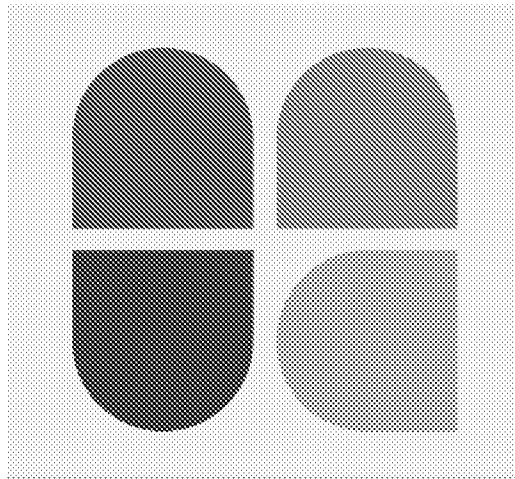




BRIGHT PLAN CIVILS

LAND AT WINGS NURSERY, LIDSEY ROAD.

PROPOSED RESIDENTIAL DEVELOPMENT

Flood Risk Assessment & Drainage Strategy

Prepared on Behalf of
Southern Housing Group Ltd

D1757/FRA1.3

05 June 2020

DOCUMENT CONTROL

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Proposed Residential Development

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1 INTRODUCTION

1.1 Background

- 1.1.1 Bright Plan Civils is instructed by Southern Housing Group Ltd to prepare a Flood Risk Assessment (FRA) and Drainage Strategy with reference to the proposed development at Wings Nursery, 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 81 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
 - MK 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 25,382m² (2.53Ha).
- 1.2.3 The site itself is largely undeveloped, although an existing dwelling ('Wings') is located centrally along the eastern boundary, whilst a dilapidated glasshouse is housed to the south-eastern extent.
- 1.2.4 A site-specific topographical survey has been undertaken by MK Surveys, dated August 2019, which demonstrates levels ranging from 8.04m AOD to 9.48m AOD, although there are no consistent falls across the entire site. The northern half of the site broadly falls from south-west to north-east, whilst the southern half of the site can largely be considered flat, with minimal falls from west to east generally evident.
- 1.2.5 In its current use, the site has an existing impermeable area to the order of 1859m² as demonstrated on

drawing **PL200 – ‘Existing Impermeable Area’**.

- 1.2.6 The site is bound to the north by a private drive which serves Lidsey Road Nursery whilst beyond the eastern boundary 2 No. ordinary watercourse ditches (which are linked via a culvert at the access to 'Wings') are present. There is existing residential development beyond the southern boundary whilst to the west, the site is bound by a watercourse which falls to the south.
- 1.2.7 The site currently drains to the existing ditches located within the immediate vicinity of the boundaries of the site, with minimal levels of infiltration also understood to support the site.
- 1.2.8 The topographical survey undertaken by MK Surveys indicates existing surface water drainage infrastructure supporting 'Wings', which is understood to discharge to the ordinary watercourse located to the east of the site.
- 1.2.9 Lidsey Road is served by a combination of traditional road gullies (primarily along the eastern channel of the carriageway) as well as kerb inlet gullies, located along the western extent of carriageway.

1.3 Ground Conditions

- 1.3.1 A site-specific ground appraisal report has been prepared by Geo-Environmental, dated October 2019.
- 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 Geo-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 Topsoil was encountered and recorded to depths ranging between 0.15m and 0.30m below ground level, in all locations with the exception of TP1, TP2 and WS7, consisting of *'dark brown silt sand with roots and rootlets.'*
- 1.3.5 River terrace Deposits were encountered within all locations to depths of between 2.00m and 4.00m below ground level, generally consisting of *'soft to very stiff silty sandy clay becoming silty sandy clay with occasional fine to coarse sub-angular chert, overlying fine to medium sand.'*
- 1.3.6 London Clay Formation was encountered at a depth of 3.50m below ground level within WS1 and WS7, although at no other locations across the site. This was described as *'stiff grey clay'*.
- 1.3.7 Full borehole and trial pits logs associated with the on-site investigation works undertaken are contained within **Appendix B** of this report.
- 1.3.8 In addition to the ground appraisal report produced by Geo-Environmental, reference has also been made to the BGS website in order to qualify the findings of the report.
- 1.3.9 Bedrock geology is reported by the BGS as being 'London Clay Formation – Clay, Silt and Sand'.

- 1.3.10 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.'

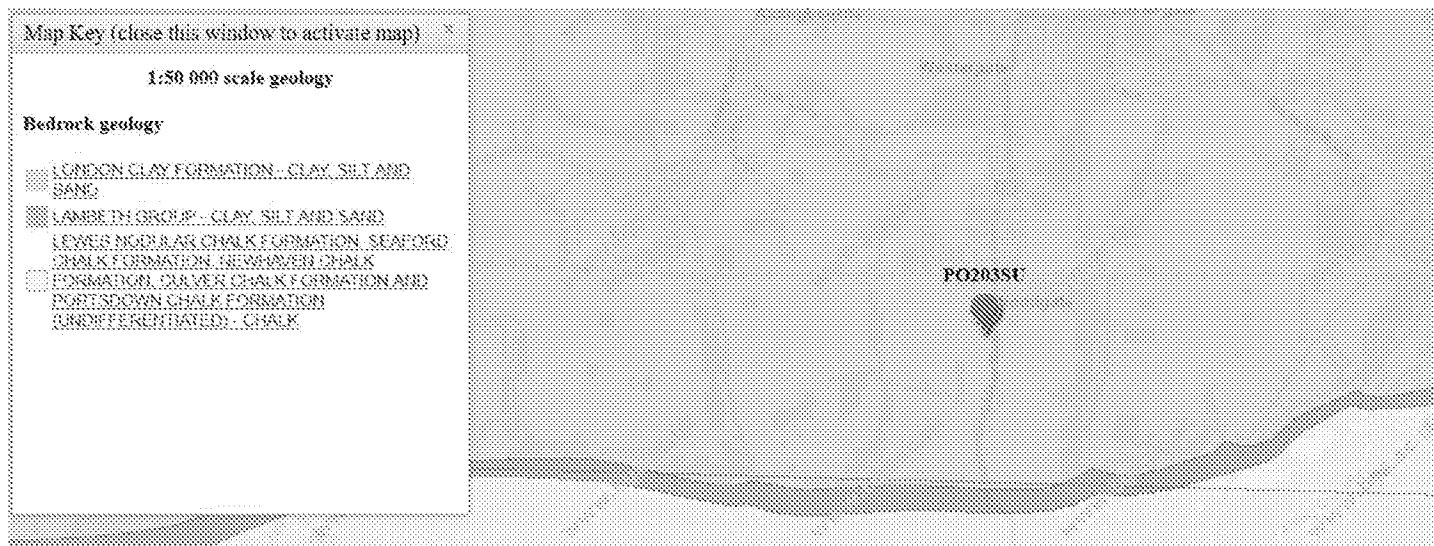


Figure 1. BGS – Bedrock Geology

- 1.3.11 Superficial Deposits are recorded as 'River Terrace Deposits (Undifferentiated) – Sand, Silt and Clay', as confirmed below, in **Figure 2**.

- 1.3.12 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).'

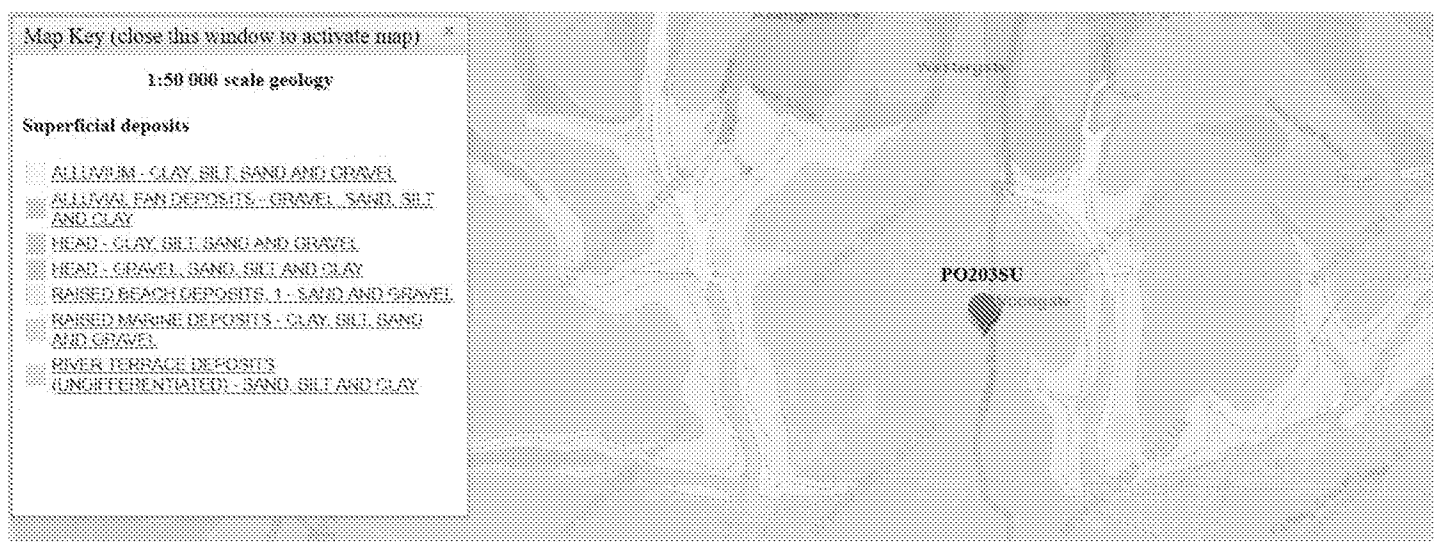


Figure 2. BGS – Superficial Deposits

- 1.3.13 BGS historic borehole records have also been reviewed in relation to the site, further to the on-site investigation undertaken.
- 1.3.14 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).

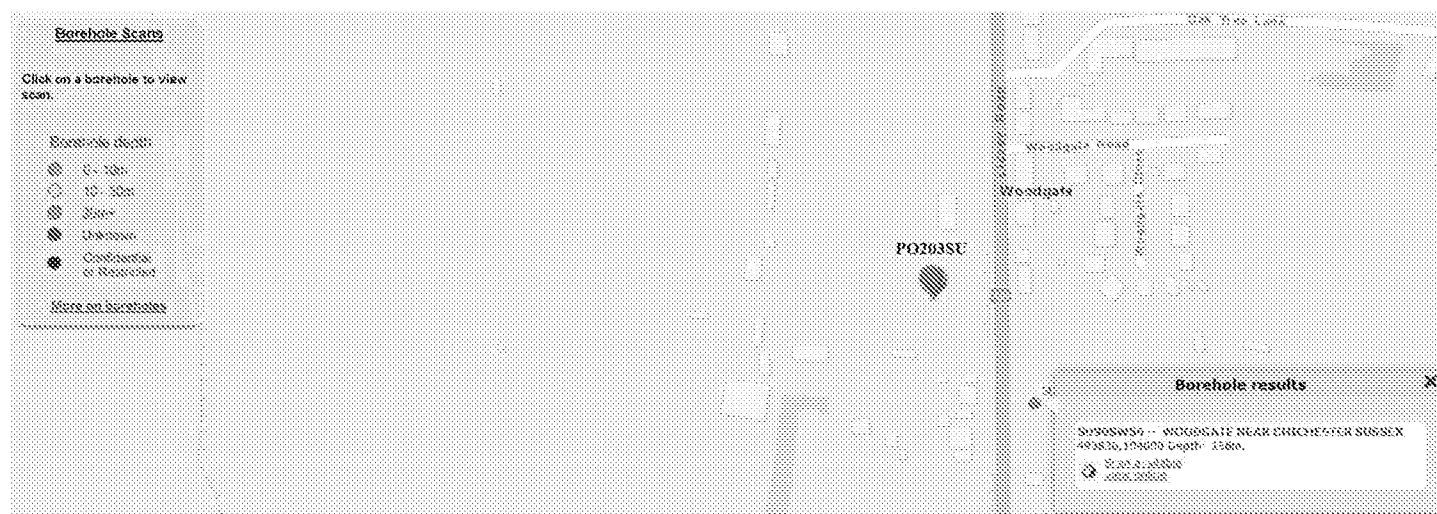


Figure 3. BGS Historic Borehole Location

- 1.3.15 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.
- 1.3.16 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.
- 1.3.17 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 Geo-Environmental included groundwater investigation and a period of subsequent groundwater monitoring.
- 1.4.2 Groundwater was encountered at depths of between 1.85m below ground level whilst siteworks were being undertaken, with standing water levels obtained ranging from 1.20m and 2.50m below ground level after a period of twenty minutes.
- 1.4.3 Groundwater monitoring wells remain in situ at present, within WS1, WS2, WS3 and WS6, to depths ranging from 2.50m and 3.70m below ground level.
- 1.4.4 At present, based on the groundwater monitoring results obtained to date, groundwater is confirmed as peaking at 0.41m below ground level, at WS1 (reading obtained on 25th November 2019). For the winter period recorded to date, groundwater levels have ranged between 1.24m below ground level and 0.41m below ground level.
- 1.4.5 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.
- 1.4.6 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.
- 1.4.7 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.

- 1.4.8 The Aquifer Designation Map (Bedrock) confirms that the site is located within an 'Unproductive' aquifer, as demonstrated in **Figure 4**, below.
- 1.4.9 'Unproductive' aquifers are determined as rock layers with low permeability that have negligible significance for water supply or river base flow.

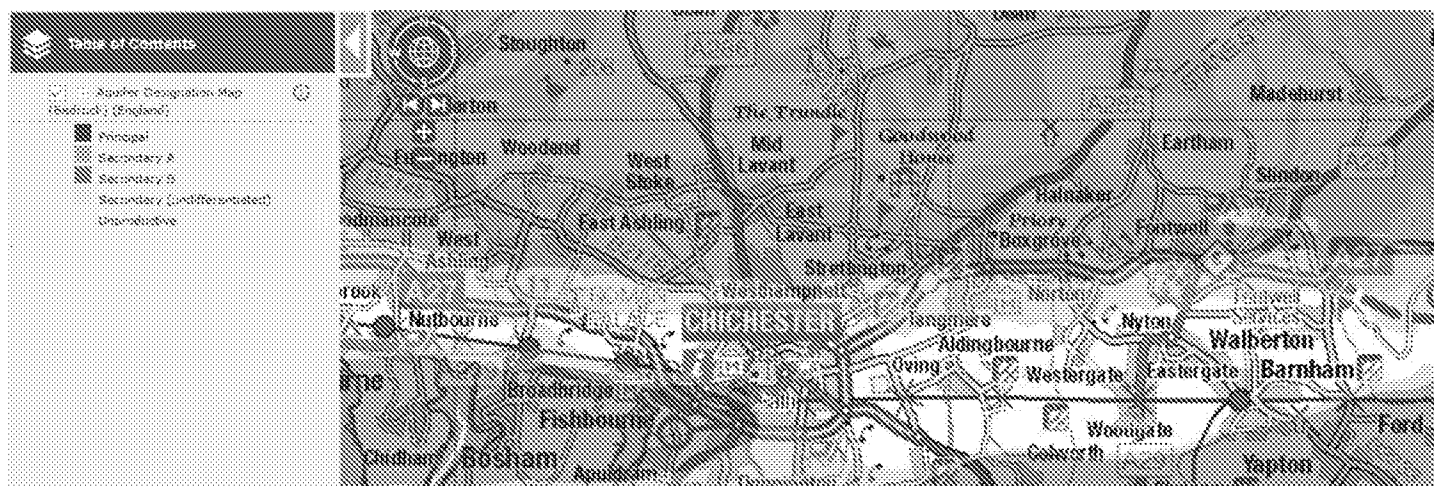


Figure 4. DEFRA Aquifer Designation Map (Bedrock)

- 1.4.10 The Aquifer Designation Map (Superficial Drift) confirms that the site is located within a 'Secondary A' aquifer, as shown in **Figure 5**.
- 1.4.11 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.'

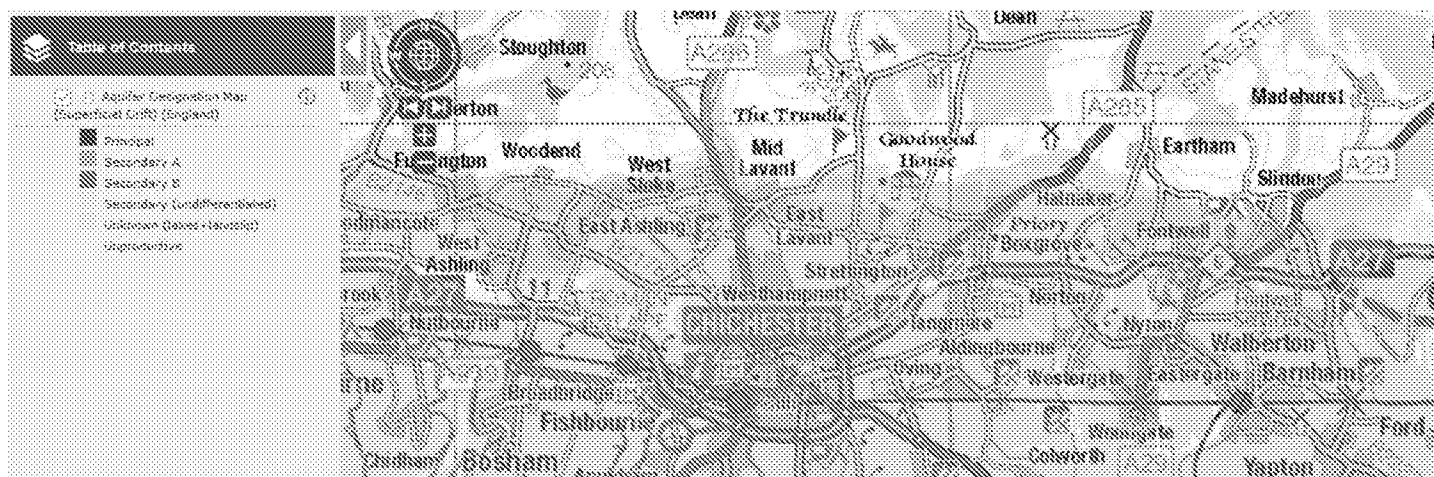


Figure 5. DEFRA Aquifer Designation Map (Superficial Drift)

- 1.4.12 The Groundwater Vulnerability Map, **Figure 6**, confirms that the site falls fully within a 'Medium – Low' Groundwater Vulnerability Zone.
- 1.4.13 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.'

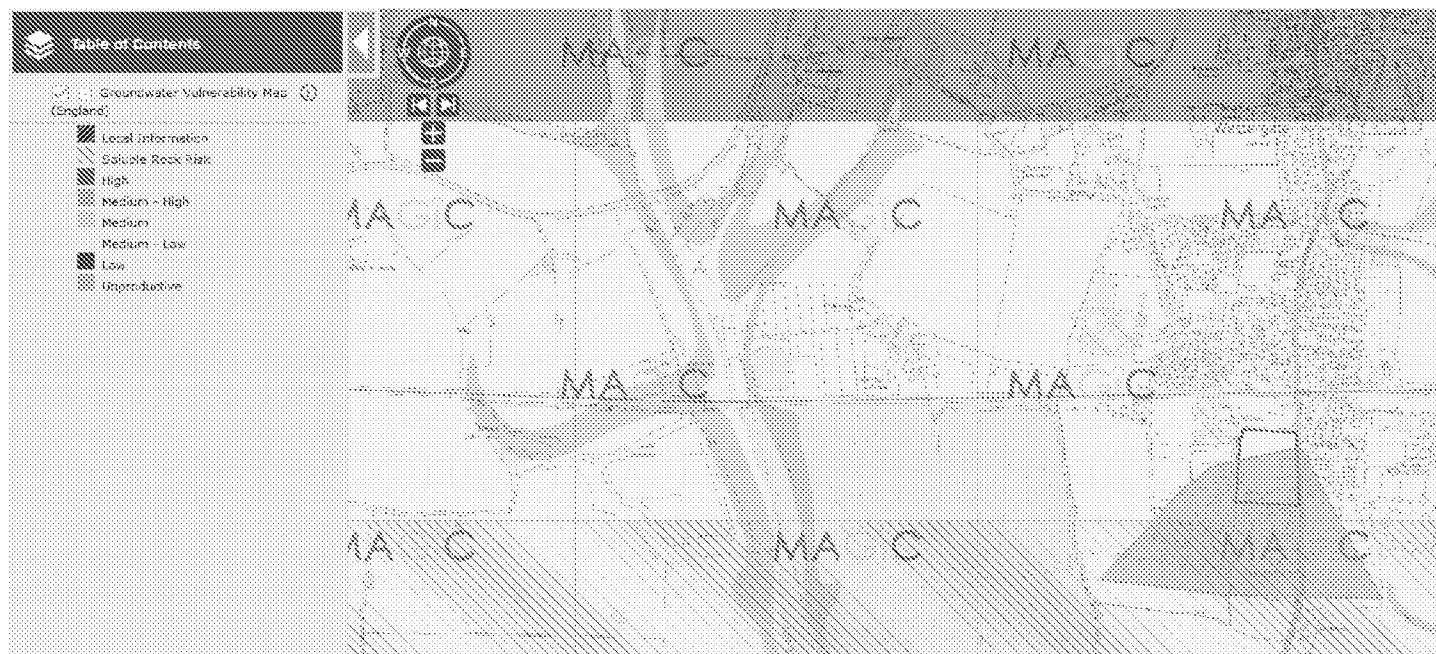


Figure 6. DEFRA Groundwater Vulnerability Map

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

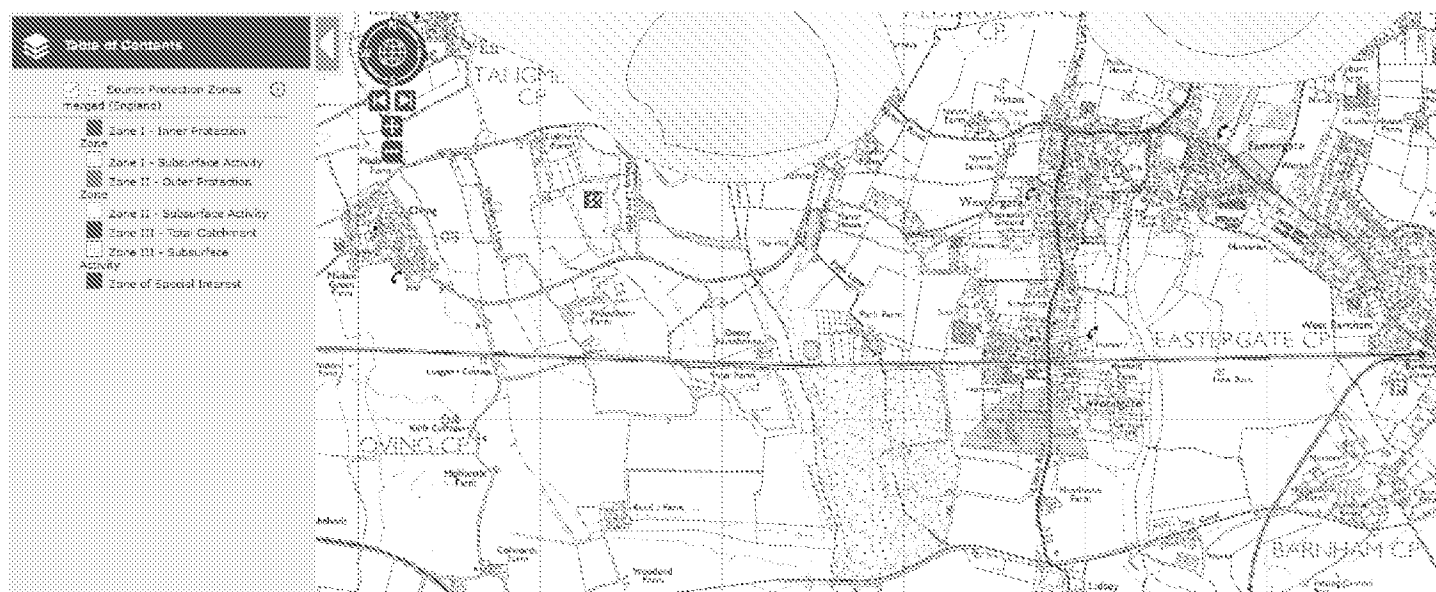


Figure 7. DEFRA Groundwater Source Protection Zone Map

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.
- As identified in 1.2.7 and 1.2.8, the site currently drains to the existing ordinary watercourse network within the vicinity of the site (to the east and west). It is also likely that limited infiltration will occur.
- There are 2 No. open ditches adjacent to the eastern boundary of the site, which are linked by a 150mm culvert at the access to 'Wings'. There is a further open ditch upstream of the site, which is again linked via a culvert, adjacent to the access to Lidsey Road Nursery.
- The topographical survey undertaken by MK Surveys identifies surface water drainage infrastructure supporting the existing property ('Wings') on site. It is understood that this infrastructure discharges to the watercourse adjacent to the eastern boundary of the site and Lidsey Road.
- MK Surveys' topographical survey also identifies a 150mm outfall to the ditch to the north of the site, adjacent to the access to Lidsey Road Nursery (private road). Investigation should be undertaken to establish whether this serves to drain the site, or an associated upstream catchment.
- Following review of the Flood Estimation Handbook (FEH) website, it is evident that the site does not fall directly within any significant upstream catchment.
- Greenfield run-off rate (Q_{bar}) has been calculated to be 9.5l/s ($Q_1 = 8.1l/s$, $Q_{30} = 21.6l/s$ and $Q_{100} = 30.4l/s$)
- The greenfield run-off volume is calculated to be 631.983m³ (based on FEH, SPR of 37% and 1-in-100 year, 360-minute event). The percentage run-off is calculated to be 38.36%.
- There is an existing impermeable area at the site, totalling approximately 1859m² (0.19Ha), associated with the existing development. In view of this, that the rate, and volume of run-off, is will to exceed that of the greenfield rates established, above.
- An assessment has been made in order to establish the 'true' rate of run-off associated with the existing impermeable area of the site, or a fairer reflection, which has been determined to be in the region of 25.82l/s (based on 50mm rainfall per hour).

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 MK Surveys.
- The public foul water sewer onsite is located at the southern boundary of the site and flows in an easterly direction before diverting to the north (parallel to the eastern boundary). The sewer then diverts to the east, and follows down Woodgate Road, to the east of the site. This sewer has a depth in the range of 2.07m to 2.39m, as confirmed onsite by MK Surveys.
- The existing property ('Wings') utilises a connection to the public foul water sewer network, although the point of connection has not currently been confirmed.

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 MK Surveys' topographical survey also captures this information.
- Although not confirmed, it is anticipated that Lidsey Road drains to the existing ditch network adjacent to the eastern boundary of the site, which in turn discharges to a piped highway drainage system to the south-east of the site.

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)

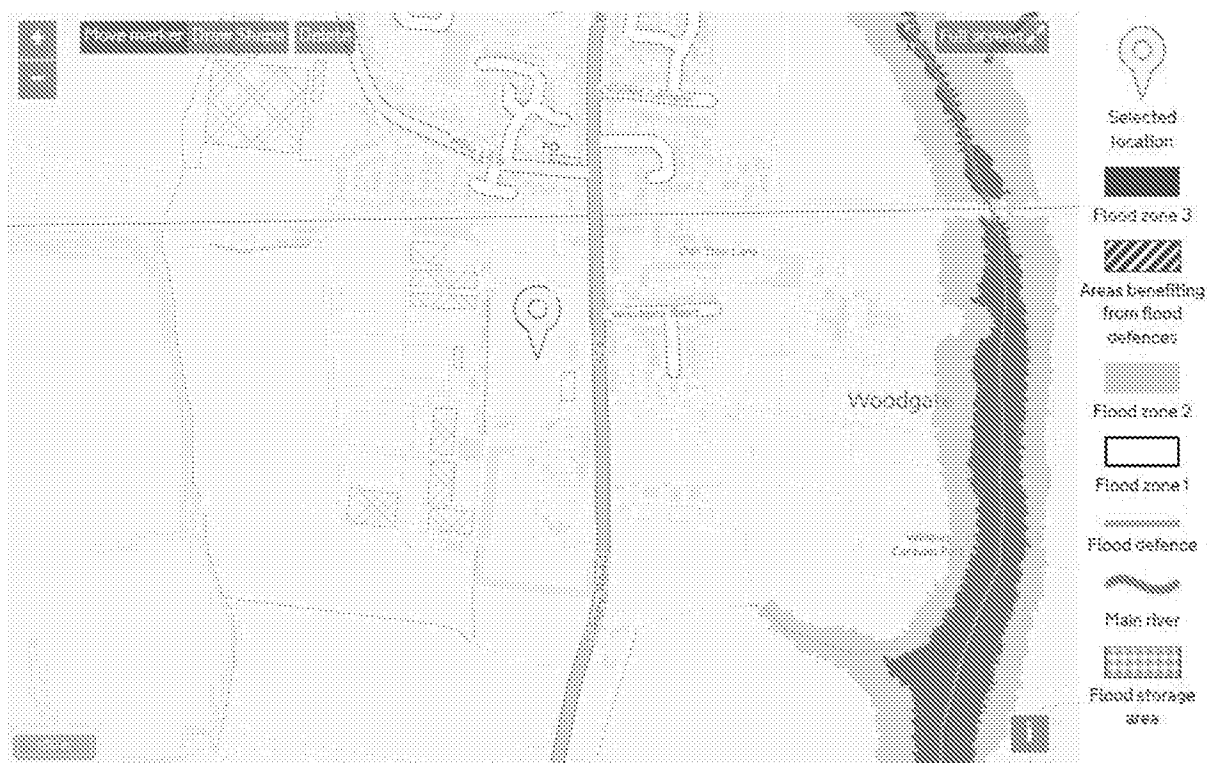


Figure 8. Flood Maps for Planning



Figure 9. Long-Term Flood Risk Map - Rivers or the Sea (.Gov.uk)

- 2.2.2 The Long-Term Flood Risk Map for Rivers or the Sea confirms that 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 500m east of the site.

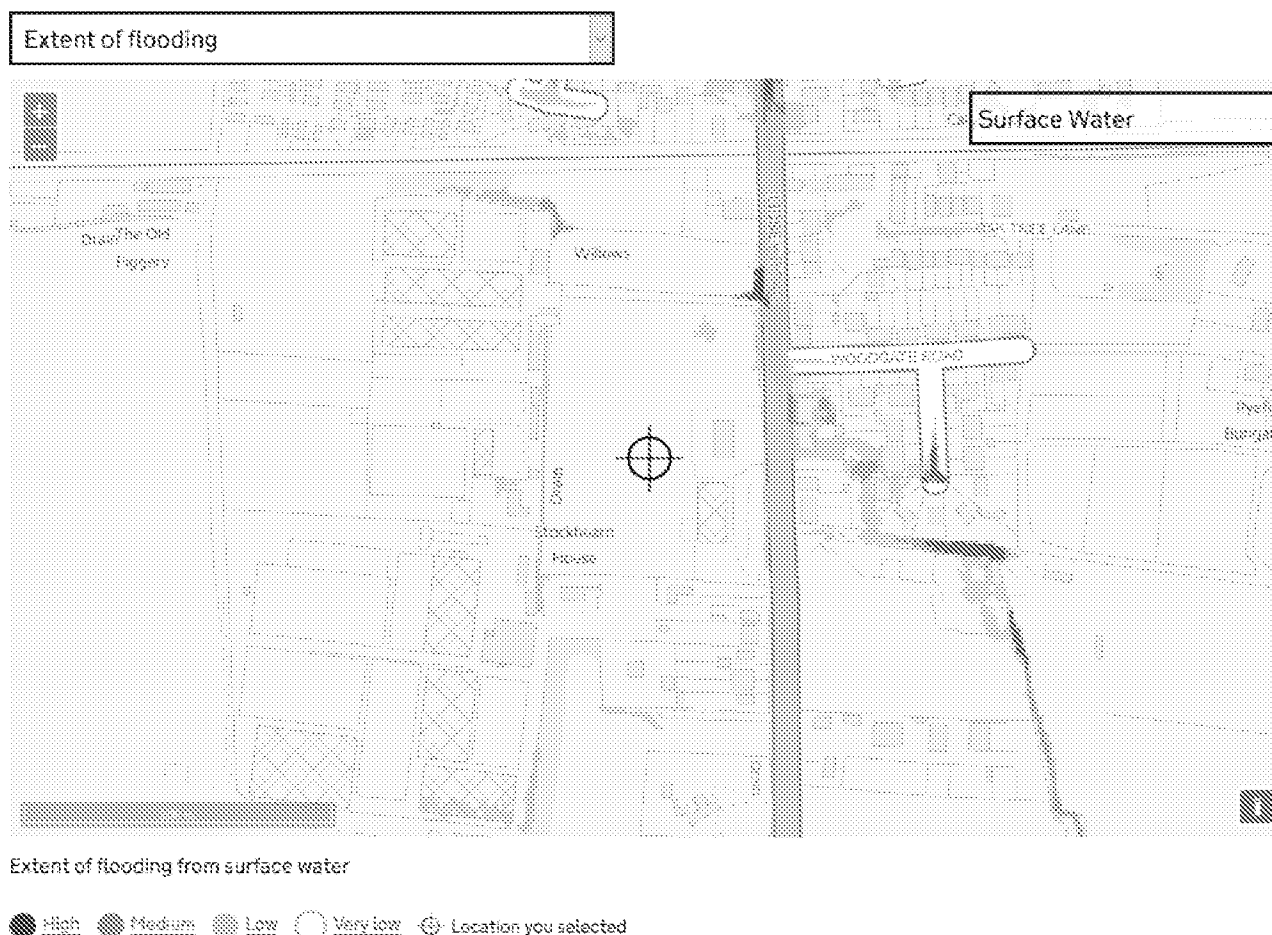


Figure 10. Long-Term Flood Risk Map - Surface Water (.Gov.uk)

- 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 north-east corner of the site is indicated as being at 'Low' risk of surface water flooding. Lidsey Road and the ordinary watercourse located towards the north-east corner of the site are also demonstrated as being at 'Low' risk of surface water flooding. Areas to the south-west of the site, adjacent to the watercourse in this area, are 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, as demonstrated below in **Figures 11**. The area to the north-east corner of the site stated to be susceptible to 'Low' risk of surface water flooding, has anticipated associated surface water flood depths of 'Below 300mm'. The areas within the vicinity of the watercourse(s) which abut the eastern boundary of the site are indicative of having associated depths of flooding in the range of '300 - 900mm' in 'Low' risk scenarios. Given that the Long-Term Flood Risk Map for Surface Water identifies low points within the local topography, it is evident that these areas are associated with the existing ditches, within which surface water will be contained.



Figure 11. Long-Term Flood Risk Map - Surface Water, 'Low' Risk Depths (.Gov.uk)

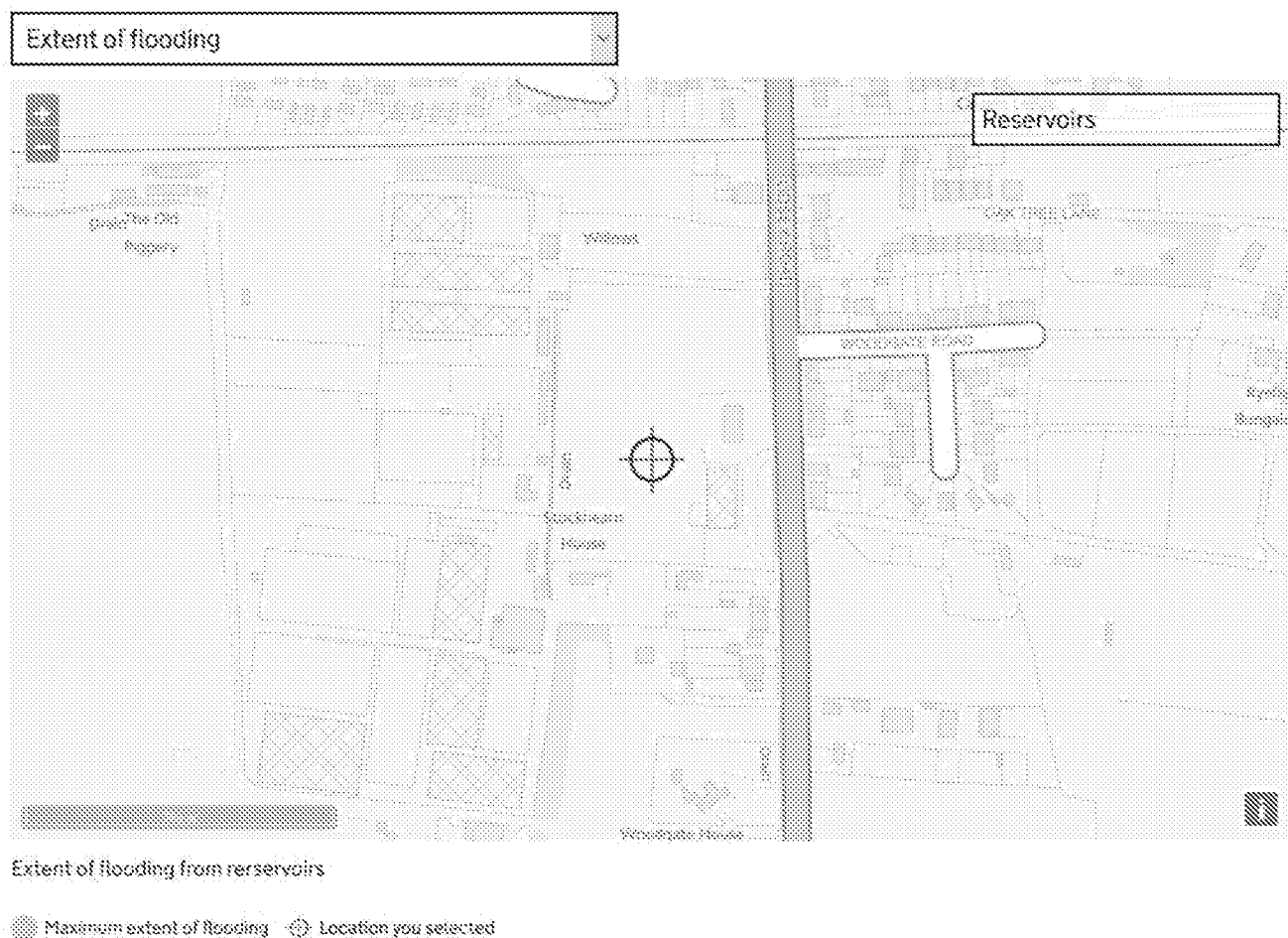


Figure 12. Long Term Flood Risk Map - Reservoirs

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 Plan 3 ('Historic Flooding', contained within **Appendix G** of this report) indicates surface water flooding within the immediate vicinity of the site, and potentially affecting 'Wings' (the existing property on site). In addition to this, the same map demonstrates sewer flooding within close proximity of the site, within Oak Tree Lane, to the east of the site.
- 2.4.6 Plan 6 ('Flood Risk from Groundwater Sources', contained within **Appendix G** of this report) indicates that the site is at an equal to or greater than 75% risk of groundwater flooding.
- 2.4.7 Plan 11 ('Modelled Flood Depths 1% AEP 1 in 100 Year Event', contained within **Appendix G** of this report) is consistent with the Long-Term Flood Risk Map for Surface Water – demonstrating surface water flooding not exceeding 300mm in depth for the areas indicated as being susceptible to this source of flooding.
- 2.4.8 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 north-eastern corner of the site, along the eastern boundary (within the vicinity of the existing ditches) as well as to the south-west corner of the site, which are indicated as being at 'Low' risk of surface water flooding. 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 development will involve the construction of 81 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 9326m² (0.93Ha) an increase of 7467m² (0.74Ha) compared with the existing impermeable area at the site which totals approximately 1859m².
- 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.
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	Geo-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 of 5.4×10^{-6} (TP2), 5.1×10^{-6} (TP3), 9.4×10^{-6} (TP5) and 5.7×10^{-6} (TP6) have been established on site further to testing undertaken in accordance with BRE Digest 365, which indicate 'relatively poor' drainage capabilities of the soils on site.
- 4.1.3 In addition to 4.1.2, groundwater has also been recorded at shallow depths (as shallow as 410mm below ground level, as determined by monitoring undertaken to date) 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, is it proposed that attenuated storage will be introduced on site, with a controlled discharge to the adjacent watercourse network provided 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 well as a level of treatment in accordance with The CIRIA SuDS Manual C753.
- 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 network of ditches within the vicinity of the site, with specific attention to the ditches to the east of the site, adjacent to Lidsey Road. These receiving ditches will be re-graded, re-profiled and in certain areas re-aligned, 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 In addition to 4.1.6, a section of the watercourse which is currently culverted (at the access to 'Wings') will be reinstated as 'open ditch'.
- 4.1.8 The extent of permeable paving will total 1330m², and with a 450mm sub-base along with 32% void ratio, will provide a volume of storage in the region of 190m³.
- 4.1.9 This high-level attenuation will be support by the installation of a dry pond providing a volume of storage totalling 550m³. The discharge from the pond to the existing watercourse network, in two locations, will be restricted to a maximum of 6.5l/s for all design storms up to and including a 1 in 100 year event.
- 4.1.10 It is proposed that existing ground levels will be raised on site, to the order of up to 600mm, in order to mitigate the risk of potential groundwater flooding.
- 4.1.11 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.

- 4.1.12 An allowance in view of Urban Creep has been provided, in the event that an increase in areas of hardstanding occurs across the design-life of the development. An additional allowance of 10% in view of the proposed impermeable area has been allowed for in design calculations and storage provision.
- 4.1.13 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.
- 4.1.14 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
- 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
 - 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 bounds of the site, with a depth in the region of 2.07m to 2.39m deep. It is proposed that this sewer will serve the development.
- 4.3.3 It is understood that the existing property on site ('Wings') benefits from a connection to this sewer, although the point of connection has not been confirmed.
- 4.3.4 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.
- 4.3.5 Based on the residual design guidance provided in Sewers for Adoption, post development, it is anticipated that total peak foul water flows will be 3.75l/s.
- 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 included in the appendices.

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 (10%), 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 watercourse network within the vicinity of the site. The ditches along the eastern boundary of the site will be cleared, re-graded, re-profiled and re-aligned, with a section which is currently culverted to be re-instated as 'open ditch'. 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 10%, 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, before being intercepted by either private drainage infrastructure or that which supports the public highway. 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 410mm below ground level. It is proposed the levels on site will be raised, up to 600mm to limit the impact of potential groundwater 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 (as it is proposed that the permeable paving will be tanked in view of site constraints) 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.
- 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 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.

Dry Pond

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 reseeded 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

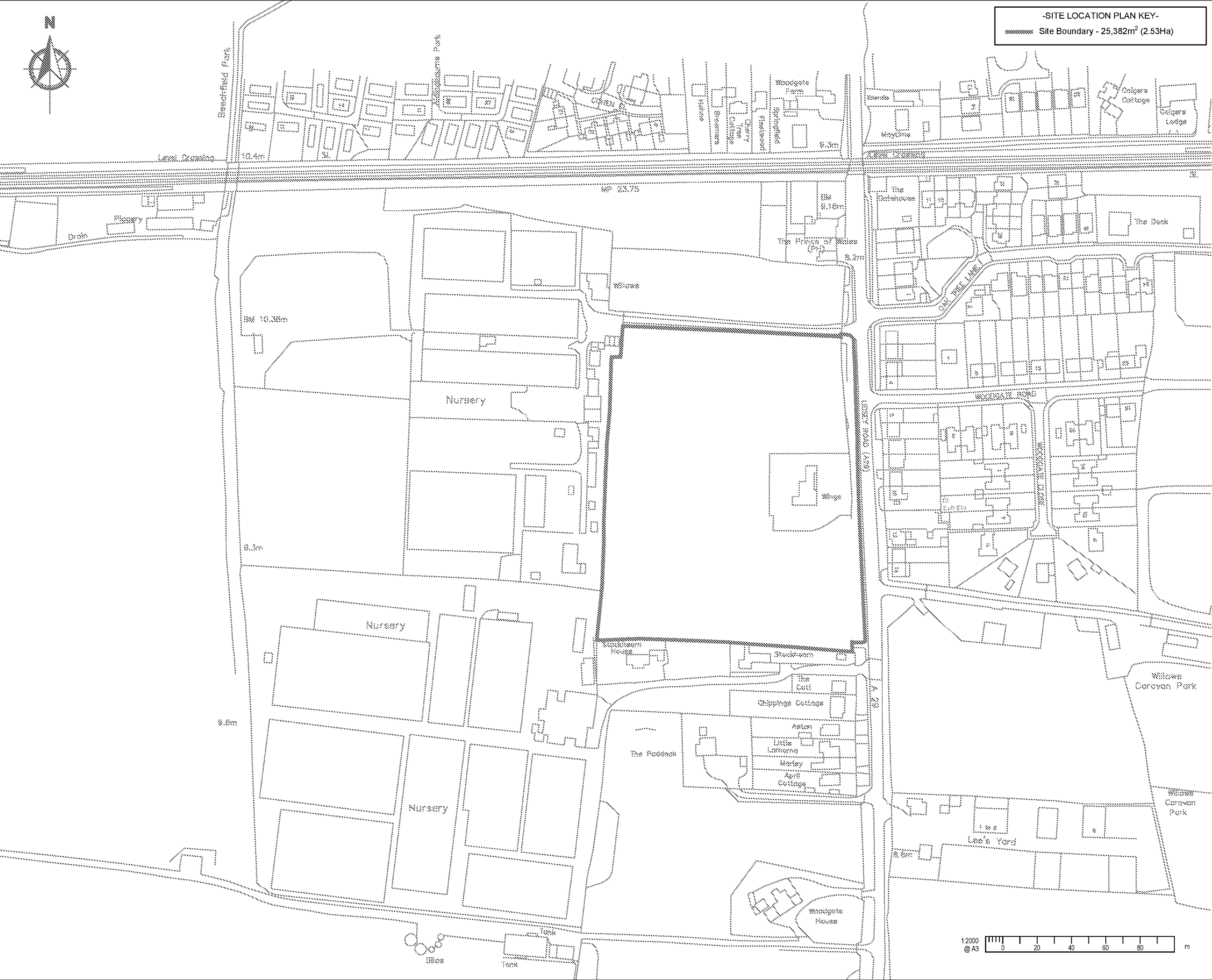
- 9.1.1 As established already within this report, offsite improvement works are proposed in relation to the watercourses within the vicinity of the site, which will serve to provide surface water drainage functionality to the development.
- 9.1.2 The existing watercourses will be cleared, re-graded, re-profiled and re-aligned, with a section which is currently culverted also being reinstated as 'open ditch' 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 10% 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 8.04m AOD to 9.48m AOD, although there are no consistent falls across the site as a whole. The northern half of the site broadly falls from south-west to north-east, whilst the southern half of the site can largely be considered flat, with minimal falls from west to east generally evident.
- 10.1.3 The pre-development impermeable area totals approximately 1859m² (0.19Ha).
- 10.1.4 The proposed development consists of 81 No. residential units, with an associated impermeable area totalling 9326m² (0.93Ha).
- 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 (10%) have been considered.
- 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 3.75l/s (based on Sewers for Adoption 7th Edition, 4000l/day). Any connection will be subject to approval from Southern Water, following a Section 106 application.
- 10.1.10 Both climate change and urban creep have been considered in the design of the proposed surface water drainage strategy.
- 10.1.11 Following completion of the development, there will be no increase in the overall flood risk either on, or off-site.
- 10.1.12 In conclusion, the development is deemed to be suitable from a flood risk and drainage perspective.

DRAWINGS

- PL100** Site Location Plan
- PL200** Existing Impermeable Area
- PL201** Proposed Impermeable Area
- PL300** Proposed Drainage Strategy



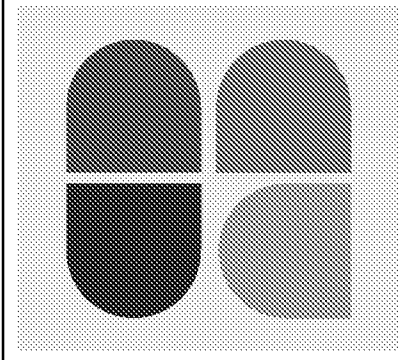
-SITE LOCATION PLAN KEY-
Site Boundary - 25,382m² (2.53Ha)

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4. Any information given regarding existing underground services is given in good faith after consultation with the relevant authority, however accuracy is not certain.

PLANNING

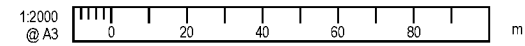
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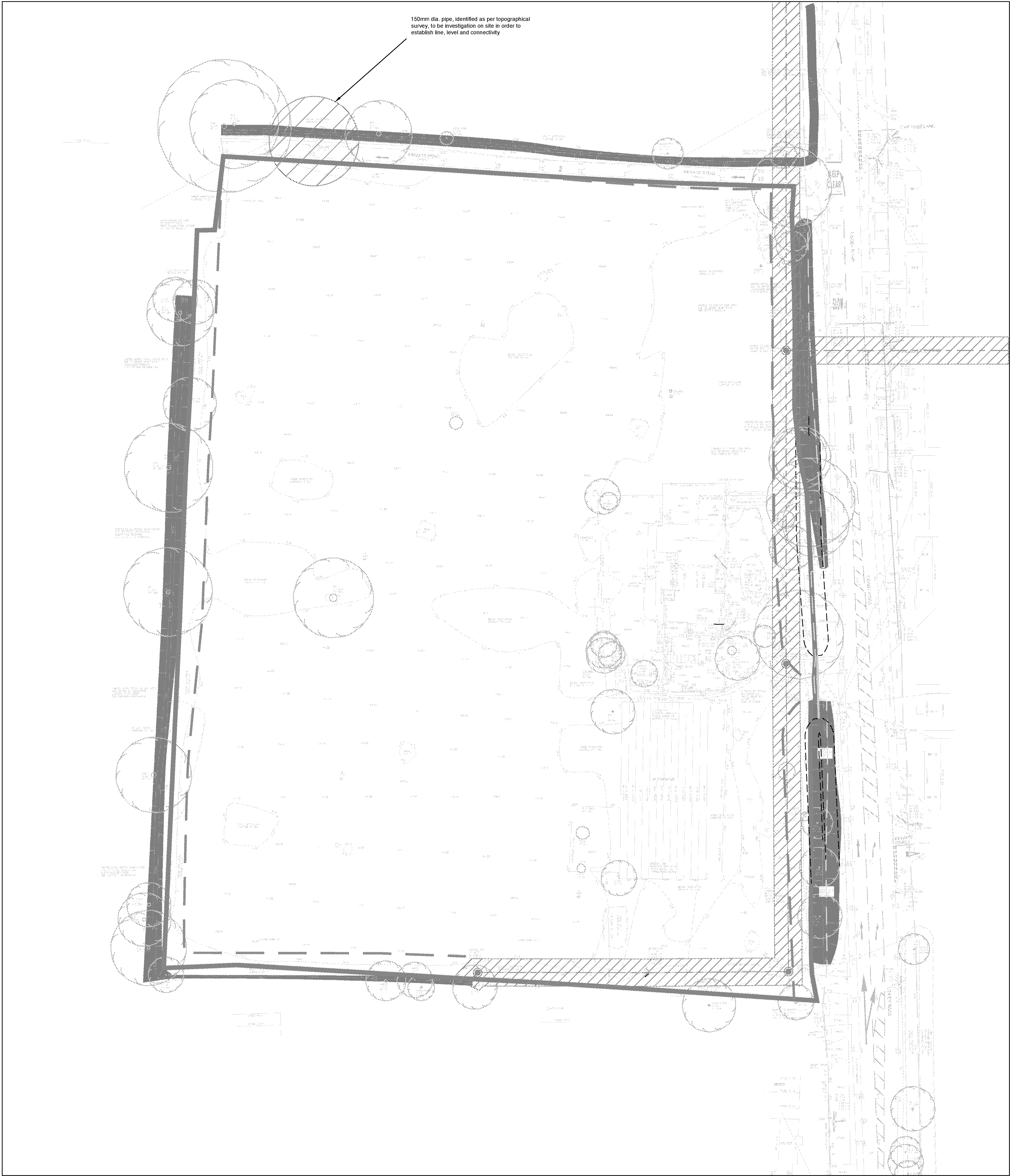
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Drawing Status	PLANNING
Client	Southern Housing Group Ltd
Drawing Title	Site Location Plan
Project	Land at Wings Nursery Lidsey Road
Scale	1:2000
Date	Jan 2020
Drawn By	SPB
Checked	MJA
Drawing No.	D1757-PL100
Rev.	-





-CONSTRAINTS KEY-	
	Site Boundary
	Existing Foul Water Sewer
	Existing Foul Water Manhole
	3.00m Sewer Easement* *Measured from external edge of sewer
	5.00m Watercourse Buffer* *Measured from top of bank
	Public Highway Boundary Extent
	Existing Watercourse
	Re-aligned Watercourse
	Proposed Culvert

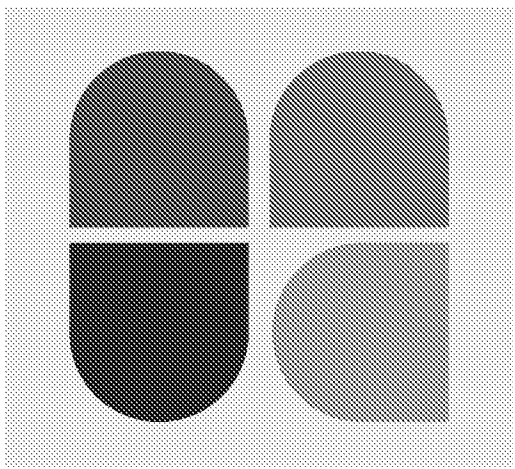
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PLANNING

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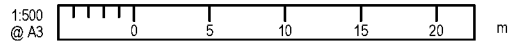
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-	Original Issue	27/01/2020
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Drawing Status	INFORMATION		
Client	Southern Housing Group Ltd		
Project	Land at Wings Nursery Lidsey Road		
Drawing Title	Constraints Plan - Drainage and Flood Risk		
Scale	Date	Drawn By	Checked By
1:500	Jan. 2020	SPB	MJA
Drawing No.	Rev.		
D1757-PL101	-		





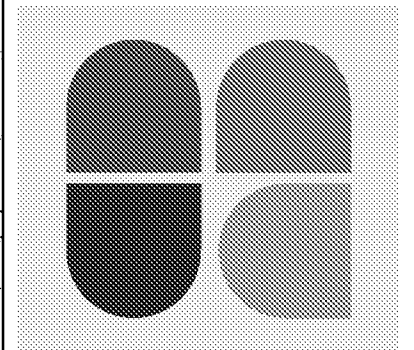
-EXISTING IMPERMEABLE AREA KEY-
Existing Impermeable Area - 1,859m² (0.19Ha)

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Drawing Status **PLANNING**

Client
Southern Housing Group Ltd

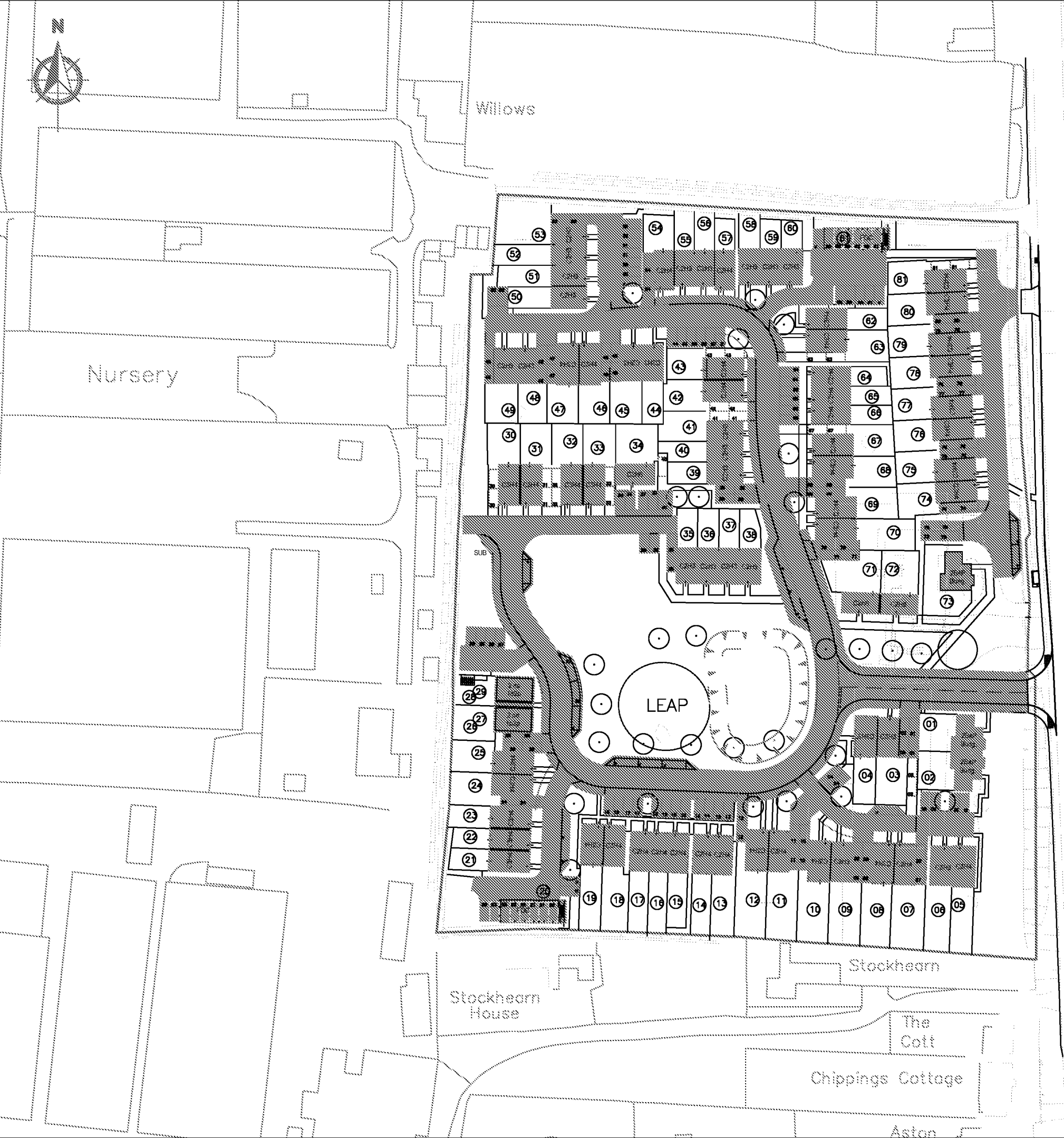
Drawing Title
Existing Impermeable Area

Project
**Land at Wings Nursery
Lidsey Road**

Scale 1:1000	Date Jan 2020	Drawn By SPB	Checked MJA
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Drawing No. D1757-PL200	Rev. -
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APRIN DISTRICT COUNCIL



-EXISTING IMPERMEABLE AREA KEY-
Proposed Impermeable Area - 9326m² (0.93Ha)

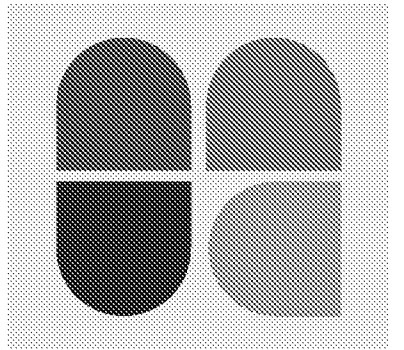
- NOTES**
1. This drawing is to be read in conjunction with all other BPC drawings, and with all relevant Architect's and Engineer's drawings and specification. Any discrepancies found are to be reported immediately to the Engineer
 2. BPC accepts no responsibility for inaccuracies in data provided by third parties such as topographic surveys or Ordnance Survey mapping.
 3. Do not scale, work to figured dimensions only. All dimensions are in millimeters unless noted otherwise and all levels are in metres from the topographic survey datum.
 4. Any information given regarding existing underground services is given in good faith after consultation with the relevant authority, however accuracy is not certain.

PLANNING

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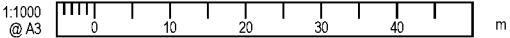
This drawing is based upon Ordnance Survey mapping. RGP accept no liability for any inaccuracies with the data.

	Original issue	29/01/2020
Rev	Amendments	Date



BRIGHT PLAN CIVILS
Transport Planning and Infrastructure Design Consultants
2 West Barn, Norton Lane, Chichester, West Sussex PO20 3AF
Tel: 01243 210418 enquiries@bpcivils.co.uk
www.bpcivils.co.uk

Drawing Status	PLANNING		
Client	Southern Housing Group Ltd		
Drawing Title	Proposed Impermeable Area		
Project	Land at Wings Nursery Lidsey Road		
Scale	1:1000	Date	Jan 2020
Drawn By	SPB	Checked	MJA
Drawing No.	D1757-PL201		Rev.
		-	



-DRAINAGE KEY-

Existing Public Foul Water Sewer
Ex. MH ##
CL ##
IL ##

Existing Public Surface Water Sewer
Ex. MH ##
CL ##
IL ##

Proposed Foul Water Sewer
Proposed Surface Water Sewer

Proposed Tanked Porous Paving

Existing Watercourse
Existing Culvert/drainage
Proposed Culvert/drainage

Maximum 5m Watercourse Buffer Zone
3m Sewer Easement

DRAINAGE STRATEGY

Surface Water

- Infiltration techniques not possible due to the presence of high groundwater across the site.
- On-site geotechnical investigation show ground water to be at between 0-9 and 1.75m below ground level.
- Surface water run-off to be discharged to the existing watercourse(s) located to the east of the proposed development site, adjacent to Lidsey Road at a controlled rate of 6.5l/s.
- A dry pond will provide the require volume of storage along with tanked porous paving
- Land Drainage Consent will be required from ADC in order to discharge surface water run-off to the existing watercourse(s)
- Existing watercourse corridor(s) to be cleared of debris and vegetation as well as locally realigned, regraded and reprofiled

Foul Water

- Foul water will be disposed of via a new connection to the existing public foul water sewer located to the east of the development site
- A Section 106 Application to connect to a public sewer will be required, pursuant to the Water Industry Act 1991.



NOTES

- This drawing is to be read in conjunction with all other BPC drawings, and with all relevant Architect's and Engineer's drawings and specification. Any discrepancies found are to be reported immediately to the Engineer.
- BPC accepts no responsibility for inaccuracies in data provided by third parties such as topographic surveys or Ordnance Survey mapping.
- Do not scale, work to figured dimensions only. All dimensions are in millimeters unless noted otherwise and all levels are in metres from the topographic survey datum.
- Any information given regarding existing underground services is given in good faith after consultation with the relevant authority, however accuracy is not certain.

PLANNING

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Rev	Original issue	29/01/2020
	Amendments	Date

BRIGHT PLAN CIVILS
Transport Planning and Infrastructure Design Consultants
2 West Barn, Norton Lane, Chichester, West Sussex PO20 3AF
Tel: 01243 210418 enquiries@bpcivils.co.uk
www.bpcivils.co.uk

Drawing Status: **PLANNING**

Client: **Southern Housing Group Ltd**

Drawing Title: **Proposed Drainage Strategy**

Project: **Land at Wings Nursery Lidsey Road**

Scale	Date	Drawn By	Checked
1:1000	Jan 2020	SPB	MJA

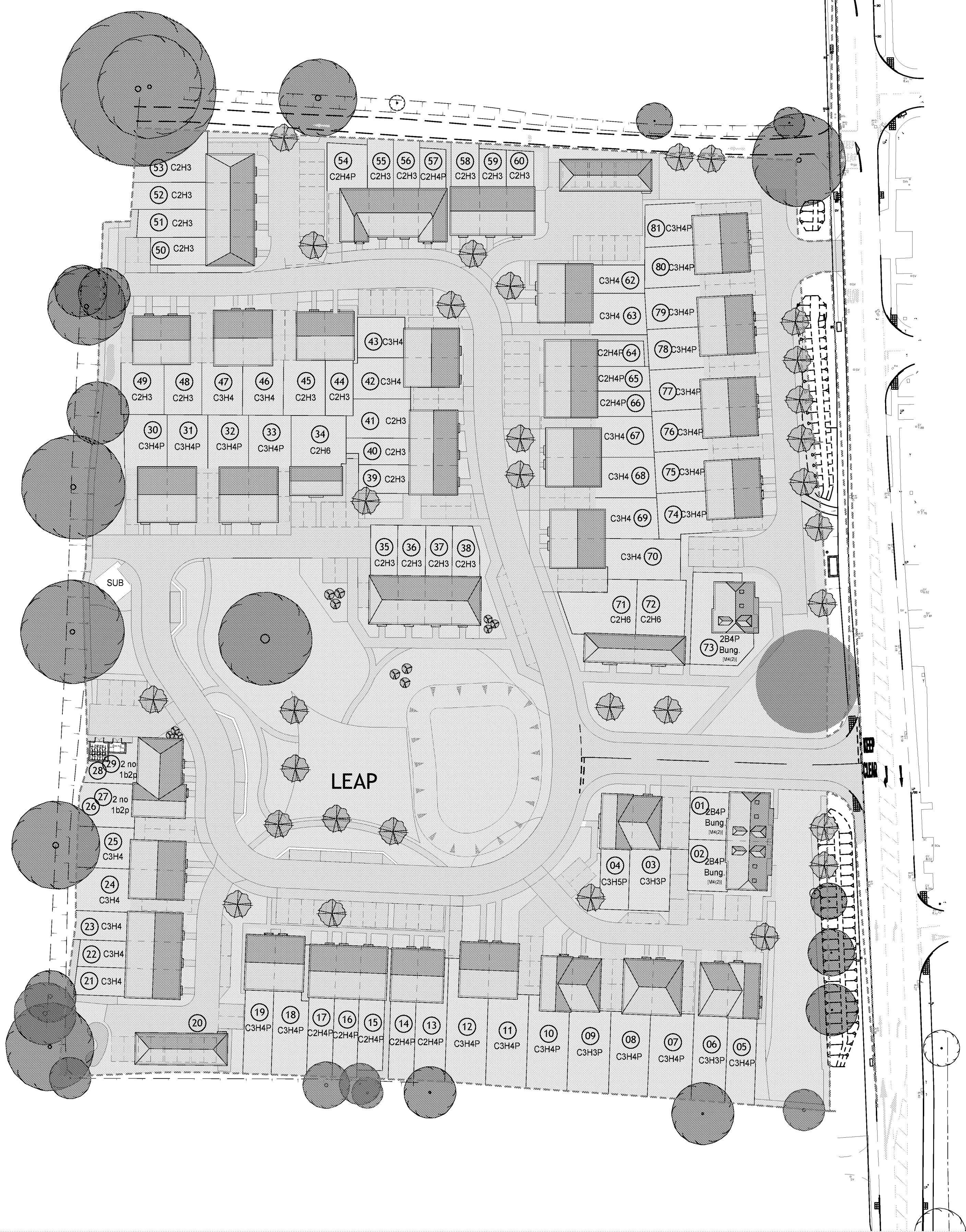
Drawing No. **D1757-PL300**

Rev. -

APPENDICES

Appendix A Architect's Development Proposals

Client Approval					
X	A	-	Approved		
X	B	-	Approved with comments		
X	C	-	Do not use		
Rev.	Revision Note/Purpose of issue	Drw By	Date	Chk By	Date



Appendix B Geo-Environmental Ground Appraisal Report



Geo-Environmental

GROUND APPRAISAL REPORT

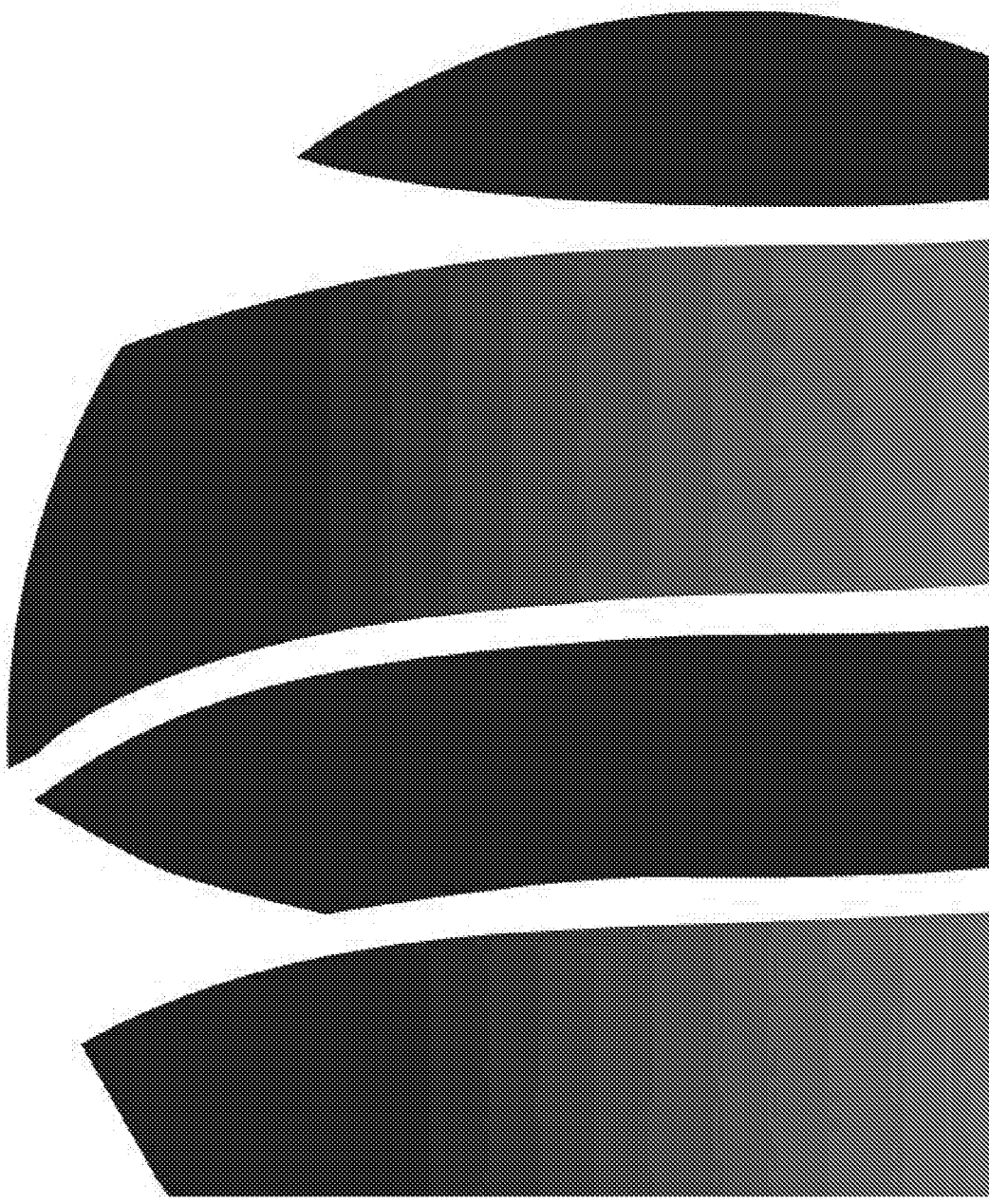
for the site at

LAND OFF LIDSEY ROAD, WOODGATE

WEST SUSSEX, PO20 3SU

on behalf of

THAKEHAM CLIENT LIMITED





Report:	GROUND APPRAISAL REPORT
Site:	LAND OFF LIDSEY ROAD, WOODGATE, WEST SUSSEX, PO20 3SU
Client:	THAKEHAM CLIENT LIMITED
Date:	10/10/2019
Reference:	GE18390-GAR-OCT-19
Version:	2.0
Prepared by:	 ANTHONY POTTER MSc, BSc (Hons), FGS SENIOR CONSULTING ENGINEER
Reviewed by:	 JONATHAN TINGLEY CEnv M.Sc. B.Eng. (Hons) F.G.S. MEnvSc. TECHNICAL DIRECTOR

Geo-Environmental Services Limited

Unit 7, Danworth Farm, Cuckfield Road, Hurstpierpoint, West Sussex, BN6 9GL



EXECUTIVE SUMMARY		
	Site Address	Land At Lidsey Road, Woodgate, West Sussex, PO20 3SU
	Form of Development	Construction of residential properties with gardens, car parking, access road and associated infrastructure.
Encountered Conditions	Scope of works	An intrusive investigation to confirm the ground and groundwater conditions and support the development of geotechnical and geo-environmental assessments of the site in relation to the proposed development.
	Ground Conditions	The ground conditions comprised a limited thickness of Topsoil and Made Ground overlying River Terrace Deposits and the London Clay Formation.
	Groundwater	Groundwater was encountered at depths of between 1.85m and 3.00m bgl, during the fieldworks, with water standing at depths of between 1.20m and 2.50m bgl after twenty minutes. Groundwater monitoring wells were installed within WS1, WS2, WS3 and WS6 to depths of between 2.50m and 3.70m bgl. Two return monitoring visits have been made to date, with further visits to be undertaken throughout the winter period. To date, groundwater has been recorded at depths of between 0.91m and 1.75m bgl.
Geotechnical Considerations	Foundations	Based on the ground and groundwater conditions encountered in the boreholes conventional foundations are considered suitable for the proposed low rise development. Foundations should be taken below any Made Ground, soft, desiccated or disturbed ground and bear onto the firm to very stiff sandy silty gravelly clays or silty sands of the River Terrace Deposits. Based on the laboratory results, the more clayey parts of the River Terrace Deposits <i>en masse</i> should be considered Medium Volume Change Potential in accordance with the NHBC Standards, Chapter 4.2. A minimum founding depth within the River Terrace Deposits of 0.90m is therefore applicable remote from trees. Foundations should not be less than 450mm in width. Within the zone of moisture demand of any existing, proposed or recently felled trees it is recommended that foundation depths be calculated in accordance with the NHBC Standards, Chapter 4.2. Foundations should also be taken through any major root zone and desiccated clay soils should this be found at greater depth. Design measures will be required to prevent heave forces from developing on the faces of the foundations where footing depths are in excess of 1.5m on account of trees. It should be noted that the NHBC stipulate that foundations cast at depths greater than 2.5m should be "engineer designed". Based on the typical settlement parameters for the types of soil encountered, a maximum net allowable bearing capacity of 125kPa is applicable for trench, strip or isolated pad foundations taken through any Made Ground, soft or loose zones, desiccated or disturbed soils and placed wholly into or onto the firm to very stiff sandy silty gravelly clays of the River Terrace Deposits. Under the above loading the settlements should remain within tolerable limits for the proposed scheme. It would be prudent to further consider the depth to the groundwater during the winter months as this could cause construction difficulties



		where intercepted within foundation or service trenches. The risk of intercepting the groundwater would be higher where foundations are required to be deepened on account of the presence of trees and careful design is required in this respect.
	Floor Slabs	Based on the laboratory testing results and the presence of trees and shrinkable soils, it is recommended that suspended ground floor slabs be adopted.
	Excavations	Shallow excavations within the Made Ground should remain relatively stable in the short term. Long deep excavations within the Made Ground are likely to be prone to instability, particularly where left open for prolonged periods, and should be battered back to a safe angle, or suitable shoring techniques should be adopted to provide stability. Shallow excavations within the River Terrace Deposits should remain relatively stable in the short term. Long, deep excavations within the River Terrace Deposits are likely to be prone to instability, particularly where left open for prolonged periods, or open to wet weather conditions and should be battered back to a safe angle, or suitable shoring techniques should be adopted to provide stability. Any excavations taken below the groundwater table is likely to be prone to collapse and running sand.
	Pavements	Where encountered, the Made Ground was noted to be of mixed composition and of limited thickness. The engineering characteristics of such soils are variable and unpredictable and the CBR value of Made Ground does not predict the overall settlements that may occur in such materials. Due to the heterogeneity of the variable amounts of Made Ground it would be prudent to assume the material to be deemed non-frost susceptible throughout. As part of the investigation, three bulk samples of the underlying River Terrace Deposits were taken from hand pits referenced TP DCP1, TP DCP4 and TP DCP6, with samples taken from depths of 0.50m bgl. The results of the laboratory remoulded (2.5kg rammer method) soaked CBR tests from gave results in the range of 1% and 9.5%. In addition, six dynamic cone penetrometer tests were undertaken across the site. The results between the depth of 300mm and 600mm bgl ranged between 5% and 22%. The Transport and Road Research Laboratory Report (LR1132) entitled '<i>The Structural Design of Bituminous Roads</i>' (1984) cites an estimated equilibrium suction index of 5% for the sandy silty gravelly clays such as those of the near surface River Terrace Deposits, under average construction conditions and a high groundwater level. An overall CBR value of 5% is recommended. Furthermore, based on the geotechnical results, the near surface River Terrace Deposits should be considered as being frost susceptible for pavement design purposes with abundant gravel noted within the sandy silty clays within the upper metre.



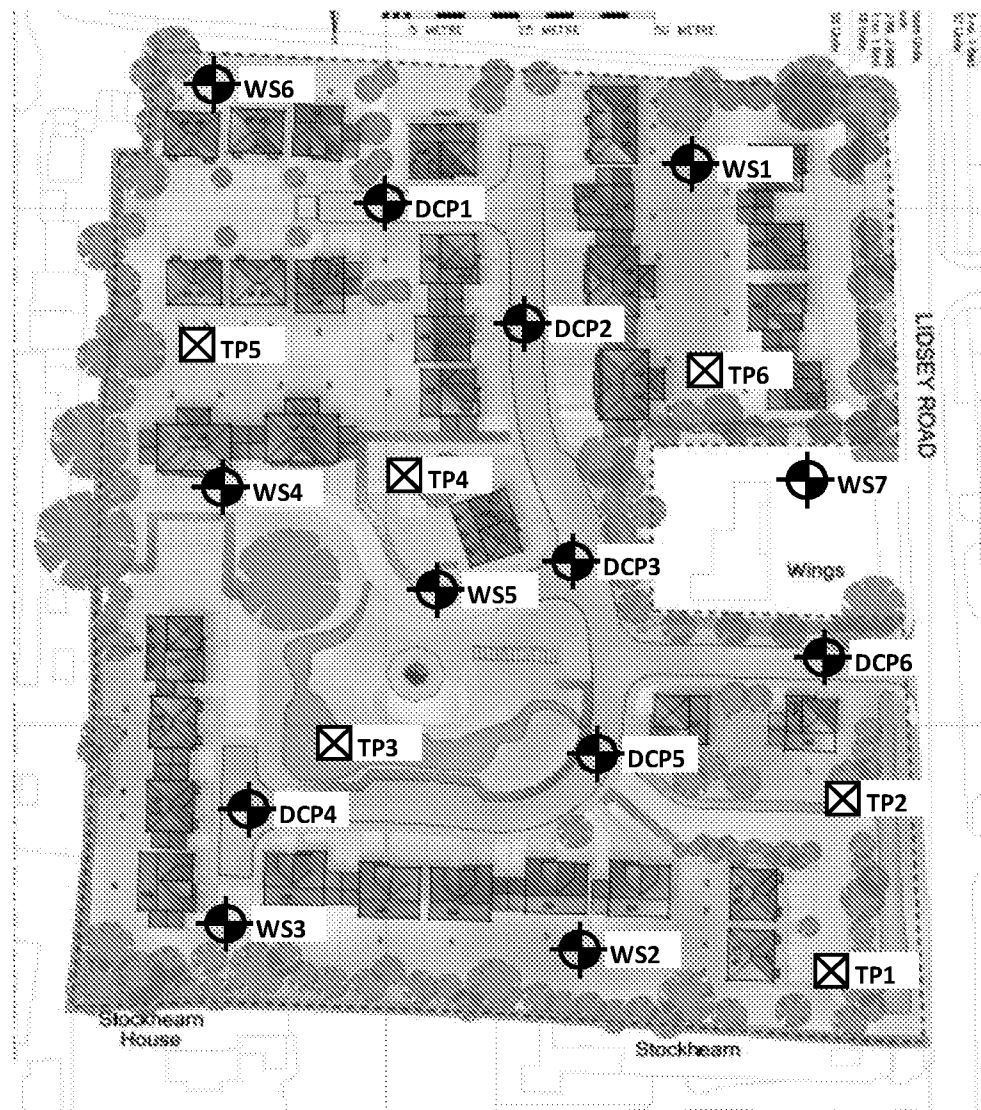
		It is recommended that the sub-grade be proof rolled and any soft spots removed and replaced with a suitable compacted granular fill.
	Drainage	The results indicate a relatively poor infiltration rate within the River Terrace Deposits, whilst groundwater was also noted to be shallow. Based on these findings, the design and construction of conventional soakaways may be viable, though the storage capacity will be severely restricted by the presence of the groundwater table.
	Buried Concrete	Seven pH and Sulphate tests were undertaken on the River Terrace Deposits. The results for the River Terrace Deposits corresponded to design class DS-1 as defined within the BRE Special Digest 1 (2005). The pH analyses indicate the ACEC class to be AC-1. It is recommended that a design class of DS-1 and an ACEC class of AC-1 be applied to all sub-surface concrete within this stratum.
Considerations	Human Health	All of the results indicated concentrations less than the Atkins ATRISK/C4SI screening values with the exception of Benzo(a)pyrene (TP1 0.10m 120mg/kg, TP2 0.10m 64mg/kg), Barium (TP2 0.10m 290mg/kg, WS7 0.20m 130mg/kg) and Beryllium (TP2 0.10m 2.40mg/kg). The Atkins ATRISK values for Benzo(a)pyrene are 4.95mg/kg, Barium 110mg/kg and 1.71mg/kg for Beryllium. The locations of TP1 and TP2 were within the area of the glasshouse, formerly used as a nursery. The location of WS7 was within the grounds of the residential property. Based on these initial findings, a cover system will be required within these areas. However, based on the limited sampling within these locations, it is recommended that further investigation in and around the garden nursery and residential property be undertaken. Those findings, along with these findings should be used to finalise a cover system for affected plots within those areas. As a preliminary guide it is likely that recommendations will be to strip the existing Made Ground from the proposed gardens and soft landscaping areas for the units located within the grounds of the house and glasshouse.
	Ground gas	Two ground gas monitoring visits have been undertaken to date to provide an initial assessment. No significant ground gas concentrations were noted and therefore no remedial works are required in this respect. A final assessment will be made upon completion of all monitoring visits.
	Built Environment	The current guidance on selection of materials for water supply pipes to be laid in contaminated land is contained in UK Water Industry Research's (UKWIR) report reference 10/WM/03/21 (re-issued 2010). However, the guidance is not mandatory and there have been concerns raised by various industry technical associations regarding the document and the methodologies proposed. Although there are concerns regarding the document, in lieu of any further guidance in the first instance the results of this investigation have been compared with the proposed thresholds published in UKWIR Table 3.1. The results of the relevant chemical analyses indicated elevated concentrations of SVOCs and TPH, barrier pipe is likely to be required on the area of the site currently occupied by the house and glasshouse, unless they are wholly placed in natural soils. It is recommended that the results of this investigation be presented to the water utility company as soon as reasonably practicable in order to



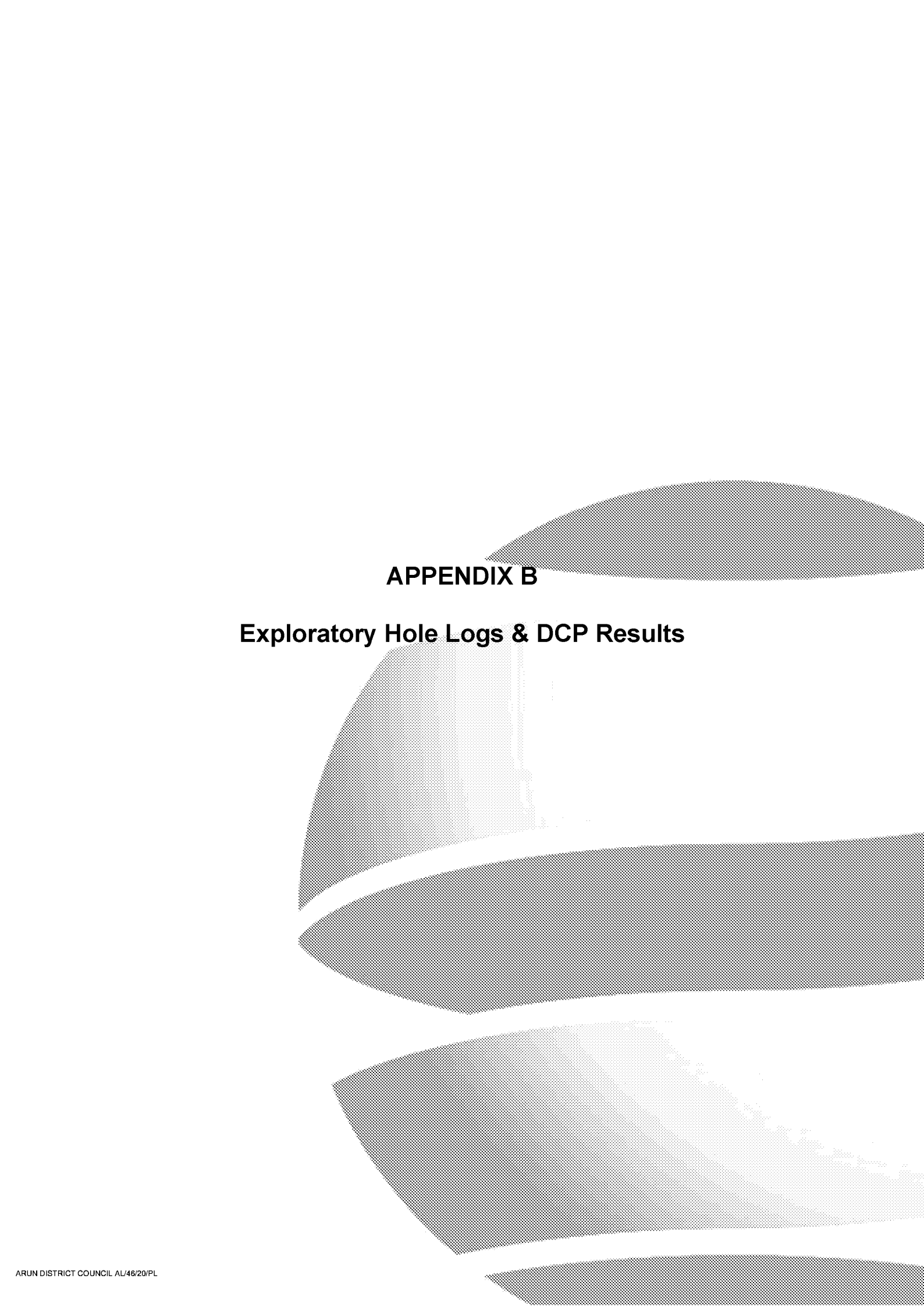
		confirm the pipe material.
	Waste Disposal	Initially, the results of the laboratory testing were submitted for Catwaste classification, the results Confirmed that the near surface soils did not have any properties that would deem the material hazardous waste for all but two samples. Samples TP1 0.10m and TP2 0.10m had hydrocarbon/oil with benzo(a)pyrene marker. Waste soils within this area require further analysis in the form of Waste Characterisation testing and Waste Acceptance Criteria testing to determine classification for off-site disposal.
Further Action: • A discovery strategy should be maintained during development such that any abnormal conditions (geotechnical or potential contamination) are identified and their potential impact on the proposed development assessed prior to determining any potential mitigation measures. • The results of this investigation be presented to the water utility company as soon as reasonably practicable in order to confirm the pipe material • Further investigation within the locations of the former garden nursery and residential property. • Further waste disposal classification comprising Waste Characterisation tests and Waste Acceptance Criteria testing.		

FIGURE 2

Site Investigation Plan



Project:	Land Off Lidsey Road, Woodgate			Title	Site Investigation Plan	
Client:	Thakeham Client Limited			Geo-Environmental Services Ltd Unit 7 Danworth Farm, Cuckfield Road Hurstpierpoint, West Sussex BN6 9GL +44(0)1273 832972 www.gesl.net	 Geo-Environmental	
Ref No:	GE18390	Revision:	v1			
Drawn:	AP	Date:	09/08/2019			
Figure:	2	Scale:	Not To Scale			



APPENDIX B

Exploratory Hole Logs & DCP Results



Unit 7, Danworth Farm
Hurstpierpoint
BN6 9GL

Geo-Environmental/www.gesl.net

Trial Pit Log

Trial Pit No

TP1

Sheet 1 of 1

Project Name: Land Off Lidsey Road, Woodgate

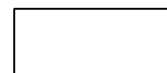
Project No.
GE18390

Co-ords: 493775.63 - 104050.83
Level: 9.00

Date
19/08/2019

Location: Woodgate, West Sussex

Dimensions
(m):



Scale
1:25

Client: Thakeham Client Limited

Depth
3.00

Logged
GE

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10	ES		0.25	8.75		Dark grey silty sand with ash, brick and concrete. MADE GROUND	
	0.50	D					Very stiff brown and orange brown mottled silty sandy CLAY.	
	0.50	PP	PP=4.5kg/cm2	0.60	8.40		Firm brown very sandy silty CLAY. RIVER TERRACE DEPOSITS	
	1.00	D					Firm brown very sandy silty CLAY. RIVER TERRACE DEPOSITS	1
	1.00	PP	PP=2.5kg/cm2	1.30	7.70		Orange brown and grey mottled very sandy silty CLAY with abundant fine flint gravel. RIVER TERRACE DEPOSITS	
	1.50	D					Orange brown and grey mottled very sandy silty CLAY with abundant fine flint gravel. RIVER TERRACE DEPOSITS	
	1.50	PP	PP=2kg/cm2	1.80	7.20		Orange brown silty fine to medium SAND. RIVER TERRACE DEPOSITS	2
	2.00	D					Orange brown silty fine to medium SAND. RIVER TERRACE DEPOSITS	
	2.50	D					Orange brown silty fine to medium SAND. RIVER TERRACE DEPOSITS	
				3.00	6.00		End of Pit at 3.00m	3
								4
								5
Water Strike		Remarks		Groundwater encountered at 1.85m bgl, backfilled with arisings.				
Depth Strike		Stability						
1.85		0.00						





Unit 7, Danworth Farm
Hurstpierpoint
BN6 9GL

Geo-Environmental/www.gesl.net

Trial Pit Log

Trial Pit No

TP2

Sheet 1 of 1

Project Name: Land Off Lidsey Road, Woodgate

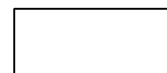
Project No.
GE18390

Co-ords: 493774.62 - 104078.16
Level: 8.99

Date
19/08/2019

Location: Woodgate, West Sussex

Dimensions
(m):



Scale
1:25

Client: Thakeham Client Limited

Depth
2.00

Logged
GE

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10	ES		0.25	8.74		Dark grey silty sand with ash, brick and concrete. MADE GROUND	
	0.50 0.50	D PP	PP=5kg/cm2	0.60	8.39		Very stiff brown and orange brown mottled silty sandy CLAY. RIVER TERRACE DEPOSITS	
	1.00 1.00	D PP	PP=2kg/cm2	1.30	7.69		Firm brown very sandy silty CLAY. RIVER TERRACE DEPOSITS	1
	1.50 1.50	D PP	PP=2.5kg/cm2	1.80	7.19		Orange brown and grey mottled very sandy silty CLAY with abundant fine chert gravel. RIVER TERRACE DEPOSITS	
	2.00	D		2.00	6.99		Orange brown silty fine to medium SAND. RIVER TERRACE DEPOSITS	2
							End of Pit at 2.00m	
								3
								4
								5
Water Strike								
Depth Strike	Water to (m)							
1.90	0.00	Remarks Groundwater encountered at 1.90m bgl, backfilled with arisings.						
		Stability						





Unit 7, Danworth Farm
Hurstpierpoint
BN6 9GL

Geo-Environmental/www.gesl.net

Trial Pit Log

Trial Pit No

TP3

Sheet 1 of 1

Project Name: Land Off Lidsey Road, Woodgate

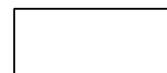
Project No.
GE18390

Co-ords: 493698.54 - 104096.26
Level: 9.23

Date
19/08/2019

Location: Woodgate, West Sussex

Dimensions
(m):



Scale
1:25

Client: Thakeham Client Limited

Depth
2.20

Logged
GE

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10	ES		0.15	9.08		Grass overlying dark brown silty sand with rootlets. TOPSOIL	
	0.50 0.50	D PP	PP=5kg/cm2				Very stiff possibly desiccated very sandy silty CLAY. RIVER TERRACE DEPOSITS	
	1.00 1.00	D PP	PP=2.5kg/cm2	0.70	8.53		Firm to stiff orange brown and grey mottled sandy silty CLAY with occasional fine to coarse sub-angular chert gravel. RIVER TERRACE DEPOSITS	1
	1.50 1.50	D PP	PP=2.5kg/cm2					
	2.00	D		1.90	7.33		Orange brown silty fine to medium SAND. RIVER TERRACE DEPOSITS	2
				2.20	7.03		End of Pit at 2.20m	
								3
								4
								5
Water Strike		Remarks		Groundwater not encountered, backfilled with arisings.				
Depth Strike		Stability						





Unit 7, Danworth Farm
Hurstpierpoint
BN6 9GL

Geo-Environmental/www.gesl.net

Trial Pit Log

Trial Pit No

TP4

Sheet 1 of 1

Project Name: Land Off Lidsey Road, Woodgate

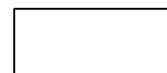
Project No.
GE18390

Co-ords: 493701.48 - 104146.65
Level: 9.21

Date
19/08/2019

Location: Woodgate, West Sussex

Dimensions
(m):



Scale
1:25

Client: Thakeham Client Limited

Depth
2.70

Logged
GE

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10	ES		0.15	9.06		Grass overlying dark brown silty sand with rootlets. TOPSOIL	
	0.50	D					Firm to stiff orange brown very sandy CLAY with occasional fine to medium chert gravel. RIVER TERRACE DEPOSITS	
	1.00	D		0.70	8.51		Firm to stiff orange brown and grey mottled sandy silty CLAY with occasional fine to coarse sub-angular chert gravel. RIVER TERRACE DEPOSITS	1
	1.00	PP	PP=2.5kg/cm2					
	1.50	D						
	1.50	PP	PP=2kg/cm2	1.70	7.50			
	2.00	D					Orange brown silty fine to medium SAND. RIVER TERRACE DEPOSITS	2
	2.50	D						
				2.70	6.50		End of Pit at 2.70m	3
								4
								5
Water Strike								
Depth Strike	Remarks	Groundwater encountered at 1.90m bgl, backfilled with arisings.						
1.90	0.00							
Stability								





Unit 7, Danworth Farm
Hurstpierpoint
BN6 9GL

Geo-Environmental/www.gesl.net

Trial Pit Log

Trial Pit No

TP5

Sheet 1 of 1

Project Name: Land Off Lidsey Road, Woodgate

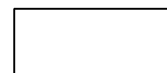
Project No.
GE18390

Co-ords: 493660.94 - 104174.25
Level: 9.09

Date
19/08/2019

Location: Woodgate, West Sussex

Dimensions
(m):



Scale
1:25

Client: Thakeham Client Limited

Depth
2.00

Logged
GE

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10	ES		0.20	8.89		Grass overlying dark brown silty sand with rootlets. TOPSOIL	
	0.50 0.50	D PP	PP=5kg/cm2	0.70	8.39		Stiff orange brown mottled sandy silty CLAY. RIVER TERRACE DEPOSITS	
	1.00 1.00	D PP	PP=2.5kg/cm2	1.40	7.69		Firm to stiff orange brown and grey mottled slightly sandy silty CLAY. RIVER TERRACE DEPOSITS	1
	1.50 1.50	D PP	PP=2.5kg/cm2	1.60	7.49		Firm orange brown and grey mottled CLAY with fine to medium sub-angular chert gravel. RIVER TERRACE DEPOSITS	
	2.00	D		2.00	7.09		Orange brown very silty damp fine to medium SAND. RIVER TERRACE DEPOSITS	2
							End of Pit at 2.00m	3
								4
								5
Water Strike								
Depth Strike								
1.90								
1.95								
		Remarks						
		Groundwater encountered at 1.90m bgl, standing at 1.95m bgl after sixty minutes. Backfilled with arisings.						
		Stability						





Unit 7, Danworth Farm
Hurstpierpoint
BN6 9GL

Geo-Environmental www.gesl.net

Trial Pit Log

Trial Pit No

TP6

Sheet 1 of 1

Project Name: Land Off Lidsey Road, Woodgate

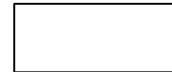
Project No.
GE18390

Co-ords: 493749.45 - 104169.18
Level: 8.65

Date
19/08/2019

Location: Woodgate, West Sussex

Dimensions
(m):



Scale
1:25

Client: Thakeham Client Limited

Depth
2.10

Logged
GE

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.15	8.50		Grass overlying dark brown silty sand with rootlets and occasional chalk and shingle. TOPSOIL	
	0.50	PP	PP=3.6kg/cm2				Firm to stiff orange brown silty sandy CLAY with abundant fine chert gravel, becoming fine to medium between 1.3m and 1.4m. RIVER TERRACE DEPOSITS	1
	1.00	PP	PP=2.25kg/cm2					
				1.40	7.25		Orange brown silty fine to medium SAND. RIVER TERRACE DEPOSITS	2
				2.10	6.55		End of Pit at 2.10m	3
								4
								5
Water Strike		Remarks		Groundwater encountered at 2.0m bgl, backfilled with arisings.				
Depth Strike		Stability						
2.00		0.00						





Geo-Environmental

Unit 7, Danworth Farm
Hurstpierpoint
BN6 9GL
www.gesl.net

Borehole Log

Borehole No.

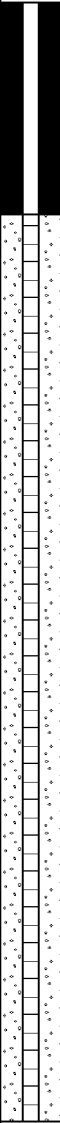
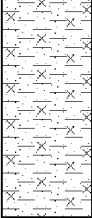
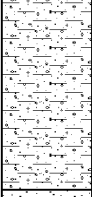
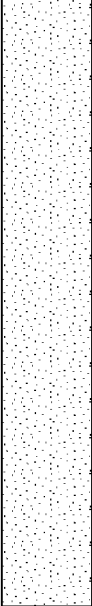
WS1

Sheet 1 of 1

Project Name:	Land Off Lidsey Road, Woodgate	Project No.	GE18390	Co-ords:	493760E - 104218N	Hole Type	WLS
Location:	Woodgate, West Sussex			Level:	8.42	Scale	1:25
Client:	Thakeham Client Limited			Dates:	19/08/2019	Logged By	AP

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.10	ES	0.8kg/cm2	0.20	8.22		Grass overlying dark brown silty sand with rootlets TOPSOIL	1
		0.50 0.50	D ES			Brown and grey mottled slightly sandy very clayey SILT with occasional rootlets and rare fine to coarse sub angular chert gravel RIVER TERRACE DEPOSITS			
		1.00 1.00	D PP			Soft orange brown and grey mottled silty CLAY with occasional fine to coarse sub angular chert gravel RIVER TERRACE DEPOSITS			
		1.50	D	0.8kg/cm2	1.00	7.42		Orange brown mottled medium SAND RIVER TERRACE DEPOSITS	2
		2.00	D						
		2.50	D						
		3.00	D	2.5kg/cm2	2.50	5.92		Brown medium to coarse SAND with occasional fine to medium sub angular chert gravel RIVER TERRACE DEPOSITS	3
		3.50 3.50	D PP						
		4.00 4.00	D PP						
		4.00 4.00	D PP	2.5kg/cm2	4.00	4.42		Stiff grey silty CLAY LONDON CLAY <i>...Collapsed to 3.5m on completion</i>	4
							End of Borehole at 4.00m		
Casing		Water Strikes (mbgl)		Chiselling (mbgl)		Remarks			
Diameter	Depth (m)	Depth Strike	Rose to	Depth from	Depth to				
		1.90	1.23			Groundwater encountered at 1.90m bgl, standing at 1.23m after twenty minutes. Standpipe installed to 3.50m bgl.			

 Unit 7, Danworth Farm Hurstpierpoint BN6 9GL www.gesl.net		Borehole Log				Borehole No. WS2	
Project Name: Land Off Lidsey Road, Woodgate		Project No. GE18390		Co-ords: 493724E - 104053N		Sheet 1 of 1 Hole Type WLS	
Location: Woodgate, West Sussex				Level: 9.25		Scale 1:25	
Client: Thakeham Client Limited				Dates: 19/08/2019		Logged By AP	

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES		0.30	8.95		Grass overlying brown silty sand with rootlets TOPSOIL	1
		0.50 0.50	D ES		0.55	8.70		Light brown sandy SILT RIVER TERRACE DEPOSITS	
		1.00 1.00	D PP	2.0kg/cm2				Stiff orange brown and grey mottled sandy silty CLAY RIVER TERRACE DEPOSITS	2
		1.50 1.50	D PP	1.0kg/cm2	1.30	7.95		Firm brown sandy CLAY with abundant fine to coarse sub angular chert gravel RIVER TERRACE DEPOSITS	
		2.00	D		1.95	7.30		Brown SAND RIVER TERRACE DEPOSITS	3
		2.50	D					...Collapsed to 2.5m on completion	
		3.00	D						
		3.50	D						
		4.00	D		4.00	5.25		End of Borehole at 4.00m	4
									5

Casing		Water Strikes (mbgl)		Chiselling (mbgl)		Remarks	
Diameter	Depth (m)	Depth Strike	Rose to	Depth from	Depth to		
		3.00	1.20				

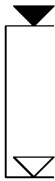
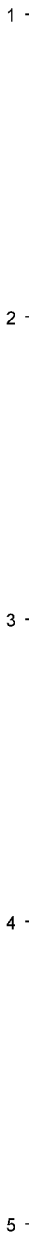
Groundwater encountered at 3.00m bgl, standing at 1.20m bgl after twenty minutes. Standpipe installed to 3.70m bgl.

		Unit 7, Danworth Farm Hurstpierpoint BN6 9GL www.gesl.net		Borehole Log			Borehole No. WS3	
Project Name: Land Off Lidsey Road, Woodgate		Project No. GE18390		Co-ords: 493666E - 104053N		Sheet 1 of 1 Hole Type WLS		
Location: Woodgate, West Sussex				Level: 9.29		Scale 1:25		
Client: Thakeham Client Limited				Dates: 19/08/2019		Logged By AP		

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES		0.25	9.04		Grass overlying brown sandy silt TOPSOIL	
		0.50	D					Stiff orange brown and grey mottled sandy CLAY with rootlets RIVER TERRACE DEPOSITS	
		0.50	ES						
		0.50	PP	3.0kg/cm2					
		1.00	D					Brown SAND RIVER TERRACE DEPOSITS	
		1.00	PP	1.5kg/cm2					
		1.50	D						
		1.50	PP	2.0kg/cm2					
		2.00	D		1.80	7.49			
		2.50	D					...Collapsed to 2.5m on completion	
	3.00	D							
	3.50	D							
	4.00	D		4.00	5.29			End of Borehole at 4.00m	

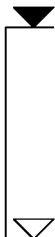
Casing		Water Strikes (mbgl)		Chiselling (mbgl)		Remarks Groundwater encountered at 3.00m bgl, standing at 2.50m bgl after twenty minutes. Standpipe installed to 2.50m bgl.	
Diameter	Depth (m)	Depth Strike	Rose to	Depth from	Depth to		
		3.00	2.50				

 Unit 7, Danworth Farm Hurstpierpoint BN6 9GL www.gesl.net		Borehole Log				Borehole No. WS4 Sheet 1 of 1	
Project Name: Land Off Lidsey Road, Woodgate		Project No. GE18390		Co-ords: 493661E - 104149N		Hole Type WLS	
Location: Woodgate, West Sussex				Level: 9.37		Scale 1:25	
Client: Thakeham Client Limited				Dates: 19/08/2019		Logged By AP	

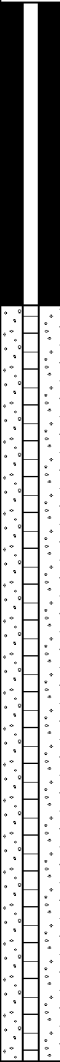
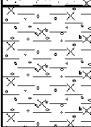
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES		0.25	9.12		Grass overlying brown sandy silt with rootlets TOPSOIL	
		0.50 0.50	D ES		0.70	8.67		Brown clayey sandy silt with rootlets RIVER TERRACE DEPOSITS	
		1.00 1.00	D PP	4.5kg/cm2				Very stiff becoming stiff orange brown and grey mottled slightly sandy silty CLAY RIVER TERRACE DEPOSITS	
		1.50 1.50	D PP	2.7kg/cm2					
		2.00	D		1.80	7.57		Orange brown mottled SAND RIVER TERRACE DEPOSITS	
		2.50	D					...collapsed to 2.50m on completion	
		3.00	D						
		3.50	D						
		4.00	D		3.90 4.00	5.47 5.37		Orange brown sand with occasional fine to coarse chert gravel RIVER TERRACE DEPOSITS	
								End of Borehole at 4.00m	

Casing		Water Strikes (mbgl)		Chiselling (mbgl)		Remarks Groundwater encountered at 3.00m bgl, standing at 2.50m bgl after twenty minutes. Backfilled with arisings.	
Diameter	Depth (m)	Depth Strike	Rose to	Depth from	Depth to		
		3.00	2.50				

 Unit 7, Danworth Farm Hurstpierpoint BN6 9GL www.gesl.net		Borehole Log				Borehole No. WS5 Sheet 1 of 1	
Project Name: Land Off Lidsey Road, Woodgate		Project No. GE18390		Co-ords: 493711E - 104105N		Hole Type WLS	
Location: Woodgate, West Sussex				Level: 9.17		Scale 1:25	
Client: Thakeham Client Limited				Dates: 19/08/2019		Logged By AP	

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description																			
		Depth (m)	Type	Results																							
		0.20	ES		0.25	8.92		Brown sandy silt with rootlets TOPSOIL	1																		
		0.50	D		0.50	8.67		Brown slightly clayey sandy SILT RIVER TERRACE DEPOSITS																			
		0.50	ES					Very stiff orange brown mottled slightly silty sandy CLAY RIVER TERRACE DEPOSITS																			
		1.00	D		1.20	7.97		Stiff brown sandy silty CLAY with rare chert gravel RIVER TERRACE DEPOSITS																			
		1.00	PP	3.0kg/cm2																							
			1.50	D		1.70	7.47		Orange brown SAND RIVER TERRACE DEPOSITS	2																	
		1.50	PP	2.5kg/cm2																							
		2.00	D																								
		2.50	D																								
		3.00	D																								
		3.50	D						3																		
	4.00	D		4.00	5.17																						
							...Collapsed to 2.3m on completion		4																		
							End of Borehole at 4.00m																				
<table border="1"> <tr> <th colspan="2">Casing</th> <th colspan="2">Water Strikes (mbgl)</th> <th colspan="2">Chiselling (mbgl)</th> </tr> <tr> <th>Diameter</th> <th>Depth (m)</th> <th>Depth Strike</th> <th>Rose to</th> <th>Depth from</th> <th>Depth to</th> </tr> <tr> <td></td> <td></td> <td>3.00</td> <td>2.30</td> <td></td> <td></td> </tr> </table> Remarks Groundwater encountered at 3.00m bgl, standing at 2.30m bgl after twenty minutes. Backfilled with arisings. 										Casing		Water Strikes (mbgl)		Chiselling (mbgl)		Diameter	Depth (m)	Depth Strike	Rose to	Depth from	Depth to			3.00	2.30		
Casing		Water Strikes (mbgl)		Chiselling (mbgl)																							
Diameter	Depth (m)	Depth Strike	Rose to	Depth from	Depth to																						
		3.00	2.30																								

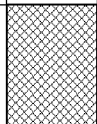
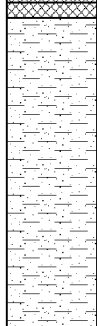
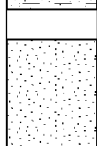
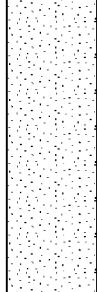
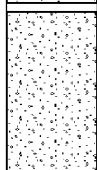
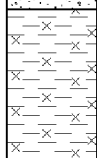
 Unit 7, Danworth Farm Hurstpierpoint BN6 9GL www.gesl.net		Borehole Log				Borehole No. WS6	
Project Name: Land Off Lidsey Road, Woodgate		Project No. GE18390		Co-ords: 493662E - 104219N		Sheet 1 of 1 Hole Type WLS	
Location: Woodgate, West Sussex				Level: 9.16		Scale 1:25	
Client: Thakeham Client Limited				Dates: 19/08/2019		Logged By AP	

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	ES	2.5kg/cm2	0.25	8.91	 Grass overlying brown silty sand with rootlets and rare flint gravel TOPSOIL	
	0.50	D	1.0kg/cm2				 Stiff becoming firm orange brown mottled silty sandy CLAY with rare rootlets RIVER TERRACE DEPOSITS	
	0.50	ES						
	0.50	PP						
		1.00	D		1.10	8.06	 Firm brown silty CLAY with frequent to abundant fine to medium sub angular chert gravel RIVER TERRACE DEPOSITS	
		1.00	PP					
		1.50	D		1.50	7.66	 Brown medium SAND RIVER TERRACE DEPOSITS <i>...Collapsed to 3.5m on completion</i>	
		2.00	D					
		2.50	D					
		3.00	D					
	3.50	D						
	3.80			3.80	5.36			
	4.00	D		4.00	5.16	 Brown SAND with frequent fine to coarse sub-angular chert gravel RIVER TERRACE DEPOSITS <i>End of Borehole at 4.00m</i>		

Casing		Water Strikes (mbgl)		Chiselling (mbgl)		Remarks
Diameter	Depth (m)	Depth Strike	Rose to	Depth from	Depth to	
		2.00	1.70			Groundwater encountered at 2.00m bgl, standing at 1.70m bgl after twenty minutes. Standpipe installed to 3.50m bgl.



 Unit 7, Danworth Farm Hurstpierpoint BN6 9GL www.gesl.net		Borehole Log				Borehole No. WS7 Sheet 1 of 1	
Project Name: Land Off Lidsey Road, Woodgate		Project No. GE18390		Co-ords: 493772E - 104149N		Hole Type WLS	
Location: Woodgate, West Sussex				Level: 8.86		Scale 1:25	
Client: Thakeham Client Limited				Dates: 19/08/2019		Logged By AP	

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
		0.20	ES		0.40	8.46		Dark brown reworked sandy silt MADE GROUND		
		0.50 0.50	D ES		0.45	8.41				Reworked chalk MADE GROUND Very stiff becoming stiff brown possibly desiccated sandy CLAY with fine roots and rootlets RIVER TERRACE DEPOSITS
		1.00 1.00	D PP	4.5kg/cm2						Brown SAND RIVER TERRACE DEPOSITS
		1.50 1.50	D PP	2.5kg/cm2	1.50	7.36				
		2.00	D					Brown SAND with occasional fine to coarse sub angular chert gravel RIVER TERRACE DEPOSITS		
		2.50	D		2.92	5.94				
		3.00	D		3.50	5.36	End of Borehole at 4.00m			
		3.50 3.50	D PP	1.8kg/cm2	4.00	4.86				
		4.00 4.00	D PP	2.0kg/cm2						

Casing		Water Strikes (mbgl)		Chiselling (mbgl)		Remarks	
Diameter	Depth (m)	Depth Strike	Rose to	Depth from	Depth to		
		2.00	2.00			Groundwater encountered at 2.00m bgl, standing at 2.00m bgl after twenty minutes. Backfilled with arisings.	

GE18390 Lidsey Road, Woodgate
Thakeham Client

Column1	Column2	Column3	Column4
Date	Position	Groundwater Depth (m)	Standpipe Depth (m)
29/08/2019	WS1	1.3	1.45
	WS2	DRY	2.21
	WS3	DRY	2.21
	WS6	DRY	1.72
01/10/2019	WS1	0.91	1.42
	WS2	1.75	2.21
	WS3	1.7	2.21
	WS6	1.22	1.7
14/10/2019	WS1	0.73	1.34
	WS2	1.52	2.21
	WS3	1.27	2.13
	WS6	0.9	1.7
28/10/2019	WS1	0.6	1.2
	WS2	1.24	2.15
	WS3	0.9	2.13
	WS6	0.85	1.7
20/11/2019	WS1	0.5	1.18
	WS2	1	2.1
	WS3	0.55	2.1
	WS6	0.71	1.7
25/11/2019	WS1	0.41	1.18
	WS2	0.91	2.07
	WS3	0.5	2.05
	WS6	0.54	1.66

Appendix C BGS Records

GEORGE STOW CO. LTD.

317

453

Waterworks Engineers

READING ROAD - HENLEY-on-THAMES, OXON.

RECORD OF WELL (SHAFT OR BOREHOLE)

Su 90/93

Borehole No. 9

DATE COMPLETED 1.8.78

All depths to be measured below Ground Level

Work carried out for Southern Water Authority, Sussex River & Water Division (Brighton)
 Locality (Exact Site) Woodgate, Nr. Chichester, Sussex - N.G.R. SU 90 SW (9883 0400)
 Level of Ground Surface above Sea Level (O.D.) 50 m.

Depth of Shaft 156 (512 ft) m. Diameter 300 (12 in) mm.
 Depth of Bore 156 (512 ft) m. Diameter: At Top 300 mm. At Bottom 200 mm.

Details of Permanent Lining Tubes

Diameter	Length Inserted	Top At	Ground Level
300 mm.	136.65 m. Plain	0.15 above	136.80
	NIL		
	Slotted		

Water Struck at depth of (in m.) 5.3

Rest Level of Water below Ground Level 5.3 m.

Yield on X Hours test. Pumping litres per sec. Date

Pump Water level X m. below Ground Level.

Time of Recovery

Remarks X Borehole drilled by mud flush Rotary therefore depth at which water struck not apparent. The borehole was developed by swabbing and jetting.
 No test pumping was carried out.