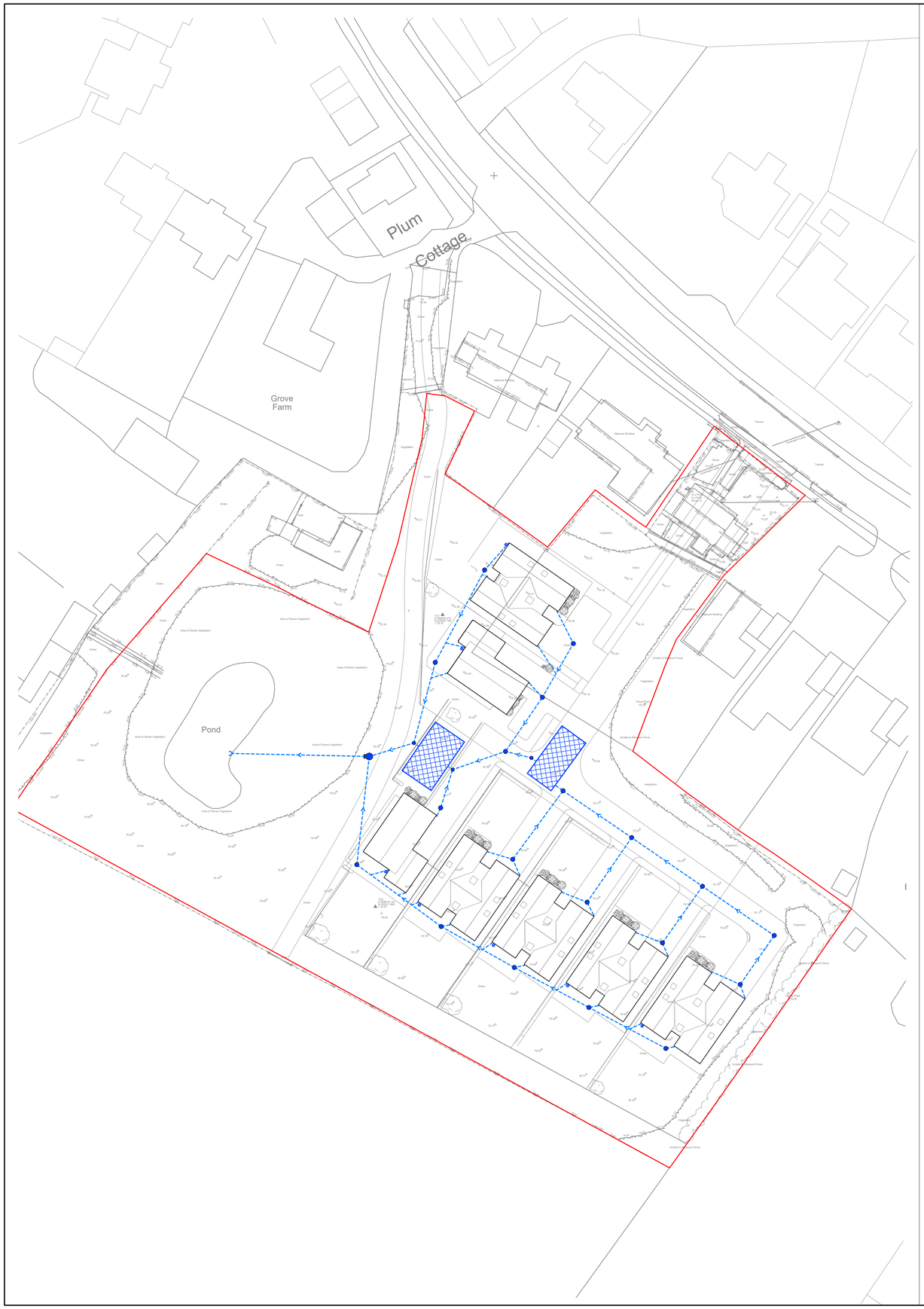
Drawn by:	Checked by:	Date:
DS	MG	Feb. 2024

Scale: 1:200, 1:500 @ A1

Status: Preliminary

Drawing No: 81010 100

Issue: P01



	Asset Type	Maintenance Schedule (and Frequency)	Party Responsible
	Permeable pavements	Regular maintenance: • Brushing and vacuuming (three time per year) • Trimming any roots and surrounding grass and weeds that may be causing blockages (annually or as required) Monitoring: • Initial inspection (monthly) • Inspect surface for poor performance or ponding (annually or after large storm events)	Privately owned and maintained by house owners or specialist asset management company as agreed / appointed between house owners
	Underground drainage pipe network and manholes / catchpits	Regular maintenance: • Remove sediment and debris from pre-treatment devices and floor of inspection tube or chamber (annually) • Cleaning of gutters and any filters on downpipes (annually) • Trimming any roots that may be causing blockages (annually or as required) Monitoring: • Inspect silt traps and note rate of sediment accumulation (monthly in the first year and then annually)	
	Attenuation tank	Regular maintenance: • Remove litter and debris from inlets and outlets (monthly) • Trimming any roots and surrounding grass blockages (as required) Monitoring: • Inspect inlets, outlets and overflows for blockages (monthly or after a heavy storm) • Inspect inlets and outlets for silt accumulation (half yearly) • Inspect infiltration surfaces for compaction and ponding (monthly) • Survey inside of tank for sediment build-up and remove (annually or as required)	
	Rain water pipe	Regular maintenance: • Remove sediment and debris from grating, channel and sump (monthly or as required) • Trimming any roots and surrounding grass blockages (as required) Monitoring: • Inspect inlets and outlets for blockages or silt accumulation (monthly or after a heavy storm)	
	Hydrobrake	Regular maintenance: • Remove silts from the Hydrobrake chamber sump (annually) • Remove any debris obstructing the inlet, outlet or control ensuring the emergency drain down mechanism if replaced correctly (annually) Monitoring: Inspect the hydrobrake control from the surface for signs of blockage or damage (as required) • Inspect the Hydrobrake chamber sump for build up of silt and the inlet and outlet for debris (annually) • Check the emergency drain down mechanism is in good working order (annually)	
	Rainwater harvesting water butt	Regular maintenance: • Clean tank, inlets, outlets, gutters, roof drain filters and withdrawal devices (annually or as required) • Empty water butt and clean interior, removing any sludge, algea or sediments (annually or as required) Monitoring: • Inspect tank for debris and sediment build up (annually and following poor performance) • Inspect inlets, outlets and overflow (annually and following poor performance)	
	Outfall	Regular maintenance: • Remove litter and debris (monthly or as required) • Manage other vegetation and remove nuisance plants (monthly at start then as required) • Repair / rehabilitate outlet, as required Monitoring: • Inspect structure and pipework for blockages and clear if required (monthly or as required)	

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Rev	Date	Detail	Drwn	Chkd
P01	02.02.24	Initial issue	DS	MG

Client:

Adrian Bird

Project:

Land to the rear of Orchard Cottage, Main Street, Grendon Underwood, HP18 0SJ

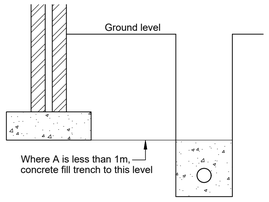
Drawing Title:

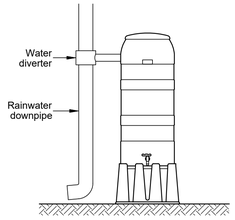
Proposed Management and Maintenance Plan

GeoSmart Information
Suite 9-11, 1st Floor, Old Bank Buildings, Bellstone, Shrewsbury, SY1 1HU

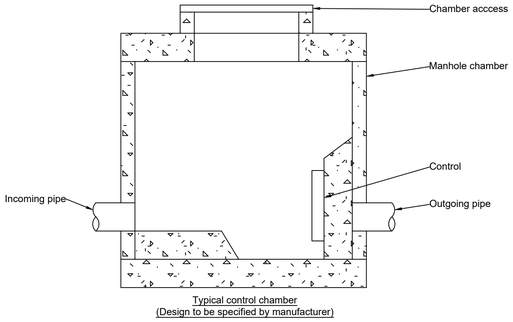
Drawn by:	Checked by:	Date:
DS	MG	Feb. 2024
Scale: NTS		Status: Preliminary
Drawing No: 81010 101		Issue: P01

1:20

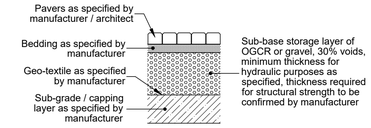




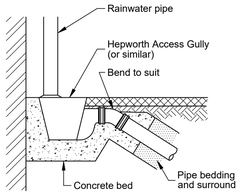
Typical Rain Water Harvest Butt



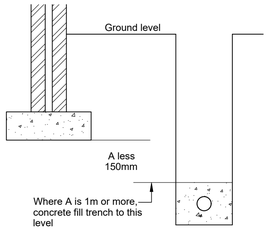
Typical control chamber
(Design to be specified by manufacturer)



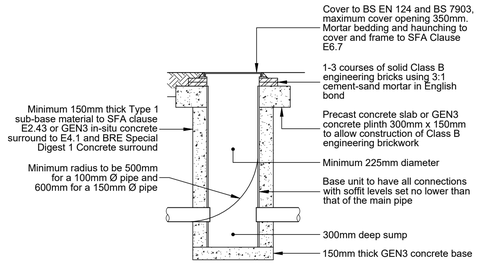
Typical Permeable Paving Detail



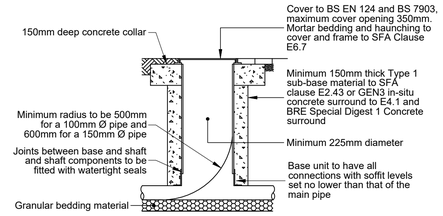
Typical Rainwater Access Gully



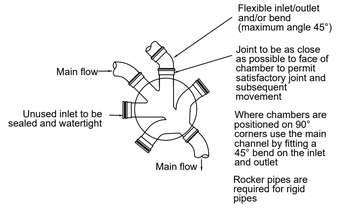
Pipe Runs Near Buildings



Typical Prefabricated Catchpit
(no vehicle access)



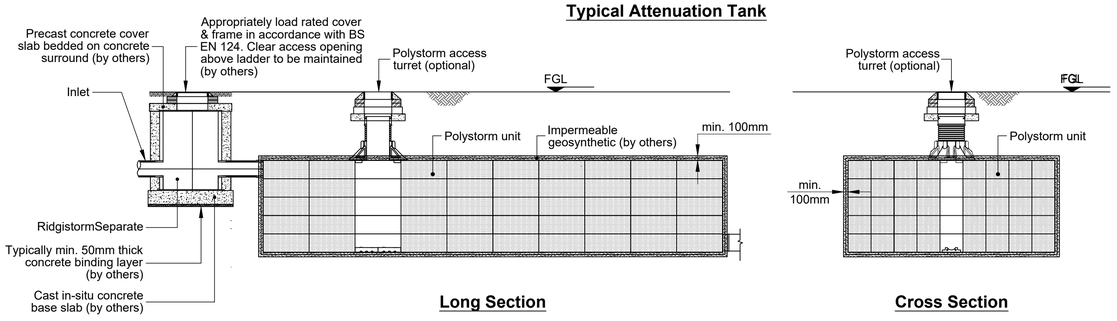
Typical Inspection Chamber
(Driveways, paved areas)



Typical base layout of Type 3 chambers

1:75

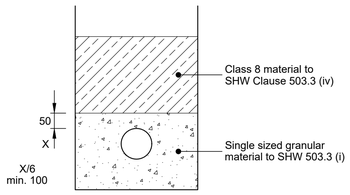
Typical Attenuation Tank



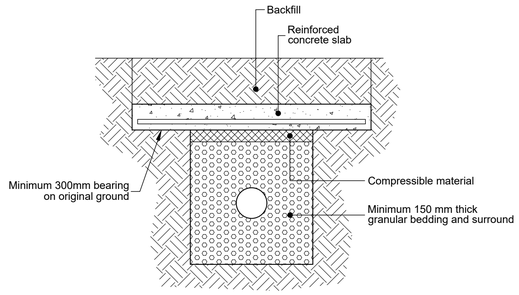
Long Section

Cross Section

1:10

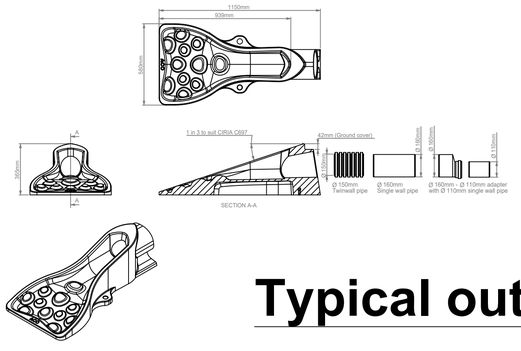


Class S Bedding



Protection of Pipes Laid at Shallow Depths

1:150



Typical outfall

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P01	02.02.24	Initial issue	DS	MG

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Land to the rear of Orchard Cottage, Main Street, Grendon Underwood, HP18 0SJ

Drawing Title:
Proposed Cross Sections

GeoSmart Information
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Drawn by:	Checked by:	Date:
DS	MG	Feb. 2024

Scale:	Status:
As shown @ A1	Preliminary

Drawing No:	Issue:
81010 102	P01

2 Site analysis

Site location

Figure 1. Aerial Imagery (Bluesky, 2024)

Figure 2. SuDS infiltration suitability (SD50) map (GeoSmart, 2024)

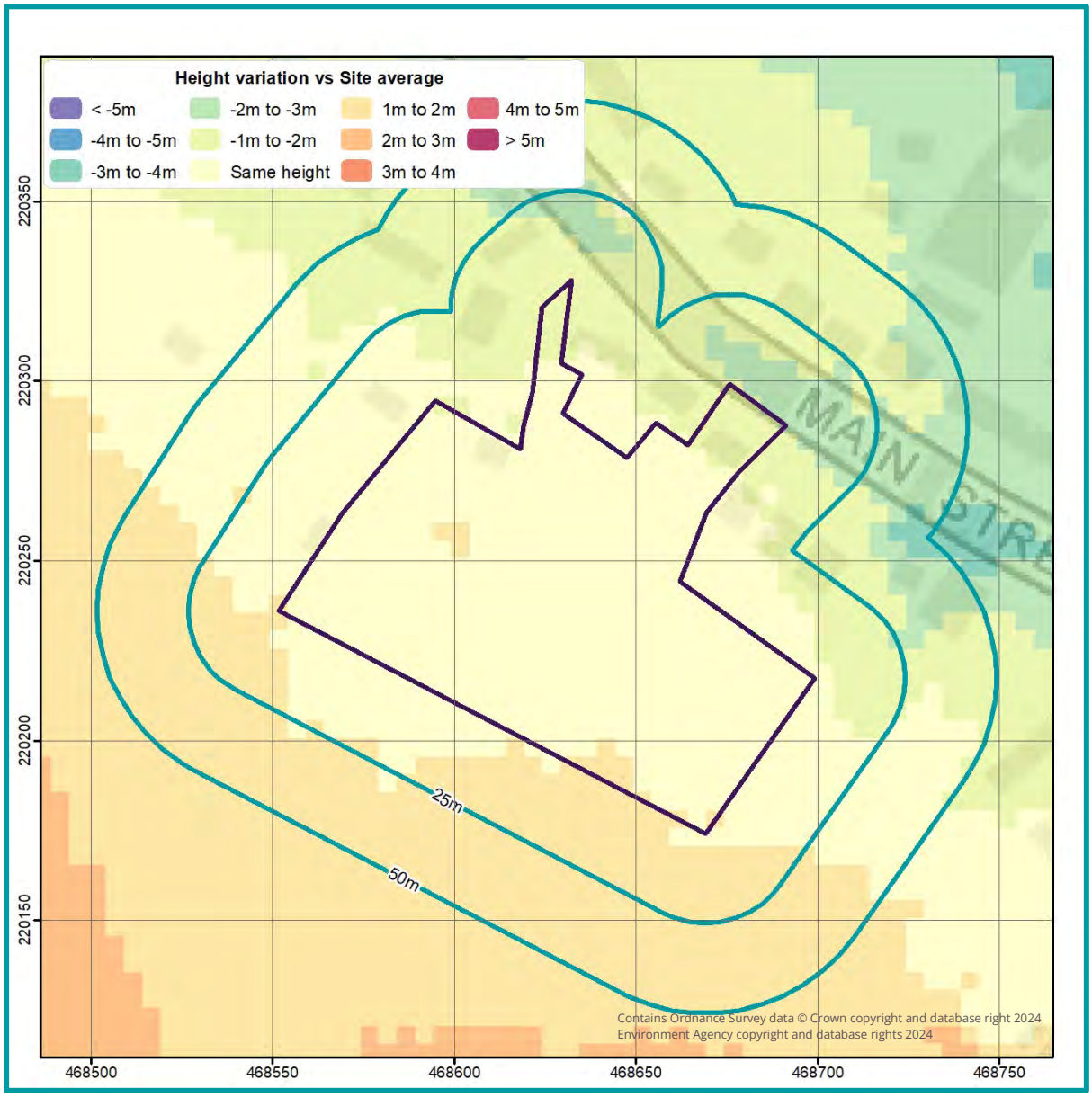
The GeoSmart SuDS Infiltration Suitability Map (SD50) screens the potential for infiltration drainage at the Site and indicates where further assessment is recommended. The map combines information on the thickness and permeability of the underlying material and the depth to the high groundwater table. It supports conceptual Site drainage design and the planning of further Site investigation.

There is a Low potential for infiltration SuDS across the Site. It is likely that the underlying geology at the Site has low permeability which would limit the effectiveness of a proposed infiltration SuDS scheme.

In-situ soil infiltration testing was conducted at the Site to confirm infiltration rates at the Site (Ref: P1175/R1/V1, EPS Consulting). Infiltration testing revealed very little soakage with

groundwater falling c. 30mm during the 90 minute test period. After this time, the pit started to collapse and the test was terminated.

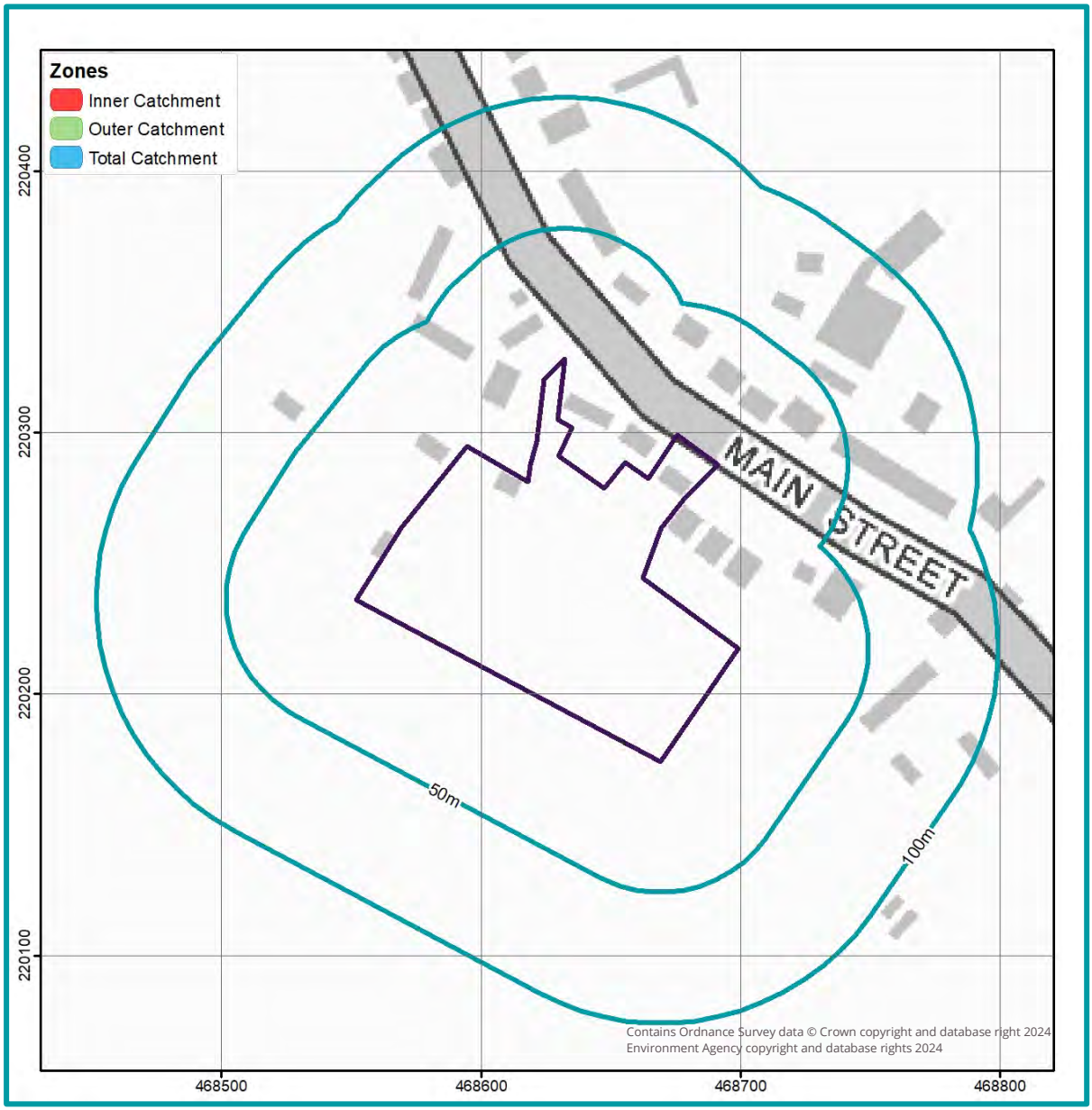
Figure 3. Site topography (GeoSmart, 2024)



An assessment of the topography at the Site has been undertaken using LiDAR DTM5 elevation data to identify the general slope and any localized depressions. The mapping shows a comparison between average ground levels on the Site with ground levels in the surrounding area. The mapping confirms the overall Site is generally level with an area of lower elevation located in the west of the site where there is a pond.

Further analysis could be undertaken by visiting the Site or by collecting additional topographic survey to provide further confirmation of ground levels.

Figure 4. Source protection zone map (EA, 2024)



An assessment of the EA's groundwater Source Protection Zones (SPZs) has been undertaken within the vicinity of the Site and confirms the Site is not located within an SPZ.

Infiltration, if possible, is likely to be acceptable providing risk screening identifies suitable mitigation measures, if required, to prevent an impact on water quality from the proposed or historical land use and contaminated land.

If further analysis is required, this would involve a review of Site specific contaminated land data. If hazards are identified, it is recommended that the Local Authority and the Environment Agency are contacted to confirm the susceptibility of any SPZs within the wider area.

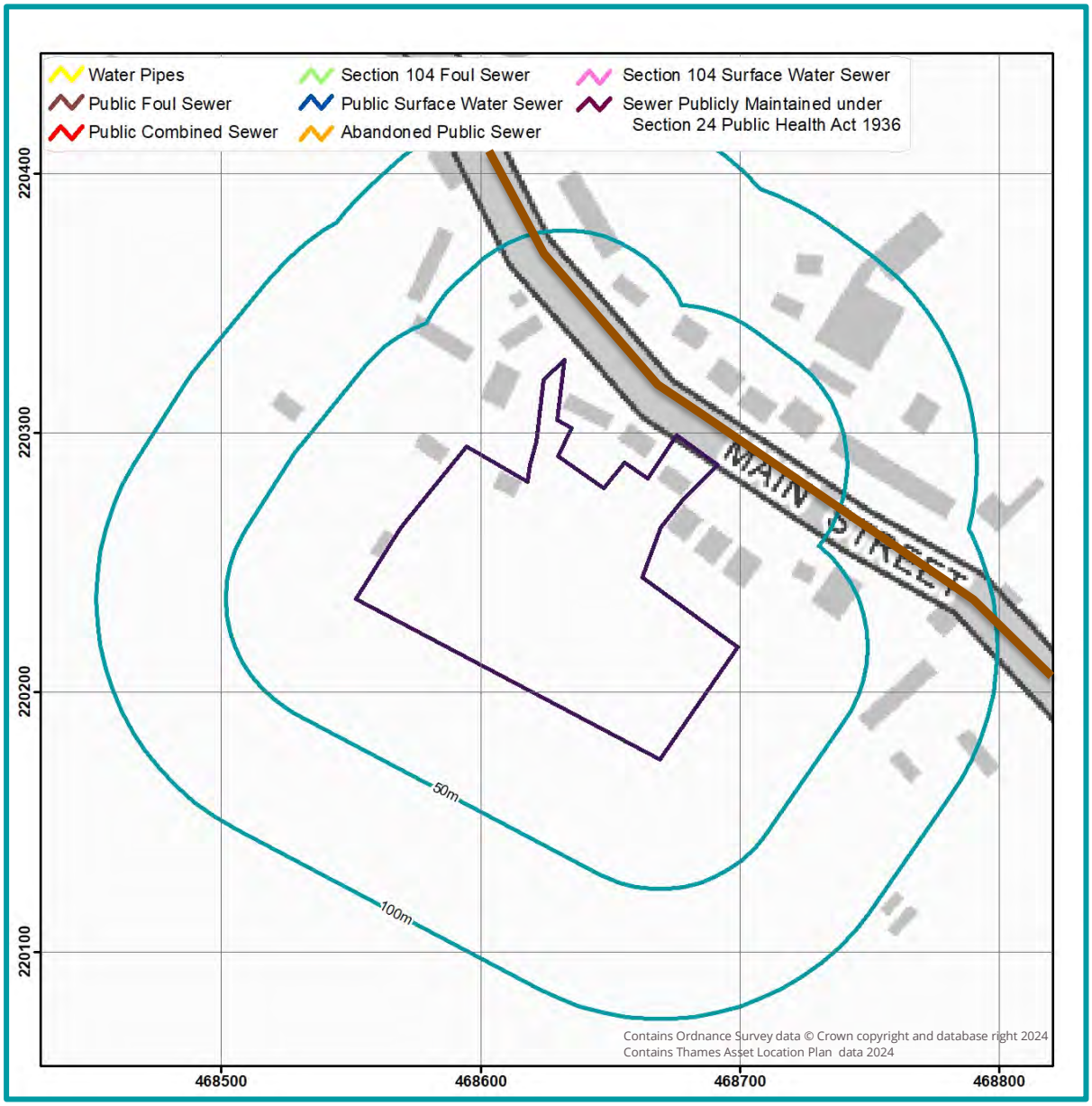
Figure 5. Surface water features map (EA, 2024)

OS mapping shows that there are no surface water features within 100 m of the Site. However aerial mapping and a topographic survey by Total Geomatics (2023) have confirmed the presence of a pond located within the west of the Site.

According to DEFRA's MagicMap, the Site is not within 250m of a SSSI or SPA.

Further analysis could be undertaken by contacting the Local Council and the Environment Agency (EA) to confirm the presence, location and condition of any mapped or additional unmapped surface water features.

Figure 6. Sewer features map (OS & Thames Water, 2024)



GeoSmart has undertaken an assessment of the location of sewer features within the vicinity of the Site. According to an asset location plan undertaken at the Site (Appendix C), there are no public surface water sewer or combined sewers located within the vicinity of the Site.

The asset plan confirms the location of a Foul Sewer located within the adjacent highway, Main Street.

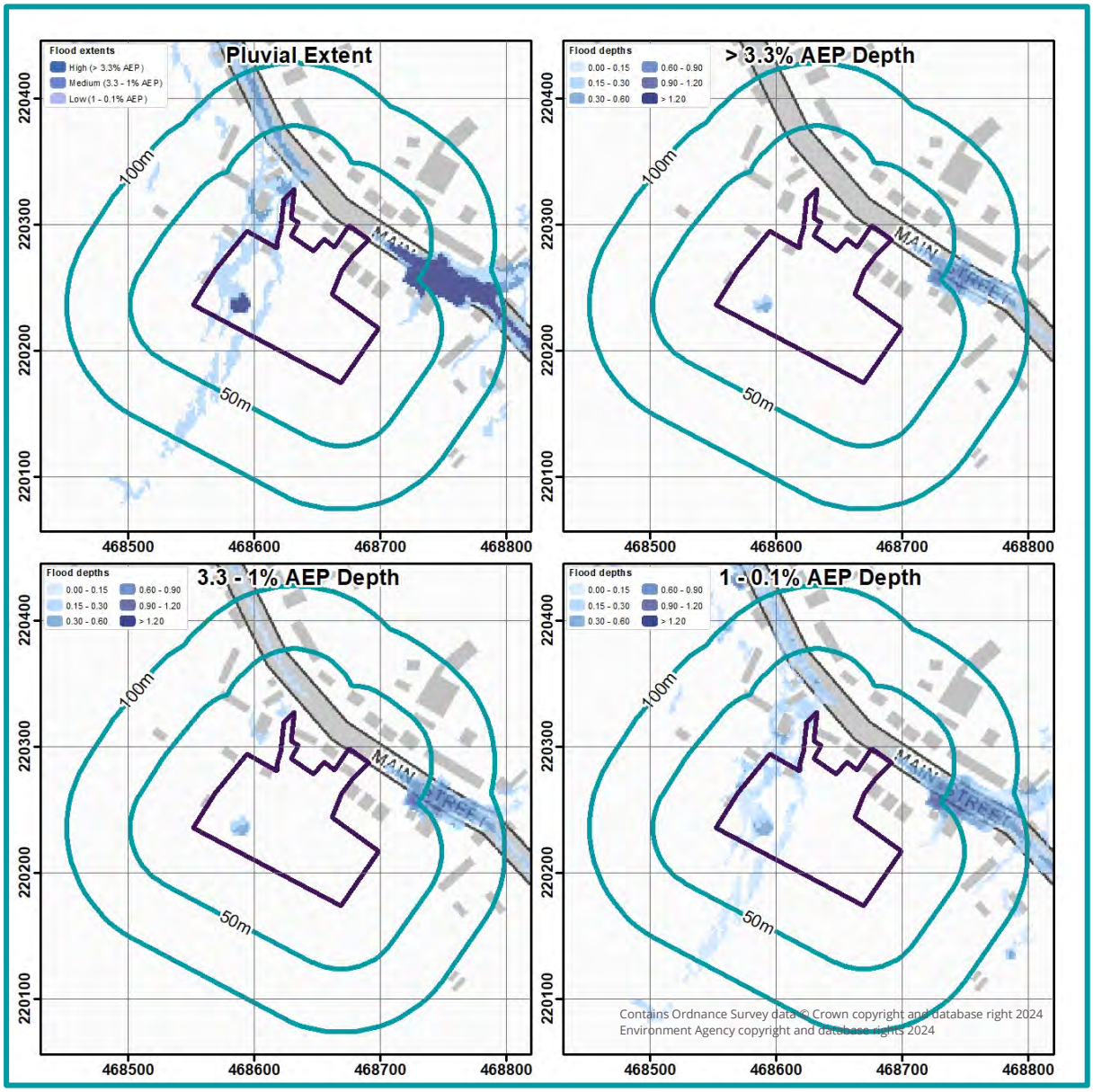
Further analysis of the connections and condition of the public surface water drainage system should be undertaken by carrying out a CCTV survey or by contacting the drainage provider or the Local Council to confirm the presence, location and condition of the sewer. Consultation with the drainage provider would also be required to determine that sufficient capacity is available to accept the proposed discharge, and to gain permission to connect if required.

Where development is proposed above or within close proximity to the public sewer network, a build-over agreement or easement may be required with the relevant utility provider.

Figure 7. Risk of flooding from rivers & sea map (EA, 2024)

According to the EA's Risk of Flooding from Rivers and the Sea (RoFRS) map, the Site has a Very Low risk of flooding from fluvial or coastal flooding, with less than 0.1% annual probability of flooding, therefore the SuDS design is unlikely to be affected.

Figure 8. Risk of surface water flooding map (EA, 2024)



GeoSmart have undertaken an assessment of the risk of flooding from surface water (pluvial) sources within the vicinity of the Site using the EA's Risk of Flooding from Surface Water (RoFSW) mapping.

The above map shows the extent and depth of flooding during the >3.3% annual probability (AEP) (1 in 30 year – High risk), 3.3 – 1% AEP (1 in 100 year – Medium risk) and 1 – 0.1% AEP (1 in 1000 year – Low risk) events. This confirms there are areas where flooding could occur in a 1 in 30 year, 1 in 100 year and 1 in 1000 year events, which most likely relates to the presence of the unmapped pond. Flooding in these areas may constrain certain types of SuDS features being used.

Further analysis could be undertaken by contacting the Local Council and the Environment Agency to confirm the pluvial flood risk, flood depths and velocities where applicable.

Figure 9. Groundwater flood risk (GW5) map (GeoSmart, 2024)

GeoSmart have undertaken an assessment of the risk of flooding from groundwater within the vicinity of the Site. GeoSmart's Groundwater Flood Risk Screening (GW5) map confirms the Site has a Negligible risk of groundwater flooding during a 1% annual probability (1 in 100 year) event.

3 Site context

Site information

The purpose of this report is to assess the potential for disposing of surface water through a Sustainable Drainage System (SuDS) for the site of Land to Rear of Orchard Cottage, Main Street, Grendon Underwood, HP18 0SJ (the site). The Site is located within the village of Grendon Underwood in a setting of commercial and residential use. The land is generally level on site with a slope falling to the north at the proposed site entrance. Elevation levels on site are between 77.52 mAOD and 74.93 mAOD. This is based on EA elevation data obtained for the Site to a 1 m resolution with a vertical accuracy of ±150 mm. Site plans and drawings are provided in Appendix A.

Development

The Site is currently used within a residential and greenfield capacity. At present there is a single building with car park and landscaped areas. Development proposals comprise the demolition of the existing dwelling and the construction of seven dwellings with access road, car parking and associated landscaping.

Geology, permeability and thickness

British Geological Survey (BGS) national superficial and bedrock geology mapping confirms the geological formations underlying the Site and each formation may have a range of permeability.

Table 1. Site Geology

Geology present on-Site		Potentially permeable?
Superficial geology (Figure 11)	No mapped superficial geology	N/A
Bedrock geology (Figure 12)	Stewartby Member Mudstone (SBY) – mudstone	X

There are no BGS boreholes available within the vicinity of the Site.

In-situ soil Infiltration testing was conducted at the Site to confirm infiltration rates at the Site (Ref: P1175/R1/V1, EPS Consulting). The trial pit undertaken as part of this Site investigation confirms the underlying geology comprises:

- Made Ground to a depth of 0.50m below ground level (bgl);

- Slightly gravelly clay to a depth of 1.80mbgl;
- Clay with occasional selenite to a depth of c. 2.6 mbgl, where the trial pit ended.

Subsequent infiltration testing within the trial pit revealed very little soakage with groundwater falling c. 30mm during the 90 minute test period. After this time, the pit started to collapse and the test was terminated. As such infiltration to ground is not considered to be feasible.

Depth to groundwater

According to GeoSmart's GW5 mapping shallow groundwater is not a concern at the Site. Site investigation by EPS Consulting noted a very slow seepage of water at 2.6 mbgl but deemed it not to be representative of a groundwater strike.

Figure 10. Superficial Geology (BGS, 2024)

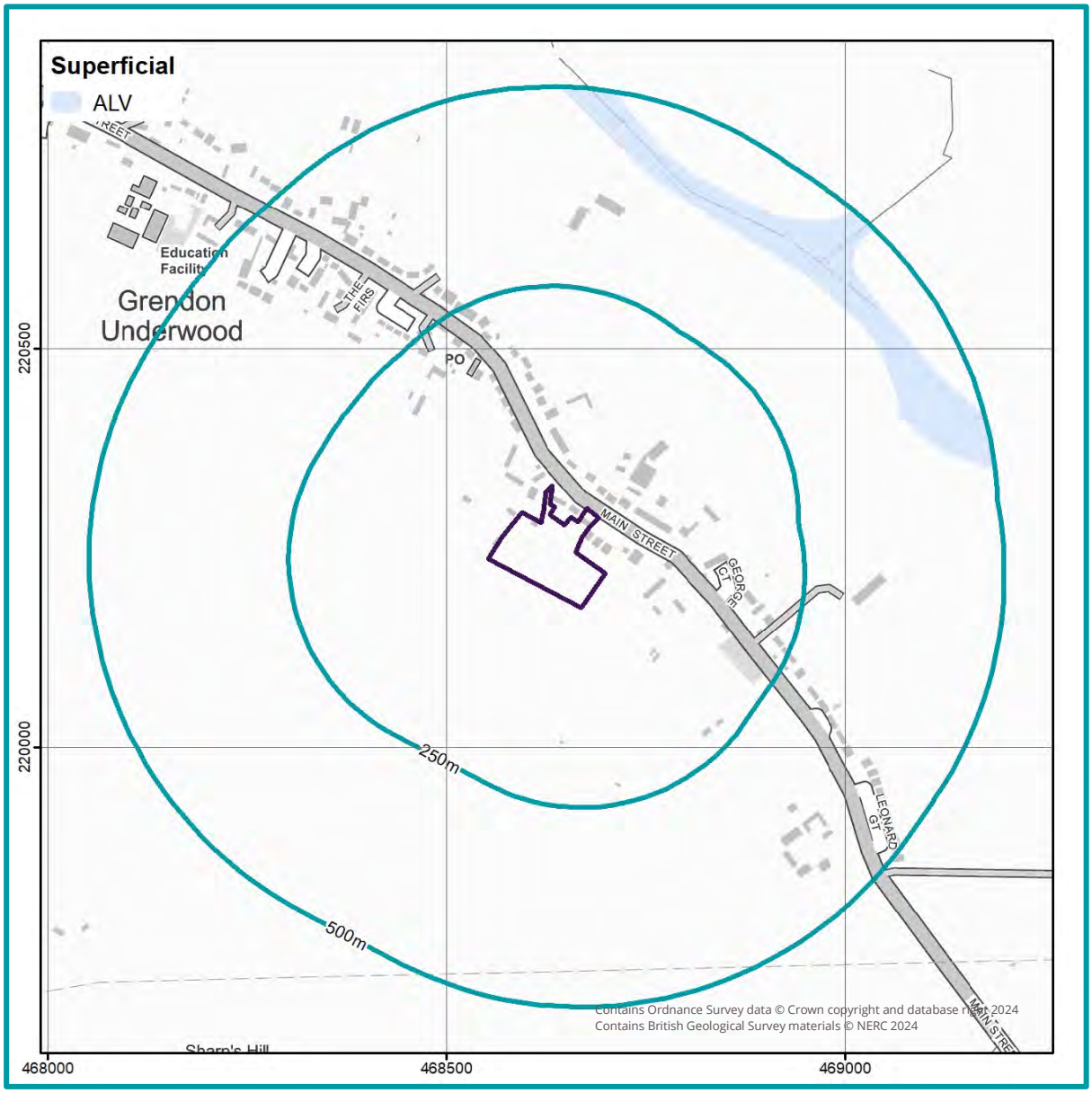
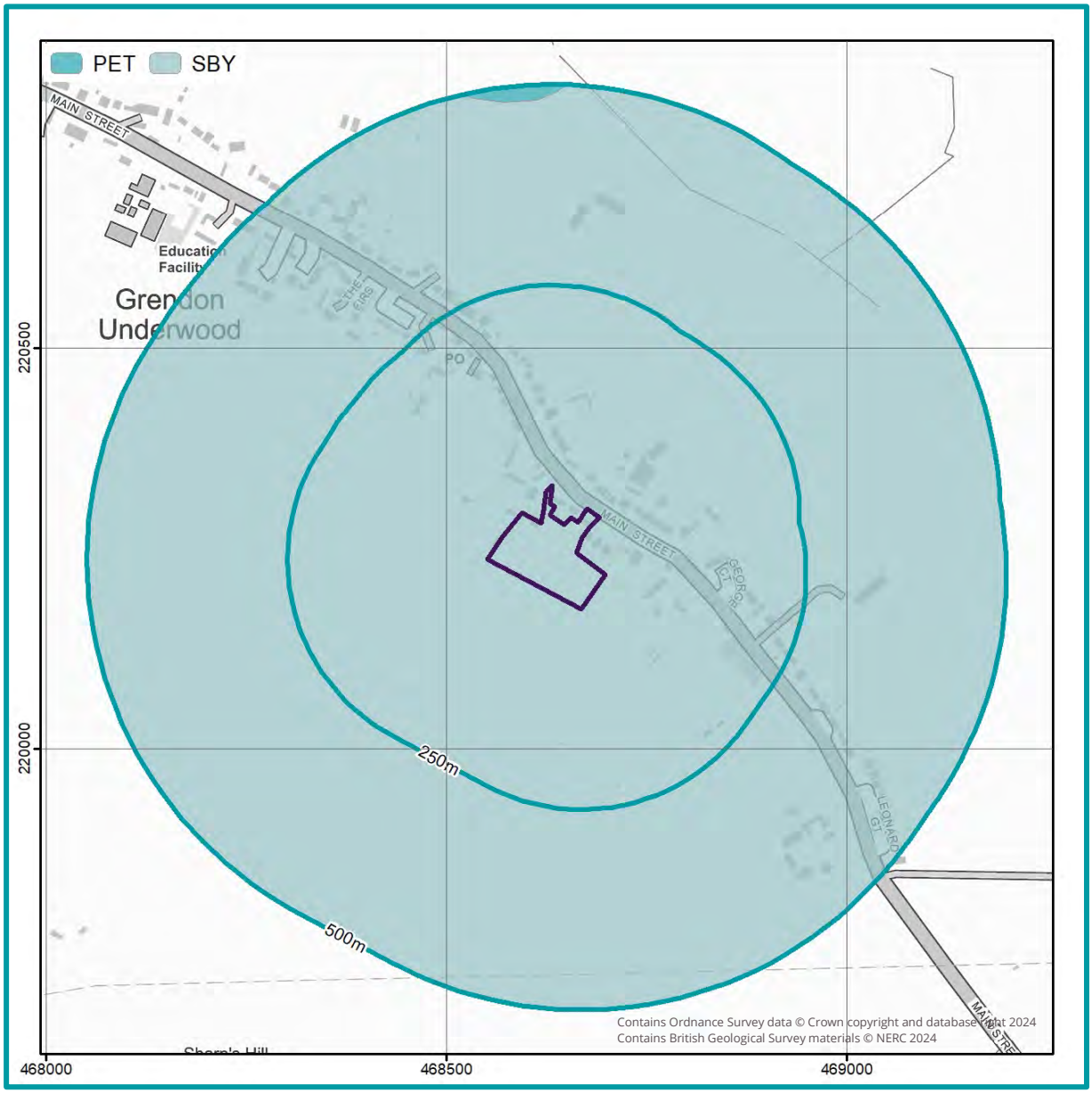


Figure 11. Bedrock Geology (BGS, 2024)



Ground conditions

Infiltration SuDS features are not proposed at the Site; therefore, a detailed investigation into the ground conditions is not required.

Water quality

The Site does not lie within an SPZ and infiltration features are not proposed; therefore, for the purposes of the sustainable drainage assessment, further consideration of the historical land uses (and any associated contamination risks) is not considered necessary.

4 National & local policy context

National Guidance

CIRIA SuDS Manual (C753) (2015)

A development should utilise sustainable drainage systems (SUDS) unless there are practical reasons for not doing so, and should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible in line with the following drainage hierarchy:

1. Use infiltration techniques, such as porous surfaces in non-clay areas,
2. attenuate rainwater in ponds or open water features for gradual release,
3. attenuate rainwater by storing in tanks or sealed water features for gradual release,
4. discharge rainwater direct to a watercourse,
5. discharge rainwater to a surface water sewer / drain,
6. discharge rainwater to the combined sewer.

Defra - Sustainable Drainage Systems: Non-statutory technical standards for sustainable drainage systems (2015)

Peak Flow control

For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.

For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should never exceed the peak greenfield runoff rate for the same event.

Volume control

Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event. The runoff volume must be discharged at a rate that does not adversely affect flood risk.

The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the Site for a 1 in 30 year rainfall event.

Ministry of Housing, Communities & Local Government – National Planning Practice Guidance: Flood risk assessments: climate change allowances (2022)

The Peak rainfall intensity allowances section provides advice on the increased rainfall effects on river levels and land and urban drainage systems. As of May 2022, the applicable climate change allowance is defined by specific Management Catchment for the 1 in 30 (≥ 3.3% AEP) and 1 in 100 (< 3.3 to 1% AEP) year event.

As the Site is located within the Cherwell and Ray Management Catchment the following climate change allowances are applicable.

Table 2. Cherwell and Ray Management Catchment peak rainfall allowances

Cherwell and Ray Management Catchment	3.3% Annual exceedance rainfall event		1% Annual exceedance rainfall event	
	2050s	2070s	2050s	2070s
Central	20%	25%	20%	25%
Upper end	35%	35%	40%	40%

The drainage system should be designed to make sure there is no increase in the rate of runoff discharged from the Site for the upper end allowance.

Where on-Site flooding for the upper end allowance presents a significant flood hazard (for example, depths and velocities of surface water runoff cause a significant danger to people), you will need to take further mitigation measures to protect people and property (for example, raising finished floor levels). As a minimum, there should be no significant flood hazard to people from on-Site flooding for the central allowance.

Local Policy

Buckinghamshire County Council – Developer Advice for Surface Water Drainage Strategies (2022)

In summary, sustainable drainage in Buckinghamshire has the potential to:

- protect people and property from increased flood risk resulting from the development
- create attractive places where people want to live, work, and play through integration of water and green spaces in the built environment
- improve people's understanding of how runoff from their development is being managed and used, and the benefits of more sustainable approaches

- support the creation of developments that are more able to cope with changes in climate
- deliver cost-effective infrastructure that uses fewer natural resources and has a smaller whole-life carbon footprint than conventional drainage
- protect the quality of groundwater and surface waters from polluted runoff from development
- protect natural flow regimes (and thus the morphology and associated ecology) in rivers, lakes and streams
- support local natural habitats and associated ecosystems by encouraging greater biodiversity and linking habitats
- improve soil moisture and replenishing depleted groundwater levels
- provide society with a valuable supply of water

Design Standards for SuDS Components

Infiltration rate testing must be carried out in accordance with Building Research Establishment Digest 365 Soakaway Design (2016) standards, in the location and to the effective depth of the proposed component, with test pits draining beyond the 25% effective depth.

A minimum infiltration rate of $1x10^{-6}$ m/s must be achieved.

If groundwater level monitoring is required, groundwater monitoring must be undertaken during the winter months (from November until April).

The base of the soakaway must be at least 1m above the groundwater level to protect the functionality of the infiltration process.

Shallow soakaways must be located a minimum of 5m away from any building foundation, retaining structure, highway or site boundary.

Half-drain time of the soakaway must be within 24 hours for the 1 in 30 year rainfall event.

Half-drain time for the 1 in 100 year storm event.

A separation distance of 10m between individual soakaways, if separation distance cannot be achieved calculations must account for reduction is capacity.

Maximum impermeable area of 1000m2 served by individual soakaway.

Soakaways must not be constructed in contaminated ground.

Any pond, wetland, infiltration basins or detention basins must be designed/carried out to the following standards:

- maximum side slopes of 1 in 3, however 1 in 5 side slopes are preferred
- maximum depth for permanent open water areas of 1.2m
- maximum depth of water should not normally exceed 2m in the most extreme design event

- minimum 300mm freeboard between bank-full and the 1 in 100 year plus climate change
- demonstration of overspill for extreme events
- they must be natural in shape, with topography and vegetation reflecting the landscape and enhancing the character of the area

In locations with high groundwater levels, the ponds, wetlands and detention basins must be lined and floatation calculations provided.

5 Storage, volume and peak flow rate

Suggested minimum and aspirational storage requirements for an infiltration or attenuation SuDS scheme for the development footprint are set out below, with more detail provided in subsequent sections. Storage volumes may be reduced (but not below the minimum level) if the design incorporates off-Site discharge.

Table 3. Storage requirements at the proposed development Site (Discharge runoff to pond)

Attenuation scenario		Attenuation required (m^3)	Explanation
Discharge runoff to pond	1 in 100 year including 40% CC	128.4	Attenuation required to ensure surface water runoff is attenuated in all storm events up to and including the 1 in 100 year event including a 40% allowance for climate change*.

*See Appendix B for associated runoff and discharge calculations. Discharge rates all restricted as close as possible to greenfield rates in their respective events.

Surface water runoff

An increase in impermeable area on-Site will result in greater rainfall runoff. Reduction in runoff will help mitigate flood risk both on and off-Site. Further information on the surface water runoff calculations is provided in Section 12 'Background Information'.

Guidance

The Non-Statutory Technical Guidance for SuDS (Defra, March 2015) states:

"Where reasonably practicable, for Greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the Greenfield runoff volume for the same event. Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the Greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event."

Table 4. Change in impermeable area associated with the development

Total Site area	10297 m^2
Impermeable area (and as a percentage of the total area of the proposed development footprint of 10297 m^2)	
Pre-development	Post-development
250 m^2 (2%)	2568 m^2 (25%)
Impermeable land use: 250 m^2 existing dwelling Permeable land use: landscaped areas/greenfield	New impermeable land use: 983 m^2 building footprint, 1585 m^2 paved areas* New permeable land use: landscaped areas

*Please note, while these areas will be utilized for SuDS, for the calculations these areas will be classed as impermeable in order to assess the potential run-off volumes and rates for the Site post- development and the potential holding capability of the proposed SuDS features.

Guidance

"The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event' and 'flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development"

(Defra, March 2015, non-statutory guidance).

6 Runoff destination

Options for the destination for the runoff generated on-Site have been assessed in line with the prioritisation set out in the Building Regulations Part H document (HM Government, published in 2010 and updated in 2015) and Defra's Non-statutory Technical Standards for SuDS (2015).

Flow attenuation using infiltration SuDS (discharge to ground) is generally the preferred option. If discharge to ground is not available, runoff discharge to surface water is the other preferred method. Only if these two options are impractical should discharge to the sewer network be considered.

Discharge to ground

According to GeoSmart's SD50 mapping the Site has Low potential for infiltration, with low permeability underlying Stewartby Member Mudstone.

In-situ soil infiltration testing was conducted at the Site to confirm infiltration rates at the Site (Ref: P1175/R1/V1, EPS Consulting). Infiltration testing revealed very little soakage with groundwater falling c. 30mm during the 90 minute test period. After this time, the pit started to collapse and the test was terminated.

Given the low permeability of the underlying geology and the results of infiltration testing at the Site, infiltration testing is not considered to be feasible and is not proposed.

Discharge to surface watercourse

OS mapping shows that there are no surface water features within 100 m of the Site. However, aerial mapping and a topographic survey by Total Geomatics (2023) have confirmed the presence of a pond located within the west of the Site.

Given the location of the pond on-Site, discharge to the pond is considered to be feasible and is proposed.

Discharge to sewer

According to a Thames Water asset plan, there are no surface water or combined sewers within close proximity to the Site. Therefore, discharge to the public sewer network is unlikely to be feasible and is not proposed.

7 Water quality

A key requirement of any SuDS system is that it protects the receiving water body from the risk of pollution. This can be effectively managed by an appropriate "train" or sequence of SuDS components that are connected in series. The frequent and short duration rainfall events are those that are most loaded with potential contaminants (silts, fines, heavy metals and various organic and inorganic contaminants). Therefore, the first 5-10 mm of rainfall (first flush) should be adequately treated with SuDS.

The minimum number of treatment stages will depend on the sensitivity of the receiving water body and the potential hazard associated with the proposed development SuDS Manual (CIRIA, 2015). The proposed development is a combination of very low (roof water) to low hazard (runoff from car parking and road). The Site does not lie within an SPZ and therefore additional treatment stages are not required.

Table 5. Level of hazard

Hazard	Source of hazard
Very Low	Residential roof drainage
Low	Residential, amenity uses including low usage car parking spaces and roads, other roof drainage.
Medium	Commercial, industrial uses including car parking spaces and roads (excluding low usage roads, trunk roads and motorways).
High	Areas used for handling and storage of chemicals and fuels, handling of storage and waste (incl. scrap-yards).

The recommended minimum number treatment stages suggested for the different runoff waters identified for the proposed development is highlighted in the table below.

Table 6. Minimum number of treatment stages for runoff

		Sensitivity of the receiving water body		
		Low	Medium	High
Hazard	Low	1	1	1
	Med	2	2	2
	High	3	3	3

8 Client checklist

A drainage strategy should now be compiled on the basis of the information provided. Prior to installation of the Site drainage system it is recommended that the client carries out the following checks to confirm the development proposals. GeoSmart would be able to support with any updates required to the drainage scheme, please contact us and we would be happy to provide you with a proposal to undertake the work.

Table 7. Potential SuDS limitations

Conditions in Non-Statutory Technical Standards (Defra, 2015), limitations to infiltration SuDS	Do these conditions arise at the Site?
Is the surface runoff greater than the rate at which water can infiltrate into the ground?	
Is there an unacceptable risk of ground instability?	
Is there an unacceptable risk of mobilising contaminants?	
Is there an unacceptable risk of pollution to groundwater?	
Is there an unacceptable risk of groundwater flooding?	
Is the infiltration system going to create a high risk of groundwater leakage to the combined sewer?	

Table 8. SuDS design considerations

Confirm that potential flooding on-Site in excess of the design storm event and exceedance flow routes have been considered.	
Review options for the control of discharge rates (e.g. hydrobrake).	
Confirm the owners/adopters of the drainage system. Consider management options for multiple owners.	
Is there an unacceptable risk of pollution to groundwater?	
Review access and way leave requirements.	
Review maintenance requirements.	

Health and safety considerations for SuDS

GeoSmart reports may include outline strategies or designs to support with development plans. Any drawings or advice provided do not comprise any form of detailed design. Implementation of any conceptual scheme options may constitute 'Construction Work' as defined by CDM Regulations (2015).

The CDM Regulations place specific Health and Safety duties on those commissioning, planning and undertaking construction works. If you are uncertain what this means you should seek the advice of your architect, builder or other competent professional.

GeoSmart does not provide health and safety advisory services but we are required to advise you of your general responsibilities under CDM (visit http://geosmartinfo.co.uk/knowledge-hub/cdm-2015/ for more information).

Please remember that detailed design work should be undertaken by a competent professional who might be your engineer, architect, builder or another competent party.

9 Methodology and limitations of study

This report assesses the feasibility of infiltration SuDS and alternative drainage strategies in support of the Site development process. From April 6th 2015 SuDS are regulated by Local Planning Authorities and will be required under law for major developments in all cases unless demonstrated to be inappropriate. What is considered appropriate in terms of costs and benefits by the Planning Authority will vary depending on local planning policy, and Site setting. The Lead Local Flood Authority will require information as a statutory consultee on major planning applications with surface water drainage implications. The National Planning Policy Framework requires that new developments in areas at risk of flooding should give priority to the use of SuDS and demonstrate that the proposed development does not increase flood risk downstream to third parties.

How was the suitability of SuDS estimated for the Site?

There are a range of SuDS options available to provide effective surface water management that intercept and store excess runoff. When considering these options, the destination of the runoff should be assessed using the order of preference outlined in the Building Regulations Part H document (HM Government, 2010) and Defra's National Standards for SuDS (2015):

1. Discharge to the ground;
2. Discharge to a surface water body;
3. Discharge to a surface water sewer;
4. Discharge to a local highway drain; and
5. Discharge to a combined sewer.

Data sets relating to each of the potential discharge options have been analysed to assess the feasibility of each option according to the hierarchy set out above. Hydrogeological characteristics for the Site are assessed in conjunction with the occurrence of SPZ's to assess infiltration suitability. The Site has been screened to determine whether flood risk from groundwater, surface water, fluvial or coastal sources may constrain SuDS. The distance to surface water bodies and sewers has been reviewed gauge whether these provide alternative options.

GeoSmart SuDS Infiltration Suitability Map (SD50)

The GeoSmart SuDS Infiltration Suitability Map (SD50) screens the suitability for infiltration drainage in different parts of the Site and indicates where further assessment is recommended. In producing the SuDS Infiltration Suitability Map (SD50), GeoSmart used data from the British Geological Survey on groundwater levels, geology and permeability to screen

for areas where infiltration SuDS may be suitable. The map classifies areas into 3 categories of High, Medium and Low suitability for infiltration SuDS. This can then be used in conjunction with additional data on Site constraints to give recommendations for SuDS design and further investigation.

The primary constraint on infiltration potential is the minimum permeability of the underlying material and in some cases the range in permeability may be considerable, ranging down to low. The map classifies these areas as moderate infiltration suitability requiring further investigation. In cases where the thickness of the receiving permeable horizon is less than 1.5 meters then additional Site investigation is recommended. If the Site is at risk of groundwater flooding for up to the 1% annual occurrence the map classifies these areas as moderate infiltration suitability requiring further investigation.

The GeoSmart SuDS Infiltration Suitability Map (SD50) is a national screening tool for infiltration SuDS techniques but a Site specific assessment should be used before final detailed design is undertaken. Further information on the GeoSmart SuDS Infiltration Suitability Map (SD50) is available at geosmartinfo.co.uk

How is the suitability to discharge to sewers and watercourses calculated?

The suitability to discharge to discharge to sewers and watercourses has been calculated using the distance from the Site to both. For example, where the Site is within 50 m of a surface water body. Discharge to surface water is potentially appropriate subject to land access arrangements and a feasibility assessment. Where the Site is within 50 m of a sewer, discharge to sewer is potentially appropriate subject to land access arrangements and a feasibility assessment. The utility company should be contacted to agree connection feasibility and sewer capacity.

Further information relating to sewers available in the area can be found in Appendix C.

What is a Source Protection Zone?

The Environment Agency have defined Source Protection Zones (SPZs) for 2000 groundwater sources such as wells, boreholes and springs used for public drinking water supply. These zones show the risk of contamination from any activities that might cause pollution in the area. The closer the activity, the greater the risk. The maps show three main zones (inner, outer and total catchment) and a fourth zone of special interest, which is occasionally applied. The zones are used to set up pollution prevention measures in areas which are at a higher risk. The shape and size of a zone depends on the condition of the ground, how the groundwater is removed, and other environmental factors. Inner zone (Zone 1) is defined as the 50 day travel time from any point below the water table to the source (minimum radius of 50 metres). Outer zone (Zone 2) is defined by a 400 day travel time. Total catchment (Zone 3) is defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source.

How was surface water runoff estimated from the Site?

In accordance with The SuDS Manual (C753) (CIRIA, 2015), the Greenfield runoff from the Site has been calculated using the IoH124 method and is assumed representative of the runoff generated on the undeveloped surfaces that are affected by the proposed development. The method used for calculating the runoff complies with the NPPF (MHCLG, 2023). For the impermeable surfaces, it has been assumed that 100% runoff will occur (calculations provided in Appendix B). Rainfall data is derived from the Flood Estimation Handbook (FEH), developed by NERC (2009). Only areas affected by the proposed development are considered in the flow and volume calculations. Permeable areas that remain unchanged are not included in the calculations as it is assumed these will not be actively drained and attenuated.

What is the peak discharge rate?

An estimation of peak runoff flow rate and volume is required to calculate infiltration, storage and discharge requirements. The peak discharge rate is the maximum flow rate at which surface water runoff leaves the Site during a particular storm event, without considering the impact of any mitigation such as storage, infiltration or flow control. Proposed discharge rates (with mitigation) should be no greater than existing rates for all corresponding storm events. If all drainage is to infiltration there will be no discharge off-Site. Discharging all flow from Site at the existing 1 in 100 event would increase flood risk during smaller events. Flow restriction is generally required to limit the final discharge from Site during all events as a basic minimum to the green field QBAR rate. A more complex flow restriction which varies the final discharge rate from the Site depending on the storm event will reduce the volume of storage required on-Site. Drainage to infiltration SuDS is subtracted from the total discharge off-Site to achieve a beneficial net affect.

What is the total discharge volume?

The total discharge volume is calculated on the basis of the surface water runoff that has the potential to leave the Site as a result of the assumed 6 hour duration design storm event. The runoff is related to the underlying soil conditions, impermeable cover, rainfall intensity and duration of the storm event. The total volume generated by the current Site is compared to the potential total volume from the developed Site (not taking into consideration any mitigation). The difference provides the minimum total volume that will need to be stored and infiltrated on-Site or released at a controlled rate. Guidance indicates that the total discharge volume should never exceed the runoff volume from the development Site prior to redevelopment for that event and should be as close as is reasonably practicable to the Greenfield runoff volume.

10 Background SuDS information

SuDS control surface water runoff close to where it falls. SuDS are designed to replicate, as closely as possible, the natural drainage from the Site before development to ensure that the flood risk downstream does not increase as a result of the Site being developed, and that the Site will have satisfactory drainage under current and likely future climatic conditions. SuDS provide opportunities to reduce the causes and impacts of flooding; remove pollutants from urban runoff at source; and combine water management with green space with benefits for amenity, recreation and wildlife. Government planning policy and planning decisions now include a presumption in favour of SuDS being used for all development Sites, unless they can be shown to be inappropriate.

For general information on SuDS see our website: http://geosmartinfo.co.uk/

Infiltration SuDS

Government policy for England is to introduce sustainable drainage systems (SuDS) via conditions in planning approvals. Guidance indicates that capturing rainfall runoff on-Site and infiltrating it into the ground (infiltration SuDS) is the preferred method for managing surface water without increasing flood risk downstream.

The greatest benefit to general flood risk is if all runoff is infiltrated on-Site, however, this may not be feasible due to physical and economic constraints in which case infiltration may be considered as a part of an integrated drainage solution. The final design capacity for an infiltration SuDS system depends on the Site constraints and the requirements of the individual Planning Authority and the Lead Local Flood Authority.

The capacity of the ground to receive infiltration depends on the nature, thickness and permeability of the underlying material and the depth to the high groundwater table. The final proportion of the Site drained by infiltration will depend on topography, outfall levels and a suitable drainage gradient. It is important to note that, even if the whole Site cannot be drained by infiltration, the use of partial infiltration is encouraged, with the remainder of runoff discharged via other SuDS systems.

Types of infiltration SuDS

Infiltration components include infiltration trenches, soakaways, swales and infiltration basins without outlets, rain gardens and permeable pavements. These are used to capture surface water runoff and allow it to infiltrate (soak) and filter through to the subsoil layer, before returning it to the water table below.

An infiltration trench is usually filled with permeable granular material and is designed to promote infiltration of surface water to the ground. An infiltration basin is a dry basin or depression designed to promote infiltration of surface water runoff into the ground. Soakaways are the most common type of infiltration device in the UK where drainage is often connected to over-sized square or rectangular, rubble-filled voids sited beneath lawns.

According to the guidance in Building Research Establishment (BRE) Digest 365 (2016) a soakaway must be able to discharge 50% of the runoff generated during a 1 in 10 year storm event within 24 hours in readiness for subsequent storm flow. This is the basic threshold criteria for a soakaway design and the internal surface area of the proposed soakaway design options should be calculated on this basis by taking into account the soil infiltration rate for the Site.

Developers need to ensure their design takes account of the construction, operation and maintenance requirements of both surface and subsurface components, allowing for any machinery access required.

SuDS maintenance and adoption

Regular maintenance is essential to ensure effective operation of the soakaway(s) over the intended lifespan of the proposed development. A maintenance schedule for SuDs is required. Sewerage undertakers or Local Authorities may adopt SuDS and will require maintenance issues to be dealt with in accordance with their Management Plan. If the SuDS will not be adopted other provision is required with associated financial implications. Maintenance is a long-term obligation requiring the upkeep of all elements of the SuDS, including mechanical components (e.g. pumps), as well as inspections, regular maintenance and repair.

Additional background SuDS information can be found on our website: http://geosmartinfo.co.uk/

11 Further information

The following table includes a list of additional products by GeoSmart:

Additional GeoSmart Products			
	Additional assessment: FloodSmart Report		The FloodSmart Report range provides clear and pragmatic advice regarding the nature and potential significance of flood hazards which may be present at a Site. Our consultants assess available data to determine the level of risk based on professional judgement and years of experience. Please contact info@geosmartinfo.co.uk for further information.
	Additional assessment: EnviroSmart Report		Provides a robust desk-based assessment of potential contaminated land issues, taking into account the regulatory perspective. Our EnviroSmart reports are designed to be the most cost effective solution for planning conditions. Each report is individually prepared by a highly experienced consultant conversant with Local Authority requirements. Ideal for pre-planning or for addressing planning conditions for small developments. Can also be used for land transactions. Please contact info@geosmartinfo.co.uk for further information.

12 References and glossary

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GeoSmart Information

Glossary

General terms

Attenuation	Reduction of peak flow and increased duration of a flow event.
Combined sewer	A sewer designed to carry foul sewage and surface water in the same pipe.
Detention basin	A vegetated depression, normally is dry except after storm events, constructed to store water temporarily to attenuate flows. May allow infiltration of water to the ground.
Evapotranspiration	The process by which the Earth's surface or soil loses moisture by evaporation of water and by uptake and then transpiration from plants.
FEH	Flood Estimation Handbook, produced by Centre for Ecology and Hydrology, Wallingford (formerly the Institute of Hydrology).
Filter drain or trench	A linear drain consisting of a trench filled with a permeable material, often with a perforated pipe in the base of the trench to assist drainage, to store and conduct water, but may also be designed to permit infiltration.
First flush	The initial runoff from a site or catchment following the start of a rainfall event. As runoff travels over a catchment it will collect or dissolve pollutants, and the "first flush" portion of the flow may be the most contaminated as a result. This is especially the case for intense storms and in small or more uniform catchments. In larger or more complex catchments pollution.
Flood plain	Land adjacent to a watercourse that would be subject to repeated flooding under natural conditions (see Environment Agency's Policy and practice for the protection of flood plains for a fuller definition).
Greenfield runoff	This is the surface water runoff regime from a site before development, or the existing site conditions for brownfield redevelopment sites.
Impermeable surface	An artificial non-porous surface that generates a surface water runoff after rainfall.
Permeability	A measure of the ease with which a fluid can flow through a porous medium. It depends on the physical properties of the medium, for example grain size, porosity and pore shape.

Runoff	Water flow over the ground surface to the drainage system. This occurs if the ground is impermeable, is saturated or if rainfall is particularly intense.
Sewerage undertaker	This is a collective term relating to the statutory undertaking of water companies that are responsible for sewerage and sewage disposal including surface water from roofs and yards of premises.
Soakaway	A subsurface structure into which surface water is conveyed to allow infiltration into the ground.
Treatment	Improving the quality of water by physical, chemical and/or biological means.

The terms included in this glossary have been taken from CIRIA (2015) guidance.

GeoSmart Information

Data Sources

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Topographic Data	OS LiDAR/EA Contains Ordnance Survey data © Crown copyright and database right 2024 Environment Agency copyright and database rights 2024

13 Appendices

GeoSmart Information

Appendix A

Site plans

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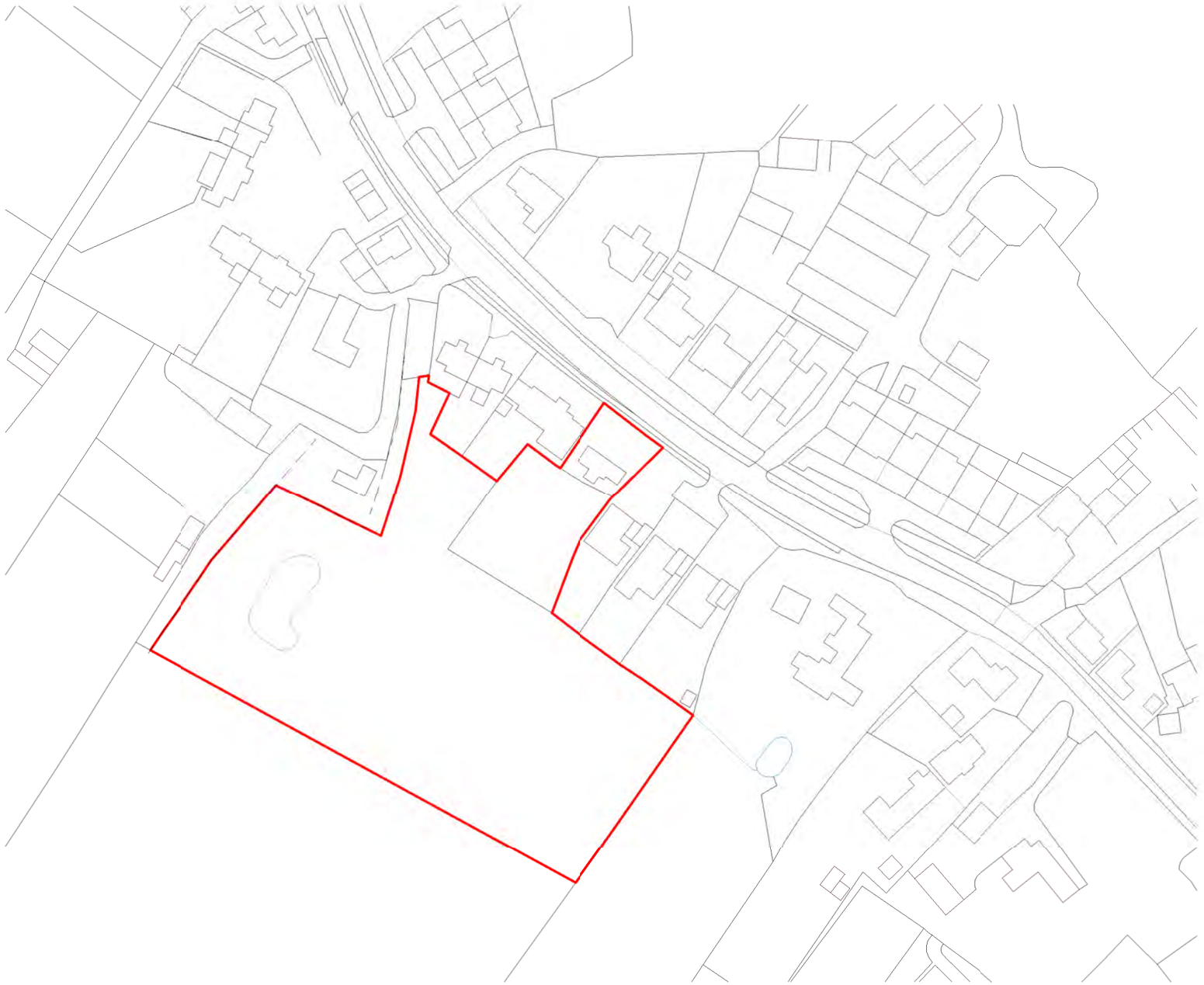

METRES 1:500

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Planning

Rev	Date	Description	Drawn
.			

Palmer+ Partners

Darren Jones

22041 - Land to the rear of Orchard Cottage, Main Street, Grendon Underwood, HP18 0SJ

B2 / Twin Gables

22041 EX 90

Existing Location Plan

Scale : 1 : 1250 @A3

Date: 11/10/2023

Drawn by: MH

GeoSmart Information

Appendix B

Rainfall runoff calculations

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	0.600
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.014	5.00	76.360	600	468680.145	220204.384	0.750
2	0.005	5.00	76.200	600	468685.928	220212.706	0.890
3	0.014	5.00	76.480	600	468666.934	220211.466	0.750
4	0.005	5.00	76.220	600	468673.732	220221.061	1.060
5	0.015	5.00	76.500	600	468654.130	220218.357	0.700
6	0.005	5.00	76.275	600	468661.703	220229.338	1.265
7	0.015	5.00	76.510	600	468641.490	220225.656	0.750
8	0.005	5.00	76.320	600	468650.042	220237.289	1.410
9	0.042	5.00	76.335	600	468646.943	220239.532	1.475
10	0.018	5.00	76.245	600	468651.785	220262.306	0.750
11	0.015	5.00	76.310	600	468646.533	220253.173	0.915
12	0.005	5.00	76.390	600	468640.256	220243.976	1.705
13	0.012	5.00	76.285	600	468636.715	220274.808	0.750
14	0.011	5.00	76.375	600	468628.323	220259.110	1.140
15	0.015	5.00	76.500	600	468629.236	220234.392	0.750
16			76.425	600	468628.309	220243.487	1.815
17	0.012	5.00	76.670	600	468667.510	220193.516	0.750
18	0.013	5.00	76.685	600	468654.437	220200.480	0.865
19	0.013	5.00	76.610	600	468641.765	220207.273	0.890
20	0.013	5.00	76.635	600	468629.320	220214.238	1.015
21	0.010	5.00	76.550	600	468614.992	220224.741	1.080
22			76.475	1200	468617.104	220243.122	2.215
22_OUT			76.400		468593.757	220243.636	2.278

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	1	2	10.134	0.600	75.610	75.310	0.300	33.8	150	5.10	50.0
1.001	2	4	14.783	0.600	75.310	75.160	0.150	98.6	150	5.34	50.0
2.000	3	4	11.759	0.600	75.730	75.160	0.570	20.6	150	5.09	50.0
1.002	4	6	14.602	0.600	75.160	75.060	0.100	146.0	150	5.63	50.0
3.000	5	6	13.339	0.600	75.800	75.060	0.740	18.0	100	5.12	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.738	30.7	1.9	0.600	0.740	0.014	0.0	25	0.972
1.001	1.012	17.9	2.6	0.740	0.910	0.019	0.0	38	0.720
2.000	2.227	39.4	1.9	0.600	0.910	0.014	0.0	23	1.156
1.002	0.829	14.7	5.1	0.910	1.065	0.038	0.0	61	0.757
3.000	1.827	14.4	2.0	0.600	1.115	0.015	0.0	25	1.291

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.003	6	8	14.114	0.600	75.010	74.910	0.100	141.1	150	5.91	49.8
4.000	7	8	14.438	0.600	75.760	74.910	0.850	17.0	150	5.10	50.0
1.004	8	9	3.826	0.600	74.910	74.860	0.050	76.5	150	5.97	49.5
1.005	9	12	8.029	0.600	74.860	74.760	0.100	80.3	150	6.09	49.1
5.000	10	11	10.535	0.600	75.495	75.395	0.100	105.4	150	5.18	50.0
5.001	11	12	11.135	0.600	75.395	74.760	0.635	17.5	150	5.26	50.0
1.006	12	16	11.957	0.600	74.685	74.610	0.075	159.4	225	6.28	48.4
6.000	13	14	17.800	0.600	75.535	75.235	0.300	59.3	150	5.23	50.0
6.001	14	16	15.623	0.600	75.235	74.950	0.285	54.8	150	5.42	50.0
7.000	15	16	9.142	0.600	75.750	74.950	0.800	11.4	150	5.05	50.0
8.000	17	18	14.812	0.600	75.920	75.820	0.100	148.1	150	5.30	50.0
8.001	18	19	14.378	0.600	75.820	75.720	0.100	143.8	150	5.59	50.0
8.002	19	20	14.261	0.600	75.720	75.620	0.100	142.6	150	5.87	49.9
8.003	20	21	17.765	0.600	75.620	75.470	0.150	118.4	150	6.19	48.7
8.004	21	22	18.502	0.600	75.470	74.335	1.135	16.3	150	6.31	48.2
1.007	16	22	11.211	0.600	74.610	74.410	0.200	56.1	225	6.39	48.0
1.008	22	22_OUT	23.353	0.600	74.260	74.122	0.138	169.2	225	6.78	46.6

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.003	0.844	14.9	7.8	1.115	1.260	0.058	0.0	77	0.853
4.000	2.456	43.4	2.0	0.600	1.260	0.015	0.0	22	1.255
1.004	1.150	20.3	10.5	1.260	1.325	0.078	0.0	76	1.159
1.005	1.123	19.8	16.0	1.325	1.480	0.120	0.0	102	1.246
5.000	0.978	17.3	2.4	0.600	0.765	0.018	0.0	38	0.690
5.001	2.417	42.7	4.5	0.765	1.480	0.033	0.0	33	1.567
1.006	1.033	41.1	20.7	1.480	1.590	0.158	0.0	113	1.034
6.000	1.308	23.1	1.6	0.600	0.990	0.012	0.0	27	0.751
6.001	1.361	24.1	3.1	0.990	1.325	0.023	0.0	37	0.944
7.000	2.997	53.0	2.0	0.600	1.325	0.015	0.0	20	1.454
8.000	0.823	14.5	1.6	0.600	0.715	0.012	0.0	34	0.543
8.001	0.836	14.8	3.4	0.715	0.740	0.025	0.0	49	0.680
8.002	0.839	14.8	5.1	0.740	0.865	0.038	0.0	61	0.762
8.003	0.922	16.3	6.7	0.865	0.930	0.051	0.0	67	0.878
8.004	2.507	44.3	8.0	0.930	1.990	0.061	0.0	43	1.908
1.007	1.750	69.6	25.5	1.590	1.840	0.196	0.0	94	1.621
1.008	1.002	39.8	32.4	1.990	2.053	0.257	0.0	154	1.113

Simulation Settings

Rainfall Methodology	FEH-22	Skip Steady State	✓	2 year (l/s)	1.0
Summer CV	0.750	Drain Down Time (mins)	1440	30 year (l/s)	2.6
Winter CV	0.840	Additional Storage (m³/ha)	20.0	100 year (l/s)	3.4
Analysis Speed	Normal	Check Discharge Rate(s)	✓	Check Discharge Volume	x

Storm Durations

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

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	0	0	0
100	0	0	0
100	40	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	2.40
Greenfield Method	IH124	Growth Factor 100 year	3.19
Positively Drained Area (ha)	0.257	Betterment (%)	0
SAAR (mm)	622	QBar	1.1
Soil Index	4	Q 2 year (l/s)	1.0
SPR	0.47	Q 30 year (l/s)	2.6
Region	6	Q 100 year (l/s)	3.4
Growth Factor 2 year	0.88		

Node 22 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	74.260	Product Number	CTL-SHE-0075-3400-2000-3400
Design Depth (m)	2.000	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	3.4	Min Node Diameter (mm)	1200

Node 1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	75.910	Slope (1:X)	300.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	124	Depth (m)	0.300
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.30	Length (m)	10.000		

Node 3 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	76.030	Slope (1:X)	300.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	52	Depth (m)	0.300
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.30	Length (m)	10.000		

Node 5 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	76.050	Slope (1:X)	300.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	36	Depth (m)	0.300
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.30	Length (m)	12.000		

Node 7 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	76.060	Slope (1:X)	300.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	28	Depth (m)	0.300
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.30	Length (m)	14.000		

Node 15 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	76.050	Slope (1:X)	300.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	28	Depth (m)	0.300
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.30	Length (m)	20.000		

Node 2 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	75.650	Slope (1:X)	300.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	300	Depth (m)	0.300
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.30	Length (m)	10.000		

Node 4 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	75.770	Slope (1:X)	300.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	252	Depth (m)	0.300
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.30	Length (m)	10.000		

Node 6 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	75.825	Slope (1:X)	300.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	208	Depth (m)	0.300
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.30	Length (m)	10.000		

Node 8 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	75.870	Slope (1:X)	300.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	148	Depth (m)	0.300
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.30	Length (m)	10.000		

Node 12 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	75.940	Slope (1:X)	300.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	108	Depth (m)	0.300
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.30	Length (m)	10.000		

Node 16 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	74.625
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	700

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	60.0	0.0	1.200	60.0	0.0	1.201	0.0	0.0

Node 9 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	74.860
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	684

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	50.0	0.0	0.800	50.0	0.0	0.801	0.0	0.0

Results for 2 year Critical Storm Duration. Lowest mass balance: 97.26%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	75.635	0.025	1.9	0.0166	0.0000	OK
15 minute winter	2	10	75.348	0.038	2.6	0.0150	0.0000	OK
15 minute winter	3	10	75.752	0.022	1.9	0.0147	0.0000	OK
15 minute winter	4	11	75.222	0.062	5.1	0.0235	0.0000	OK
15 minute winter	5	10	75.825	0.025	2.0	0.0180	0.0000	OK
15 minute winter	6	11	75.089	0.079	7.5	0.0287	0.0000	OK
15 minute winter	7	10	75.782	0.022	2.0	0.0150	0.0000	OK
15 minute winter	8	11	74.994	0.084	10.1	0.0296	0.0000	OK
15 minute winter	9	14	74.938	0.078	15.5	3.7709	0.0000	OK
15 minute winter	10	10	75.535	0.040	2.5	0.0305	0.0000	OK
15 minute winter	11	10	75.429	0.034	4.5	0.0205	0.0000	OK
240 minute winter	12	180	74.938	0.253	5.5	0.0861	0.0000	SURCHARGED
15 minute winter	13	10	75.562	0.027	1.6	0.0160	0.0000	OK
15 minute winter	14	11	75.271	0.036	3.1	0.0174	0.0000	OK
15 minute winter	15	10	75.770	0.020	2.0	0.0139	0.0000	OK
240 minute winter	16	180	74.938	0.328	6.9	17.9341	0.0000	SURCHARGED
15 minute winter	17	10	75.953	0.033	1.6	0.0200	0.0000	OK
15 minute winter	18	11	75.868	0.048	3.4	0.0279	0.0000	OK
15 minute winter	19	11	75.782	0.062	5.1	0.0355	0.0000	OK
15 minute winter	20	11	75.693	0.073	6.7	0.0391	0.0000	OK
15 minute winter	21	11	75.513	0.043	8.1	0.0204	0.0000	OK
240 minute winter	22	180	74.937	0.677	4.6	0.7661	0.0000	SURCHARGED
15 minute summer	22_OUT	1	74.122	0.000	2.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	2	1.9	0.701	0.061	0.0276	
15 minute winter	2	1.001	4	2.5	0.495	0.140	0.0767	
15 minute winter	3	2.000	4	1.9	0.651	0.048	0.0501	
15 minute winter	4	1.002	6	5.0	0.738	0.340	0.0987	
15 minute winter	5	3.000	6	2.0	1.236	0.140	0.0228	
15 minute winter	6	1.003	8	7.6	0.773	0.507	0.1381	
15 minute winter	7	4.000	8	2.0	0.659	0.046	0.0842	
15 minute winter	8	1.004	9	10.1	1.354	0.495	0.0348	
15 minute winter	9	1.005	12	9.2	1.052	0.466	0.0706	
15 minute winter	10	5.000	11	2.5	0.734	0.142	0.0353	
15 minute winter	11	5.001	12	4.4	1.530	0.103	0.0320	
240 minute winter	12	1.006	16	5.2	0.654	0.126	0.4755	
15 minute winter	13	6.000	14	1.6	0.585	0.068	0.0481	
15 minute winter	14	6.001	16	3.0	0.918	0.124	0.0509	
15 minute winter	15	7.000	16	2.0	1.416	0.037	0.0128	
240 minute winter	16	1.007	22	3.0	0.768	0.043	0.4459	
15 minute winter	17	8.000	18	1.6	0.409	0.107	0.0571	
15 minute winter	18	8.001	19	3.3	0.565	0.222	0.0839	
15 minute winter	19	8.002	20	5.0	0.661	0.340	0.1089	
15 minute winter	20	8.003	21	6.8	1.080	0.416	0.1125	
15 minute winter	21	8.004	22	8.1	1.193	0.183	0.2020	
240 minute winter	22	Hydro-Brake®	22_OUT	2.6				49.5

Results for 30 year Critical Storm Duration. Lowest mass balance: 97.26%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	75.654	0.044	5.7	0.0287	0.0000	OK
15 minute winter	2	12	75.483	0.173	7.7	0.0683	0.0000	SURCHARGED
15 minute winter	3	10	75.769	0.039	5.7	0.0253	0.0000	OK
15 minute winter	4	12	75.461	0.301	14.1	0.1135	0.0000	SURCHARGED
15 minute winter	5	10	75.846	0.046	6.1	0.0324	0.0000	OK
240 minute winter	6	232	75.443	0.433	4.6	0.1568	0.0000	SURCHARGED
15 minute winter	7	10	75.798	0.038	6.1	0.0259	0.0000	OK
240 minute winter	8	232	75.443	0.533	6.0	0.1886	0.0000	SURCHARGED
240 minute winter	9	232	75.443	0.583	9.0	28.1743	0.0000	SURCHARGED
15 minute winter	10	10	75.568	0.073	7.4	0.0554	0.0000	OK
15 minute winter	11	10	75.453	0.058	13.4	0.0352	0.0000	OK
240 minute winter	12	232	75.442	0.757	8.8	0.2582	0.0000	SURCHARGED
15 minute winter	13	10	75.582	0.047	4.9	0.0281	0.0000	OK
240 minute winter	14	232	75.442	0.207	1.8	0.0985	0.0000	SURCHARGED
15 minute winter	15	10	75.786	0.036	6.1	0.0244	0.0000	OK
240 minute winter	16	232	75.442	0.832	12.4	46.8283	0.0000	SURCHARGED
15 minute winter	17	10	75.979	0.059	4.9	0.0357	0.0000	OK
15 minute winter	18	12	75.951	0.131	10.1	0.0766	0.0000	OK
15 minute winter	19	11	75.913	0.193	14.5	0.1111	0.0000	SURCHARGED
15 minute winter	20	11	75.812	0.192	18.3	0.1037	0.0000	SURCHARGED
15 minute winter	21	12	75.550	0.080	21.9	0.0377	0.0000	OK
240 minute winter	22	232	75.442	1.182	4.7	1.3364	0.0000	SURCHARGED
15 minute summer	22_OUT	1	74.122	0.000	2.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	2	5.7	0.944	0.185	0.1077	
15 minute winter	2	1.001	4	6.9	0.611	0.386	0.2603	
15 minute winter	3	2.000	4	5.7	0.727	0.144	0.1245	
15 minute winter	4	1.002	6	12.2	0.853	0.831	0.2571	
15 minute winter	5	3.000	6	6.1	1.307	0.423	0.0753	
240 minute winter	6	1.003	8	4.4	0.635	0.296	0.2485	
15 minute winter	7	4.000	8	6.1	0.750	0.140	0.1523	
240 minute winter	8	1.004	9	5.8	0.830	0.283	0.0674	
240 minute winter	9	1.005	12	6.6	0.890	0.333	0.1413	
15 minute winter	10	5.000	11	7.3	0.999	0.423	0.0772	
15 minute winter	11	5.001	12	13.3	1.897	0.312	0.1317	
240 minute winter	12	1.006	16	8.5	0.618	0.207	0.4755	
15 minute winter	13	6.000	14	4.8	0.792	0.210	0.1093	
240 minute winter	14	6.001	16	1.8	0.749	0.074	0.2750	
15 minute winter	15	7.000	16	6.1	1.945	0.115	0.0837	
240 minute winter	16	1.007	22	3.2	0.770	0.046	0.4459	
15 minute winter	17	8.000	18	4.8	0.542	0.332	0.1638	
15 minute winter	18	8.001	19	9.2	0.690	0.624	0.2442	
15 minute winter	19	8.002	20	13.4	0.802	0.905	0.2511	
15 minute winter	20	8.003	21	18.0	1.284	1.103	0.2418	
15 minute winter	21	8.004	22	21.7	1.412	0.489	0.2518	
240 minute winter	22	Hydro-Brake®	22_OUT	2.7				116.7

Results for 100 year Critical Storm Duration. Lowest mass balance: 97.26%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	13	75.689	0.079	7.4	0.0520	0.0000	OK
15 minute winter	2	13	75.686	0.376	9.9	0.4412	0.0000	SURCHARGED
15 minute winter	3	10	75.774	0.044	7.4	0.0289	0.0000	OK
15 minute winter	4	12	75.666	0.506	16.4	0.1907	0.0000	SURCHARGED
15 minute winter	5	11	75.863	0.063	7.9	0.0445	0.0000	OK
240 minute winter	6	232	75.651	0.641	5.5	0.2320	0.0000	SURCHARGED
15 minute winter	7	10	75.803	0.043	7.9	0.0296	0.0000	OK
240 minute winter	8	232	75.650	0.740	7.0	0.2621	0.0000	SURCHARGED
240 minute winter	9	232	75.650	0.790	10.7	38.2068	0.0000	SURCHARGED
240 minute winter	10	236	75.650	0.155	1.8	0.1180	0.0000	SURCHARGED
240 minute winter	11	236	75.650	0.255	3.3	0.1556	0.0000	SURCHARGED
240 minute winter	12	236	75.650	0.965	8.7	0.3289	0.0000	SURCHARGED
240 minute winter	13	236	75.650	0.115	1.2	0.0691	0.0000	OK
240 minute winter	14	236	75.650	0.415	2.3	0.1974	0.0000	SURCHARGED
15 minute winter	15	10	75.791	0.041	7.9	0.0279	0.0000	OK
240 minute winter	16	236	75.650	1.040	11.7	58.7252	0.0000	SURCHARGED
15 minute winter	17	12	76.153	0.233	6.3	0.1405	0.0000	SURCHARGED
15 minute winter	18	12	76.137	0.317	12.1	0.1851	0.0000	SURCHARGED
15 minute winter	19	12	76.072	0.352	16.7	0.2025	0.0000	SURCHARGED
15 minute winter	20	12	75.923	0.303	22.2	0.1633	0.0000	SURCHARGED
240 minute winter	21	232	75.649	0.179	6.1	0.0840	0.0000	SURCHARGED
240 minute winter	22	236	75.649	1.389	6.1	1.5713	0.0000	SURCHARGED
15 minute summer	22_OUT	1	74.122	0.000	2.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	2	7.3	0.960	0.239	0.1371	
15 minute winter	2	1.001	4	9.1	0.629	0.509	0.2603	
15 minute winter	3	2.000	4	7.4	0.781	0.187	0.1288	
15 minute winter	4	1.002	6	14.1	0.830	0.960	0.2571	
15 minute winter	5	3.000	6	7.6	1.253	0.532	0.0866	
240 minute winter	6	1.003	8	5.1	0.646	0.339	0.2485	
15 minute winter	7	4.000	8	7.9	0.742	0.181	0.1574	
240 minute winter	8	1.004	9	6.7	0.825	0.327	0.0674	
240 minute winter	9	1.005	12	6.5	0.882	0.327	0.1413	
240 minute winter	10	5.000	11	1.8	0.680	0.104	0.1855	
240 minute winter	11	5.001	12	3.3	1.070	0.077	0.1960	
240 minute winter	12	1.006	16	8.2	0.644	0.200	0.4755	
240 minute winter	13	6.000	14	1.2	0.550	0.052	0.2853	
240 minute winter	14	6.001	16	2.3	0.776	0.096	0.2750	
15 minute winter	15	7.000	16	7.8	2.086	0.148	0.0892	
240 minute winter	16	1.007	22	-3.3	0.772	-0.048	0.4459	
15 minute winter	17	8.000	18	5.7	0.543	0.390	0.2608	
15 minute winter	18	8.001	19	10.7	0.695	0.723	0.2531	
15 minute winter	19	8.002	20	16.2	0.921	1.093	0.2511	
15 minute winter	20	8.003	21	21.8	1.314	1.337	0.2703	
240 minute winter	21	8.004	22	6.1	1.017	0.138	0.3257	
240 minute winter	22	Hydro-Brake®	22_OUT	2.9				143.8

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 97.26%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute winter	1	236	76.174	0.564	3.3	4.0594	0.0000	FLOOD RISK
240 minute winter	2	236	76.174	0.864	5.3	4.5805	0.0000	FLOOD RISK
240 minute winter	3	236	76.174	0.444	1.9	2.1856	0.0000	SURCHARGED
240 minute winter	4	236	76.174	1.014	5.9	4.6215	0.0000	FLOOD RISK
240 minute winter	5	236	76.174	0.374	2.0	2.1330	0.0000	SURCHARGED
240 minute winter	6	236	76.173	1.163	7.9	4.6605	0.0000	FLOOD RISK
240 minute winter	7	236	76.173	0.413	2.0	2.1685	0.0000	SURCHARGED
240 minute winter	8	236	76.173	1.263	9.7	4.6865	0.0000	FLOOD RISK
240 minute winter	9	236	76.173	1.313	14.8	39.1424	0.0000	FLOOD RISK
240 minute winter	10	236	76.172	0.677	2.5	0.5166	0.0000	FLOOD RISK
240 minute winter	11	236	76.172	0.777	4.5	0.4748	0.0000	FLOOD RISK
240 minute winter	12	236	76.172	1.487	10.7	3.7222	0.0000	FLOOD RISK
240 minute winter	13	236	76.172	0.637	1.6	0.3841	0.0000	FLOOD RISK
240 minute winter	14	236	76.172	0.937	3.1	0.4460	0.0000	FLOOD RISK
240 minute winter	15	236	76.172	0.422	2.0	2.9467	0.0000	SURCHARGED
240 minute winter	16	236	76.172	1.562	16.9	68.8990	0.0000	FLOOD RISK
15 minute winter	17	12	76.627	0.707	8.8	0.4265	0.0000	FLOOD RISK
15 minute winter	18	12	76.606	0.786	15.1	0.4582	0.0000	FLOOD RISK
15 minute winter	19	12	76.514	0.794	21.6	0.4568	0.0000	FLOOD RISK
15 minute winter	20	13	76.305	0.685	28.4	0.3694	0.0000	SURCHARGED
240 minute winter	21	236	76.172	0.702	8.4	0.3286	0.0000	SURCHARGED
240 minute winter	22	236	76.172	1.912	8.3	2.1620	0.0000	SURCHARGED
15 minute summer	22_OUT	1	74.122	0.000	2.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
240 minute winter	1	1.000	2	-2.3	0.675	-0.074	0.1784	
240 minute winter	2	1.001	4	-3.2	0.471	-0.179	0.2603	
240 minute winter	3	2.000	4	1.9	0.559	0.048	0.2070	
240 minute winter	4	1.002	6	4.5	0.684	0.304	0.2571	
240 minute winter	5	3.000	6	2.0	1.145	0.139	0.1044	
240 minute winter	6	1.003	8	6.8	0.645	0.456	0.2485	
240 minute winter	7	4.000	8	2.0	0.564	0.046	0.2542	
240 minute winter	8	1.004	9	9.1	0.918	0.447	0.0674	
240 minute winter	9	1.005	12	6.9	0.850	0.346	0.1413	
240 minute winter	10	5.000	11	2.5	0.738	0.147	0.1855	
240 minute winter	11	5.001	12	4.4	1.019	0.103	0.1960	
240 minute winter	12	1.006	16	10.5	0.687	0.255	0.4755	
240 minute winter	13	6.000	14	1.6	0.584	0.069	0.3134	
240 minute winter	14	6.001	16	2.9	0.776	0.120	0.2750	
240 minute winter	15	7.000	16	2.0	1.187	0.038	0.1609	
240 minute winter	16	1.007	22	-5.2	0.750	-0.074	0.4459	
15 minute winter	17	8.000	18	6.5	0.548	0.448	0.2608	
15 minute winter	18	8.001	19	12.6	0.717	0.855	0.2531	
15 minute winter	19	8.002	20	19.3	1.095	1.299	0.2511	
15 minute winter	20	8.003	21	26.4	1.505	1.617	0.3127	
240 minute winter	21	8.004	22	8.3	1.017	0.187	0.3257	
240 minute winter	22	Hydro-Brake®	22_OUT	3.3				201.0

GeoSmart Information

Appendix C

Thames Water Asset Location Plan

Asset location search

Property Searches

GeoSmart Information Ltd
1st Floor,Old Bank Buildings,S Old Bank Buildings

SHREWSBURY
SY1 1HU

Search address supplied

Orchards Cottage
Main Street
Grendon Underwood
Aylesbury
HP18 0SH

Your reference 81010

Our reference ALS/ALS Standard/2024_4935733

Search date 19 January 2024

Notification of Price Changes

From 1st April 2023 Thames water Property Searches will be increasing the prices of its CON29DW, CommercialDW Drainage & Water Enquiries and Asset Location Searches. Historically costs would rise in line with RPI but as this currently sits at 14.2%, we are capping it at 10%.

Customers will be emailed with the new prices by January 1st 2023.

Any orders received with a higher payment prior to the 1st April 2023 will be non-refundable. For further details on the price increase please visit our website at www.thameswater-propertysearches.co.uk

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

searches@thameswater.co.uk
www.thameswater-propertysearches.co.uk

0800 009 4540

Asset location search

Property Searches

Search address supplied: Orchards Cottage, Main Street, Grendon Underwood, Aylesbury, HP18 0SH

Dear Sir / Madam

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

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

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

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

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

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

Contact Us

If you have any further queries regarding this enquiry please feel free to contact a member of the team on 0800 009 4540, or use the address below:

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

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

Waste Water Services

Please provide a copy extract from the public sewer map.

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

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

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

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

For your guidance:

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

Clean Water Services

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

Enclosed is a map showing the approximate positions of our water mains and associated apparatus. Please note that records are not kept of the positions of individual domestic supplies.

For your information, there will be a pressure of at least 10m head at the outside stop valve. If you would like to know the static pressure, please contact our Customer Centre on 0800 316 9800. The Customer Centre can also arrange for a full flow and

pressure test to be carried out for a fee.

For your guidance:

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

Payment for this Search

A charge will be added to your suppliers account.

Further contacts:

Waste Water queries

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

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

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

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

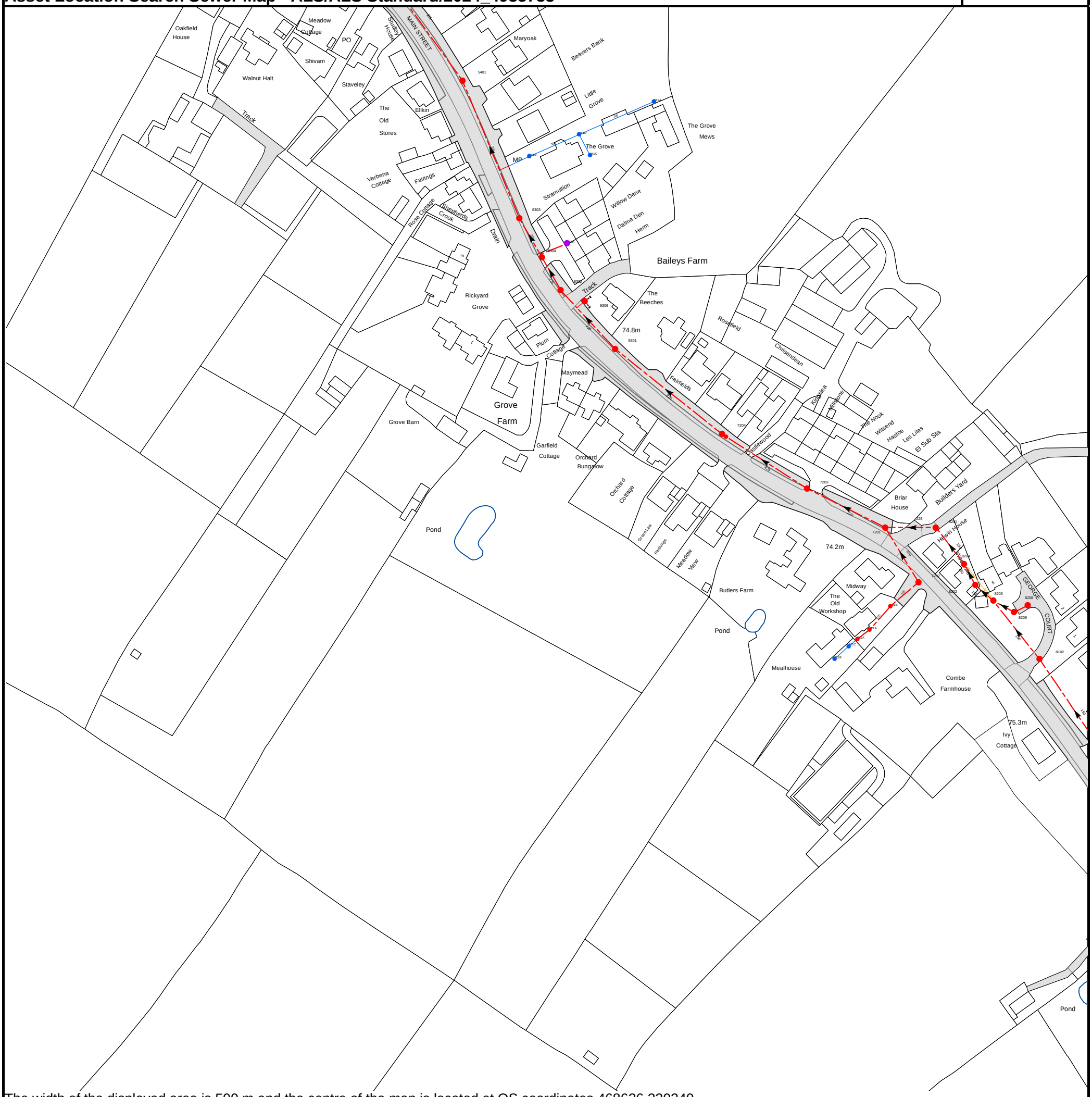
Clean Water queries

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

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

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

Asset Location Search Sewer Map - ALS/ALS Standard/2024_4935733



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 468626,220240

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

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

Manhole Reference	Manhole Cover Level	Manhole Invert Level
6303	74.2	71.36
641B	n/a	n/a
641C	n/a	n/a
641D	n/a	n/a
641A	n/a	n/a
5401	73.57	71.01
8102	75.11	72.88
711B	n/a	n/a
711C	n/a	n/a
711A	n/a	n/a
721A	n/a	n/a
8209	74.4	72.65
721B	n/a	n/a
8208	74.4	72.84
8203	74.7	72.5
8202	74.75	72.43
7202	74.29	72.87
8204	74.45	72.36
8201	74.08	72.25
7201	74.2	72.11
7203	74	71.9
7204	74.43	71.74
6301	75.02	71.53
6306	n/a	n/a
6302	74.65	71.49
6304	73.99	71.29
631A	n/a	n/a

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

Asset Location Search - Sewer Key

Public Sewer Types (Operated and maintained by Thames Water)

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

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

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

- Storm Sewer
- Sludge Sewer
- Foul Trunk Sewer
- Surface Trunk Sewer
- Combined Trunk Sewer
- Foul Rising Main
- Surface Water Rising Main
- Combined Rising Main
- Vacuum
- Thames Water Proposed
- Vent Pipe
- Gallery

Other Sewer Types (Not operated and maintained by Thames Water)

- Sewer
- Culverted Watercourse
- Proposed
- Decommissioned Sewer
- Content of this drainage network is currently unknown
- Ownership of this drainage network is currently unknown

Sewer Fittings

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

- Air Valve
- Meter
- Dam Chase
- Vent
- Fitting

Operational Controls

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

- Ancillary
- Drop Pipe
- Control Valve
- Weir

End Items

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

- Inlet
- Outfall
- Undefined End

Other Symbols

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

- Change of Characteristic Indicator
- Public / Private Pumping Station
- Invert Level
- Summit

Areas

Lines denoting areas of underground surveys, etc.

- Agreement
- Chamber
- Operational Site

Ducts or Crossings

- Casement — Ducts may contain high voltage cables. Please check with Thames Water.
- Conduit Bridge
- Subway
- Tunnel

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.
2) All measurements on the plan are metric.
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate the direction of flow.
4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.
5) 'na' or '0' on a manhole indicates that data is unavailable.
6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in millimeters. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement.

If you are unsure about any text or symbology, please contact Property Searches on 0800 009 4540.

Asset Location Search Water Map - ALS/ALS Standard/2024_4935733

The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 468626, 220240.

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

Asset Location Search - Water Key

Water Pipes (Operated & Maintained by Thames Water)

Distribution Main: The most common pipe shown on water maps. With few exceptions, domestic connections are only made to distribution mains.

Trunk Main: A main carrying water from a source of supply to a treatment plant or reservoir, or from one treatment plant or reservoir to another. Also a main transferring water in bulk to smaller water mains used for supplying individual customers.

Supply Main: A supply main indicates that the water main is used as a supply for a single property or group of properties.

Fire Main: Where a pipe is used as a fire supply, the word FIRE will be displayed along the pipe.

Metered Pipe: A metered main indicates that the pipe in question supplies water for a single property or group of properties and that quantity of water passing through the pipe is metered even though there may be no meter symbol shown.

Transmission Tunnel: A very large diameter water pipe. Most tunnels are buried very deep underground. These pipes are not expected to affect the structural integrity of buildings shown on the map provided.

Proposed Main: A main that is still in the planning stages or in the process of being laid. More details of the proposed main and its reference number are generally included near the main.

PIPE DIAMETER	DEPTH BELOW GROUND
Up to 300mm (12")	900mm (3')
300mm - 600mm (12" - 24")	1100mm (3' 8")
600mm and bigger (24" plus)	1200mm (4')

Valves

- General Purpose Valve
- Air Valve
- Pressure Control Valve
- Customer Valve

Hydrants

- Single Hydrant

Meters

- Meter

End Items

Symbol indicating what happens at the end of a water main.

- Blank Flange
- Capped End
- Emptying Pit
- Undefined End
- Manifold
- Customer Supply
- Fire Supply

Operational Sites

- Booster Station
- Other
- Other (Proposed)
- Pumping Station
- Service Reservoir
- Shaft Inspection
- Treatment Works
- Unknown
- Water Tower

Other Symbols

- Data Logger
- **Casement:** Ducts may contain high voltage cables. Please check with Thames Water.

Other Water Pipes (Not Operated or Maintained by Thames Water)

Other Water Company Main: Occasionally other water company water pipes may overlap the border of our clean water coverage area. These mains are denoted in purple and in most cases have the owner of the pipe displayed along them.

Private Main: Indicates that the water main in question is not owned by Thames Water. These mains normally have text associated with them indicating the diameter and owner of the pipe.

Payment Terms and Conditions

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

1. All goods remain in the property of Thames Water Utilities Ltd until full payment is received.
2. Provision of service will be in accordance with all legal requirements and published TWUL policies.
3. All invoices are strictly due for payment within 14 days of the date of the invoice. Any other terms must be accepted/agreed in writing prior to provision of goods or service or will be held to be invalid.
4. Penalty interest may be invoked by TWUL in the event of unjustifiable payment delay. Interest charges will be in line with UK Statute Law 'The Late Payment of Commercial Debts (Interest) Act 1998'.
5. Interest will be charged in line with current Court Interest Charges, if legal action is taken.
6. A charge may be made at the discretion of the company for increased administration costs.

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

We publish several Codes of Practice including a guaranteed standards scheme. You can obtain copies of these leaflets by calling us on 0800 316 9800.

If you are unhappy with our service, you can speak to your original goods or customer service provider. If you are still not satisfied with the outcome provided, we will refer the matter to a Senior Manager for resolution who will provide you with a response.

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GeoSmart Information

Appendix D

EPS Consulting Soil Infiltration Testing Report

SOIL INFILTRATION TESTING REPORT

LAND TO REAR OF ORCHARD COTTAGE, MAIN STREET, GRENDON UNDERWOOD, HP18 0SJ

REFERENCE: P1175/R1/V1

REPORT PREPARED FOR: HANNAFORD PROJECT MANAGEMENT LIMITED

REPORT PREPARED BY: EPS CONSULTING

DECEMBER 2023

PLANNING | DUE DILIGENCE | CONSTRUCTION

QUALITY ASSURANCE

Issue/revision	Issue 1	Revision 1	Revision 2
Author	Hayley Elson		
Job Title	Senior Engineer		
Authorised by	Stuart Phillips		
Job title	Director		
Project number	P1175/R1/V1		

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203 Westminster Bridge Road
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SE1 7FR

www.epsconsulting.co.uk

EXECUTIVE SUMMARY	
Site Address	Orchard Cottage, Main Street, Grendon Underwood, HP18 0SJ
National Grid Reference	SP6862420271
Current Site Use	The site currently comprises an existing residential property, Orchard Cottage and a vacant field to the rear of the cottage.
Proposed Development	The development proposal is for the demolition of the existing dwelling and erection of seven dwellings with parking and associated landscaping.
Scope of Site Investigation Works	Soil infiltration testing within a single location (ref. TP1) to determine the feasibility of adopting shallow soakaways to inform the sustainable drainage system (SuDS) design.
Summary of Ground Conditions Encountered	▶ A thin layer of Topsoil overlying Made Ground to a depth of 0.40mbgl; ▶ Firm brown slightly gravelly CLAY to 1.80mbgl; ▶ Stiff bluish grey CLAY to >2.60mbgl; and ▶ A very slow groundwater seepage was observed within a clay fissure at 2.60mbgl but was not deemed to represent a groundwater strike. The test was therefore continued and deemed representative.
Findings and recommendations	In-situ soil Infiltration testing revealed very little soakage with groundwater falling c. 30mm during the 90minute test period which is generally typical of firm to stiff CLAY. After this time, the pit started to collapse and the test was terminated. Based on the above, alternative methods of surface water disposal will be required such as the disposal to the existing pond on site.

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APPENDICES

1.0 INTRODUCTION

1.1 Background

eps consulting (EPS) has been commissioned by Hannaford Project Management Limited ("the Client") to undertake soil infiltration testing at the Land to the rear of Orchard Cottage, Main Street, Grendon, Underwood, HP18 0SJ.

A Site Location Plan is presented as Figure 1 within Appendix I.

1.2 Proposed Development

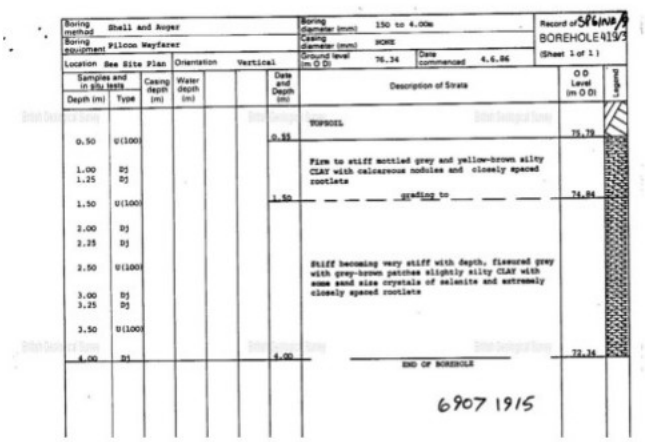
It is understood that the site currently comprises an existing residential property, Orchard Cottage, with a vacant open field to the rear of the cottage. A pond, surrounded by mature willow trees is located in the south-western corner of the Site. The development proposal is for the demolition of the existing dwelling and erection of seven dwellings with parking and associated landscaping. A proposed development plan is presented as Figure 2 within Appendix I.

1.3 Objectives

The objective of this report is to provide information on ground conditions and soil infiltration rates to determine the feasibility of adopting shallow soakaways to inform the sustainable drainage system (SuDS) design. All works were undertaken in accordance with eps consulting's fee proposal letter dated 30th November 2023 (ref. P1175/231127/P1).

Historical BGS maps were reviewed during the fee proposal stage and indicated that the site is underlain by Stewartby Member Mudstone Formation comprising Mudstone and Clay. The nearest BGS historical borehole, situated c. 1km from the site (see extract below), confirmed this with ground conditions comprising yellow brown firm to stiff clay overlying stiff to very stiff grey-brown clay.

SP61NE9



1.4 Sources of Information

The following sources of information have been utilised in the preparation of this report:

- Berrys: Flood Risk Assessment Land to the rear of Orchard Cottage (October 2023 – SA46443_FRA1_Issue 1.1);
- Palmer + Partners: Proposed Block Plan (22041-PL95-RevE);
- Palmer + Partners: Proposed Site Plan (22041-PL96);
- Palmer + Partners: Existing Location Plan (22041-EX 90); and
- Buckinghamshire Council: Objection Letter (23/03314/APP).

1.5 Confidentiality

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1.6 Limitations

The full limitations of this report are presented in Appendix II.

2.0 SITE INVESTIGATION

2.1 Summary of Fieldwork

A site walkover was undertaken by eps on 28th November 2023 with the site conditions noted to be very wet and boggy, comprising small pools of water and a large pond in the south-west corner. As such, reasonable access for plant and equipment was only available near the main entrance to the site.

Intrusive site investigation works were carried out on 6th December 2023 and comprised a single machine excavated trial pit (TP1) to a depth of 2.60mbgl. Soil infiltration testing was undertaken at the base of the pit. During the infiltration monitoring the water level fell only c. 30mm in 90 minutes. At this stage the pit started collapsing and the test was terminated. Upon completion of testing excess water was removed and the pit was backfilled with arisings in reverse order and compacted in layers.

The location of the trial pit is shown on Figure 3 within Appendix I, the soil infiltration test certificate is presented within Appendix IV, and a selection of photographs are presented within Appendix V.

2.2 Site Investigation Standards

All exploratory works, associated sampling, in-situ testing, and logging were carried out broadly in accordance with techniques outlined in:

- BS5930:2015+A1:2020 Code of Practice for Ground Investigations;
- BS EN ISO 14688-1 Identification of Soil;
- BS EN ISO 14688-2 Classification of Soil;
- BS EN ISO 22475 Sampling methods and groundwater measurements; and
- BRE Digest 365 Soakaway Design (revised 2016).

3.0 GROUND AND GROUNDWATER CONDITIONS

3.1 Summary of Ground Conditions

Ground conditions encountered in TP1 were generally consistent with published geology comprising a thin veneer of Topsoil overlying Made Ground to a depth of 0.40mbgl. The Made Ground comprised fine-grained soils of slightly gravelly CLAY. Gravels of flint and rare brick were noted.

Firm brown slightly gravelly CLAY was encountered to a depth of 1.80mbgl. This was underlain by stiff blueish grey CLAY to a depth greater than >2.60mbgl.

An exploratory hole log is presented within Appendix IV.

3.2 Groundwater

A very slow groundwater seepage was observed within a clay fissure at 2.60mbgl but was not deemed to represent a groundwater strike. The test was therefore continued and deemed representative.

4.0 SOIL INFILTRATION TESTING

In-situ soil Infiltration testing revealed very little soakage with groundwater falling c. 30mm during the 90minute test period which is generally typical of firm to stiff CLAY. After this time, the pit started to collapse and the test was terminated.

Based on the above, it is likely that alternatively methods of surface water disposal will be required, such as the disposal to the existing pond on site.

END OF REPORT

APPENDIX I

DRAWINGS

KEY:

N

studio@palmerandpartners.co.uk
www.palmerandpartners.co.uk
109 High Street, Thame OX9 3DZ
01844 318 501

METRES 1:500
0 25 50

Planning

Rev	Date	Description	Drawn

Palmer+ Partners

Darren Jones

22041 - Land to the rear of Orchard Cottage, Main Street, Grendon Underwood, HP18 0SJ

B2 / Twin Gables

22041 EX 90

Existing Location Plan

Scale: 1 : 1250 @A3
Date: 11/10/2023
Drawn by: MH

eps consulting

Job No. & Title:
P1175
Land to the rear of Oaks Cottage

Client:
Hannaford Project Management Limited

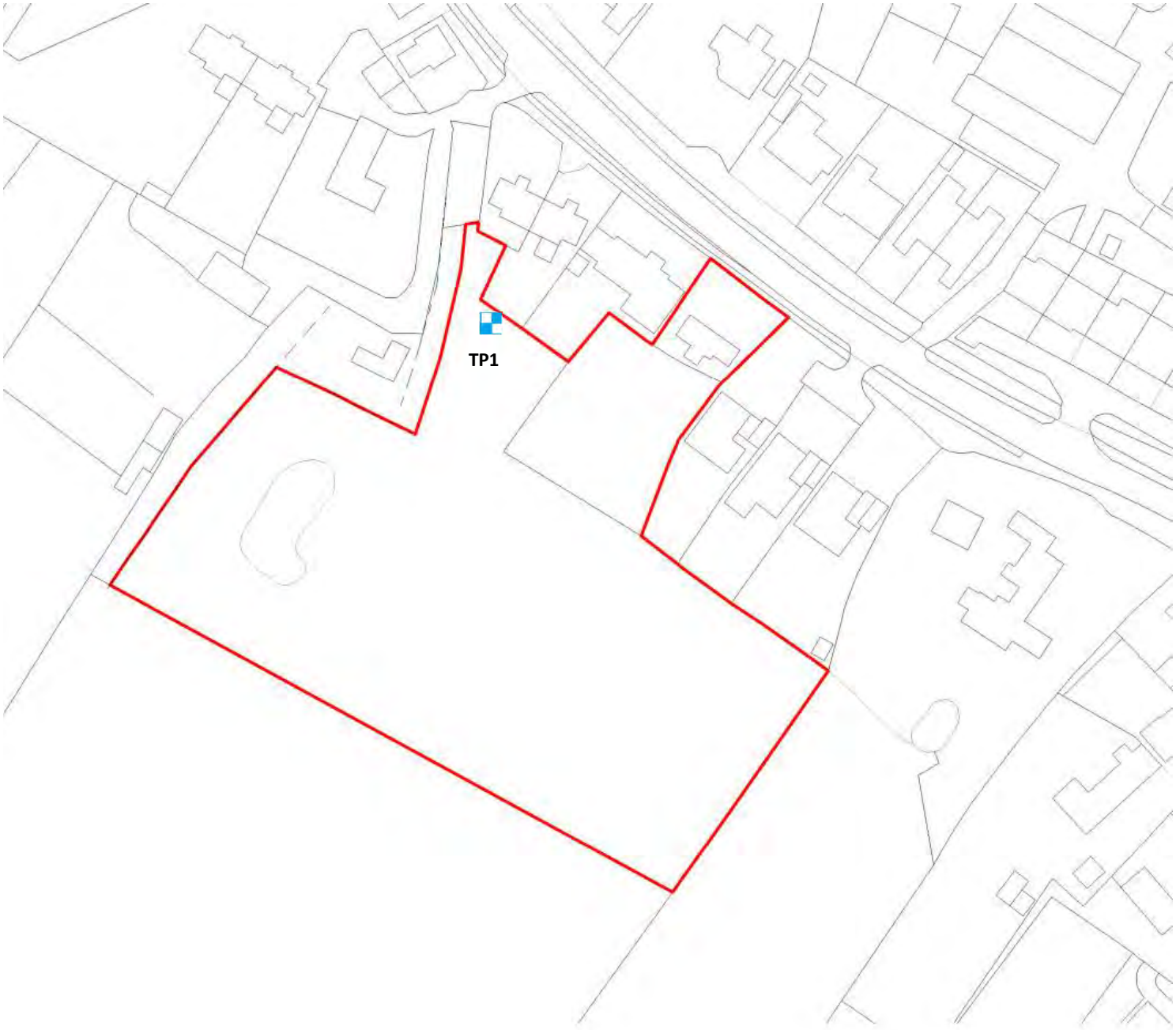
Drawn by: TC
Approved by: SP
Date: December 2023

Notes:
NOT DRAWN TO SCALE

Drawing Title:
Figure 1
Site Location Plan

KEY:

N



eps consulting

Job No. & Title:	P1175 Land to the rear of Oaks Cottage
Client:	Hannaford Project Management Limited
Drawn by:	TC
Approved by:	SP
Date:	December 2023
Notes:	NOT DRAWN TO SCALE
Drawing Title:	Figure 2 Site Investigation Layout Plan

KEY:

eps consulting

Job No. & Title:	P1175 Land to the rear of Oaks Cottage
Client:	Hannaford Project Management Limited
Drawn by:	TC
Approved by:	SP
Date:	December 2023
Notes:	NOT DRAWN TO SCALE
Drawing Title:	Figure 3 Proposed Development Plan

APPENDIX II – LIMITATIONS

1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between EPS and the Client.

2. For the work, reliance has been placed on publicly available data obtained from the sources identified. The information is not necessarily exhaustive and further information relevant to the site may be available from other sources. When using the information, it has been assumed it is correct. No attempt has been made to verify the information.

3. This report has been produced in accordance with current UK policy and legislative requirements for land and groundwater contamination which are enforced by the local authority and the Environment Agency. Liabilities associated with land contamination are complex and requires advice from legal professionals.

4. During the site walkover reasonable effort has been made to obtain an overview of the site conditions. However, during the site walkover no attempt has been made to enter areas of the site that are unsafe or present a risk to health and safety, are locked, barricaded, overgrown, or the location of the area has not be made known or accessible.

5. Site sensitivity assessments have been made based on available information at the time of writing and are ultimately for the decision of the regulatory authorities.

6. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.

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8. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.

APPENDIX III

EXPLORATORY HOLE LOG

endeavour drilling

Contract Name:			Client:		Trial Pit ID:
Land To The Rear Of Orchards Cottage, Grendon Underwood			EPS Consulting		TP1
Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 1
J5628	06/12/2023	JJW	OW	FINAL	
Trial Pit Log	Easting:	Northing:	Ground Level:	Plant Used:	Date Printed: / Scale:
				3T Excavator	08/12/2023 / 1:35

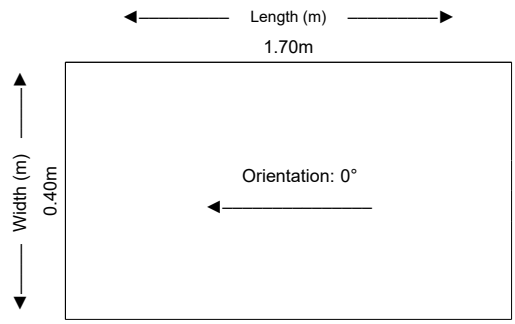
Weather: Dry/Sunny | Termination: Reached target depth. | Stability: Collapsed during soak away test .

Samples & In Situ Testing			Strata Details				Water	Backfill
Depths	Sample ID	Test Result	Reduced Level	Depth (m) (Thickness)	Legend	Strata Description		
				0.10		TOP SOIL		
				(0.40)		MADE GROUND - Soft dark greyish brown slightly gravelly clay. Gravel is fine to coarse subangular to subrounded of flint and rare brick.		
				0.50		Firm yellowish brown slightly gravelly CLAY. Gravel is fine to coarse subangular to subrounded of flint.		
				(1.30)				
				1.80		Stiff bluish grey mottled brown CLAY with occasional fine to medium sand sized selenite and rare dead rootlet traces (<2mm).		
				(0.80)				
						...from 2.40mbgl with rare coarse gravel size mudstone.		
				2.60		End of Trial Pit at 2.60m		

1 2 3 4 5

Dimensions:

Final Depth: 2.60m



Inclination: 90°

General Remarks:

1. Position machine excavated to 2.60mbgl, 2. Ground water encountered at 2.60mbgl (slow inflow). 3. Soak away test carried out at 2.60mbgl. 4. Backfilled with arisings on completion.

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
2.60			0		Slow inflow.

APPENDIX IV

SOIL INFILTRATION TEST CERTIFICATE

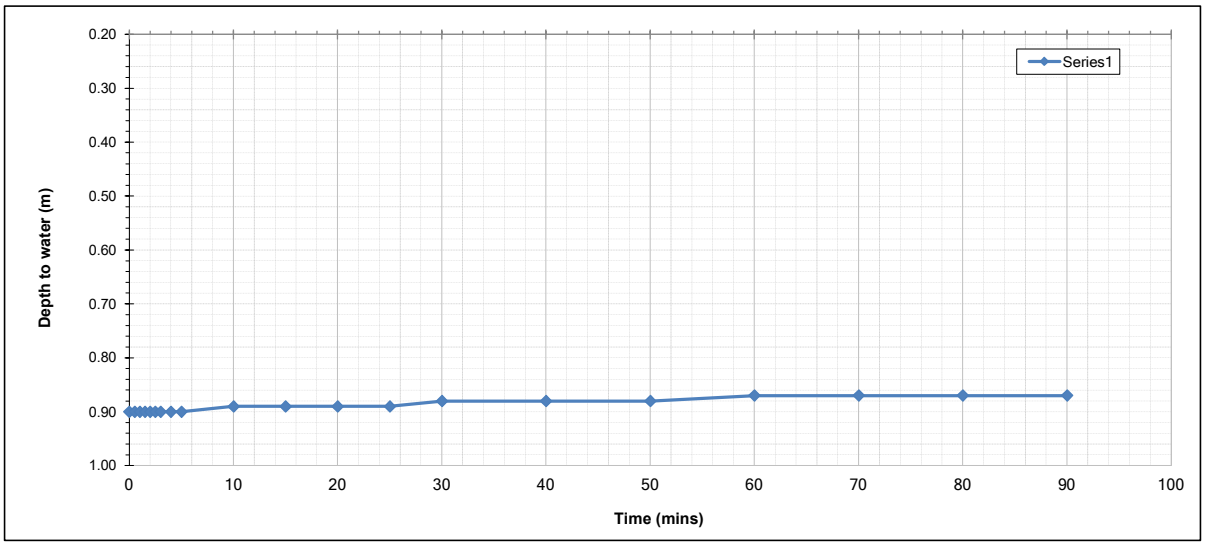
eps consulting

Site	**Land to rear of Orchard Cottage**	Trial Pit Number.....	**TP1**	
Job Number	**P1175**	Length.....	1.70	m
Date of Test	**06/12/2023**	Width.....	0.40	m
		Depth.....	2.60	m
		Groundwater Level.....	2.6	m

Depth(mbgl)	Ground conditions	**TEST 1** Time(min)	Depth to Water (m)
GL to 0.10	TOPSOIL		
0.10 to 0.50	MADE GROUND - Soft dark greyish brown slightly gravelly clay. Gravel is fine to coarse subangular to subrounded of flint and rare brick.	0	0.90
		0.5	0.90
		1	0.90
		1.5	0.90
0.5 to 1.80	Firm yellowish brown slightly gravelly CLAY. Gravel is fine to coarse subangular to subrounded of flint.	2	0.90
		2.5	0.90
		3	0.90
1.80 to 2.60	Stiff bluish grey mottled brown CLAY with occasional fine to medium sand sized selenite and rare dead rootlet traces (<2mm).	4	0.90
		5	0.90
		10.0	0.89
		15.0	0.89
		20.0	0.89
		25.0	0.89
		30.0	0.88
		40.0	0.88
		50.0	0.88
		60.0	0.87
		70.0	0.87
		80.0	0.87
		90.0	0.87

Effective Storage Depth	m	1.70
75% Effective Storage Depth	m	1.28
(i.e. depth below GL)	m	1.33
25% Effective Storage Depth	m	0.43
(i.e. depth below GL)	m	2.18
Effective Storage Depth 75%-25%	m	0.85
Time to fall to 75% effective depth	mins	Did not fall to required level
Time to fall to 25% effective depth	mins	Did not fall to required level
V (75%-25%)	m3	0.58
a (50%)	m2	4.25
t (75%-25%)	mins	N/A
SOIL INFILTRATION RATE	m/s	**Unable to derive due to minimal soakage**

DESIGN SOIL INFILTRATION RATE, f **Unable to derive due to minimal soakage.**



APPENDIX V

PHOTOGRAPHS

Photograph 1 – TP1 (prior to excavation)

Photograph 2 – TP1 Spoil Pile Showing Clay Soils

Photograph 3 – TP1 (following backfilling and completion of soil infiltration testing)

Photograph 4 – Facing north from southern boundary, on-site pond in background

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Tel: 01743 298 100

Email: info@geosmartinfo.co.uk

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GeoSmart Information

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Salisbury

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Martin Lucass

Commercial Director

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Tel: 01743 298 100

martinlucass@geosmartinfo.co.uk

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