GeoSmart Information

SuDSmart Plus

Sustainable Drainage Assessment

Site Address

Land at Corner of East St and New Rd
Shoreham-by-Sea
BN43 5ZQ

Grid Reference

521692, 105079

Report Prepared for

Guy Mayo

Date

2023-08-30

Report Status

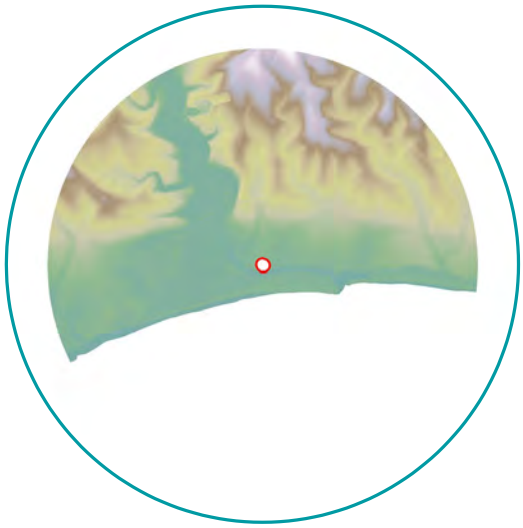
FINAL

Site Area

0.16 ha

Report Reference

80014R1



Discharge to Ground/ As existing

The proposed Sustainable Drainage Scheme (SuDS) strategy is comprised of rainwater harvesting, permeable paving, green roofs and a soakaway to attenuate surface water runoff from the new proposed developments during the 1 in 100 plus 45% climate change event, whilst the existing developments are proposed to drain as existing.

Surface water from the new developments will discharge to ground while the existing development will continue to drain as existing, subject to the confirmation of infiltration suitability, the sewer utility provider, and the incorporation of SuDS.

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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?	Moderate
	What is the potential to discharge to surface water features?	Low
	What is the potential to discharge to sewers?	High
	What is the potential to discharge to highway drains?	High
Flooding	What is the river (fluvial) flood risk at the Site?	Very Low
	What is the surface water (pluvial) flood risk at the Site?	Very Low - Low
	What is the groundwater flood risk at the Site?	Moderate
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 commercial capacity. At present there are numerous buildings, car park/ vehicular access and landscaped areas. Development proposals comprise the conversion of existing buildings in the west (R1-R3) and south (R8-R9) of the Site and construction of new dwellings/ extensions to existing dwellings to create mixed-use commercial/ residential units, in addition to associated access and landscaping.

Summary of discharge routes

GeoSmart's SuDS Infiltration Potential (SD50) map indicates the Site has a Moderate potential for infiltration, primarily due to variable permeability of the underlying geology. However, based on the available borehole information and groundwater flood risk mapping there is the potential for high groundwater levels at the Site due to hydraulic continuity with the River Adur.

A site investigation comprising trial pits is recommended to confirm the depth to groundwater and allow infiltration tests to be undertaken to confirm the feasibility of an infiltration SuDS scheme.

Ordnance Survey (OS) mapping indicates River Adur is located ~75 m south of the Site. However, discharging surface water runoff to this feature would require drainage pipework to cross a significant distance across third-party, urbanised land including an SSSI and therefore, discharge into this feature should not be considered.

The Southern Water Sewer Asset Location plan included in Appendix C confirms there is a public combined sewer, located adjacent to the west of the Site, therefore discharge to sewer is likely to be appropriate.

According to Google Streetview, highway gullies are located within the highway of East Street and New Road, indicating the presence of the highway drainage network.

Runoff rate and attenuation requirements

Discharging via infiltration requires 23.8 m^3 of attenuation to be provided to ensure there is no flooding as a result of the development in all storm events up to and including the 1 in 100 year (6 hour storm) including a 45% allowance for climate change. This volume is subject to the results of infiltration testing and would ensure runoff is not increased above the greenfield scenario.

Discharging off-Site requires 107.9 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 45% allowance for climate change. This volume is subject to the discharge rate being restricted to 1 l/s (a reduction on the existing brownfield 1 in 1 year runoff rate of 1.9 l/s and minimum achievable discharge rate without increasing the potential for blockages).

Proposed SuDS strategy

SuDS features comprised of rainwater harvesting, permeable paving, green roofs and a soakaway are proposed to attenuate a minimum of 23.8m^3 of surface water runoff from the new proposed developments whilst the existing developments are proposed to drain as existing. The SuDS features would provide some water quality benefits (interception and filtration) prior to discharging to the public combined sewer network.

The proposed SuDS strategy would ensure surface water runoff is stored on-Site in SuDS features for the 1 in 100 year event including a 45% allowance for climate change and will not cause flooding to the proposed development in accordance with DEFRAs non-statutory technical standards (DEFRA, 2015).

SuDS & drainage network maintenance

The management and maintenance of the SuDS features, in line with the details and schedules outlined in Section 10 of this report, will be undertaken by contractors appointed by the owners and occupiers of the new residential building, where payments for the works will form part of the property deeds and / or rental agreements.

Recommendations

A site investigation is required to confirm the infiltration capacity of the ground in line with BRE 365 guidelines to confirm the infiltration rate and the groundwater level.

Where site investigation confirms the underlying ground conditions are not conducive to infiltration, the capacity of the public sewer network should be confirmed with the utility provider and gain permission to connect where required.

2 Proposed SuDS strategy

The most suitable SuDS options are outlined below and a SuDS strategy schematic is shown overleaf. Supporting information is provided in subsequent sections.

Table 1. Proposed SuDS type, features, discharge location and rate restriction

SuDS type	Source control (interception) and infiltration SuDS.
SuDS features	Rainwater harvesting, permeable paving, green roofs, soakaway
Discharge location	Infiltration / Drain as existing (assumed to public combined sewer network)
Discharge rate	1 x 10^{-5} m/s (where infiltration is proposed) / As existing (where discharge via existing drainage networks is proposed)

Table 2. Proposed SuDS sizing (dimensions) and attenuation volumes

Rainwater Harvesting	Rainwater harvesting butts should be established for each new proposed development. In terms of attenuation storage within this SuDS scheme, the volume of run-off which could be attenuated by Rainwater Harvesting has not been considered within the Preliminary SuDS schematic.
Green Roof	Green roofs covering a total area of 72 m^2 with a green roof mix example volume of 14.4 m^3 (0.2m depth) and Geocomposite example volume of 0.7 m^3 (0.01m depth) is proposed to provide flow control, amenity and biodiversity benefits.
Permeable paving	A 513 m^2 area of self-draining permeable paving (underlain with a Type 3 aggregate material) within the proposed driveway and access areas to a depth of 0.3 m, with a 30% porosity is proposed to reduce the required volume of focused infiltration features.
Soakaway	A soakaway with a length of 5 m, width of 5 m and depth of 1 m in the centre of the Site with a 95% void ratio would result in c. 23.8 m^3 attenuation.
Total Attenuation Provided	23.8 m^3

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Figure 1. Proposed SuDS scheme

- Green roof
- Soakaway
- Permeable paving
- Rainwater harvesting butt
- Surface water drainage network
- Flow control
- Public combined sewer
- Exceedance flow routes
- Site boundary

Surface water from the proposed new dwellings should be conveyed into the proposed green roofs, rainwater harvesting features and soakaway as appropriate for infiltration to ground. Self-draining permeable paving is proposed for access and parking areas and the existing developments are proposed to discharge via their assumed existing connections to an existing drainage network.

Exceedance flows are directed towards non-essential, landscaped areas on Site.

Proposed site plan Scale 1:200@A3

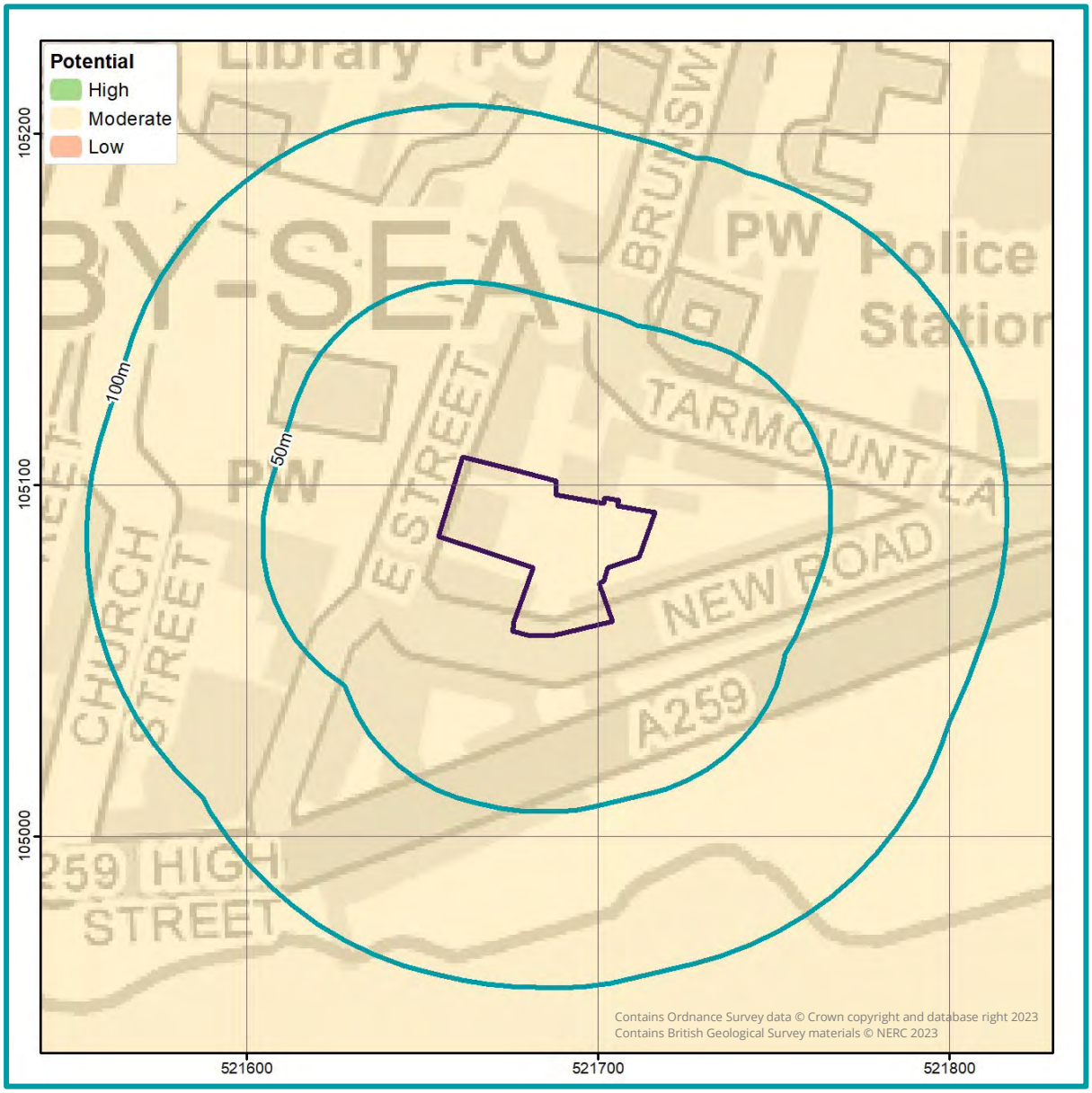
Schematic is not to scale

3 Site analysis

Site location

Figure 2. Aerial Imagery (Bluesky, 2023)

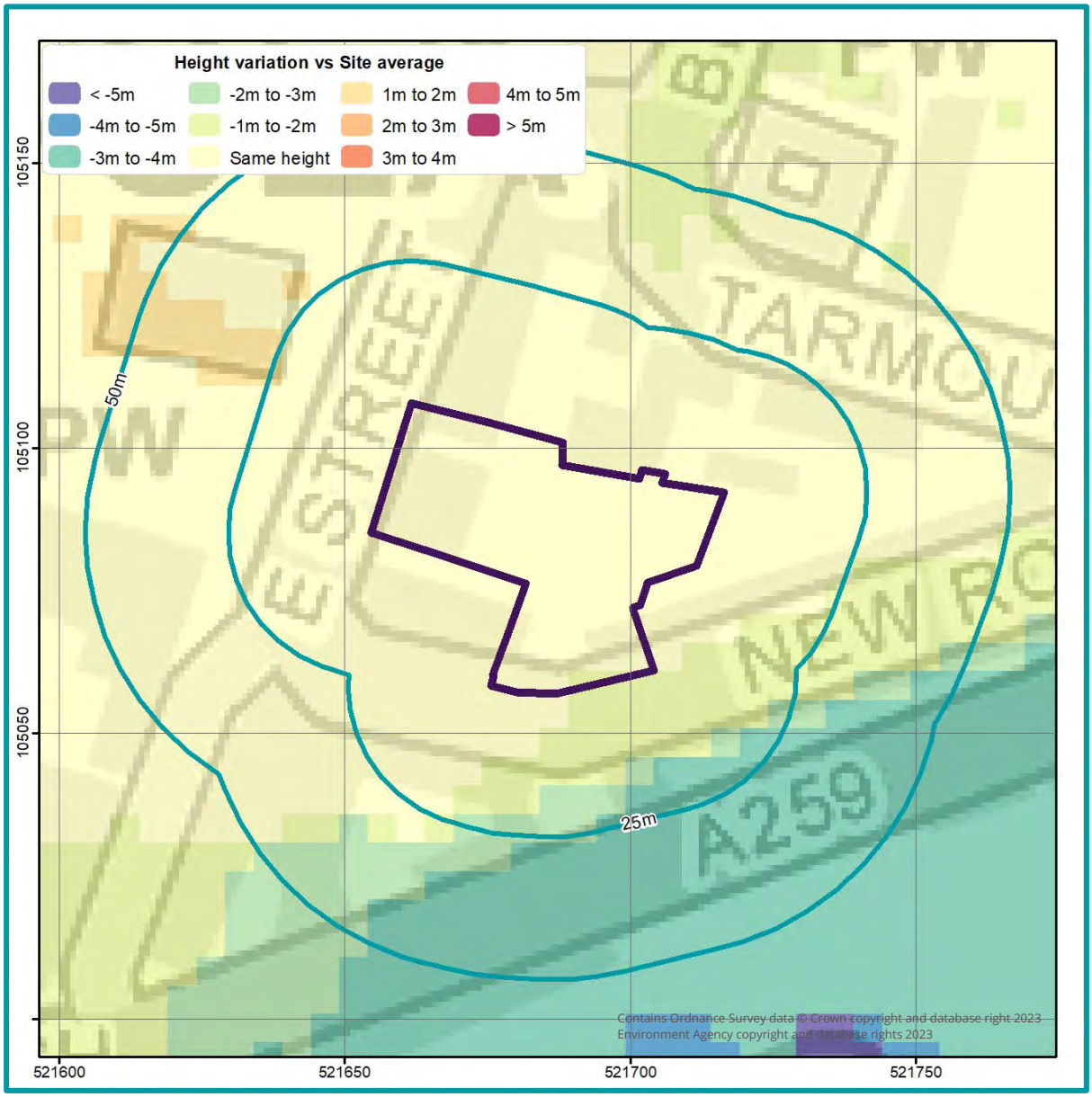
Figure 3. SuDS infiltration suitability (SD50) map (GeoSmart, 2023)



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.

The SD50 mapping indicates that there is a Moderate potential for infiltration SuDS across the Site. It is likely that the underlying geology at the Site has variable permeability, and an infiltration SuDS scheme could be possible at the Site.

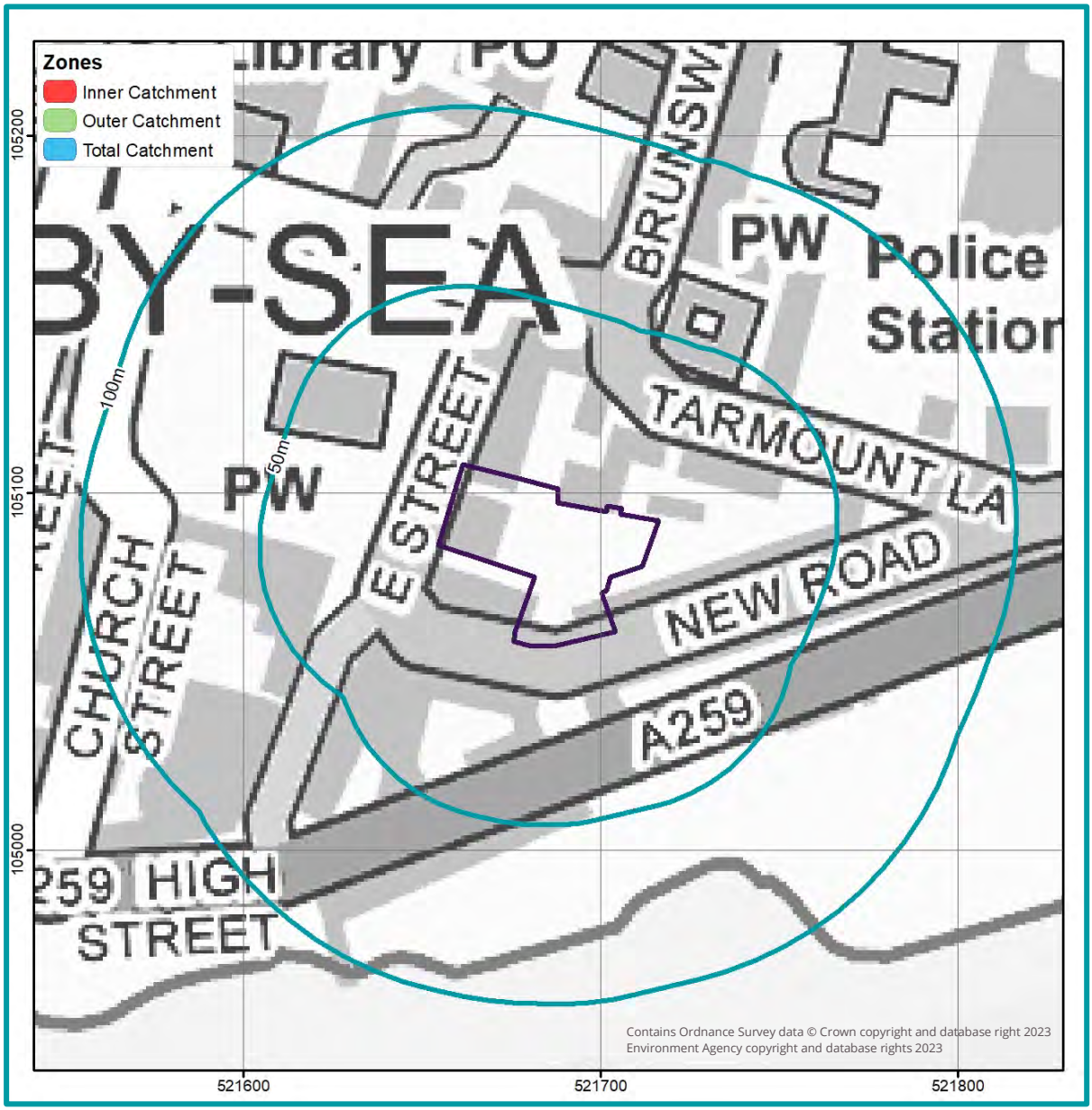
Figure 4. Site topography (GeoSmart, 2023)



An assessment of the topography at the Site has been undertaken using LiDAR DTM5 elevation data to identify the general slope and any localised 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 on a gradual slope to the southeast.

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

Figure 5. Source protection zone map (EA, 2023)

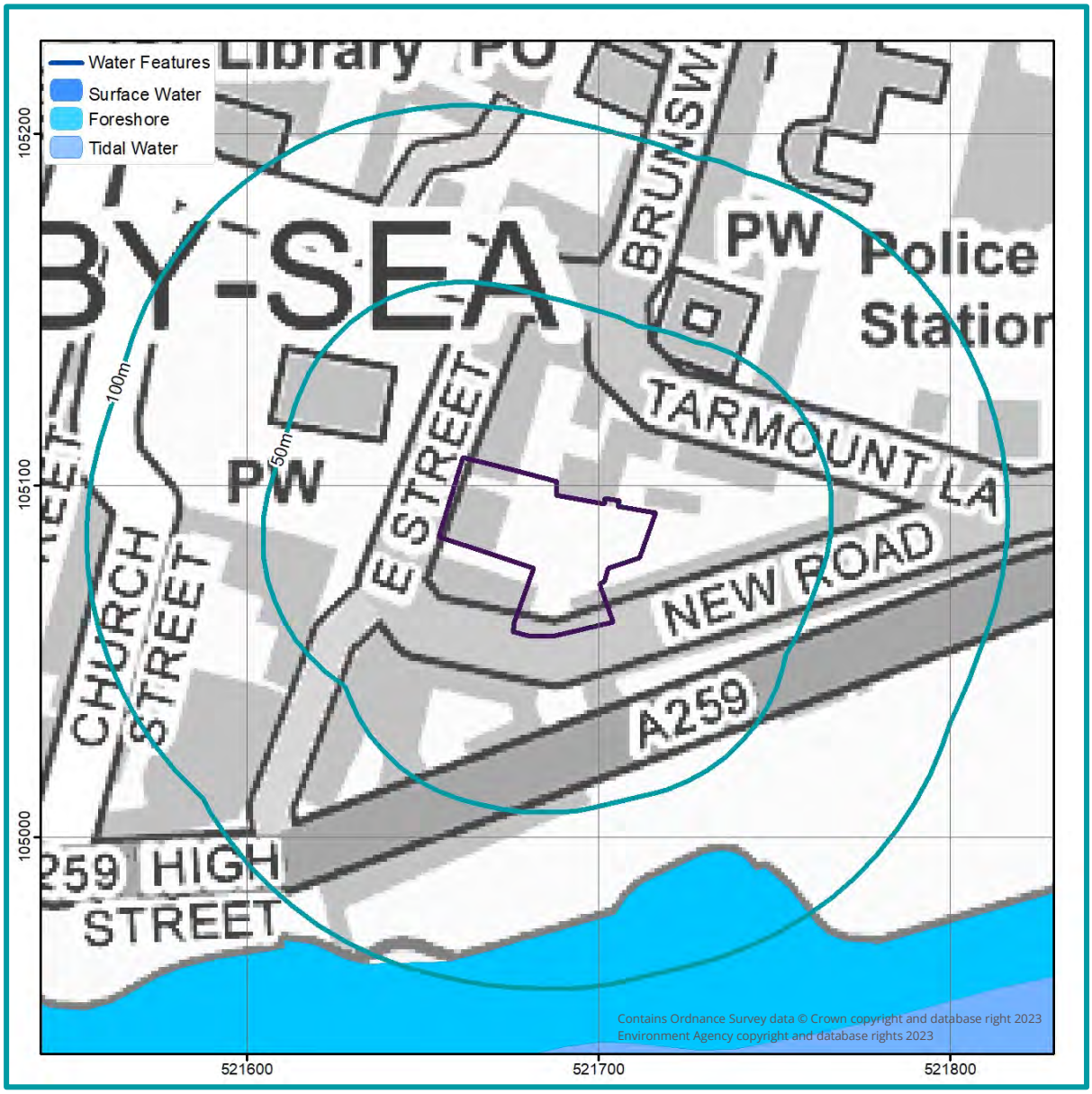


An assessment of the EA's groundwater Source Protection Zones (SPZs) has been undertaken within the vicinity of the Site and confirms the Site is not located within an SPZ.

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 6. Surface water features map (EA, 2023)

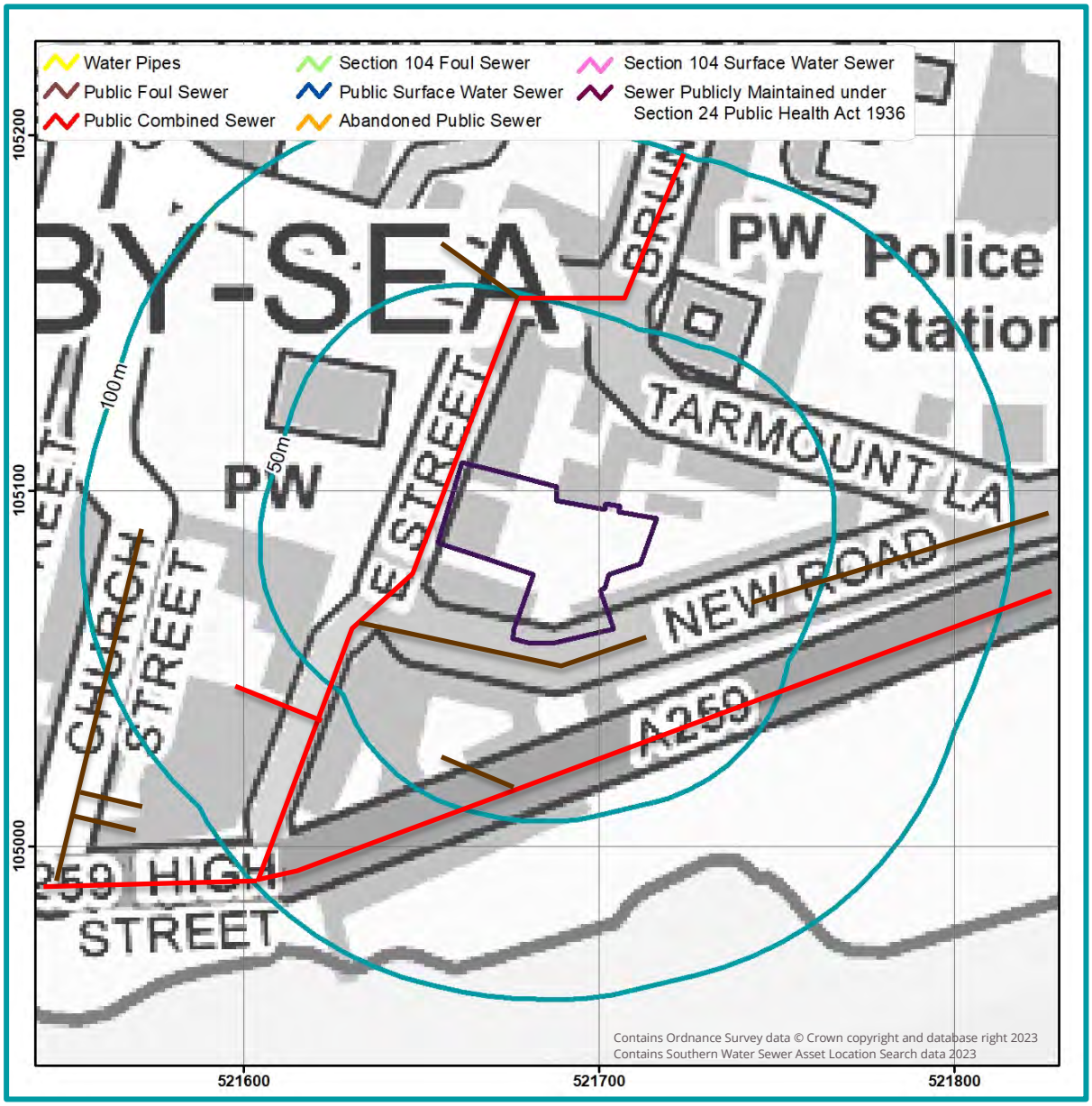


OS mapping indicates the River Adur is located ~75 m southeast of the Site. According to DEFRA's Magic Map, the Site is within 250m of a SSSI or SPA. The Adur Estuary SSSI is located 140 m southwest of the Site.

Discharging surface water runoff to this feature would require drainage pipework to cross a significant distance across third-party, urbanised land including an SSSI and therefore, discharge into this feature should not be considered.

Further analysis could be undertaken by visiting the Site or 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.

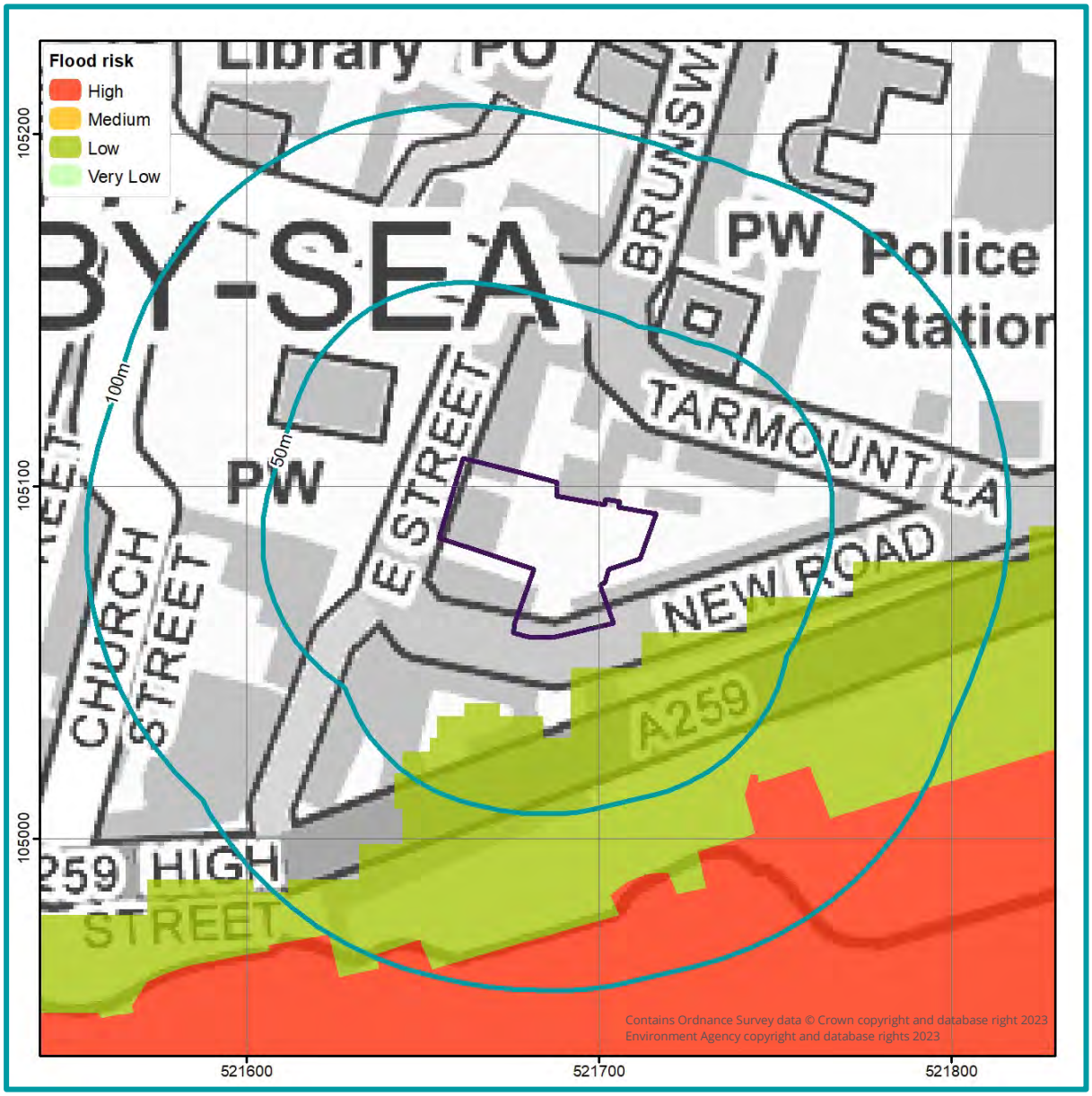
Figure 7. Sewer features map (OS & Southern Water, 2023)



GeoSmart has undertaken an assessment of the location of sewer features within the vicinity of the Site. The Southern Water asset location search confirms that there is a public combined sewer, located adjacent to the west of the Site in East Street, therefore discharge to sewer is likely to be appropriate. It is assumed that the existing buildings on-Site drain to the combined sewer line in the highway of East Street.

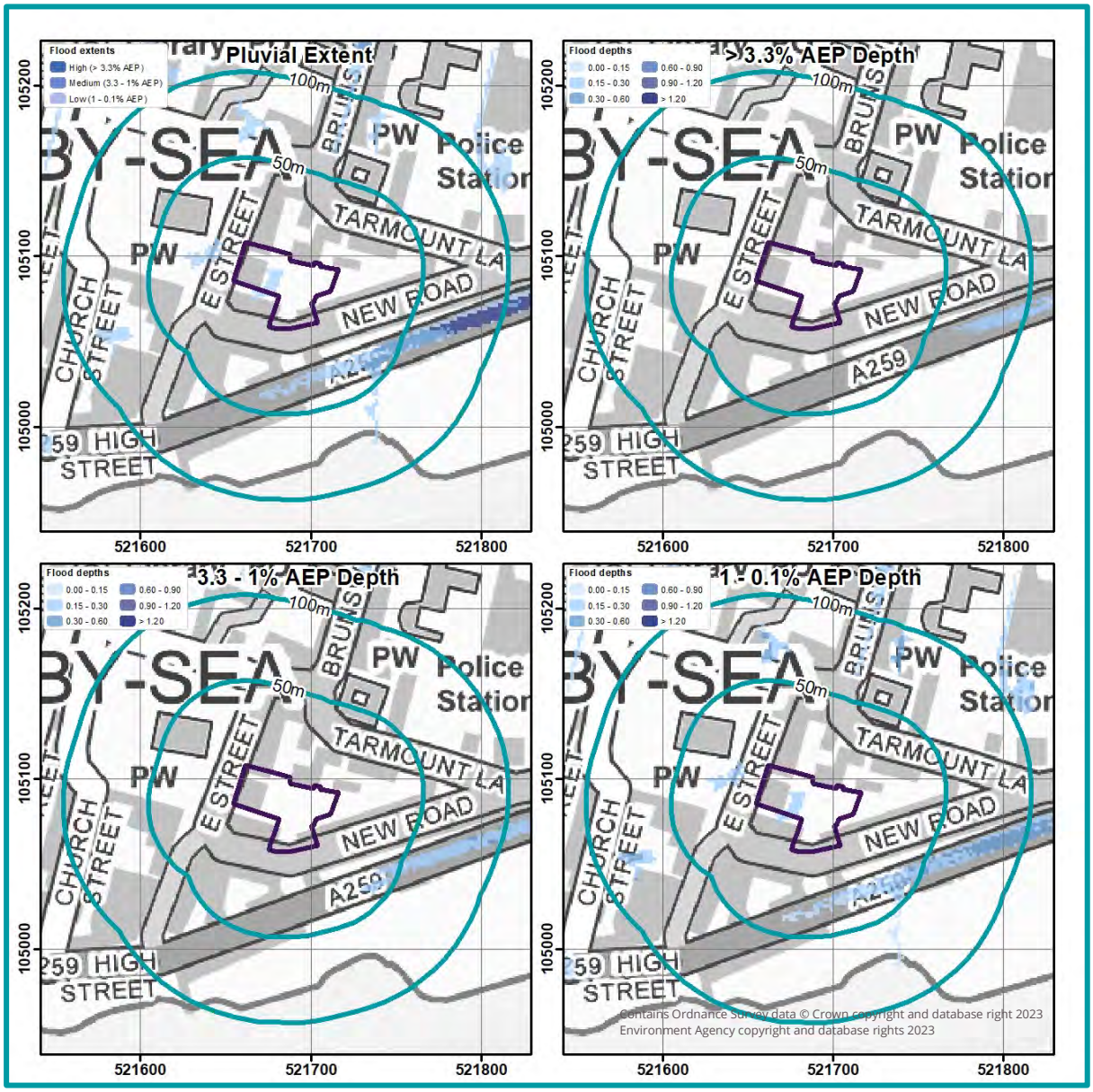
Further analysis of the connections and condition of the public surface water drainage system should be undertaken by carrying out a CCTV survey or by contacting the drainage provider or the Local Council to confirm the presence, location and condition of the sewer. Consultation with the drainage provider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

Figure 8. Risk of flooding from rivers & sea map (EA, 2023)



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 9. Risk of surface water flooding map (EA,2023)

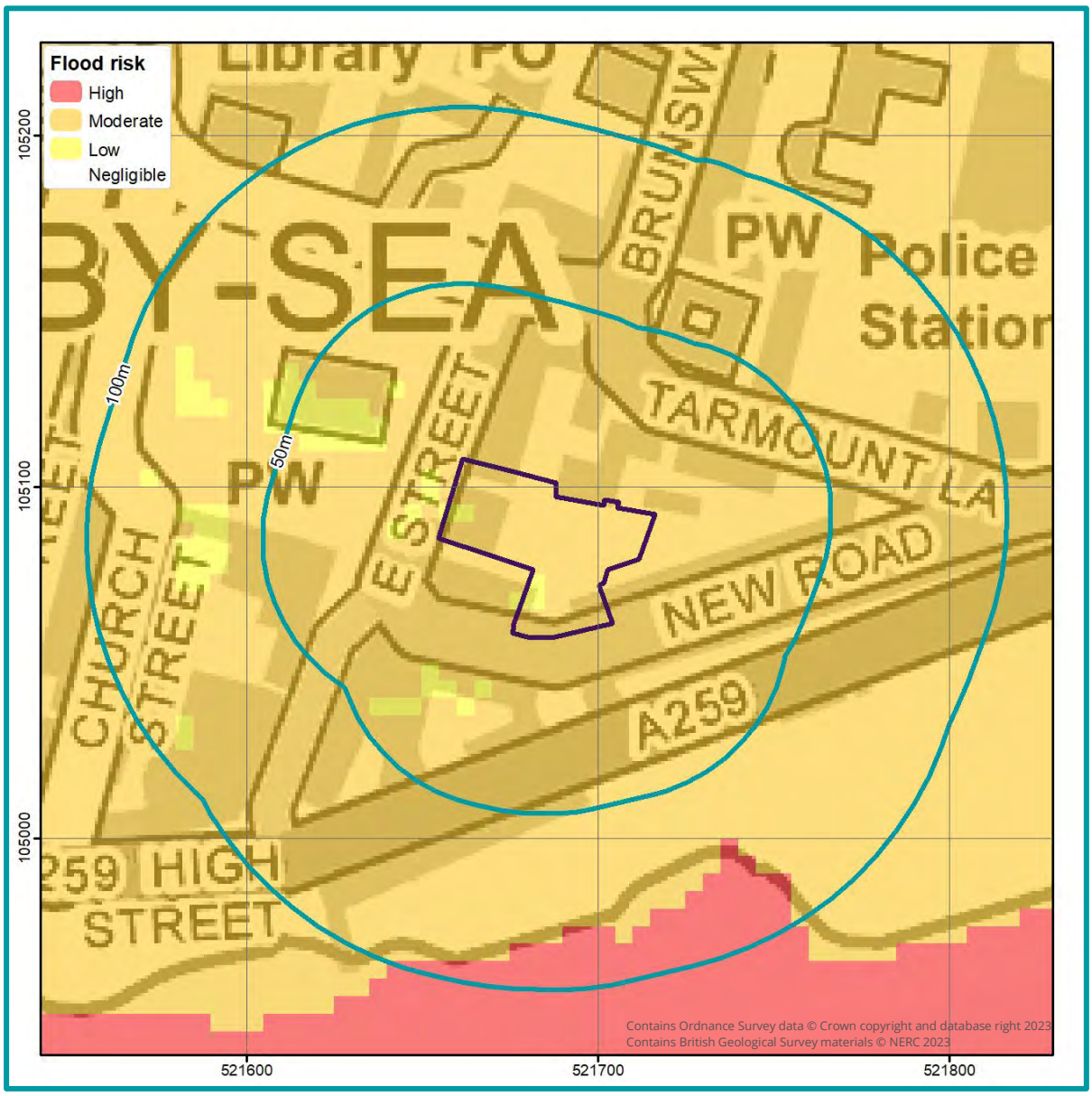


GeoSmart have undertaken an assessment of the risk of flooding from surface water (pluvial) sources within the vicinity of the Site using the EA's Risk of Flooding from Surface Water (RoFSW) mapping. The EA's mapping confirms the Site is considered to be at Very Low - Low risk of surface water flooding.

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 that there are areas of the Site which would be affected by surface water flooding during a 1 in 1000 year event, with flood depths of up to 0.3 m. However, the areas modelled to be affected are non-essential areas of the Site (e.g., green spaces).

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

Figure 10. Groundwater flood risk (GW5) map (GeoSmart, 2023)



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 Moderate risk of groundwater flooding during a 1% annual probability (1 in 100 year) event.

The Moderate risk indicates the groundwater table may be particularly shallow in these areas and further investigation may be required.

The use of SuDS features may be constrained in areas where there is a High or Moderate risk of groundwater emergence.

4 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 at Corner of East St and New Rd, Shoreham-by-Sea, BN43 5ZQ (the Site). The Site is located in a setting of commercial and residential use. The land slopes to the southeast from 7.05 mAOD to 6.28 mAOD along the southeastern boundary. This is based on EA elevation data obtained for the Site to a 1 m resolution with a vertical accuracy of ±150 mm.

Development

The Site is currently used within a commercial capacity. At present there are numerous buildings, car park/ vehicular access and landscaped areas. Development proposals comprise the conversion of existing buildings in the west of the Site and construction of new dwellings/ extensions to existing dwellings to create mixed-use commercial/ residential units, in addition to associated access and landscaping. Site plans and drawings are provided in Appendix A.

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 3. Site Geology

Geology present on-Site		Potentially permeable?
Superficial geology (Figure 11)	Head – Clay, Silt Sand and Gravel (HEAD)	✓
Bedrock geology (Figure 12)	Newhaven Chalk Formation (NCK)	✓

The permeability of the underlying material at the Site shown within the BGS mapping is moderate, confirmation of the infiltration capacity is required.

The BGS website was used to extract ground information from the nearest borehole records to the Site (refs: TQ20SW29 and TQ20SW43). These boreholes are located approximately 135 m and 160 m to the southwest of the Site respectively.

The borehole record of TQ20SW29 at an elevation of 1.95 mAOD confirms the underlying geology is comprised of made ground to a depth of 0.90 m below ground level (bgl) underlain by gravel/sand to a depth of 4.2 m bgl. Chalk with flints to a depth of 7.92 m bgl and chalk to the end of the borehole record at a depth of 15.24 m bgl.

The borehole record of TQ20SW43 at an elevation of 1.07 mAOD confirms the underlying geology is comprised of silty sandy gravel to a depth of 0.76 m below ground level (bgl) underlain by gravel/sand to a depth of 3.05 m bgl, sandy chalky gravel to a depth of 4.57 m bgl and Chalk with flints to the end of the borehole record at a depth of 12.19 m bgl.

Depth to groundwater

The SuDS system should be designed to operate in periods of extreme groundwater levels.

According to borehole data and GeoSmart's Groundwater Flood Risk (GW5) map, shallow groundwater is potentially a problem at the Site.

Relevant borehole records TQ20SW29 and TQ20SW43 indicate groundwater levels may fluctuate around 4.2m bgl and 7.62 m bgl respectively.

The base of the infiltration system needs to be 1 m above the expected seasonal high-water table. Passage through unsaturated soil is important for improving the quality of infiltrating water before it reaches the water table.

Figure 11. Superficial Geology (BGS, 2023)

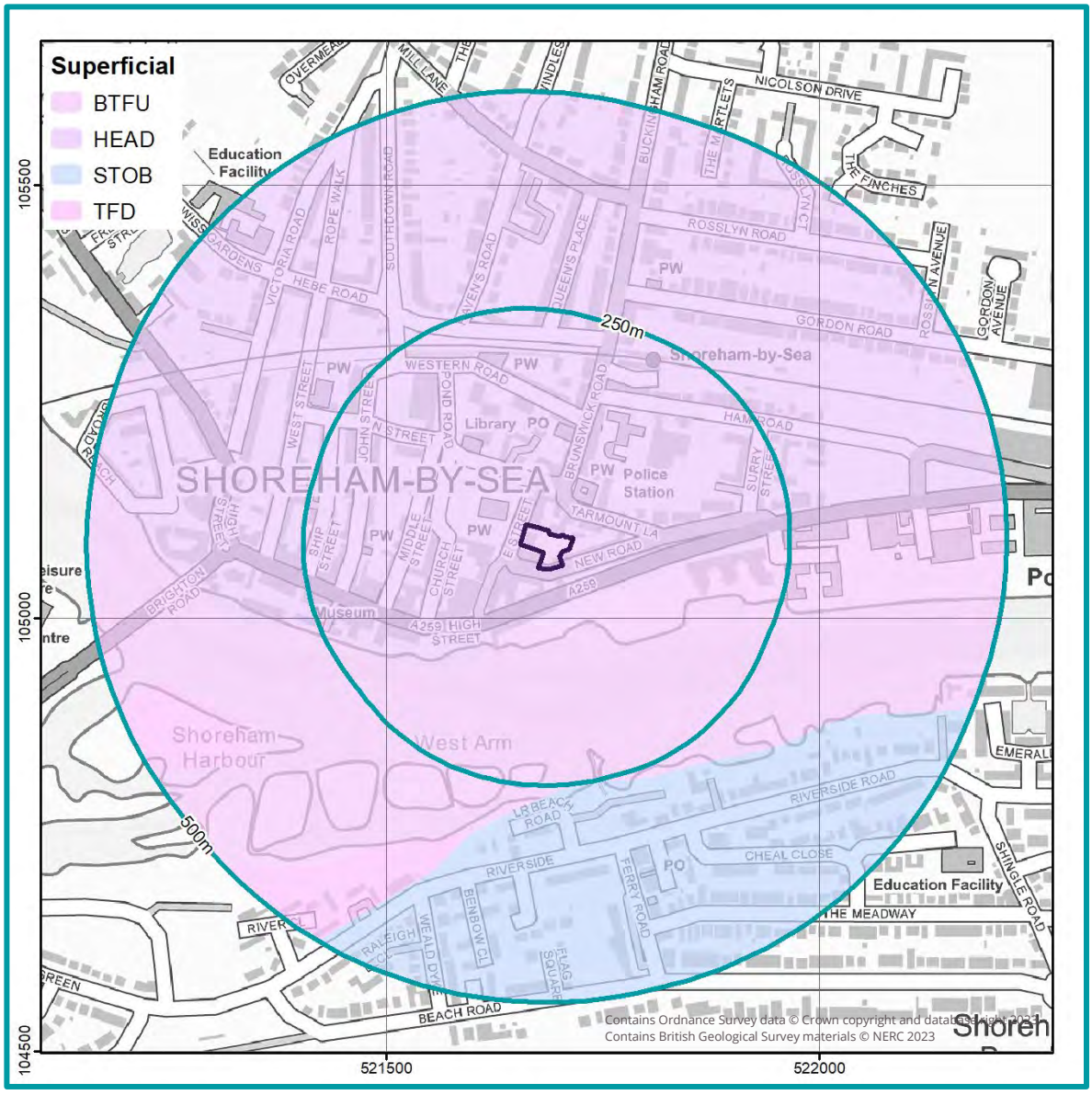
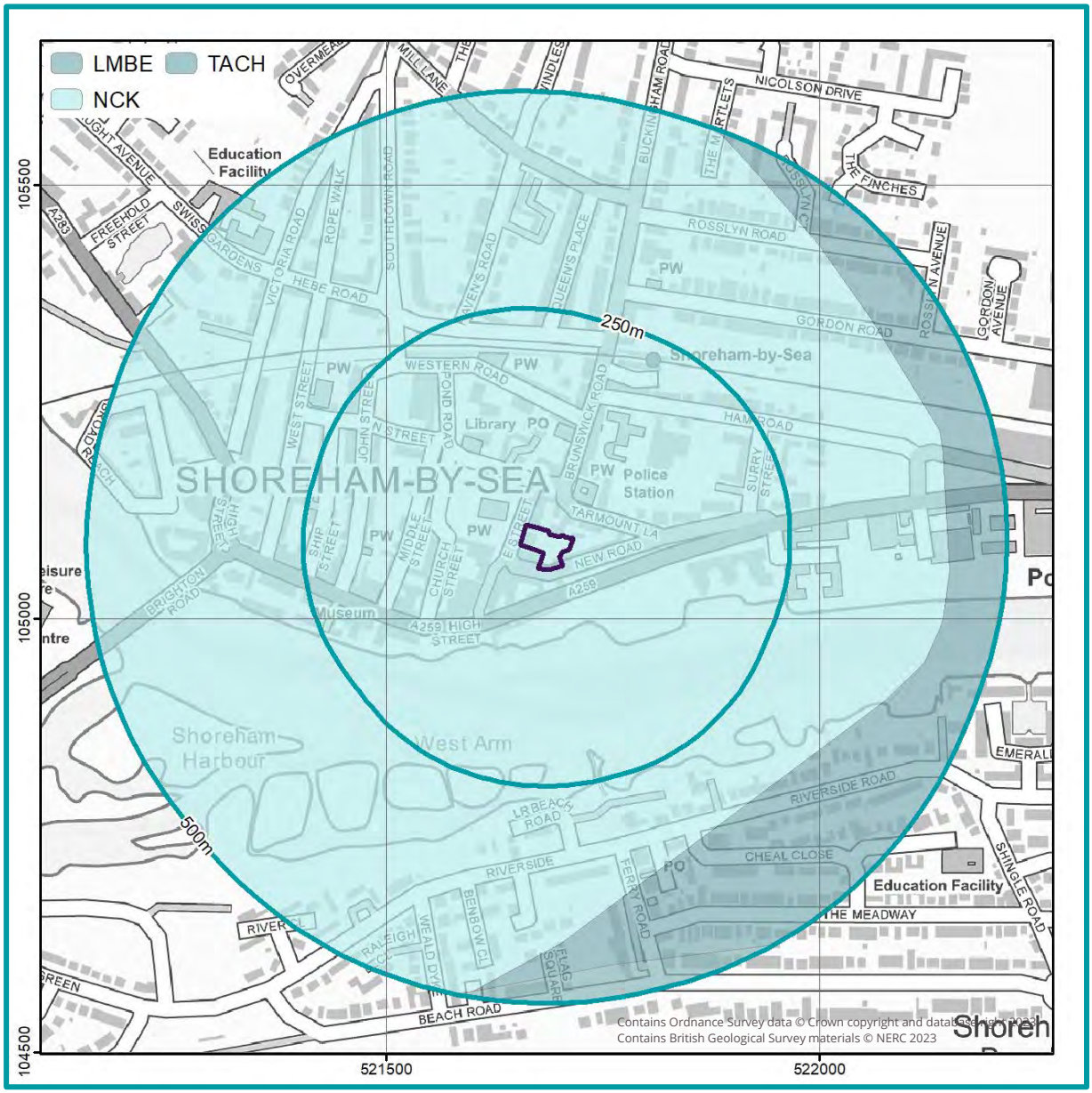


Figure 12. Bedrock Geology (BGS, 2023)



Ground conditions

A Site-specific review of underlying ground conditions is recommended to ensure focused infiltration does not cause ground instability as a result of landslide or collapse associated with dissolution or shallow mining. Hazards that should be considered include soluble rocks, landslides, compressible ground, collapsible ground, shrink-swell clays, running sand and shallow mining.

Soakaways should be a minimum of 5m away from the foundations of a building and local guidance may recommend a greater distance, such as 10m on some areas of the Chalk. A detailed ground assessment is recommended: on steep slopes where infiltrating water would

produce saturation and instability downslope; or within layered geology, where infiltrating water would produce springs down gradient.

Water quality

The Site does not lie within an SPZ. The infiltrated water quality should be of sufficient quality that it does not give rise to pollution of the underlying groundwater. Further consultation with the water company is unlikely to be required.

The influence of surface runoff on water quality will depend on whether there is a source of contamination on-Site and the sensitivity of the receiving environment, either groundwater or surface water. The intervening pathway from source to receptor including mitigation and natural attenuation will determine the final impact.

The impact of contaminants on the receiving environment will be reduced by travel and natural attenuation through the unsaturated soil zone. A greater depth of unsaturated zone and the presence of significant clay and organic material will provide greater protection for the underlying groundwater. Rapid flow through fractures will provide less protection than intergranular flow around soil and rock particles.

5 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 Adur and Ouse Management Catchment the following climate change allowances are applicable.

Table 4. Adur and Ouse Management Catchment peak rainfall allowances

Adur and Ouse Management Catchment	3.3% Annual exceedance rainfall event		1% Annual exceedance rainfall event	
	2050s	2070s	2050s	2070s
Central	20%	20%	20%	25%
Upper end	35%	40%	45%	45%

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.

Sub-national Drainage Policy

West Sussex LLFA Policy for the Management of Surface Water (AECOM, 2018).

West Sussex County Council was made LLFA for West Sussex by the Flood and Water Management Act 2010 (the Act). As LLFA, West Sussex County Council has a strategic overview of 'local flooding.' Local flooding is defined by the Act as flooding which is caused by:

- Surface water; and/or
- Groundwater; and/or
- Ordinary Watercourses.

SuDS Policy 1: Discharge Hierarchy

Surface water must not be discharged into the foul sewer system. Discharge to a watercourse or surface water sewer must be restricted to the estimated mean greenfield runoff rate (Q1) by means of a controlled outflow.

SuDS Policy 2: Manage Flood Risk through Design

The drainage system must be designed to operate without any flooding occurring during any rainfall event up to (and including) the critical 1 in 30 year storm (3.33% AEP). The system must also be able to accommodate the rainfall generated by events of varying durations and intensities up to (and including) the critical, climate change adjusted 1 in 100 year storm (1% AEP) without any on-site property flooding and without exacerbating the off-site flood-risk. Sufficient steps are to be taken to ensure that any surface flows between the 1 in 30 and 1 in 100 year events are retained on site.

Attenuation storage volume provided by any drainage area should half empty within 24 hours so that it can receive runoff from subsequent storms.

SuDS Policy 3: Mimic Natural Flows and Drainage Flow Paths

Runoff rates should match Greenfield runoff rates, follow natural or existing drainage routes, utilise existing natural low-lying areas or conveyance pathways, and match infiltration rates and discharges as far as possible for all events up to and including the climate-change adjusted 1 in 100 year (1% AEP) design event.

Redevelopment on brownfield land has the potential to rectify or reduce flood risk. In all cases, including on brownfield sites, runoff should where possible be restricted to the greenfield 1 in 1 year runoff rate during all events up to and including the 1 in 100 year rainfall event with climate change. An alternative approach would be for discharge rates to be limited to a range of greenfield rates, based on the 1 in 1, 1 in 30 and 1 in 100 year storm events. However, the use of this method to restrict discharge rates requires the inclusion of on-line long-term storage, sized to take account of the increased post development volumes, discharging at no greater than 2l/s/ha.

SuDS Policy 7: Safeguard Water Quality

West Sussex LLFA expects developers to demonstrate that the first 5 mm of any rainfall event can be accommodated and disposed of on-site, rather than being discharged to any receiving watercourse or surface water sewer. This can frequently be achieved through the inclusion of sustainable drainage measures such as infiltration systems, rain gardens, bioretention systems, swales, and permeable pavement.

Local Policy

Adur Local Plan, Adur District Council 2017

Policy 35: Water Quality and Protection

Development will be permitted provided that: It does not have an unacceptable impact on the quality and potential yield of local water resources and the water environment; also

It protects and enhances groundwater, surface water features and controls aquatic pollution to help achieve the objectives of the Water Framework Directive; and

It has an adequate means of water supply (even in a drought), sufficient foul and surface water drainage and adequate sewage treatment capacity.

Development must be phased to take into account the timing of any water and/or wastewater infrastructure required which must be in place prior to the occupation of development.

A preliminary risk assessment will be required for any development where there is potential risk of contamination of controlled waters.

New development within Groundwater Source Protection Zones will only be permitted provided that it has no adverse impact on the quality of the groundwater source or a risk to its ability to maintain a public water supply.

Policy 36: Flood Risk and Sustainable Drainage

The Council will work with relevant bodies to ensure that flood risk in Adur is reduced. A site specific flood risk assessment must be submitted with planning applications for:

- Proposals of 1 hectare or greater in Flood Zone 1
- All development or changes of use to a more vulnerable use in Flood Zones 2 and 3
- All development or changes of use to a more vulnerable use, regardless of flood zone or size, where flood risk from other sources (surface water, sewer, groundwater) is identified by the Strategic Flood Risk Assessment.

The flood risk assessment will need to demonstrate that development:

- is appropriately flood resilient and resistant, includes safe access and escape routes where required, and that any residual risk can be safely managed;
- will be safe for its lifetime taking account of the vulnerability of its users;
- will not increase flood risk (including sewer flooding, surface water and groundwater flood risk) elsewhere; will, where possible, reduce flood risk overall; and
- will give priority to the use of sustainable drainage systems. The flood risk assessment will also need to demonstrate that, where possible, higher vulnerability uses have been located on parts of the site at the lowest probability of flooding.

New development within Adur must include some form of Sustainable Drainage System (SuDS) or other appropriate design measures in order to reduce the risks of surface water flooding and to mitigate the risk of pollution to groundwater sources. SuDS should be considered before other forms of disposal.

Substantial storage through SuDS will be required to achieve a reduction in runoff to levels below that experienced prior to development. On relevant sites, storage of runoff during the high part of the tidal cycle should be addressed. SuDS must be designed sensitively and must seek to enhance landscapes, increase biodiversity gains, and provide quality spaces.

For all developments, applicants will be required to demonstrate that acceptable management arrangements are in place and funded to ensure the ongoing maintenance of

SuDS into the future. Where it is not practical to provide SuDS on site, the development of strategic level SuDS may be considered appropriate. In these circumstances, contributions may be required through s106 undertakings/ CIL.

6 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 5. Storage requirements at the proposed development Site (Discharge runoff via infiltration)

Attenuation scenario		Attenuation required (m^3)	Explanation
Discharge runoff via infiltration	1 in 100 year including 45% CC	23.8	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 45% allowance for climate change*.

*Subject to confirmation through infiltration testing.

Table 6. Storage requirements at the proposed development Site (Discharge runoff to combined sewer)

Attenuation scenario		Attenuation required (m^3)	Explanation	
Discharge runoff to combined sewer	1 in 30 year	50.2	Attenuation required to ensure surface water runoff is attenuated in all storm events up to and including the 1 in 30 year (4 hour, Critical Storm Duration) event*. Flooding of the Site of 16.8 m^3 should be contained within permeable landscaped areas within the Site to ensure no flooding of internal areas during the 1 in 100 year storm event.	A further 40.9 m^3 should be managed within overland flow routes to ensure there is no increase in flood risk in all events up to the 1 in

	1 in 100 year	67.0	Attenuation required to ensure surface water runoff is attenuated in all storm events up to and including the 1 in 100 year (5 hour, Critical Storm Duration) event*.	100 year including 45% allowance for climate change.
	1 in 100 year including 45% CC	107.9	Attenuation required to ensure surface water runoff is attenuated in all storm events up to and including the 1 in 100 year (8 hour, Critical Storm Duration) event including a 45% 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 7. Change in impermeable area associated with the development

Total Site area	1,661 m^2
Impermeable area (and as a percentage of the total area of the proposed development footprint of 1,661 m^2)	
Pre-development	Post-development
1,356 m^2 (82%)	1,199 m^2 (72%)

Total Site area	1,661 m^2
Impermeable land use: Commercial office, car park Permeable land use: landscaped areas	New impermeable land use: 686 m^2 commercial and residential units (406 m^2 of which to drain as existing), 513 m^2 permeable paving and access* New permeable land use: 462 m^2 of green landscaping

*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).

Peak discharge rates

The table below presents peak discharge rates for a range of storm events used to assess the impact of the proposed development and select the maximum permitted discharge rate. Further information on the calculation and control of peak discharge rates is provided in Section 12 'Background Information'.

Table 8. Peak discharge rates associated with the development

Rainfall event	Greenfield runoff rates (l/s)	Existing runoff rates[1] (l/s)	Potential runoff rates without attenuation (l/s)	Potential minus existing (l/s)
QBAR	0.5	N/A	N/A	N/A
6 hour 1 in 1 year	0.4	1.9	1.8	-0.1
6 hour 1 in 10 year	0.8	3.1	2.9	-0.2
6 hour 1 in 30 year	1.1	4.0	3.7	-0.3

Rainfall event	Greenfield runoff rates (l/s)	Existing runoff rates[1] (l/s)	Potential runoff rates without attenuation (l/s)	Potential minus existing (l/s)
6 hour 1 in 100 year	1.6	5.0	4.7	-0.3
6 hour 1 in 100 year + 20% CC	N/A	N/A	5.6	0.6
6 hour 1 in 100 year + 45% CC	N/A	N/A	6.8	1.8

[1] Assumes 100% runoff from impermeable surfaces. Assumes Greenfield runoff from permeable surfaces calculated using the IoH124 method.

Relevant national, regional and local planning policy has been consulted in Section 5 to determine restrictions on runoff from previously developed and greenfield sites. In some cases, greenfield rates may be requested, but in practice it is difficult to restrict discharge rates at any one control point to less than 1 l/s, without increasing the risk of any potential blockages occurring in the drainage network.

Total discharge volumes

The table below presents discharge volumes for a range of storm events used to assess the impact of the proposed development and calculate the required storage volumes. Further information on the calculation of total discharge volumes is provided in Section 11 'Methodology and Limitations'.

Table 9. Total discharge volumes associated with the development

Rainfall event	Greenfield runoff volume (m^3)	Existing runoff volume[2] (m^3)	Potential runoff volume without attenuation (m^3)	Potential minus existing (m^3)
QBAR	18.6	N/A	N/A	N/A
6 hour 1 in 1 year	17.4	41.6	38.8	-2.8
6 hour 1 in 10 year	28.9	67.1	62.7	-4.4
6 hour 1 in 30 year	36.3	86.8	81.0	-5.8
6 hour 1 in 100 year	45.4	108.5	101.2	-7.3

Rainfall event	Greenfield runoff volume (m^3)	Existing runoff volume[2] (m^3)	Potential runoff volume without attenuation (m^3)	Potential minus existing (m^3)
6 hour 1 in 100 year + 20% CC	N/A	N/A	121.4	12.9
6 hour 1 in 100 year + 45% CC	N/A	N/A	146.7	38.2

[2] Assumes 100% runoff from impermeable surfaces. Assumes Greenfield runoff from permeable surfaces calculated using the IoH124 method.

Critical storm duration and volume requirements

Storage volumes for a range of return periods including the 1 in 30 year, 1 in 100 year and 1 in 100 year plus climate change (45%) events have been calculated to assess the impact of the proposed development. The required storage volumes for attenuation features have been calculated for the critical storm durations, limited to a maximum discharge rate of 1 l/s.

Table 10. Critical Storm Duration and Attenuation volume requirements

Return Period	Runoff rate restriction (l/s)	Critical Storm Duration (hr)	Attenuation volume required (m^3)
1 in 30 year	1	4	50.2
1 in 100 year	1	5	67.0
1 in 100 year including a 45% climate change	1	8	107.9

7 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

The Site has moderate potential for infiltration. However, based on the available borehole information and groundwater flood risk mapping there is the potential for high groundwater levels at the Site due to hydraulic continuity with the River Adur, which could limit the effectiveness of any infiltration SuDS features.

A site investigation comprising trial pits is recommended to confirm the depth to groundwater and allow infiltration tests to be undertaken to confirm the feasibility of an infiltration SuDS scheme.

Discharge to surface watercourse

The River Adur is located ~75 m south of the Site. However, discharging surface water runoff to this feature would require drainage pipework to cross a significant distance across third-party, urbanised land including an SSSI and therefore, discharge into this feature should not be considered.

Discharge to sewer

GeoSmart has undertaken an assessment of the location of sewer features within the vicinity of the Site. There is a public combined sewer, located adjacent to the west of the Site, therefore discharge to sewer is likely to be appropriate.

Discharge to sewer is likely to be the optimum sustainable drainage option for the new development area due to infiltration to ground and discharging to a surface water feature being unsuitable. If required consultation with the local sewer undertaker should be undertaken. Discharge to sewer would only be accepted if it can be demonstrated that none of the above options are reasonably practical. Discharge would have to be controlled and on-Site attenuation would be required.

The topographic gradient on the Site undulates across most of the Site but falls gradually southwards in the south of the Site to the south away from the existing drainage network

along the main road. It would not be difficult to drain the majority of the Site under gravity to the existing sewer network.

8 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 (car parking and road) runoff. The Site does not lie within an SPZ and therefore additional treatment stages are not required.

Table 11. 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 12. 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

9 Proposed SuDS strategy

Sustainable drainage systems

DEFRA's non-statutory requirements for SuDS require the below ground drainage systems to have the capacity to accommodate at least the 1 in 30 year event and to manage the 1 in 100 year event without flooding of on-site buildings and substations. All runoff should be managed on-Site though for the 1 in 100 year event, accounting for the maximum impacts of climate change to ensure flood risk is not increased to third-parties.

It is assumed that drainage from areas outside the development footprint will continue to use existing drainage arrangements.

A surface water drainage strategy (summarised in Section 2 of this report) includes the following SuDS features to intercept, attenuate and treat surface water runoff.

Primary SuDS Strategy:

Ground conditions at the Site are conducive to infiltration, surface water runoff from the new proposed development will be managed within SuDS features and infiltrated to ground.

Surface water runoff from the existing development within the Site will continue to drain as existing (assumed to public combined sewer network).

Table 13. Proposed SuDS type, features, discharge location and rate restriction

SuDS type	Source control (interception) and infiltration SuDS.
SuDS features	Rainwater harvesting, permeable paving, green roofs, soakaway.
Discharge location	Infiltration / Drain as existing (assumed to public combined sewer network).
Discharge rate	1 x 10^{-5} m/s (where infiltration is proposed) / As existing (where discharge via existing drainage networks is proposed).

Table 14. Proposed SuDS sizing (dimensions) and attenuation volumes

Rainwater Harvesting	Rainwater harvesting butts should be established for each new proposed development. In terms of attenuation storage within this SuDS scheme, the volume of run-off which could be attenuated by Rainwater Harvesting has not been considered within the Preliminary SuDS schematic.
Green Roof	Green roofs covering a total area of 72 m^2 with a green roof mix example volume of 14.4 m^3 (0.2m depth) and Geocomposite example

	volume of 0.7 m^3 (0.01m depth) is proposed to provide flow control, amenity and biodiversity benefits.
Permeable paving	A 513 m^2 area of self-draining permeable paving (underlain with a Type 3 aggregate material) within the proposed driveway and access areas with a 30% porosity is proposed to reduce the required volume of focused infiltration features.
Soakaway	A soakaway with a length of 5 m, width of 5 m and depth of 1 m in the centre of the Site with a 95% void ratio would result in c. 23.8 m^3 attenuation.
Total Attenuation Provided	23.8 m^3

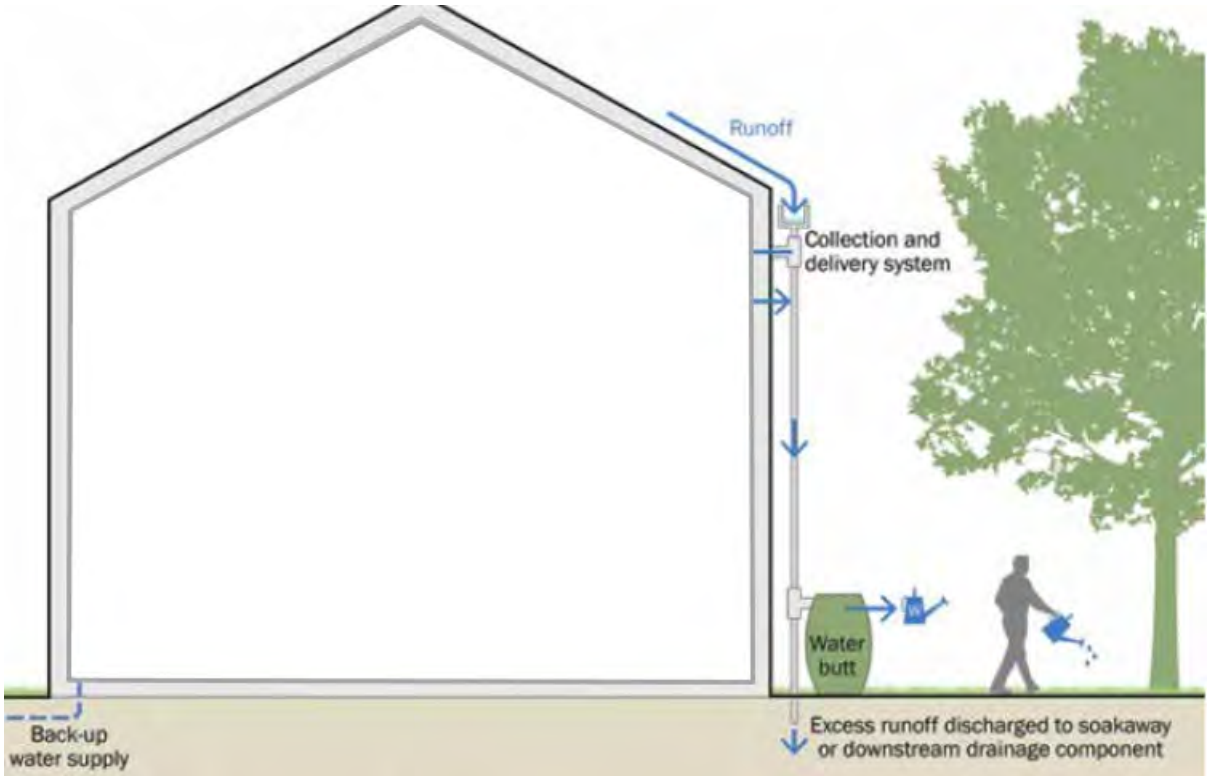
Rainwater harvesting

Rainwater harvesting butts are proposed for each residential dwelling. The run-off from the proposed residential development roofs should be led into rainwater harvesting butts via rainwater downpipes and guttering to catch run-off from the extension roof. Overflow from the butts should be discharged into the storage system provided by the soakaway.

Due to the relatively insignificant amounts of attenuation provided by rainwater harvesting tanks in this instance and the requirement to retain water for non-potable uses such garden maintenance, the volume of run-off which could be attenuated by rainwater harvesting has not been considered within the report.

As there is an issue with the storage capability of Rainwater Harvesting tanks, this method should have a fixed attenuation volume and a controlled outlet to discharge into the proposed SuDS feature. An overflow system will be required for implementation on the Site due to exceedance events (where the pumps fail or there is a blockage within the system / or the number of residents and subsequent water usage is reduced).

Roof run-off is generally less polluted than run-off from road surfaces but can still generate pollutants such as sediments. Pollutants would be captured by the collection and filtration system and, by reducing the volume of run-off generated from the Site. Primary screening devices are used to prevent leaves and other debris from entering the butt and first flush devises can be designed to divert the first part of the rainfall away from the main storage tank and can pick up most of the dirt, debris and contaminates that collect on a residential roof.



Modified from Figure 11.3 of the CIRIA SuDS Manual (C753) (2015)

Green Roof

Green Roofs are proposed on selected roofs which will aim to intercept and store runoff within a porous substrate (depth of 0.2 m) over a total area of 72.2 m^2.

Green roofs provide improvements to water quality as they intercept water at the source, and the layering of the substrate can incorporate filtration measures to remove pollutants from the system. Green Roofs are roofs which incorporate planting, often sedum or wildflower and meadow planting, grasses and mosses. In fact, some can even be planted with trees and shrubs. Brown roofs are similar to green roofs, the main difference is that whilst green roofs are often installed partly for aesthetic value, brown roofs tend to be installed for environmental reasons, mainly, to encourage plants and wildlife.

In addition, although green roofs absorb most of the rainfall that they receive during frequent events, there will always be a need to discharge excess water to the building's drainage system and these areas should be positively drained. The hydraulic performance of green roofs once saturated tends to be fairly similar to standard roofs. Therefore, the hydraulic design of green roof drainage should follow the advice in BS EN 12056-3:2000. Useful information is also provided in BS 6229:2003. Detailed guidelines for the planning, execution and upkeep of green roof sites are contained within GRO (2014).

It is recommended that attenuation should be provided in the form of a high porosity substrate underlying the growing medium (approximately 50% depending on the supplier), which would provide sufficient storage (depending on loading requirements of a fully saturated substrate). It is likely that the high porosity medium would only have to be relatively thin in order to achieve the attenuation requirements. Surface water would then be throttled

to a suitable rate at a downpipe entrance before discharging to the combined sewer system, via an existing connection.

Permeable paving

Permeable Paving is proposed for access and car parking areas to intercept runoff. Suitable aggregate materials (angular gravels with suitable grading as per CIRIA, 2015) will improve water quality due to their filtration capacity and usually work to a 30% porosity. A geotextile layer will be required for paving underlain by aggregate material to intercept silt/particles. Permeable pavements are multi-layered surfacing systems. The surface layer is constructed out of permeable material allowing infiltration of water through gaps along its surface. A geomembrane isolates stored water from the surrounding soil, especially in contaminated areas and a geotextile layer prevents clogging and damage to the geo-cellular modules.

The geotextile layer works to intercept silt/particles flowing through the system via direct rainfall, or through vehicle use deposited onto the car park area and into the permeable paving. The majority of silt would be trapped within the top 30mm of the joining material between the paving blocks.

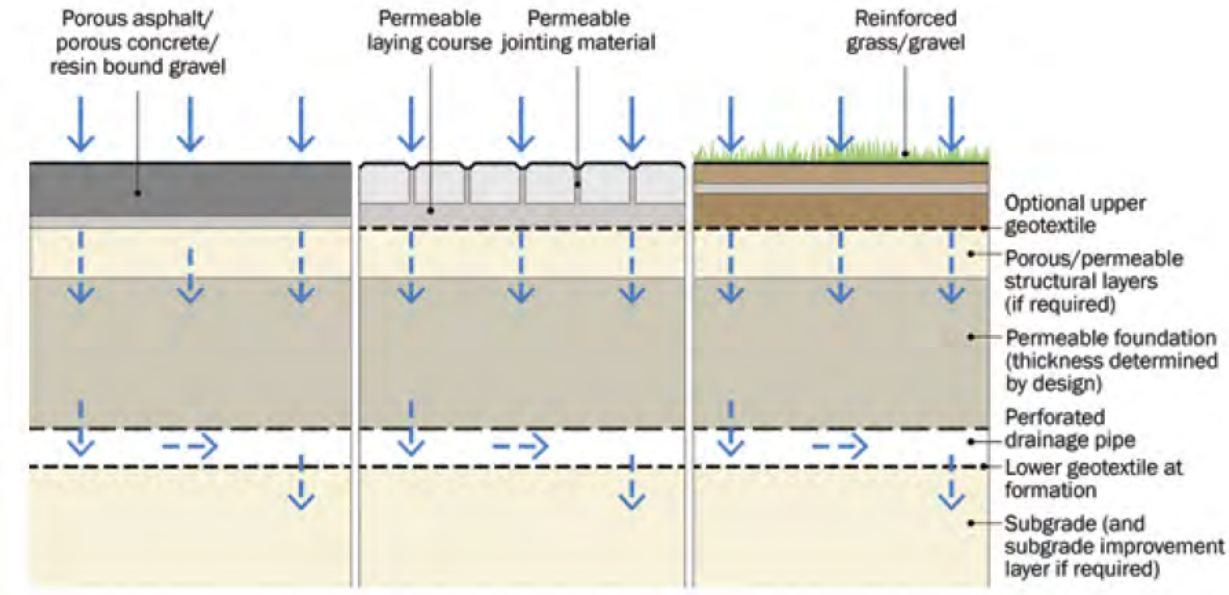


Figure 20.13 of the CIRIA SuDS Manual (C753) (2015)

Plastic geo-cellular systems could also be used, which can increase the void space and therefore storage but do not allow filtration unless they are combined with aggregate material and/or permeable geotextiles which could increase their storage potential by up to 20%. Geo-cellular modules also have the added advantage of reducing the amount of aggregate sub base required, thus keeping costs lower. Void systems, such as permavoids, have a void ratio of 95% (i.e. for every 1 m^3 there is 0.95 m^3 of space available for water storage), which has been factored into the storage capacity calculations.

Soakaway

Soakaways should be used to store run-off and infiltrate collected water gradually into the ground. Proposed topographic data indicates roof water could be collected and conveyed by underground pipes to the features which are located at the Site. The base of the infiltration

features should lie at an elevation at least 1 m above the highest winter groundwater levels, to ensure there is sufficient space for surface water to discharge. Soakaway excavation should be outside of the root zone of any protected trees and dimensions will depend on the depth to the sand layer where the soakaway is eventually situated.

Draining via soakaways means that property owners are less likely to pay for the utility company to drain surface water. In terms of future ownership and maintenance, where a soakaway drains a single property, the ownership and maintenance would be the property owner's responsibility.

Secondary SuDS Strategy:

Where infiltration to ground is not achievable at the Site, an attenuation volume of 107.9 m³ should be stored within lined SuDS features to accommodate the calculated 8 hour Critical Storm Duration for surface water discharge runoff, restricted to 1 l/s. SuDS features listed in the primary recommendations are still applicable to the secondary recommendation the Site. Permeable paving can still be incorporated if discharge to ground is not achievable however paving will need to be lined to ensure groundwater does not interact with the system.

Table 15. Proposed SuDS type, features, discharge location and rate restriction

SuDS type	Source control (interception) and attenuation SuDS.
SuDS features	Rainwater harvesting, permeable paving and green roofs.
Discharge location	Public combined sewer network.
Discharge rate	1 l/s

Table 16. Proposed SuDS sizing (dimensions) and attenuation volumes

Rainwater Harvesting	Rainwater harvesting butts should be established for each proposed residential development. In terms of attenuation storage within this SuDS scheme, the volume of run-off which could be attenuated by Rainwater Harvesting has not been considered within the Preliminary SuDS schematic.
Green Roof	Green roofs covering a total area of 72 m^2 with a green roof mix example volume of 14.4 m^3 (0.2m depth) and Geocomposite example volume of 0.7 m^3 (0.01m depth) is proposed to provide flow control, amenity and biodiversity benefits.
Permeable paving	A 513 m^2 area of lined permeable paving (underlain with a Type 3 aggregate material) within the proposed driveway areas to a depth of 0.6 m, with a 30% porosity would result in c. 92.3 m^3 attenuation.

Total Attenuation Provided	108.1 m^3
Total Attenuation Required	107.9 m^3
Freeboard Storage Provided	0.2 m^3

Flow control devices and systems

Hydrobrake Flow control systems can be used to reduce the runoff rate from the Site. These are usually a device used for controlling water flow into a connecting feature, such as a sewer, to a specific attenuation performance. The design consists of an intake, a volute and an outlet and the configuration is critical to ensure discharge control. For drainage areas which are less than 3 ha, outlet throttle diameters would have to be small (<150mm diameter) to achieve outflow rates which could result in blockage. For most SuDS features, a flow control device will comprise a fixed orifice or a throttle such as a short pipe.

A Vortex Control is usually a self-activating vortex flow device which directs water into a volute to form a vortex. For the Site, rainwater down pipes from the development roof should drain directly into the attenuation feature to reduce infill from potential flood water.

Drainage protection devices

A non-return flap value is recommended for outflow pipes to reduce the risk of backflow from the channel/sewer during a large scale rainfall event.

Exceedance Flows

Exceedance flow routes are included within the proposed SuDS drainage layout. Where possible, exceedance flows should be directed away from buildings and into non-essential areas of the Site such as the car park. The SuDS system recommended for the Site should provide enough storage that this method would only be utilised during a worst case scenario.

10 SuDS maintenance

Regular maintenance is essential to ensure effective operation of the SuDS features over the intended lifespan of the proposed development. The SuDS Manual (C753) (CIRIA, 2015) provides a maintenance schedule for SuDS with details of the necessary required actions as shown in the Table below.

Table 17. SuDS operation and recommended maintenance requirements

Asset type	Maintenance schedule (and frequency)
Permeable pavements	Regular maintenance: • Brushing and vacuuming (three times per year). • Trimming any roots and surrounding grass and weeds that may be causing blockages (annually or as required). Monitoring: • Initial inspection (monthly). • Inspect for poor performance and inspection chambers (annually).
Hydro-Brake Flow Control	Low amounts of maintenance required as there are no moving parts within the Hydro-Brake® Flow Control. • Initial monthly inspection at the manhole once the construction phase is over. If blockages occur they normally do so at the intake. Hydro-Brake® Flow Controls are fitted with a pivoting by-pass door, which allows the manhole chamber to be drained down should blockages occur. Inspection should be undertaken annually or when a storm event occurs.
Underground drainage pipe network	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).
Green Roof	Regular inspection: • Inspect all components (soil substrate, vegetation, drainage, irrigation systems, membranes and roof structure, waterproofing, structural stability (annually and after severe storms)

Asset type	Maintenance schedule (and frequency)
	• Inspect soil substrate for evidence of erosion channels (annually and after severe storms). • Inspect drain inlets for unrestricted run-off (annually and after severe storms). • Inspect underside of roof for leakage (annually and after severe storms). Regular maintenance: • Remove litter and debris from inlet drains (six monthly, annually or as required). • Cleaning of clippings (six monthly or as required). • Trimming of grasses and removal of nuisance weeds and invasive vegetation (six monthly or as required). • Replace dead plants (annually or as required). Monitoring: • Stabilise any erosion channels with extra soil substrate (as required). • Identify sources of erosion and control (as required). • Investigate and repair drain inlet if inlet has settled, cracked or moved (as required).
Rainwater Harvesting	Regular maintenance: • Inspection of tank for debris and sediment build up (annually and following poor performance). • Inspection of inlets, outlets, overflow areas, pumps and filters (annually and following poor performance). • Cleaning of tank, inlets, outlets, gutters, roof drain filters and withdrawal devices (annually or as required). Remedial actions: • Repair or overflow erosion damage or damage to tank and associated components (as required)

Client checklist

A drainage strategy has been recommended as suitable 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 18. 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 19. 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.

11 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, 2021). 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.

12 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/

13 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.

14 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.

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Data Sources

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Flood Risk (Groundwater) and SuDS infiltration suitability (SD50)	GeoSmart, BGS & OS GW5 (v2.4) Map (GeoSmart, 2023) Contains British Geological Survey materials © NERC 2023 Ordnance Survey data © Crown copyright and database right 2023
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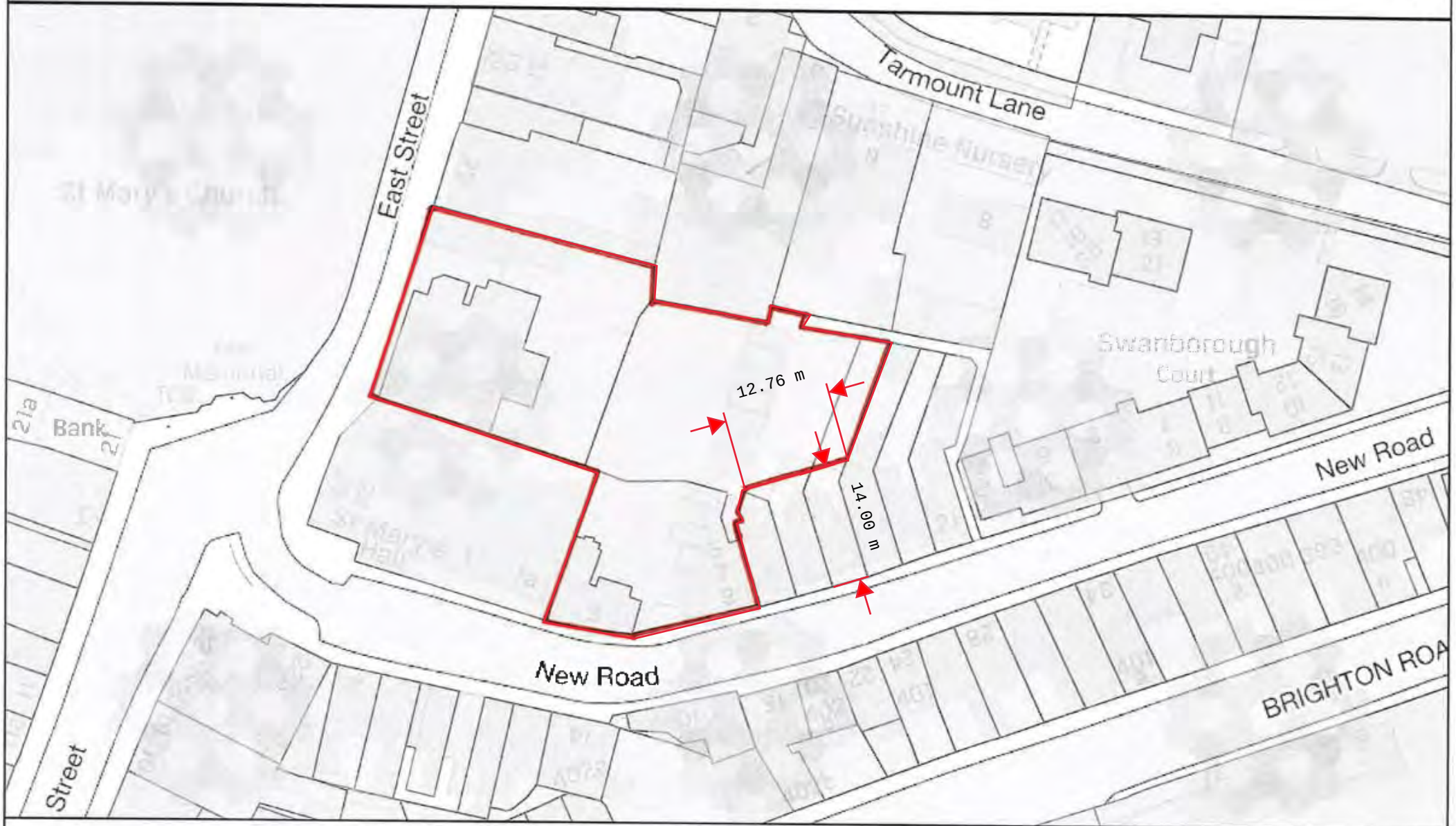
15 Appendices

GeoSmart Information

Appendix A

Site plans



Map scale 1:625

Data last updated 10:00pm 12 FEBRUARY, 2020

Proposed site plan Scale 1:200@A3

0m 2m 4m 6m 8m 10m

0.59 in

N

Accommodation schedule:

Commercial units:

C1	new ground retail unit - 60 sqm
C2	Existing commercial unit.

Residential units:

R1-R3	Conversion of former bank to form three 4 bedroom town houses
R4	3 bedroom apartment above retail unit - 90 sqm
R5, R6	3 bedroom mews house
R7	3/4 bedroom mews house
R8	Existing town house with first floor extension
R9	Extended first floor apartment over C2

key

A	vehicle entrance gates
B	pedestrian access to site
C	green roof
D	private garden
E	roof terrace
F	EV charging point
G	pergola
H	slate or tiled roof to match existing
J	conservation type rooflight
K	profiled metal roof

draft

rev.	date

client

project East Street and New Road Shoreham

drawing Proposed site plan

scale Shown@A3 date March 2023
drawn MOONCIE

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Turner Associates
Architects and Planning Consultants

TA 1484 /SK10 rev.

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Appendix B

Rainfall runoff calculations

Design Settings

Rainfall Methodology	FEH-13	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)	1.200
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)	Cover Level (m)	Depth (m)
1	0.028	10.000	1.600

Simulation Settings

Rainfall Methodology	FEH-13	Analysis Speed	Normal	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	0.840	Drain Down Time (mins)	240	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	45	0	0

Node 1 Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.03600	Invert Level (m)	8.400	Depth (m)	1.000
Side Inf Coefficient (m/hr)	0.03600	Time to half empty (mins)	1131	Inf Depth (m)	
Safety Factor	2.0	Pit Width (m)	5.000	Number Required	1
Porosity	0.95	Pit Length (m)	5.000		

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	1	296	8.588	0.188	0.8	4.5277	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
360 minute winter	1	Infiltration	0.1

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

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	1	352	8.864	0.464	1.6	11.1779	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
360 minute winter	1	Infiltration	0.2

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

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	1	352	9.003	0.603	2.0	14.5276	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
360 minute winter	1	Infiltration	0.2

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	1	472	9.319	0.919	2.3	22.1574	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
480 minute winter	1	Infiltration	0.2

Greenfield Site Run-Off Calculations usng the IoH124 method

Greenfield peak run-off rate (QBAR):

Parameters	Input	Units	Comments
Area	50	ha	mimimum 50ha
SAAR	740	mm	FEH CD ROM (NERC, 2009)
SPR	0.37	N/A	Soil run-off coefficient
Region	7	N/A	Region on Hydrological area map

QBAR

$$Q_{BAR(rural)} = 1.08AREA^{0.89}SAAR^{1.17}SPR^{2.17}$$

Where:

$Q_{BAR(rural)}$	is the mean annual flood (a return period of 2.3 years) in l/s
AREA	is the area of the catchment in km² (minimum of 0.5km²)
SAAR	is the standard average rainfall for the period 1941 to 1970 in mm
SPR	is the soil run-off coefficient

$Q_{BAR(rural)}$ can be factored by the UK Flood Studies Report regional growth curves to produce peak flood flows for any return period.

$Q_{BAR(rural)}$	=	153.29	l/s for 50ha site
Divided by 50 to scale down	=	3.07	l/s/ha
Actual Area of the entire Site	=	0.17	ha

Return Periods (Growth curves obtained from DEFRA report)

Return Period		Growth Factor	l/s/ha	Peak site run-off rate (l/s)
1	**$Q_{BAR(rural)}$ x**	**0.85**	**2.61**	**0.433**
2	$Q_{BAR(rural)}$ x	0.88	2.70	0.45
5	$Q_{BAR(rural)}$ x	1.28	3.92	0.65
10	$Q_{BAR(rural)}$ x	1.62	4.97	0.82
25	$Q_{BAR(rural)}$ x	2.14	6.56	1.09
30	**$Q_{BAR(rural)}$ x**	**2.24**	**6.87**	**1.141**
50	$Q_{BAR(rural)}$ x	2.62	8.03	1.33
100	**$Q_{BAR(rural)}$ x**	**3.19**	**9.78**	**1.62**
200	$Q_{BAR(rural)}$ x	3.86	11.83	1.97

Greenfield total run-off volume:

= actual area of the entire site x SPR x 6 hour rainfall depth

Return Period	6 hour rainfall (mm) from FEH CD-ROM	Area (ha)	SPR	Total run-off (m^3)
2.3 (QBAR)	30.21	0.17	0.37	18.6
1	28.32	0.17	0.37	17.4
10	47.06	0.17	0.37	28.9
30	59.1	0.17	0.37	36.3
100	73.84	0.17	0.37	45.4

Developed site run-off calculation sheet

1 in 1 year

Proposed impermeable area	0.120	ha
CC Factor	45%	
Total volume for surfaces during 6 hour event	33.96	m³
Total volume for 6 hour event inc CC	49.24	m³
Total volume for 6 hour event exc CC	33.96	m³

Duration	Rainfall 1 yr event	Run-off rate 1 yr event	Run-off rate 1 yr +cc event
hours	mm	m³	m³
0.25	7.81	9.36	13.58
0.5	10.21	12.24	17.75
0.75	11.71	14.04	20.36
1	12.91	15.48	22.44
2	18.61	22.31	32.35
3	22.20	26.62	38.60
4	24.78	29.71	43.08
5	26.74	32.06	46.49
6	28.32	33.96	49.24
8	30.73	36.85	53.43
10	32.58	39.06	56.64
12	34.10	40.89	59.28
16	36.53	43.80	63.51
20	38.49	46.15	66.92
24	40.20	48.20	69.89
28	41.77	50.08	72.62
32	43.23	51.83	75.16
36	44.61	53.49	77.56
40	45.94	55.08	79.87
44	47.22	56.62	82.09
48	48.45	58.09	84.23

1 in 30 year

Proposed impermeable area	0.120	ha
CC Factor	45%	
Total volume for surfaces during 6 hour event	70.86	m³
Total volume for 6 hour event inc CC	102.75	m³
Total volume for 6 hour event exc CC	70.86	m³

Duration	Rainfall 30 yr event	Run-off volume 30 yr event	Run-off volume 30 yr +cc event
hours	mm	m³	m³
0.25	21.33	25.57	37.08
0.5	28.39	34.04	49.36
0.75	32.84	39.38	57.09
1	36.11	43.30	62.78
2	44.75	53.66	77.80
3	50.05	60.01	87.01
4	53.84	64.55	93.60
5	56.75	68.04	98.66
6	59.10	70.86	102.75
8	62.74	75.23	109.08
10	65.55	78.59	113.96
12	67.85	81.35	117.96
16	71.51	85.74	124.32
20	74.41	89.22	129.37
24	76.86	92.16	133.62
28	79.04	94.77	137.41
32	81.04	97.17	140.89
36	82.91	99.41	144.14
40	84.67	101.52	147.20
44	86.35	103.53	150.12
48	87.96	105.46	152.92

Outflow at 1 l/s	inflow from rain	Diff (storage required)
0.90	25.57	24.67
1.80	34.04	32.24
2.70	39.38	36.68
3.60	43.30	39.70
7.20	53.66	46.46
10.80	60.01	49.21
14.40	64.55	50.15
18.00	68.04	50.04
21.60	70.86	49.26
28.80	75.23	46.43
36.00	78.59	42.59
43.20	81.35	38.15
57.60	85.74	28.14
72.00	89.22	17.22
86.40	92.16	5.76
100.80	94.77	-6.03
115.20	97.17	-18.03
129.60	99.41	-30.19
144.00	101.52	-42.48
158.40	103.53	-54.87
172.80	105.46	-67.34

1 in 100 year

Proposed impermeable area	0.120	ha
CC Factor	45%	
Total volume for surfaces during 6 hour event	88.53	m³
Total volume for 6 hour event inc CC	128.37	m³
Total volume for 6 hour event exc CC	88.53	m³

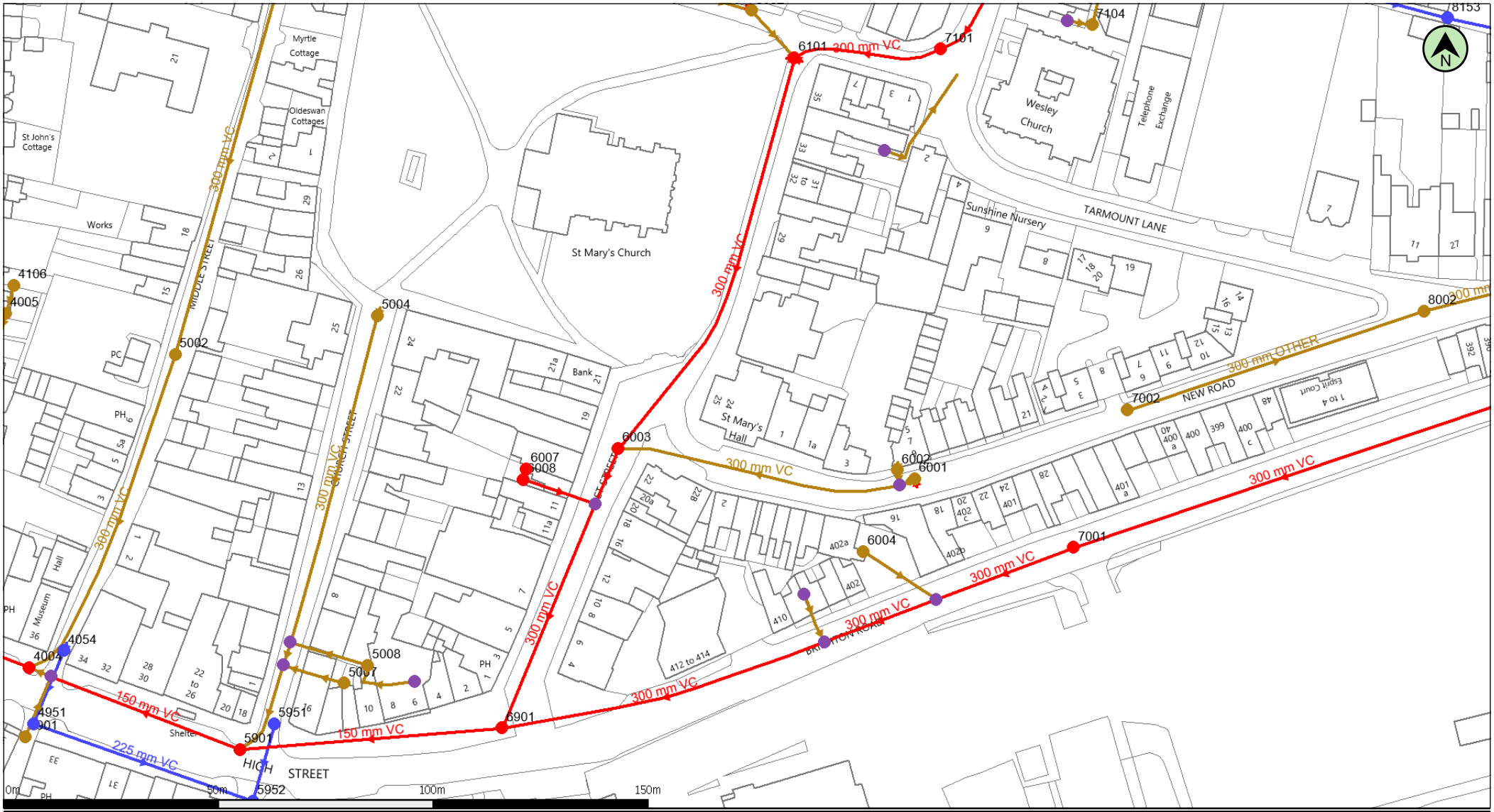
Duration	Rainfall 100 yr event	Run-off volume 100 yr event	Run-off volume 100 yr +cc event
hours	mm	m³	m³
0.25	27.09	32.48	47.10
0.5	36.39	43.63	63.27
0.75	42.27	50.68	73.49
1	46.65	55.93	81.10
2	56.52	67.77	98.26
3	62.75	75.24	109.09
4	67.32	80.72	117.04
5	70.89	85.00	123.25
6	73.84	88.53	128.37
8	78.60	94.24	136.65
10	82.33	98.71	143.13
12	85.37	102.36	148.42
16	90.11	108.04	156.66
20	93.74	112.39	162.97
24	96.74	115.99	168.19
28	99.40	119.18	172.81
32	101.82	122.08	177.02
36	104.05	124.76	180.90
40	106.13	127.25	184.51
44	108.10	129.61	187.94
48	109.96	131.84	191.17

Outflow at 1 l/s	inflow from rain	100yr Scenario Diff (storage required)	CC Scenario Diff (storage required)
0.90	47.10	31.58	46.20
1.80	63.27	41.83	61.47
2.70	73.49	47.98	70.79
3.60	81.10	52.33	77.50
7.20	98.26	60.57	91.06
10.80	109.09	64.44	98.29
14.40	117.04	66.32	102.64
18.00	123.25	67.00	105.25
21.60	128.37	66.93	106.77
28.80	136.65	65.44	107.85
36.00	143.13	62.71	107.13
43.20	148.42	59.16	105.22
57.60	156.66	50.44	99.06
72.00	162.97	40.39	90.97
86.40	168.19	29.59	81.79
100.80	172.81	18.38	72.01
115.20	177.02	6.88	61.82
129.60	180.90	-4.84	51.30
144.00	184.51	-16.75	40.51
158.40	187.94	-28.79	29.54
172.80	191.17	-40.96	18.37

GeoSmart Information

Appendix C

Southern Water Sewer Asset Location Plan

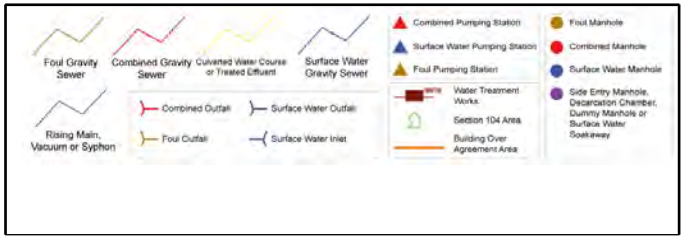


Date: 08/08/23 | Scale: 1:1250 | Map Centre: 521658,105073 | Data updated: 05/05/23 | Our Ref: 1244789 - 1 | Wastewater Plan A4

The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. This plan is produced by Southern Water Services Ltd (c) Crown copyright and database rights 2023 Ordnance Survey 100031673 .This map is to be used for the purposes of viewing the location of Southern Water plant only. Any other uses of the map data or further copies is not permitted.

WARNING: BAC pipes are constructed of Bonded Asbestos Cement.

WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement.



davidsouth@geosmartinfo.co.uk

80014

WATER for LIFE from Southern Water

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
4004	C	5.74	0.00	-
5901	C	0.00	0.00	-
6003	C	6.63	0.00	-
6007	C	0.00	0.00	-
6008	C	0.00	0.00	-
6101	C	6.76	2.56	-
6901	C	0.00	0.00	-
7001	C	3.88	0.00	-
7101	C	6.27	2.67	-
4005	F	0.00	0.00	-
4106	F	0.00	0.00	-
4901	F	0.00	0.00	-
5002	F	6.35	2.15	-
5004	F	6.84	0.00	-
5007	F	0.00	0.00	-
5008	F	0.00	0.00	-
6001	F	6.20	0.00	-
6002	F	6.31	0.00	-
6004	F	0.00	0.00	-
6102	F	6.11	3.08	-
7002	F	0.00	0.00	-
7104	F	0.00	0.00	-
8002	F	0.00	0.00	-
4054	S	5.89	0.00	-
4951	S	0.00	0.00	-
5951	S	0.00	0.00	-
5952	S	0.00	0.00	-
8153	S	0.00	0.00	-

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Disclaimer

This report has been prepared by GeoSmart in its professional capacity as soil, groundwater, flood risk and drainage specialists, with reasonable skill, care and diligence within the agreed scope and terms of contract and taking account of the manpower and resources devoted to it by agreement with its client and is provided by GeoSmart solely for the internal use of its client.

The advice and opinions in this report should be read and relied on only in the context of the report as a whole, taking account of the terms of reference agreed with the client. The findings are based on the information made available to GeoSmart at the date of the report (and will have been assumed to be correct) and on current UK standards, codes, technology and practices as at that time. They do not purport to include any manner of legal advice or opinion. New information or changes in conditions and regulatory requirements may occur in future, which will change the conclusions presented here.

This report is confidential to the client. The client may submit the report to regulatory bodies, where appropriate. Should the client wish to release this report to any other third party for that party's reliance, GeoSmart may, by prior written agreement, agree to such release, provided that it is acknowledged that GeoSmart accepts no responsibility of any nature to any third party to whom this report or any part thereof is made known. GeoSmart accepts no responsibility for any loss or damage incurred as a result, and the third party does not acquire any rights whatsoever, contractual or otherwise, against GeoSmart except as expressly agreed with GeoSmart in writing.

For full T&Cs see http://geosmartinfo.co.uk/terms-conditions

Further information

Information on confidence levels and ways to improve this report can be provided for any location on written request to info@geosmart.co.uk or via our website. Updates to our model are ongoing and additional information is being collated from several sources to improve the database and allow increased confidence in the findings. Further information on groundwater levels and flooding are being incorporated in the model to enable improved accuracy to be achieved in future versions of the map. Please contact us if you would like to join our User Group and help with feedback on infiltration SuDS and mapping suggestion.

Important consumer protection information

This search has been produced by GeoSmart Information Limited, Suite 9-11, 1st Floor, Old Bank Buildings, Bellstone, Shrewsbury, SY1 1HU.

Tel: 01743 298 100

Email: info@geosmartinfo.co.uk

GeoSmart Information Limited is registered with the Property Codes Compliance Board (PCCB) as a subscriber to the Search Code. The PCCB independently monitors how registered search firms maintain compliance with the Code.

The Search Code:

- provides protection for homebuyers, sellers, estate agents, conveyancers and mortgage lenders who rely on the information included in property search reports undertaken by subscribers on residential and commercial property within the United Kingdom.
- sets out minimum standards which firms compiling and selling search reports have to meet.
- promotes the best practice and quality standards within the industry for the benefit of consumers and property professionals.
- enables consumers and property professionals to have confidence in firms which subscribe to the code, their products and services.
- By giving you this information, the search firm is confirming that they keep to the principles of the Code. This provides important protection for you.

The Code's core principles

Firms which subscribe to the Search Code will:

- display the Search Code logo prominently on their search reports.
- act with integrity and carry out work with due skill, care and diligence.
- at all times maintain adequate and appropriate insurance to protect consumers.
- conduct business in an honest, fair and professional manner.
- handle complaints speedily and fairly.
- ensure that products and services comply with industry registration rules and standards and relevant laws.
- monitor their compliance with the Code.

GeoSmart Information

Complaints

If you have a query or complaint about your search, you should raise it directly with the search firm, and if appropriate ask for any complaint to be considered under their formal internal complaints procedure. If you remain dissatisfied with the firm's final response, after your complaint has been formally considered, or if the firm has exceeded the response timescales, you may refer your complaint for consideration under The Property Ombudsman scheme (TPOs). The Ombudsman can award up to £5,000 to you if the Ombudsman finds that you have suffered actual financial loss and/or aggravation, distress or inconvenience as a result of your search provider failing to keep to the Code.

Please note that all queries or complaints regarding your search should be directed to your search provider in the first instance, not to TPOs or to the PCCB.

TPOs contact details:

The Property Ombudsman scheme

Milford House

43-55 Milford Street

Salisbury

Wiltshire SP1 2BP

Tel: 01722 333306

Fax: 01722 332296

Email: admin@tpos.co.uk

You can get more information about the PCCB from www.propertycodes.org.uk.

Please ask your search provider if you would like a copy of the search code

Complaints procedure

GeoSmart Information Limited is registered with the Property Codes Compliance Board as a subscriber to the Search Code. A key commitment under the Code is that firms will handle any complaints both speedily and fairly. If you want to make a complaint, we will:

- Acknowledge it within 5 working days of receipt.
- Normally deal with it fully and provide a final response, in writing, within 20 working days of receipt.
- Keep you informed by letter, telephone or e-mail, as you prefer, if we need more time.
- Provide a final response, in writing, at the latest within 40 working days of receipt.
- Liaise, at your request, with anyone acting formally on your behalf.

If you are not satisfied with our final response, or if we exceed the response timescales, you may refer the complaint to The Property Ombudsman scheme (TPOs): Tel: 01722 333306, E-mail: admin@tpos.co.uk.

We will co-operate fully with the Ombudsman during an investigation and comply with his final decision. Complaints should be sent to:

Martin Lucass

Commercial Director

GeoSmart Information Limited

Suite 9-11, 1st Floor,

Old Bank Buildings,

Bellstone, Shrewsbury, SY1 1HU

Tel: 01743 298 100

martinlucass@geosmartinfo.co.uk

16 Terms and conditions, CDM regulations and data limitations

Terms and conditions can be found on our website:

http://geosmartinfo.co.uk/terms-conditions/

CDM regulations can be found on our website:

http://geosmartinfo.co.uk/knowledge-hub/cdm-2015/

Data use and limitations can be found on our website:

http://geosmartinfo.co.uk/data-limitations/