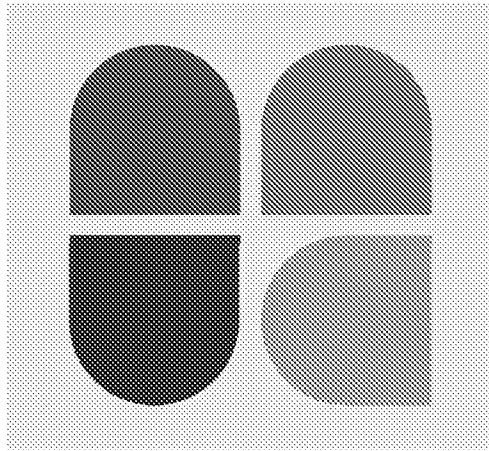




BRIGHT PLAN CIVILS

**LAND NORTH OF LEE'S YARD, LIDSEY
ROAD, WOODGATE, PO20 3SU**

PROPOSED RESIDENTIAL DEVELOPMENT

Flood Risk Assessment & Drainage Strategy

Prepared on Behalf of

Southern Home Ownership & Thakeham
Partnerships Ltd

D2019/FRA1.1

22 February 2022

DOCUMENT CONTROL

Project: Land North of Lee's Yard, Lidsey Road, Woodgate, PO20 3SU

Proposed Residential Development

Document: Flood Risk Assessment & Drainage Strategy

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1 INTRODUCTION

1.1 Background

- 1.1.1 Bright Plan Civils is instructed by Southern Home Ownership & Thakeham Partnerships Ltd to prepare a Flood Risk Assessment (FRA) and Drainage Strategy with reference to the proposed development at the land north of Lee's Yard, Lidsey Road, Woodgate, Chichester, West Sussex PO20 3SU.
- 1.1.2 This FRA has been undertaken in accordance with Planning Practice Guidance: Flood Risk and Coastal Change and National Planning Policy Framework Section 14.
- 1.1.3 The proposed development will involve the construction of 38 No. residential units, as demonstrated by the architectural development proposals contained within **Appendix A**.
- 1.1.4 In preparing this report, Bright Plan Civils has referred to the following documents and information;
- Environment Agency Flood Maps for Planning
 - Environment Agency Long-Term Flood Risk Maps
 - West Sussex County Council (WSCC) Strategic Flood Risk Assessment (SFRA)
 - Arun District Council (ADC) and WSCC Drainage Records
 - Southern Water Public Sewer Records
 - British Geological Survey (BGS) Information and Records
 - CD Surveys Topographical Survey
 - Lidsey Surface Water Management Plan (SWMP)
- 1.1.5 This report has been prepared to assess if the proposed development is suitable for the site and confirms if mitigation is required to ensure that flood risk is not increased, and that the proposed development remains safe during its design life.
- 1.1.6 This report has been prepared for the benefit of the named Client only.

1.2 Site Location and Description

- 1.2.1 A site location plan is included within this report (**PL100 – 'Site Location Plan'**).
- 1.2.2 The site is located approximately 11km south-east of the centre of Chichester and measures approximately 15,253m² (1.5Ha).
- 1.2.3 The site itself is largely undeveloped greenfield, bound by planting on all boundaries.
- 1.2.4 A site-specific topographical survey has been undertaken by CD Surveys, dated September 2021, which demonstrates levels ranging from 8.90m AOD to 6.70m AOD, with consistent easterly falls across the entire site. The north-south cross section of the site can largely be considered flat.
- 1.2.5 In its current use, the site has no measurable existing impermeable area.
- 1.2.6 The site is bound to the west by Lidsey Road (Public Highway) where access is gained via an existing

private access which runs alongside the north boundary feeding into the Willows caravan park adjacent the eastern boundary.

- 1.2.7 The topographical/GPR survey undertaken by CD Surveys indicates there is a 450mm diameter culverted ordinary watercourse confirmed to be routed under the Willows private access which discharges to an open watercourse in vicinity of the south-east corner of the site.
- 1.2.8 There is 1 No. ordinary watercourse running along the southern boundary which is observed to be shallow. This links above ground to a larger watercourse located within Willows caravan park as cited in 1.2.7.
- 1.2.9 The site currently drains towards the east boundary. A small portion of the site drains towards the existing watercourse along the southern boundary. Arun DC has advised the Willows caravan park installed a French drain intercepting trench just beyond the east boundary to deal with historic greenfield run-off from this site.
- 1.2.10 Lidsey Road is served by a combination of traditional road gullies and kerb inlet gullies. The topographical/GPR survey shows these link to a series of Highway catchpits, with some linking to the culverted ordinary watercourse in vicinity of the private access.

1.3 Ground Conditions

- 1.3.1 A site-specific ground appraisal report has been prepared by Leap Environmental, dated October 2021, ref: LP2616/SI/2.
- 1.3.2 The report and associated site-works extended to include ground investigation in order to establish the underlying geological composition, infiltration testing as well as a period of groundwater monitoring.
- 1.3.3 The Leap Environmental report confirms that the ground conditions encountered were 'generally consistent with those anticipated' (Alluvium overlying River Terrace Deposits, overlying London Clay Formation).
- 1.3.4 Full borehole and trial pits logs associated with the on-site investigation works undertaken are contained within **Appendix B** of this report.
- 1.3.5 In addition to the ground appraisal report produced by Leap Environmental, reference has also been made to the BGS website in order to qualify the findings of the report.
- 1.3.6 Bedrock geology is reported by the BGS as being 'London Clay Formation – Clay, Silt and Sand'.

- 1.3.7 The associated London Clay Formation is described as 'Sedimentary Bedrock formed approximately 48 to 56 million years ago in the Palaeogene Period. Local environment previously dominated by deep seas.'

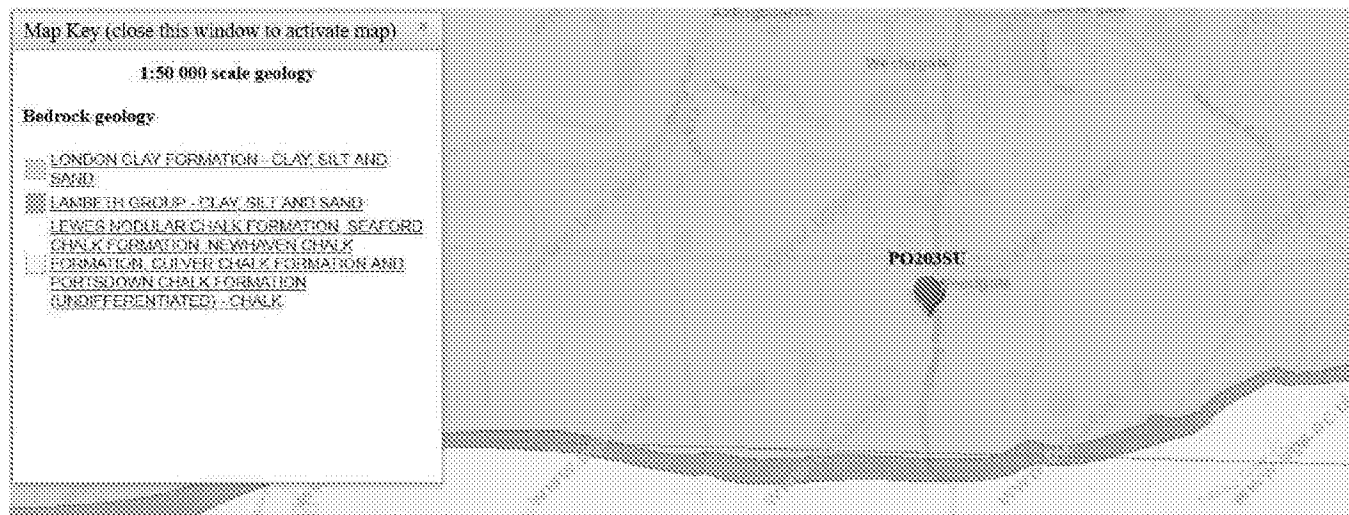


Figure 1. BGS – Bedrock Geology

- 1.3.8 Superficial Deposits are recorded as 'River Terrace Deposits (Undifferentiated) – Sand, Silt and Clay', as confirmed below, in **Figure 2**.
- 1.3.9 These River Terrace Deposits are described as 'Superficial Deposits formed up to 3 million years ago in the Quaternary Period. Local environment previously dominated by rivers (U).'

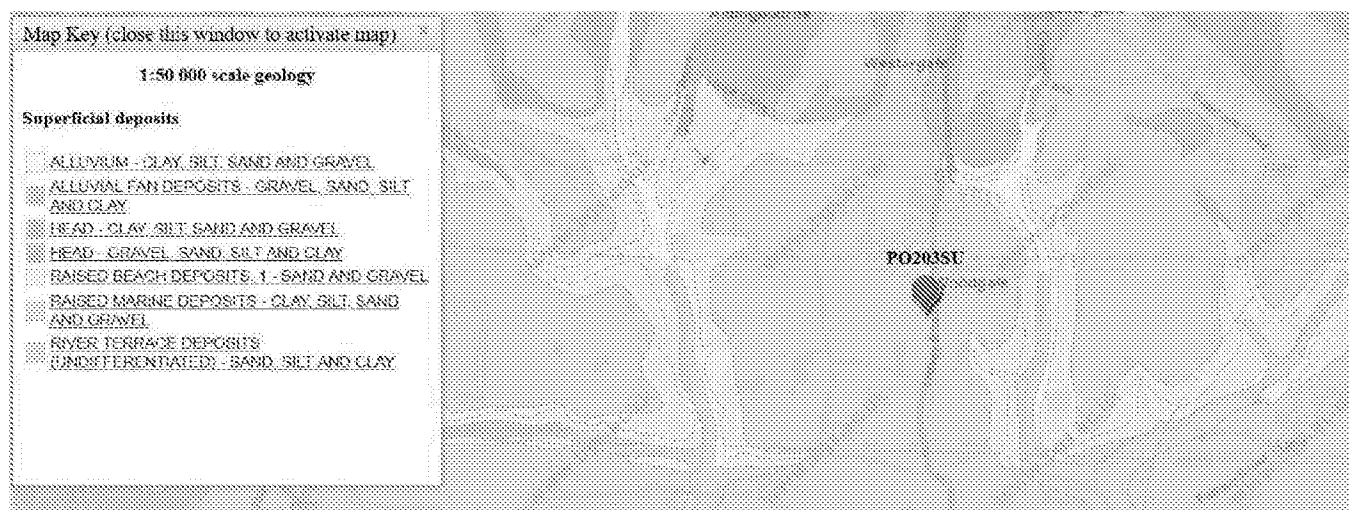


Figure 2. BGS – Superficial Deposits

- 1.3.10 BGS historic borehole records have also been reviewed in relation to the site, further to the on-site investigation undertaken.
- 1.3.11 SU90SW56 is the closest borehole located to the site, within the same geological classification as detailed, above. This borehole is located south-east of the site, to the east of Lidsey Road (A29).

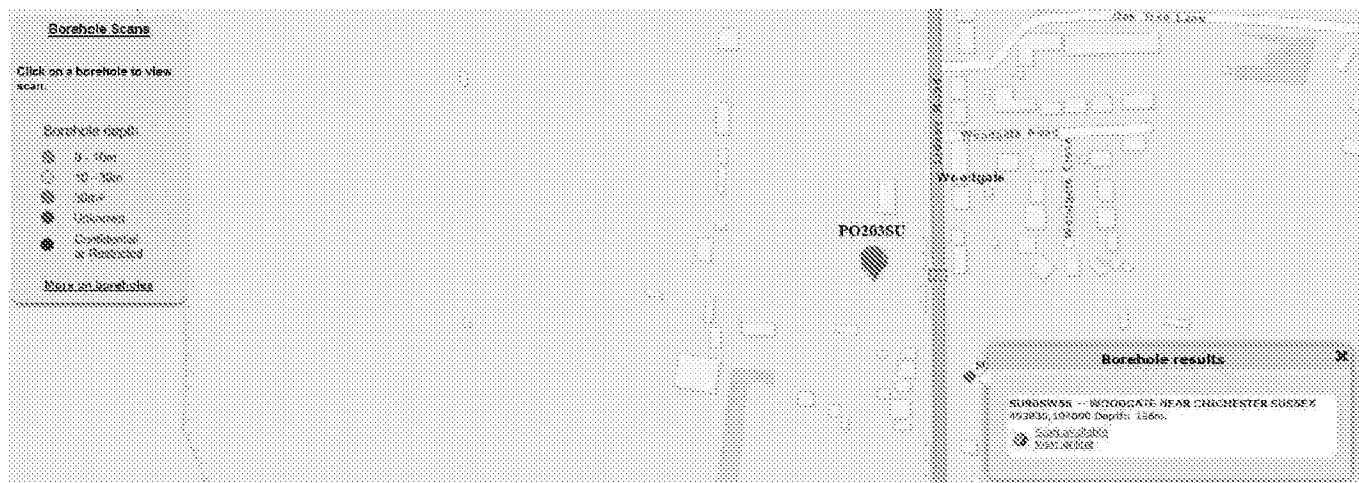


Figure 3. BGS Historic Borehole Location

- 1.3.12 The borehole extends to a depth of 156m below ground level, with the encountered geology recognised as being consistent with the findings of the on-site investigation.
- 1.3.13 The BGS borehole record reviewed confirms the presence of topsoil (500mm thick), beneath which 'sandy brown clay', 'clay with stones' and 'bed of gravel' was encountered to depths up to 3.00m below ground level. London Clay Formation recorded as 'sandy blue clay' from 3.00m below ground level to a depth of 12.00m below ground level.
- 1.3.14 A copy of the BGS records reviewed can be found within **Appendix C** of this report.

1.4 Groundwater

- 1.4.1 The ground appraisal report prepared by Leap Environmental included groundwater investigation and a period of subsequent groundwater monitoring.
- 1.4.2 Groundwater was encountered at depths ranging from 1.10mbgl (approx. 6.05mAOD) to 2.10mbgl (approx. 6.15mAOD) whilst siteworks were being undertaken.
- 1.4.3 At present, based on the groundwater monitoring results obtained to date for November, groundwater is confirmed as peaking at 0.21m below ground level (approx. 7.04mAOD).
- 1.4.4 Following consultation, WSCC Drainage Team has confirmed that the site is shown to be at 'Moderate' risk of groundwater flooding, based on current JBA mapping. 'Moderate' risk of groundwater flooding is determined as groundwater levels reaching between 0.025m and 0.5m below ground level.
- 1.4.5 WSCC has confirmed in their consultation response that they are aware of known groundwater flooding issues north of the railway, although they hold no records of issues of this nature to the south.
- 1.4.6 Mapping managed by MAGIC (magic.defra.gov.uk) provides geographic information concerning the natural environment from across government. This mapping tool has been referred to in order to confirm whether the site is located within either any groundwater source protection zones or groundwater vulnerability zones.
- 1.4.7 The Aquifer Designation Map (Bedrock) confirms that the site is located within an 'Unproductive' aquifer, as demonstrated in **Figure 4**, below.

- 1.4.8 'Unproductive' aquifers are determined as rock layers with low permeability that have negligible significance for water supply or river base flow.

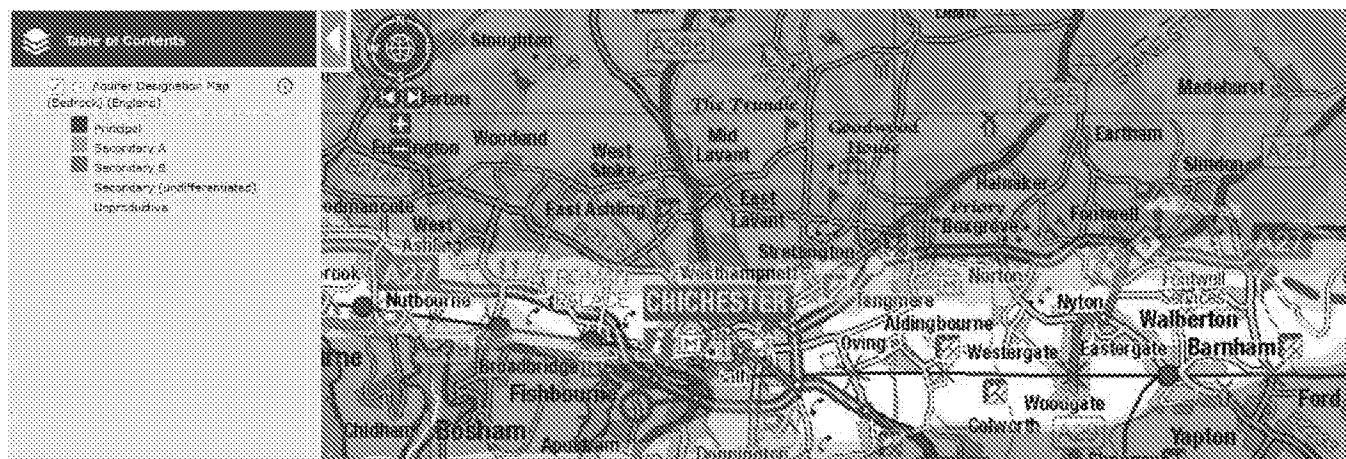


Figure 4. DEFRA Aquifer Designation Map (Bedrock)

- 1.4.9 The Aquifer Designation Map (Superficial Drift) confirms that the site is located within a 'Secondary A' aquifer, as shown in **Figure 5**.

- 1.4.10 Secondary A aquifers are identified as 'permeable layers that can support local water supplies and may form an important source of base flow to rivers.'

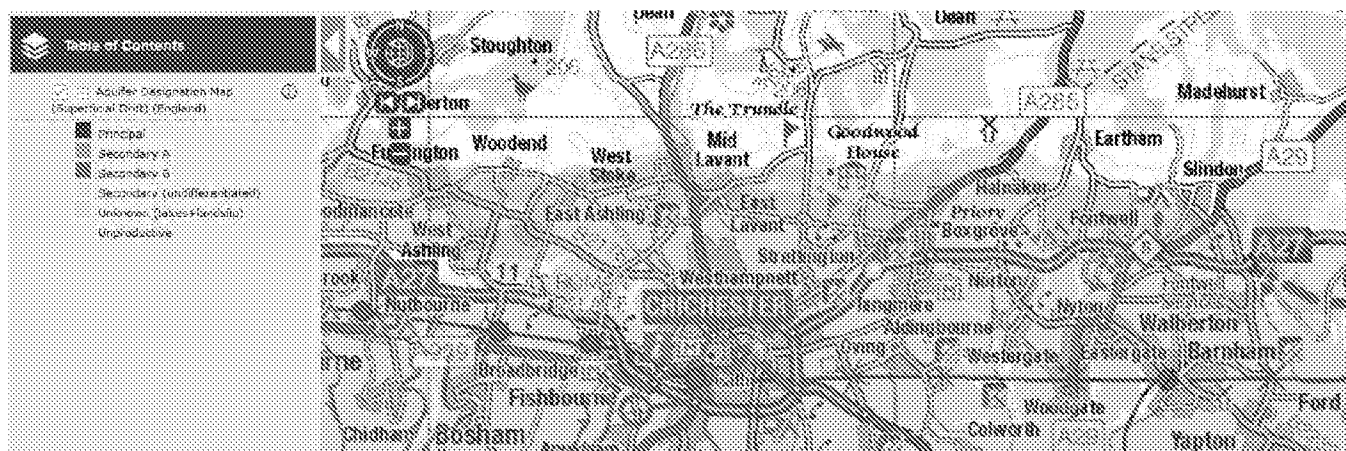
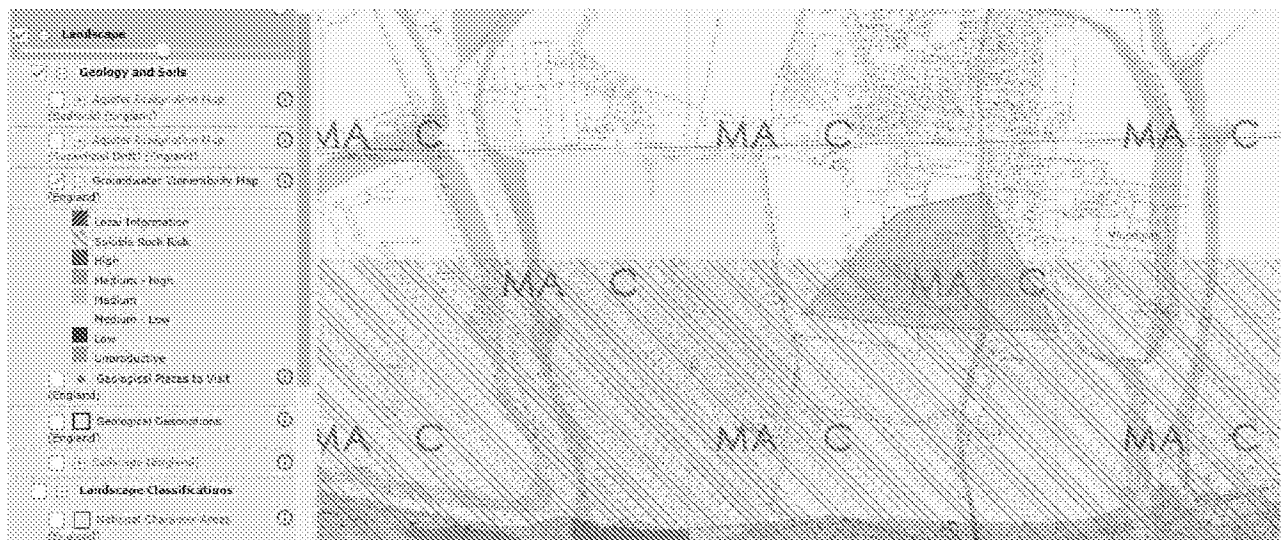


Figure 5. DEFRA Aquifer Designation Map (Superficial Drift)

- 1.4.11 The Groundwater Vulnerability Map, **Figure 6**, confirms that the site falls fully within a 'Medium – Low' Groundwater Vulnerability Zone.
- 1.4.12 A 'Medium - Low' Groundwater Vulnerability Zone is determined as 'areas that offer some groundwater protection', and/or 'areas that provide the greatest protection to groundwater from pollution. They are likely to be characterised by low-leaching soils and/or the presence of low-permeability superficial deposits.'



- 1.4.13 The site is not classified as falling within a Groundwater Source Protection Zone, as confirmed in **Figure 7**.



Figure 7. DEFRA Groundwater Source Protection Zone Map

1.5 Existing Drainage

- 1.5.1 The site falls within the Lidsey Foul Water Treatment Catchment Area, as confirmed by ADC. This area is recognised as being a sensitive area in terms of drainage whereby both foul and surface water is concerned. 'The Lidsey Surface Water Management Plan' (SWMP) largely covers the same area as the Lidsey Foul Water Treatment Catchment Area.
- 1.5.2 Surface Water:

- The Southern Water public sewer records (**Appendix D**) do not indicate any public surface water sewers within the bounds of the site, or within the immediate surrounding areas.

- Following review of the Flood Estimation Handbook (FEH) website, it is evident that the site does not fall directly within any significant upstream catchment as shown in **Figure 7**.

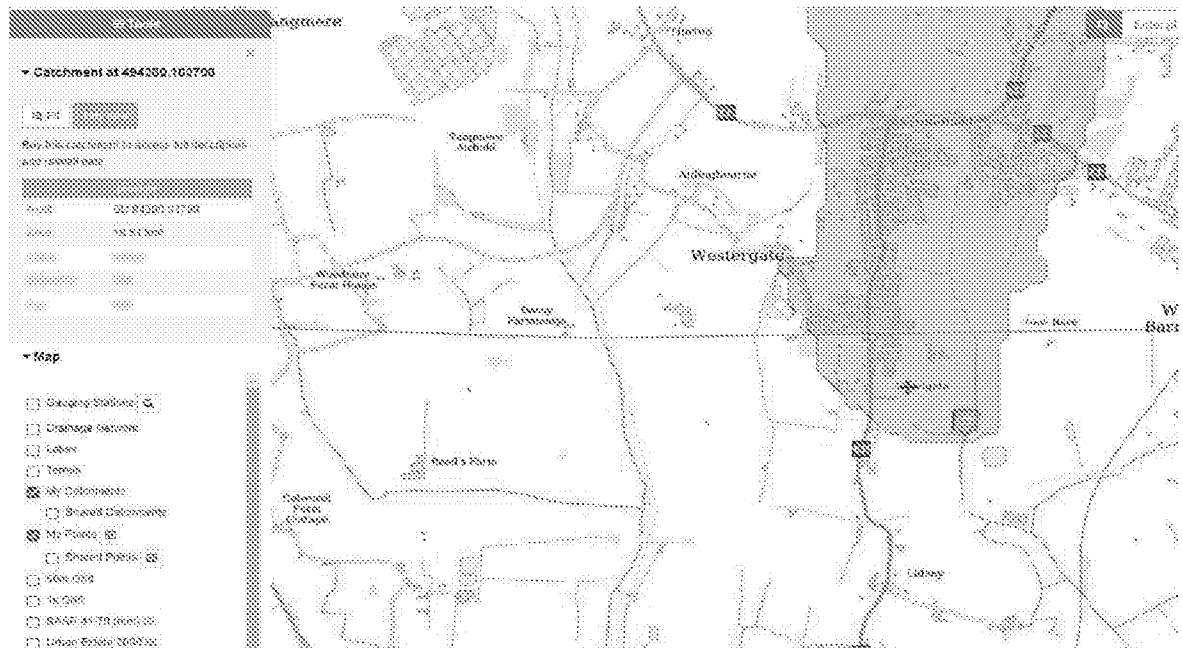


Figure 8. FEH Catchment (Wallingford)

- Greenfield run-off rate (Q_{bar}) has been calculated to be 3.0l/s ($Q_1 = 2.55$ l/s, $Q_{30} = 6.9$ l/s and $Q_{100} = 9.56$ l/s).
- There is no measurable existing impermeable area within the site. In view of this the aforementioned greenfield rates will wholly apply.

1.5.3 Foul Water:

- The Southern Water public sewer records (**Appendix D**) demonstrate existing public foul water sewers located within the bounds of the site. This is also confirmed following review of the topographical survey undertaken by CD Surveys.
- The public foul water sewer onsite is located at the northern boundary of the site and flows in a northerly direction towards Woodgate Road where it travels due east. This sewer has a depth in the range of 1.95m to 2.39m, as confirmed from Southern Water records.

1.5.4 Highway Drainage:

- Lidsey Road is served by a combination of traditional road gullies as well as kerb inlet gullies, as stated in 1.2.9. Records have been provided by WSCC confirming the positions of such, whilst CD Surveys' topographical survey also captures this information and other associated apparatus.
- The CD Survey demonstrates the highway gullies link to a series of Highway catchpits, with some linking to the culverted ordinary watercourse in vicinity of the private access.

2 PROBABILITY

2.1 Sources of Information

- 2.1.1 The NPPF requires that all sources of flooding are considered being Tidal, Fluvial, Pluvial, Groundwater, Sewers and Man-made reservoirs/canals.
- 2.1.2 The likelihood of the site flooding has been established by reviewing the following information:
- Environment Agency Flood Maps for Planning
 - Long Term Flood Risk Assessment Surface Water Flood Risk Maps
 - Long Term Flood Risk Assessment Reservoir Flood Risk Maps
 - WSCC SFRA
 - Consultation with ADC, EA and WSCC
 - Lidsey SWMP

2.2 Flood Maps and Modelling

- 2.2.1 The Environment Agency's on-line Flood Maps for Planning (Rivers and Sea) confirms that the site is located fully within Flood Zone 1.

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding. (Land shown in dark blue on the Flood Map)
Zone 3b The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map)

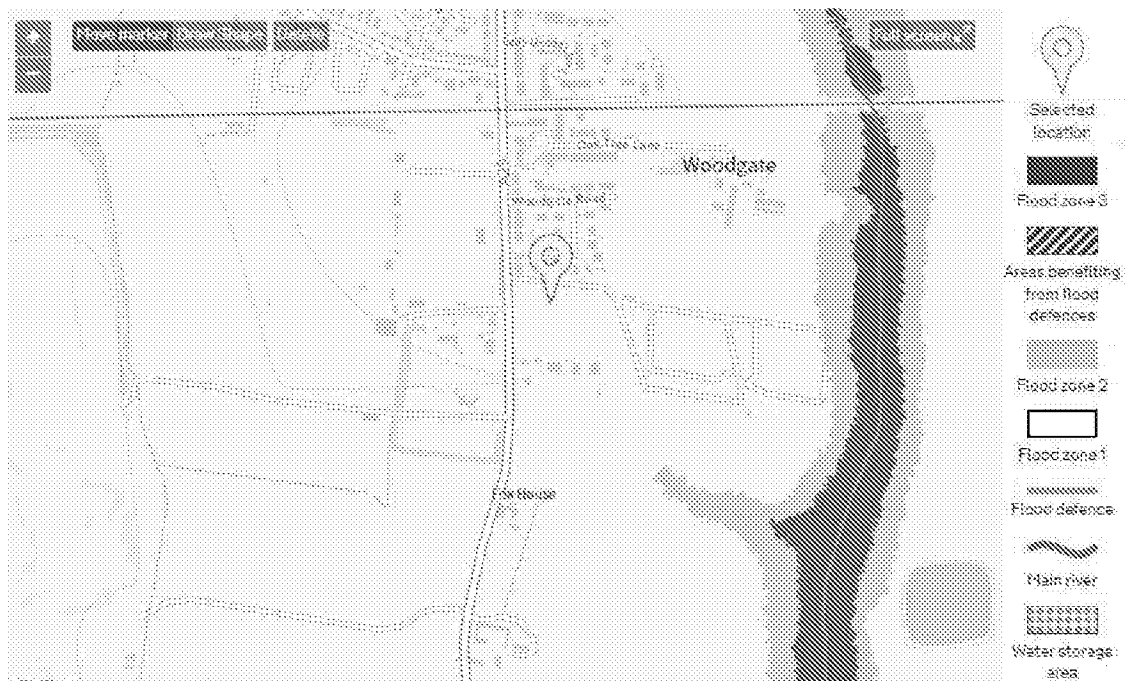


Figure 9. Flood Maps for Planning

2.2.2 The Long-Term Flood Risk Map for Rivers or the Sea confirms that part of the site is not at risk of flooding from either source (Rivers or the Sea). The nearest risk of flooding from this source is located some 200m east of the site.

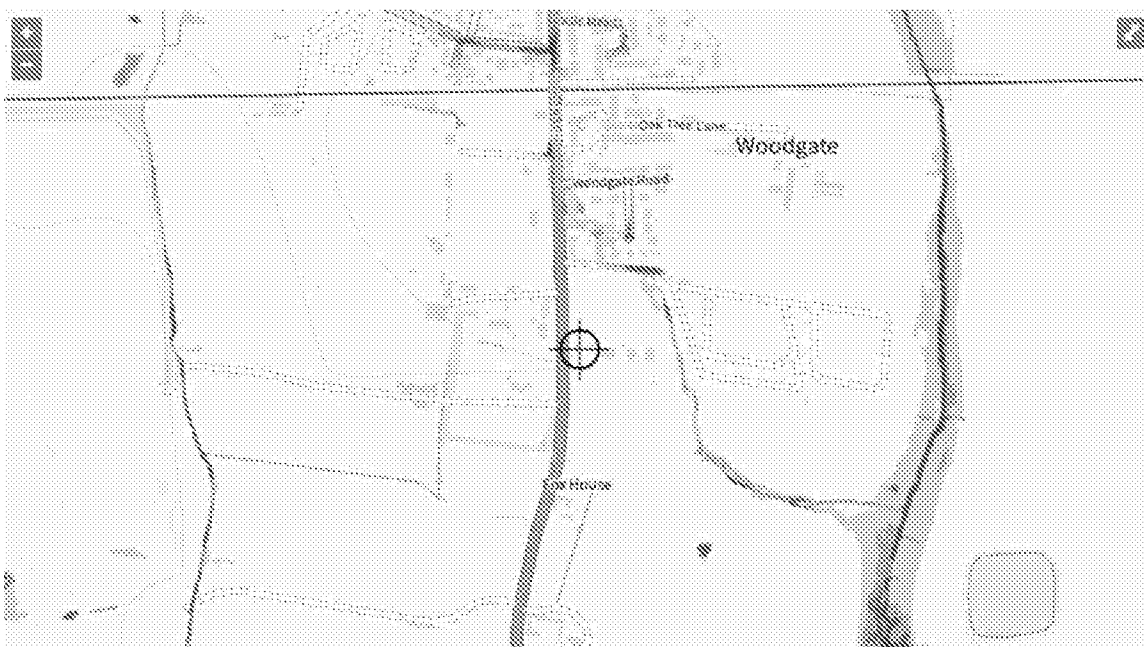


Figure 10. Long-Term Flood Risk Map - Surface Water (.Gov.uk)

2.2.3 The Long-Term Flood Risk Map for Surface Water confirms that the site is largely at 'Very Low' risk of surface water flooding. A small area to the eastern boundary is indicated as being at 'Low' risk of

surface water flooding. It is evident this area sits above the historic culverted ordinary watercourse routing which flows to the south to the receiving open watercourse in this area, which is also indicated as being at 'Low' risk of surface water flooding.

- 2.2.4 Following review of the Long-Term Flood Risk Map associated with surface water flooding (2.2.3), the associated depths of surface water flooding have also been reviewed, has anticipated surface water flood depths of 'Below 300mm'. Given that the Long-Term Flood Risk Map for Surface Water identifies low points within the local topography (See LiDAR Elevation Banding), it is evident that these areas are associated with the existing valley and watercourse which surface water will be contained.

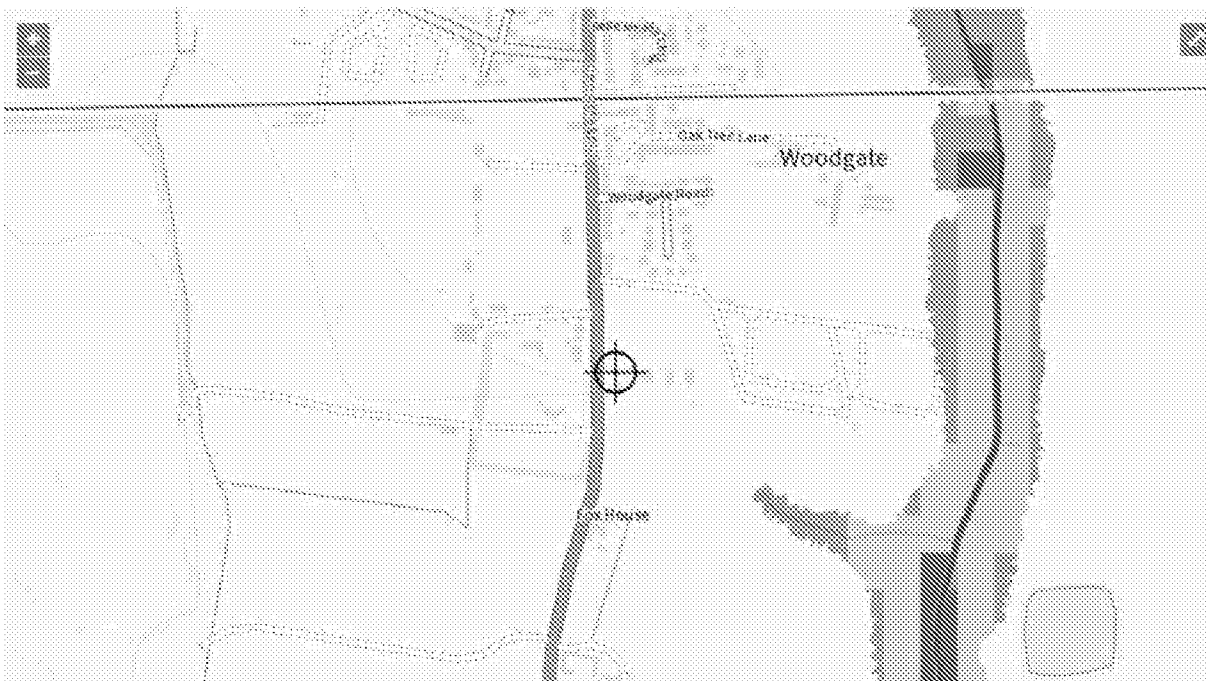


Figure 11. Long Term Flood Risk Map - Reservoirs

- 2.2.5 The Long-Term Flood Risk Map for Reservoirs confirms that the site is not at risk of flooding from this source.

2.3 Strategic Flood Risk Assessment

- 2.3.1 The site falls under the jurisdiction of ADC and WSCC.
- 2.3.2 WSCC has a published SFRA, dated January 2010, along with Local Flood Risk Management Strategy, published in May 2014.
- 2.3.3 Flood mapping and information contained within the SFRA is consistent with other flood maps reviewed and detailed within this report. The site is not specifically referenced within the SFRA.

2.4 Lidsey Surface Water Management Plan (SWMP)

- 2.4.1 As has been confirmed earlier in this report, the site falls within the Lidsey Foul Water Treatment Catchment Area and is therefore covered by the Lidsey Surface Water Management Plan (SWMP).
- 2.4.2 The report confirms that the SWMP covers generally the same areas as Southern Water's Lidsey wastewater drainage catchment, which covers Barnham, Eastergate, Elmer, Felpham, Middleton-on-

Sea, Walberton, Woodgate and Yapton.

- 2.4.3 The report, and specifically the mapping contained within its appendices, refers to the site, whilst it is noted that the mapping contained within is again consistent with that as obtained from other sources.
- 2.4.4 Within the SWMP, 'Local Flood Risk Zones' are determined. In view of such, the site falls outside of LFRZ_018 (Oak Tree Lane, Woodgate).
- 2.4.5 Extracts from the Lidsey SWMP can be found within **Appendix G** of this report.

2.5 Historic Flooding

- 2.5.1 WSCC has confirmed that they hold no records of historic flooding directly affecting the site.
- 2.5.2 WSCC has confirmed, however, that historic flooding has occurred within close proximity of the site, and within the public highway. This historic flooding is said to have occurred at the junction of Oak Tree Lane and Lidsey Road, affecting No. 1 and No. 2 Lidsey Road. It has been stated that this was as a result of surface water run-off from Lidsey Road not draining away once it flows onto the existing grass verge.
- 2.5.3 As confirmed in Section 2.4, mapping contained within the Lidsey SWMP confirms that historic surface water flooding and sewer flooding has occurred within the vicinity of the site. Confirmation of such can be found within **Appendix G** of this report ('Historic Flooding – Plan 3' mapping).

2.6 Summary of Flood Risk

2.6.1 The potential sources of flooding are:

Source of Flooding	Level of Risk
Rivers and Coastal	Very Low The site is located fully within Flood Zone 1 and there are no Main Rivers or Tidal Waters located within the immediate vicinity of the site.
Surface Water	Very Low to Low The site is confirmed as being almost entirely at 'Very Low' risk of surface water flooding, with the exceptions being to the eastern boundary of the site. The anticipated depths of surface water flooding in 'Low' risk scenarios is stated to be 'Below 300mm'.
Groundwater	Medium to High WSCC has confirmed that current JBA groundwater mapping indicates a 'moderate' risk of groundwater flooding occurring at the site, although no known instances of groundwater flooding have been recorded south of the railway lines located to the north of the site. The Lidsey SWMP indicates an equal to or greater than 75% risk of groundwater flooding at the site, whilst current groundwater monitoring results indicate groundwater at depths as shallow as 410mm below ground level.
Sewers	Low The Lidsey SWMP indicates historic sewer flooding within the vicinity of the site, understood to have occurred in Oak Tree Lane. Southern Water has been consulted in relation to historic as well as potential current issues regarding the public sewer network, and a response is currently outstanding.
Artificial Sources	None The site is not identified as being at risk of flooding from artificial sources.

2.6.2 The site is located within the Lidsey Foul Water Treatment Catchment Area, this area forming part of the Lidsey SWMP.

2.6.3 The greatest risks of flooding to the site are presented by groundwater, although there are known issues associated with surface water within the vicinity of the site, understood to be associated with the ditches located to the east, which serve to assist in draining Lidsey Road. This information should be considered in view of the proposed drainage strategy to ensure that sufficient, effective mitigation is provided to the development, whilst also ensuring that the risk of flooding occurring elsewhere, offsite, is not increased.

3 PROPOSED DEVELOPMENT

3.1 Description of Development

- 3.1.1 The proposed develop will involve the construction of 38 No. residential units, as demonstrated by the design proposals, contained within **Appendix A**.
- 3.1.2 The type of development falls within the 'More Vulnerable' classification ('Flood Risk and Coastal Change', Table 2) and is appropriate in Flood Zone 1 ('Flood Risk and Coastal Change', Table 3).

Flood Zones	Flood Risk Vulnerability Classification				
	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Flood Zone 1	✓	✓	✓	✓	✓
Flood Zone 2	✓	Exception Test Required	✓	✓	✓
Flood Zone 3a†	Exception Test Required †	✗	Exception Test Required	✓	✓
Flood Zone 3b*	Exceptions Test Required *	✗	✗	✗	✓
✓ = Development is appropriate ✗ = Development should not be permitted					

- 3.1.3 The post-development impermeable area has been determined to be 6,721m² (0.67Ha) being a significant increase compared with the existing scenario.
- 3.1.4 The use of Sustainable Drainage System (SuDS) methods and techniques (where site conditions and constraints allow) within the bounds of the site (whilst adhering to the SuDS hierarchy as stated within Building Regulations (Part H) and The CIRIA SuDS Manual C753) will be used to provide a betterment of surface water run-off compared to the existing site.
- 3.1.5 The specific foul and surface water drainage proposals are detailed in **Section 4** of this report.

4 PROPOSED DRAINAGE STRATEGY

4.1 Surface Water

4.1.1 The SUDS manual and Building Regulations set out a hierarchy of drainage methods to ensure that developments maximise the use of sustainable drainage techniques. The hierarchy favours infiltration methods of disposal over other methods such as watercourse and sewers, as detailed below;

- i. Utilise infiltration techniques
- ii. Attenuate rainwater in ponds or open water features for gradual release
- iii. Attenuate rainwater by storing in tanks or sealed water features for gradual release
- iv. Discharge rainwater direct to a watercourse
- v. Discharge rainwater to a surface water sewer/drain
- vi. Discharge rainwater to a combined sewer

SUDS Technique	Suitable	Comments
Living Roof	No	Unlikely to be viable in view of client's development proposals.
Basins and Ponds (such as Constructed Wetlands, Balancing Ponds, Detention Basins, Retention Ponds)	Yes	No current constraints identified limiting the use of such measures, although the presence of groundwater will need to be considered in their design. Anticipated 'land take' will also need to be considered in conjunction with the planted boundaries.
Filter strips and swales	Yes	No current constraints associated with such methods although, again, the presence of groundwater will need to be considered.
Infiltration Devices - Soakaways - Infiltration trenches and basins	No	Leap-Environmental has undertaken infiltration testing at the site, in accordance with BRE Digest 365. 'Relatively poor' infiltration rates were recorded within the River

		Terrace Deposits, whilst high groundwater identified during monitoring means such methods are unviable.
Permeable surfaces and filter drains - Gravelled areas - Porous block paving	Yes	It is possible permeable paving may be viable, if tanked, given the presence of shallow groundwater on site. The storage volume, and therefore the ability to infiltrate, would therefore be heavily restricted in view of such.
Tanked systems - Oversized pipes - Cellular tanks	Yes	No initial constraints identified.

- 4.1.2 Infiltration rates between 3.4×10^{-6} and 1.2×10^{-5} have been established on site with testing undertaken in accordance with BRE Digest 365, which indicate 'relatively poor' drainage capabilities of the soils on site. Infiltration testing was undertaken outside of the winter months therefore worse results are likely.
- 4.1.3 In addition to 4.1.2, groundwater has also been recorded at shallow depths (as shallow as 210mm below ground level, as determined by monitoring undertaken during November 2021) therefore also impacting upon the ability of the ground to accept surface water run-off through infiltration methods and techniques.
- 4.1.4 In view of the constraints associated with the underlying geological conditions, it is proposed that attenuated storage will be introduced on site, with a controlled discharge to the adjacent watercourse in order to manage surface water run-off generated by the development. Run-off will be restricted to mimic greenfield run-off rates, whilst a betterment will be sought, where possible.
- 4.1.5 Permeable paving will be introduced on site in order to provide high-level attenuation, as a compliant level of treatment in accordance with The CIRIA SuDS Manual C753 (Table 26.2).
- 4.1.6 Following discussions with ADC as well as WSCC, it is proposed that clearance works will be undertaken in relation to the existing ordinary watercourse within the confines of the site. The receiving watercourse will be re-graded, re-profiled in order to improve the conveyance of flows. These works are also in recognition of the recommendations as detailed within the Lidsey SWMP.
- 4.1.7 The primary surface water drainage system will support an impermeable area of $6,721 \text{ m}^2$ (0.67Ha).
- 4.1.8 A surface water detention basin measuring 716 m^2 (1.10m depth, 1:3 side-slopes) is proposed which will be supplemented by permeable paving to provide attenuation on-site.
- 4.1.9 The extents of permeable paving associated with the primary system amounts to of the order of 978 m^2 , with a sub-base depth of 500mm and 32% voids, providing a volume of storage to the order of 156.48 m^3 .
- 4.1.10 The surface water detention basin will discharge to the ordinary watercourse within the south-east corner of the site, at a controlled rate. Total discharge flows will be restricted to a maximum of 2.0l/s (pro-rata of impermeable area $(0.67)/(3.0) \text{ QBAR}$), whilst the network has been designed to accommodate up to and including a 1-in-100-year storm event, with an allowance for both climate change (40%) and urban creep (5%).

- 4.1.11 It is proposed that existing ground levels will be raised on site, to the order of up to 800mm. Whilst this mitigates the risk of potential high groundwater and surface water flooding previously advised, it also ensures the surface water basin provision remains unsaturated above groundwater. Furthermore level raising reduces the number of properties requiring a FW pumped solution (see Foul section).
- 4.1.12 The existing topography of the site, and overland (exceedance) flow routes have been considered and will be honoured in view of the proposed development to ensure that there is no increase in the risk of flooding on, or off site.
- 4.1.13 An allowance in view of urban creep has been provided in accordance with table 5.2 of the West Sussex LLFA Policy for the Management of Surface Water, in the event that an increase in areas of hardstanding occurs across the design-life of the development. An additional allowance of 5% in view of the proposed impermeable area has been allowed for in design calculations and storage provision.
- 4.1.14 The strategy above will ensure that there is no increase in the rate of run-off leaving the site, therefore no increase in the risk of flooding from this source.
- 4.1.15 The proposed surface water drainage strategy is demonstrated on drawing **PL300 – 'Proposed Drainage Strategy'**.

4.2 Treatment

- 4.2.1 The use of permeable paving will ensure that run-off from the site receives a level of treatment required by the SuDS manual, with hydrocarbons being filtered by the aggregate and geotextile layers.
- 4.2.2 In accordance with the CIRIA SuDS Manual C753 regarding methods for managing pollution risks, the risk posed by surface water run-off to the receiving environment depends on the pollution hazard at the site (the source), SuDS treatment techniques (the pathway), and the sensitivity of the environment (the receptor).
- 4.2.3 The simple index approach considers whether SuDS techniques are appropriate for the site. The states that for SuDS components to deliver adequate treatment, the total pollution mitigation index for each contaminant type should equal or exceed the pollution hazard index.
- 4.2.4 The SuDS Manual outlines three categories of pollution hazard identification, which vary depending on proposed land use, which are as follows:
- Total Suspended Solids (TSS).
 - Metals (M).
 - Hydrocarbons (H).
- 4.2.5 In accordance with C753 Table 26.2, the proposed land uses at the site are categorised as follows:
- Residential Roofs and non-trafficked areas – very low/TSS=0.2/M=0.2/H=0.05
 - Individual property driveways and low traffic roads – low/TSS=0.5/ M=0.4/H=0.4
- 4.2.6 In accordance with C753 Table 26.3, the values of SuDS Mitigation indices are provided for permeable

paving:

- Permeable Pavement – TSS=0.7/M=0.6/H=0.7
- SW Basin (Pond) - TSS-0.7/M-0.7/H-0.5

4.2.7 As the pollution hazard index does not exceed any pollution mitigation index for any contaminant type, the proposed SuDS methods will provide sufficient treatment for the proposed development.

4.3 Foul Water Drainage

4.3.1 It is proposed that the development will utilise a connection to the existing public foul water sewer network.

4.3.2 As confirmed in 1.5.3, there is a 150mm dia. public foul water sewer located within the confines of the site, with a depth in the region of 1.95m deep. It is proposed that this sewer will serve the development.

4.3.3 Investigation in relation to the existing foul water drainage infrastructure located on site should be undertaken prior to any development works being undertaken, as it is possible existing connections could be retained, and utilised, where appropriate.

4.3.4 Part of the lower lying site will require a pumping station to serve approximately half of the proposed dwellings. Allowance has been made for a Type 2 pumping station in accordance with the Design and Construction Guidance (2020) (DCG).

4.3.5 Based on the residual design guidance provided in Design and Construction Guidance (2020), post development, it is anticipated that total peak foul water flows will be 1.76l/s. This will of course vary where a foul water pump is required.

4.3.6 Recent changes to infrastructure and connection charges (OFWAT Charging Rules) place the onus on the sewerage undertaker to reinforce their network should there no longer be sufficient capacity to serve the new development. Funding for this is provided by revised charging arrangements for infrastructure and connection charges for each dwelling constructed comprising a Network Reinforcement Charge and Site-Specific Charges. The revised charging arrangement (funded by the developer) covers alterations to the Existing Sewer Network and the sewerage undertaker remains responsible for the cost of reinforcing their Strategic Assets. The developer is responsible for connecting the development to the public sewer network.

4.3.7 A connection to the public sewer network will require consent from Southern Water in conjunction with a Section 106 approval.

4.3.8 As confirmed by ADC, the site falls within the Lidsey Foul Water Treatment Catchment Area. Given the sensitivity of drainage matters within this catchment area, Southern Water has been consulted in relation to the development proposals. Their response is pending, however it is noted no formal response was provided for the current planning approval for this site.

4.4 Climate Change

4.4.1 In December 2019 the Environment Agency updated the latest climate change allowances (available online at <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>), which supports the NPPF in making an allowance for climate change within flood risk assessment. The allowances provide predictions of anticipated change for peak river flow by river basin district and peak

rainfall intensity.

- 4.4.2 The table below shows the anticipated changes in extreme rainfall intensity. For flood risk assessments, both the central and upper end allowances should be assessed to understand the range of impact.

Applies across all of England	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper End	10%	20%	40%
Central	5%	10%	20%

- 4.4.3 Based on the latest allowances, an increase of 20% should be applied to peak rainfall to this development, with a review undertaken to determine the impact of a 40% increase.

5 RESIDUAL RISK AND MITIGATION

5.1 Residual Risk

5.1.1 The following residual risks have been identified in relation to the proposed development:

- i. Extreme rainfall events that exceed the design criteria used for the drainage system causing surface water flooding.
- ii. Blockage of the receiving ordinary watercourse(s) resulting in flooding on site.
- iii. Blockage/failure of the proposed drainage system causing flooding to the site.
- iv. Flooding in the event of high groundwater levels.
- v. Flooding in the event of blockage/failure/surcharging of the public sewer network.

5.2 Mitigation

5.2.1 Consideration has been taken to the residual risks stated in Section 5.1, and the following mitigation measures are proposed:

- The proposed drainage strategy has been developed to accommodate a 1-in-100-year storm event, inclusive of an allowance for the effect of climate change (40%) as well as Urban Creep (5%), should the impermeable area at the site increase across its design life. Should a rainfall event occur which exceeds this design criteria, there is potential for the drainage system to be inundated, and exceedance to occur, potentially resulting in flooding. Exceedance flows would follow the existing topography of the site with post-development flow routes mimicking the existing situation, as so not to increase the risk of flooding elsewhere, either on, or off-site. The Long-Term Flood Risk Maps for Surface Water indicate 'Very Low' and at worse a 'Low' risk of surface water flooding, with anticipated depths of surface water flooding stated to be 'Below 300mm'. On-site levels shall be engineered to ensure that any exceedance flows are directed away from buildings, and in particular, thresholds.
- Improvements are proposed in relation to the existing ordinary watercourse within the site. This will be cleared, re-graded, re-profiled. These measures will ensure a greater ability for the channel(s) to convey flows, whilst also reducing the risk of blockage. Maintenance is critical in ensuring flood risk is managed effectively – the required actions in relation to the maintenance of the ordinary watercourse network is detailed within **Section 8 – 'Maintenance'**.
- The proposed drainage system will attenuate run-off up to a 1-in-100-year storm event, inclusive of allowances for climate change and urban creep (40% and 5%, respectively). Blockages to the components of the drainage system has the potential to cause flooding to proposed development. Surcharged flows will likely follow the local natural topography, conveyed to a larger downstream watercourse. Maintenance plays an essential role in managing flood risk and ensuring the drainage system is kept operating to its peak capacity. **Section 8 – 'Maintenance'** will mitigate the risk of the system becoming blocked.

- WSCC state that there is a 'moderate' risk of groundwater flooding at the site, whilst the Lidsey SWMP indicates a risk of groundwater flooding equal to or greater than 75% probability. Groundwater monitoring undertaken to date confirms the presence of groundwater at depths as shallow as 210mm below ground level. It is proposed the levels on site will be raised, up to 800mm to limit the impact of potential groundwater and surface water flooding. In addition to this, levels will be designed in order to ensure any flows are directed away from dwellings, and specifically, thresholds.
- Southern Water has been consulted in relation to the development proposals, with acknowledgement of an increase in foul water flows generated in association with the development, which will discharge to the public sewer network. Following recent changes to infrastructure and connection charges (OFWAT Charging Rules), it is the responsibility of Southern Water to ensure that their network is reinforced sufficiently in order to support development should capacity not exist already. This is funded through the revised charging arrangement. At present, a response from Southern Water has not yet been received. An update will be provided, in due course, once a response has been received.

6 SEQUENTIAL AND EXCEPTION TESTS

6.1 Sequential Test

- 6.1.1 The proposed development and site is located fully within Flood Zone 1 and is therefore at 'Low' risk of flooding. In view of this, the application of the Sequential Test is not required.

6.2 Exception Test

- 6.2.1 The proposed development fall within the 'More Vulnerable' classification as specified in 'Flood Risk and Coastal Change', Table 2.
- 6.2.2 Table 3, 'Flood Risk and Coastal Change' confirms that 'More Vulnerable' development is compatible with Flood Zone 1.
- 6.2.3 In view of the above, application of the Exception Test is not required.

7 FLOOD RISK MANAGEMENT

7.1 Safe Access and Egress

- 7.1.1 Pedestrian and vehicular access to the site will be available directly off of Lidsey Road.
- 7.1.2 The proposed development falls entirely within Flood Zone 1 and is expected to remain for its intended design life.
- 7.1.3 The site is confirmed as being at 'Very Low' to 'Low' risk of surface water flooding. The areas at perceived increased risk of surface water flooding ('Low' risk) have associated anticipated depths of flooding not exceeding 300mm ('Below 300mm'). Should surface water flooding occur to such depths, it is not envisaged that Emergency Service vehicles would be restricted in terms of their ability to safely access or egress from the site.
- 7.1.4 Further to 7.1.3, it is not envisaged either that standard vehicles would be impeded by depths of flooding 'Below 300mm'.
- 7.1.5 In view of the above, it is deemed that safe access and egress from the proposed development can be provided.

8 MAINTENANCE

8.1 Proposed Maintenance Regime

- 8.1.1 Maintenance is required to ensure the long-term operational performance of the proposed surface water drainage system.
- 8.1.2 The drainage system has been designed to minimise maintenance requirements; however, a number of key tasks will need to be undertaken so that the system remains in optimum condition. These operations are summarised in the table below, along with the required frequency of works.

Drainage System feature	Proposed maintenance / remedial works	Required frequency of works
Permeable Paving	Surface sweeping to reduce silt and debris accumulation.	Every 8 to 12 weeks
	Removal / management of weed growth	At least once a year
	Silt removal from permeable surfaces, possibly involving raking out of joints, redressing, removal and remedial works.	As required / to be specified by manufacturer
Inlet, Outfall and Existing Watercourses	Inspection, vegetation clearance and additional clearing/cleansing of potential outfall blockages	At least once a year
	Desilting	Year 1, Year 3, then every 5 years
Diffuser units & catch pits, gully sumps and drains	Inspection and additional cleansing as required.	Annual
	Desilting	Year 1, Year 3, then every 5 years
Pipework	Jetting to clear blockages	As required

- 8.1.3 The responsibility of any drainage infrastructure supporting a single dwelling/plot will be the sole responsibility of the owner/occupier of the associated dwelling.
- 8.1.4 Additional maintenance activities beyond this will be the responsibility of a nominated management company, to be appointed by the developer upon completion of the development.
- 8.1.5 A detailed maintenance document shall be established prior to appointment in order to detail the roles and responsibilities where maintenance is concerned.

Permeable Paving / Diffuser Units

- 8.1.6 The areas of permeable paving are designed to allow surface water run-off to percolate through the joints in the block paving surface course and into the sub-base below. This provides a volume of attenuated storage before collected run-off is discharged, at a control rate, to the receiving outfall(s).
- 8.1.7 As part of the permeable paving system, diffuser units are used to discharge surface water run-off from roof areas into the sub-base, as well as forming links between areas of permeable paving. These diffuser units are small heavy-duty cellular units which allow more efficient discharge of surface water into the sub-base base of the permeable paved areas. Catchpits will be installed upstream of diffusers to mitigate fines/debris entering the sub-base.
- 8.1.8 The areas of permeable paving will require additional maintenance measures to ensure they operate

as designed. Failure in carrying out this maintenance, could increase the risk of flooding. The additional measures are as follow:

- Periodic surface sweeping to reduce silt and debris accumulation. The permeable surfaces should be swept at least every 8 to 12 weeks with additional sweeps in the autumn to clear fallen leaves
- Removal / management of weed growth, as required. Typically, once or twice a year for regularly used areas
- Periodic silt removal from permeable surfaces as described by the manufacturer. If any areas are showing signs of ponding, they shall be dealt with by raking out the joints and redressing. The entire surface shall be monitored and when there are signs of excessive siltation resulting in poor drainage over the whole area, the blocks shall be taken up and a replacement of bedding layer and geotextile shall be undertaken
- Redressing of joints on the block paving as required
- Catchpits upstream of diffuser units should be emptied and inspected on the same regime as all catchpits specified previously set out in this document

Flow Control Chambers/Devices

- 8.1.9 A flow control chamber (such as a HydroBrake or Crown Vortex Flow Control) or device is self-activating, relying on upstream hydraulic head to generate an air-filled vortex within the centre of the casing. Once the vortex is initiated water drains down through a small opening in the back of the device at the designed restricted flow rate.
- 8.1.10 Whilst the units are self cleansing and thus by default, boast a very low risk of blockage, the flow control device has two measures in case of emergency (i.e. blockage). The first is a door situated in the front of the unit itself, this can be operated from the surface by a release cable situated just under the manhole cover which closes under its own weight and does not require any mechanism to operate. The second is a high-level overflow pipe situated within the flow control manhole. Both measures allow the system to drain down freely, until the blockage can be cleared.
- 8.1.11 The flow control chamber will require additional maintenance measures to ensure it operates as designed. The additional measures are as follows:
- The sump within the flow control chamber should be monitored for build-up of silts and should be emptied, as a minimum, on the same regime as specified for catchpits previously within this document
 - The drain down door located on the centre of the unit will require inspection and opening annually, to ensure it is operating as intended.

Surface Water Detention Basin

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Remove litter and debris	Monthly
	Cut grass in and around pond	Monthly (during growing season) or as required
	Manage other vegetation and remove nuisance plants	Monthly at start and then as required
	Inspect inlets and outlets for blockages and clear as required	Monthly
	Inspect banks for damage and repair as required	Monthly
	Inspect inlets and pond surface for silt accumulation. Establish silt removal frequency	Monthly for first year then annually or as required
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlet	Annually or as required
Occasional Maintenance	Reseed areas of poor growth	As required
	Trim overhanging trees and remove cuttings	Every 2 years
Remedial Actions	Repair erosion or other damage by reseeding or returfing	As required
	Repair inlets and outlets	As required
	Relevel uneven surfaces and reinstate design levels	As required

Remedial/Repair Actions

- 8.1.12 Significant storm events may cause considerable damage to SuDS and their associated components. As such, it may be necessary to inspect and carry out essential recovery works to return the feature to full working order.
- 8.1.13 Resetting of uneven blocks by lifting block area, removing bedding material and relaying to match original design are all actions which may need to be undertaken.

Accidental Spillages

- 8.1.14 It is not envisaged that any materials are to be stored onsite once the development has been completed, which could cause major spills and potential pollution issues within the drainage system. If this situation alters in the future consultation with a specialist will be required in order to confirm if any

upgrades to the existing system are necessary.

- 8.1.15 Minor spillages of fuels and oils will be dealt with by the permeable paving and deep trapped gullies, by biodegrading and collecting the hydrocarbons respectively.

Future Alterations to the Development

- 8.1.16 Any future alterations to the permeable paving should be confirmed by a specialist. Where possible any future services are to avoid being located through areas of permeable paving. If new services are required to run through areas of permeable paving, services should be installed below the depth of permeable paving with the permeable system reinstalled above.

9 OFFSITE IMPACTS

- 9.1.1 As established already within this report, improvement works are proposed in relation to the existing watercourse within the site, which will serve to provide surface water drainage functionality to the development.
- 9.1.2 The existing watercourse will be cleared, re-graded, re-profiled and re-aligned in order to provide an overall betterment, and improved conveyance of flows.
- 9.1.3 There will be no increase in the rate of run-off leaving the site, as flows will be restricted to pre-development greenfield run-off rates as a minimum, although betterment will be sought, where possible.
- 9.1.4 There will be an increase in foul water flows presented to the public sewer network, however, in view of revised charging arrangements, it is Southern Water's responsibility to provide reinforcement to their assets in order to provide capacity to support development.
- 9.1.5 The effects of climate change along with urban creep have both been considered in the overall drainage strategy for the site, with allowances of 40% and 5% made, respectively, in view of each.
- 9.1.6 In view of the above, there will be no adverse off-site impacts as a result of the development being completed.

10 SUMMARY

- 10.1.1 This site-specific flood risk assessment is based on Flood Maps for Planning, Long-Term Flood Risk Maps, WSCC SFRA, ADC, WSCC and Southern Water Drainage Records, Geo-Environmental Ground Appraisal Report, BGS Information and Records and the Lidsey SWMP.
- 10.1.2 Levels on site range from 8.90m AOD to 6.70m AOD with consistent easterly falls across the entire site. The north-south cross section of the site can largely be considered flat.
- 10.1.3 There is no measurable pre-development impermeable area.
- 10.1.4 The proposed development consists of 38 No. residential units, with an associated impermeable area totalling 6,721m² (0.67Ha).
- 10.1.5 The site, and proposed development, falls entirely within Flood Zone 1, and is at 'Very Low' to 'Low' risk of flooding from all sources, with the exception of groundwater flooding ('Medium' to 'High').
- 10.1.6 Post-development surface water run-off will be managed via sustainable means. Infiltration has been confirmed to be unviable, in view of infiltration rates determined on site as well as because of the presence of groundwater at shallow depths. Surface water will discharge, to the existing ordinary watercourse network, at a controlled rate, to mimic greenfield run-off rates.
- 10.1.7 Improvement works will be undertaken in relation to the existing ordinary watercourse network to provide betterment.
- 10.1.8 The proposed drainage system has been designed to accommodate a 1-in-100-year storm event, whilst both climate change (40%) and urban creep (5%) have been included. Flows leaving the site will be restricted to QBAR greenfield rates, which for this site is 2.0l/s.
- 10.1.9 Foul water will discharge to the Southern Water public foul water sewer network. Post-development peak foul flows have been determined to be in the region of 1.76l/s (based on Design and Construction Guidance (2020), 4000l/day). Any connection will be subject to approval from Southern Water, following a Section 106 application.
- 10.1.10 Following completion of the development, there will be no increase in the overall flood risk either on, or off-site.
- 10.1.11 In conclusion, the development is deemed to be suitable from a flood risk and drainage perspective.

DRAWINGS

- PL100** Site Location Plan
- PL101** Surface Water Flood Extents Plan
- PL102** Surface Water Flood Hazard Plan
- PL103** LiDAR Contours
- PL104** LiDAR Elevation Banding
- PL105** Proposed Levels & Contours
- PL200** Impermeable Areas
- PL300** Drainage Strategy
- PL301** SW Basin Cross Sections



NOTES

1. The drawings to be used in conjunction with all other drawings, and with all relevant documents and information, shall be the responsibility of the Engineer.
2. BPC assumes no responsibility for inaccuracies in data provided by third parties and/or topographic surveys in subsequent survey mapping.
3. The road works work to figure dimensions only. All dimensions are to be confirmed before any work commences and all work to be done from the topographic survey data.
4. Any information given regarding existing underground services is given in good faith after consultation with the relevant authority, however accuracy is not certain.

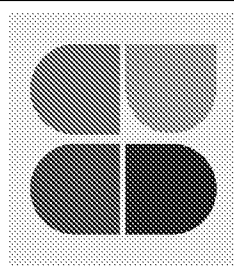
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PLANNING

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