JNP GROUP

CONSULTING ENGINEERS

Flood Risk Assessment and Drainage Strategy

Project: Land West of Shoreham Road,
Small Dole,
West Sussex
BN5 9YH

Client: Wates Developments

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Contents

1 INTRODUCTION

1.1 Terms of Reference

1.1.1 JNP Group has been commissioned by Wates Developments to prepare a flood risk assessment and drainage strategy for outline planning of the proposed Land West of Shoreham Road development.

1.1.2 This report assesses flood risk at the development site from all potential sources and describes the measures adopted in the outline planning process to manage such risks. It has been prepared in compliance with current policies and best practices.

1.1.3 This report reviews the surface and foul water drainage hierarchy and proposes a drainage strategy. It describes the surface water drainage system and identifies management and maintenance tasks for the system. It also outlines a Surface Water Construction Management Plan for drainage during construction.

1.2 Policy Framework and Key Stakeholders

1.2.1 The *National Planning Policy Framework* (NPPF) sets strict tests to protect people and property from flooding which all local planning authorities are expected to follow. Where these tests are not met, national policy is clear that new development should not be allowed.

1.2.2 The NPPF refers to the flood zones which are shown on the Environment Agency Flood Map, and establishes the range of uses which are appropriate, or comparable, land uses for each flood zone.

1.2.3 In decision making, local planning authorities must ensure a sequential approach to site selection and master planning is followed so that development is, as far as reasonably possible, located where the risk of flooding (from all sources) is lowest, taking account of climate change and the vulnerability of future users to flood risk.

1.2.4 Where development needs to be in locations where there is a risk of flooding, local planning authorities and developers must ensure development is appropriately flood resilient and resistant, safe for its users for the development's lifetime, and will not increase flood risk elsewhere.

1.2.5 The Environment Agency (EA) is a statutory consultee on applications where there is a risk of flooding from the sea or main rivers.

1.2.6 Lead local flood authorities (LLFAs) are responsible for managing local flood risk from ordinary watercourses, surface water or groundwater, and for preparing local flood risk management strategies. Local planning authorities (LPAs) work with lead local flood authorities to ensure local planning policies are compatible with the local flood risk management strategy.

1.2.7 West Sussex County Council (WSCC) is the LLFA and Horsham District Council (HDC) is the local planning authority (LPA).

1.2.8 The site has not yet been granted planning permission.

1.2.9 At the time of reporting, pre-planning advice has not been received from Southern Water (water company or LPA). The report will be updated once received.

1.2.10 Where relevant, local planning authorities and developers must also take advice from:

- Sewerage undertakers; to ensure they can assess the impact of new development on their assets and plan any required improvements. Southern Water (SW) is the local sewerage undertaker.
- Reservoir undertakers; to avoid an intensification of development within areas at risk from reservoir failure and ensure they can assess the cost implications of any reservoir safety improvements required due to change in land use downstream of their assets.
- Navigation authorities; in relation to developments adjacent to, or which discharge into, canals (especially where these are impounded above natural ground level).

1.3 Sources of Information

1.3.1 This flood risk assessment has been based on the following sources of information:

- Bespoke topographic survey undertaken by JB Surveyors Ltd in September 2014;
- British Geological Survey's GeoIndex Tool;

  http://mapapps2.bgs.ac.uk/geoindex/home.html
- DEFRA / EA's aquifer and source protection data;

  https://magic.defra.gov.uk/MagicMap.aspx
- Cranfield University's soils data;

  (http://www.landis.org.uk/soilscapes/)
- FEH's catchment data;

  https://fehweb.ceh.ac.uk/
- EA's Flood Map for Planning;

  https://flood-map-for-planning.service.gov.uk/
- EA's Long Term Flood Risk Information;

  https://flood-warning-information.service.gov.uk/long-term-flood-risk/map
- Flood risk vulnerability classification

  (https://www.gov.uk/guidance/national-planning-policy-framework/annex-3-flood-risk-vulnerability-classification)
- Flood risk assessments: climate change allowances

  (https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances)
- EA's Historic Flood Outlines;

  https//environment.data.gov.uk/DefraDataDownload/?mapService=EA/RecordedFloodOutlines&Mode=spatial

https://environment.data.gov.uk/DefraDataDownload/?mapService=EA/HistoricFloodMap&Mode=spatial

- Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015) and The SuDS Manual (2015);
- Design and Construction Guidance (DCG) for foul and surface water sewers offered for adoption under the Code for adoption agreements for water and sewerage companies operating wholly or mainly in England (May 2021);
- Site specific Location Plan by OSP Architecture in March 2025;
- Site specific Topographical Survey by CD Surveys Ltd in July 2023; and
- Site specific GI undertaken by Geo-Environmental Services Limited in December 2023.

2 EVELOPMENT SITE

2.1 Location

2.1.1 The site is located at on the land west of Shoreham Road, Small Dole as shown in Figure 2.1 and Table 2.1.

Figure 2.1: Site Location

Table 2.1: Site Location

OS X	OS Y	Site Area (ha)	Nearest Postcode
521264	113128	5.453	BN5 9YH

2.1.2 The site is square shaped with a proposed access from Shoreham Road/ Henfield Road to the east. Henfield Road (A2037) passes along the eastern boundary and an unnamed ordinary watercourse flows along the southern boundary. The site is sloped in a south west direction towards the unnamed watercourse. Agricultural fields occur to the west and existing dwellings are located along the northern boundary and to the east of Henfield Road. The area is generally rural with woodland along field edges.

2.1.3 The surrounding land uses are summarised in the following table.

Table 2.2: Surrounding Land Use

Direction	Land Use
North	Dwellings and New Hall Lane
East	Henfield Road and Small Dole village beyond
South	Unnamed ordinary watercourse and agricultural fields beyond
West	Agricultural fields

2.2 Current and historic land use

2.2.1 The sire's current land use is wholly agricultural, and the National Library of Scotland georeferenced map shows no noteworthy historic land use.

Figure 2.2: Current and Historic Land Use

2.2.2 The nearby area was subjected to developments in the late 20th century, mainly consisting of residential and small amounts of commercial developments predominantly in the east and north of the site.

2.3 Topography

2.3.1 Regional topography undulates across east to west flowing tributaries of the north to south flowing River Adur. The site is located on the northern bank of one of these tributaries and straddles the catchment divide (ridge) with another tributary further to the north. The divide is in the northern quarter of the site.

2.3.2 The available topographic information is provided in **Appendix B** and shows that ground levels within the development site range between 16.20m aOD (above Ordnance Datum) and 7.5m aOD, falling with an average slope of 1:20 towards one prominent overland flow path, being a small river flowing east-west along the site's southern boundary.

2.4 Geology

2.4.1 The geology of the site has been determined by reference to the 1:50,000 scale British Geological Survey (BGS) online Geoindex Tool.

2.4.2 No artificial or made ground is indicated to be present underlying the site, however, from the aerial imagery viewed hardstanding is present in at the northern entrance to the site, where a dirt road meets New Hall Lane.

2.4.3 The superficial geology of the site to be is indicated to be River Terrace Deposits along the south boarder and Head Deposits along the north border. River Terrace Deposit is described by the BGS as *"Sand and gravel, locally with lenses of silt, clay or peat".* Head Deposit is described by the BGS as *"poorly sorted and poorly stratified, angular rock debris and/or clayey hillwash and soil creep […] comprises gravel, sand and clay. Locally with lenses of silt, clay or peat and organic material".*

2.4.4 The underlying geology is indicated to be the Lower Greensand Group, which is described by the BGS as "*silty sandstone*".

2.4.5 Cranfield University's soils data indicates that soils on the site are classified as "*freely draining slightly acid loamy soils*" with possibly "*slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils*" towards the northern boundary.

2.4.6 JNP Group have consulted online borehole records held by the BGS. The record of one borehole exists within 250m of the site.

2.4.7 Borehole TQ21SW58 encountered weald clay from the top of existing ground level to a depth of 42m below existing ground level (bgl). Underlying the weald clay a thin layer of red clay was found between depths of 44m and 46m, this was found to overlay a thin layer or weald clay between depths of 46m and 48m. The lowermost layer recorded contains a mixture of weald clay with interbedded bands of mudstone between depths of 46m and 58m. This cohesive soil is considered to represent the Weald Clay Formation. There is no information on groundwater within this survey.

2.4.8 The EA's Aquifer Maps indicate that the site is underlain by a Secondary A Aquifer overlying a Principal Aquifer. These refer to the superficial River Terrace Deposits and Lower Greensand Group bedrock respectively.

2.4.9 The EA define a Principal Aquifer as:

2.4.10 *"Layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer."*

2.4.11 The EA define a Secondary-A Aquifer as:

2.4.12 *"Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers."*

2.4.13 The EA define a Secondary-B Aquifer as:

2.4.14 *"Predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers."*

2.4.15 The EA define a Secondary (undifferentiated) Aquifer as:

2.4.16 *"Cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type."*

2.4.17 The EA define unproductive strata as:

2.4.18 *"These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow."*

2.4.19 The site's proximity to groundwater Source Protection Zones (SPZs) was determined by reference to the EA's website. These zones show the risk of contamination from any activities that might cause pollution in the area, with the closer the activity, the greater the associated risk. The maps show three main zones (inner, outer and total catchment) to a groundwater source.

2.4.20 The site lies outside of any SPZs. No SPZs were identified within a 1km radius of the site boundary.

2.4.21 Site specific geology was investigated in a Ground Appraisal Report **Appendix C**. The report outlines that groundwater levels within the development site range between 0.1m bgl in the east part of the site and 2.50m bgl in the central part of the site and are thought to be representative of the Principal Aquifer.

2.4.22 Tests in accordance with BRE 365 indicate infiltration rates ranging between 6.0 x 10^{-7} m/s in the southern central part of the site and 3.2 x 10^{-6} m/s in the eastern part of the site.

2.4.23 Based on the available geological and hydrogeological information, namely permeability, water table levels and infiltration rates, infiltration drainage is deemed unfeasible at the development site.

2.5 Hydrology

2.5.1 The nearest surface water feature is the Horton Sewer watercourse located along the southern site boundary.

2.5.2 The Horton Sewer flows east-west along the southern boundary of the development site. It is classified by the EA as a 'Ordinary Watercourse' and defines a total catchment area of 1.1 km² at the point where it leaves the vicinity of the site. The Horton Sewer flows into the River Adur through a flap valve in the river's flood embankment, 1 km to the west of the site boundary. There is a 3.5m difference in bed elevation between the site boundary and the flap valve. The bed level adjacent to the western boundary of the site is approximately 5.0m AOD whilst bed levels in Horton Sewer close its outfall into the River Adur are approximately 1.5m AOD.

2.5.3 Based on the available hydrological information discharge to a surface watercourse is deemed feasible at the development site.

3 PROPOSED DEVELOPMENT

3.1.1 The proposed development (as shown in Figure 3.1 and **Appendix D**) comprises 5.453 ha of residential development, including 0.819 ha of hard paved / impermeable surfaces (e.g. roofs, roads, driveways, parking areas, etc.) and 4.634 ha of soft paved / permeable surfaces (e.g. gardens, green corridors, public open spaces, etc.).

3.1.2 Under the Flood Risk and Coastal Change – Annexe 3: Flood Risk Vulnerability Classification, the proposed residential development is classified as more vulnerable.

Figure 3.1: Proposed Development

4 FLOOD RISK ASSESSMENT

4.1 Overview

4.1.1 All potential sources of flood risk at the development site have been assessed based on the information listed in Section 1.3 and are summarised below. The key sources of flood risk to the proposed development are further described in the ensuing sections.

Table 4.1: Potential Sources of Flood Risk

Source	Flood Risk
Coastal	*No risk.*
Fluvial	*Very low risk.*
Surface Water	*Very low risk.*
Groundwater	*Very low risk.*
Sewers	*No risk.*
Infrastructure Failure	*Very low risk.*

4.2 Climate Change

4.2.1 The NPPF sets out how the planning system should help minimise vulnerability and provide resilience to the impacts of climate change. This includes demonstrating how flood risk will be managed now and over the development's lifetime, taking climate change into account.

4.2.2 In accordance with the EA's climate change guidance, the proposed development must take account of the following allowances:

- Peak River Flows (Adur and Ouse Management Catchment, development lifespan into 2080s)
  - Central 37%
  - Higher Central 55%
  - Upper End 107%
- Peak Rainfall Intensity (Adur and Ouse Management Catchment, 2070s)
  - Central 25%
  - Upper End 45%
- Sea Level Rise (southeast England, development lifespan into 2100s)
  - Higher Central ..... 1.2 m
  - Upper End ..... 1.6 m

4.2.3 The EA's Climate Change guidance indicates that the central allowance should be used for more vulnerable developments in and near to Flood Zone 2.

4.2.4 *UKCP18* (November 2018) is the official source of information on how the climate of the UK may change over the rest of this century. While the above allowances are still the best national representation of how climate change is likely to affect peak river flows, peak

rainfall intensities and sea level rise until new advice is published in 2019, there are exceptional cases where the *UKCP18* projections should be used to estimate sea level rise.

4.3 Coastal Flood Risk

4.3.1 Coastal flooding occurs when normally dry, low-lying land is flooded by seawater. It usually occurs when storm surges coincide with high astronomical tides and may lead to overtopping or breaching of natural or manmade barriers.

4.3.2 Besides posing a direct flood risk to low-lying areas, high sea levels can exacerbate other sources of flood risk by surcharging / locking outfalls, thus preventing the normal discharge of flows or even back flowing into tributary drainage systems.

4.3.3 In accordance with the EA's *Flood Map for Planning* (Figure 4.1), all of the development site is in Flood Zone 1 (< 0.1 % AEP).

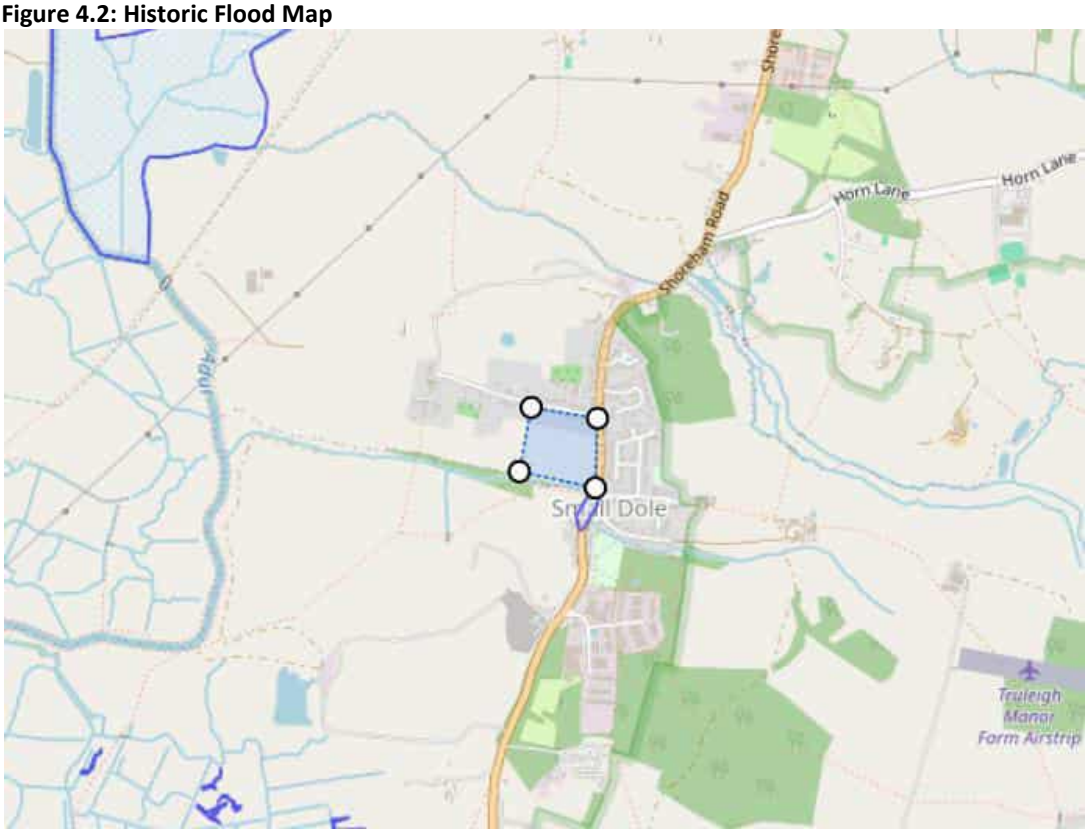
4.3.4 The site benefits from existing raised embankment flood defences along the River Adur with an estimated standard of protection of 1% AEP in the Horsham District.

Figure 4.1: *Flood Map for Planning*

4.3.5 WSCC's strategic flood risk assessments are based on the EA's *Flood Map for Planning* and do not provide any additional information regarding coastal flood risk.

4.3.6 The EA's historic flood outlines indicate that a small residential area immediately south of the boundary and the wider area upstream of the River Adur encountered flooding in the early 1900s, however this had no effect on the site.

Figure 4.2: Historic Flood Map



4.3.7 In accordance with the EA's *Flood Risk Assessment: Climate Change Allowances*, upper end results indicate that the sea levels in the South East of England are expected to rise by 1.2m by 2125. However, in line with interim guidance provided by the EA, a more severe sea level rise of 1.6m by 2125 has been established using *UKCP18*.

4.3.8 The very low tidal flood risk to the site is due to its higher elevation relative to the coast. Newhaven, which is 24 km to the east of Shoreham-by-Sea, is the nearest location with tide level predictions. A summary of the predicted highest astronomical tide (HAT), mean high water springs (MHWS) and mean high water neaps (MHWN) is given in Table 4.2 together with the Environment Agency's forecasts of sea level rise in the southeast of England.

4.3.9 Conservatively assuming a development lifespan to 2125 and 'upper end' sea level rise forecasts, the HAT is predicted to increase from 3.8 m AOD to 5.4 m AOD. This compares with a minimum ground elevation in the site of 7.5m AOD and confirms no risk of tidal flooding to the site even if flood defences along the River Adur are overtopped.

4.3.10 No flood mitigation measures specific to tidal flooding are required.

Table 4.2 Tide level predictions

Type	Tide Level (m ACD)	Tide level (m AOD)	Forecast sea level rise (m)	Adjusted Tide Level (m AOD)
HAT	7.32	3.8	1.60	5.40
MHWS	6.72	3.2	1.60	4.80
MHWN	5.22	1.7	1.60	3.30

Notes:
Tide levels at Newhaven, m ACD = m above chart datum, m AOD m above ordinance datum
HAT = highest astronomical tide, MHWS = mean high water springs, MHWN = mean high water neaps
Forecasted sea level rise is 'upper end' allowance for 2096 to 2125 epoch

4.4 Fluvial Flood Risk

4.4.1 Fluvial flooding occurs when a catchment area receives greater than usual amounts of water (e.g. rainfall or snow melt). When the converging runoff exceeds the conveyance capacity of the receiving channel, water spills onto the surrounding floodplains and fluvial flooding occurs.

4.4.2 Fluvial flooding usually occurs hours or days after heavy and / or prolonged rainfall and its effects often last several hours or days.

4.4.3 Besides posing a direct flood risk to floodplain areas, high water levels in watercourses can exacerbate other sources of flood risk by surcharging / locking outfalls, thus preventing the normal discharge of flows or even back flowing into tributary drainage systems.

4.4.4 In accordance with the EA's *Flood Map for Planning* (Figure 4.2) all of the development site is in Flood Zone 1 (< 0.1 % AEP). Flooding at the site can potentially occur from high-water levels in the River Adur due to fluvial events or fluvial events in Horton Sewer.

4.4.5 The very low fluvial flood risk to the site is due to its higher elevation relative to the floodplain in the River Adur. The very low fluvial flood risk from Horton Sewer is due to the asymmetrical shape of the channel along the southern site boundary.

4.4.6 The development site has a minimum ground elevation of 7.5m AOD and the nearest proposed dwelling to Horton Sewer has an existing ground elevation of approximately 9.4m AOD.

4.4.7 Elevations in the River Adur floodplain are typically less than 3m AOD. Flood defences along the River Adur have a standard of protection of around 3% (1 in 30 years) according to the HDC's SFRA (2010) and a crest elevation in the vicinity of the site of 4.5m AOD (from LiDAR). Should the defences be overtopped flood water would disperse across the low-lying River Adur floodplain and thereby make it extremely unlikely for flood levels to rise 3m to encroach on the site.

4.4.8 Ground elevations on the opposite left bank of Horton Sewer that have the same elevation as the lowest point along the site boundary (7.5m AOD) are 50m away from the right bank. The right bank is nearly vertical (1V in 2H) and its bed is typically 2m below the site boundary at this location. Therefore, a flood event in Horton Sewer with a flow area of approximately 25 m^2 would be required for flood levels to encroach on the site. Horton Sewer has a catchment of 1.1 km^2 and a 1 in 100-year flood peak is estimated to be in the region of 2 m^3/s. Therefore, an unrealistically slow velocity (0.08 m/s = 2 m^3/s / 25 m^2) would be required for this 1 in 100-year flood peak to encroach on the site together with an unrealistically large flood volume from such a small catchment.

4.4.9 The site benefits from formal flood defences such as raised embankments along the west and east of River Adur with an estimated standard of protection of less than 1% AEP in the Horsham District.

Figure 4.2: ***Flood Map for Planning***

4.4.10 WSCC's strategic flood risk assessments indicate the development site is in Flood Zone 1. However, it is important to note some incompatibility between the SFRA flood extents and the available topographic data. The SFRA recognizes that the large-scale model (JFLOW) used to derive fluvial flood zone extents has limitations and that appropriate judgment should be exercised where inaccuracies are clear.

4.4.11 The EA's historic flood outlines show that the site has no history of fluvial flooding.

4.4.12 Given its very low risk no measures specific to fluvial flooding are proposed.

4.5 Surface Water Flood Risk

4.5.1 Surface water flooding is a description for excessive overland flows that have yet to enter a natural or manmade receptor (e.g. aquifer, watercourse or sewer). Surface water flooding also occurs when the amount of runoff exceeds the capacity of the collecting system and spills onto overland flow routes.

4.5.2 Surface water flooding is usually the result of intense, short lived rainfall events, but can also occur during milder, longer lived rainfall events, when collecting systems are at or near capacity or the ground is saturated. It often results in the inundation of low points in the terrain.

4.5.3 In accordance with the EA's *Long Term Flood Risk Information* (Figure 4.3) the development site is at very low (< 0.1% AEP) risk of surface water flooding. Flooding along Horton Sewer next to the southern site boundary ends abruptly at the boundary due to the steepness of the right bank (1V in 2H).

Figure 4.3: Surface Water Flood Risk Map

4.5.4 The available information suggests there is a potential for rapid overland flow across the site and its surrounding area following prolonged rainfall due to the water table levels and relatively steep ground. However, LiDAR data shows no areas of higher ground next to the site that would otherwise be a source of surface runoff entering the site from external areas.

4.5.5 The management measures proposed to deal with off-site overland flows reaching the site are described in Section 5.

4.5.6 The risk of surface water flooding from runoff generated within the development site will be managed by the drainage strategy described in Section 5.

4.6 Groundwater Flood Risk

4.6.1 Groundwater flooding occurs when the level of water filling the pores and / or cracks in the underlying soil and / or rock (i.e. water table) rises and emerges on the surface. The level of the water table varies seasonally and depends upon long term rainfall, thickness and porosity of the underlying strata and groundwater abstraction.

4.6.2 Groundwater flooding is most common in areas where the underlying bedrock and superficial deposits are very porous, but it can also happen at locations where superficial layers of sand or gravel overlay impermeable bedrock.

4.6.3 Groundwater flooding usually occurs after days or weeks of prolonged rainfall and often lasts for days or weeks, as subsiding of the water table can be a very slow process.

4.6.4 Besides posing a direct flood risk to developments (particularly basements), high water table levels can exacerbate other sources of flood risk by preventing infiltration and / or leaking into drainage systems.

4.6.5 The HDC SFRA Level 1 has no record of groundwater flooding in the area.

4.6.6 The bespoke ground investigation undertaken by Geo Environmental in December 2023, **Appendix C**, shows groundwater at 0.1m bgl in the south of the site. This is likely to be shallow groundwater due to the Principle and Secondary A aquifers present as well as the watercourse along the southern boundary. Due to the topography of the site, any emerging

groundwater will flow southward towards the watercourse and will not pose a risk to the development.

4.6.7 In accordance with WSCCS's Strategic Flood Risk Assessment, the development site is in an area with a less than 25% risk of groundwater emergence; this is the proportion of the 1km grid square in which the site is located, where geological and hydrogeological conditions show that groundwater might emerge. It does not show the likelihood of groundwater flooding occurring.

4.6.8 It is assumed that groundwater flooding is a very low risk. No specific flood risk management measures are proposed.

4.7 Sewer Flood Risk

4.7.1 Sewer flooding occurs when a manmade drainage system receives greater than usual amounts of water and the overwhelmed system starts overflowing at gullies and manholes, thus generating overland flows.

4.7.2 Sewer flooding is usually the result of very intense, short lived rainfall events, but can also occur during milder, longer lived rainfall events, when outfalls become surcharged / locked by high water levels in the receiving feature.

4.7.3 In addition to a flood risk, overflowing combined sewers also pose a significant public health and environmental risk.

4.7.4 Southern Water's asset location plans show several public sewers near the development site. The nearby existing clean water and wastewater sewer networks include pipes along New Hall Lane and Henfield Road (Appendix C).

4.7.5 The standard of protection is not known. If either network along New Hall Lane is overwhelmed overland flow will follow road surface gradients westwards away from the site. The networks along Henfield Road run parallel to the eastern site boundary and any flow would follow road surface gradients southwards away from the site.

4.7.6 The risk of sewer flooding is very low and no specific flood risk management measures are proposed.

4.8 Infrastructure Failure Flood Risk

4.8.1 Infrastructure failure flooding occurs when a feature holding water above natural ground levels (e.g. reservoir or canal) is overtopped or breached. Infrastructure failure flooding is usually the result of extreme events in excess of the high standards of protection usually considered in the design of such structures (namely reservoirs).

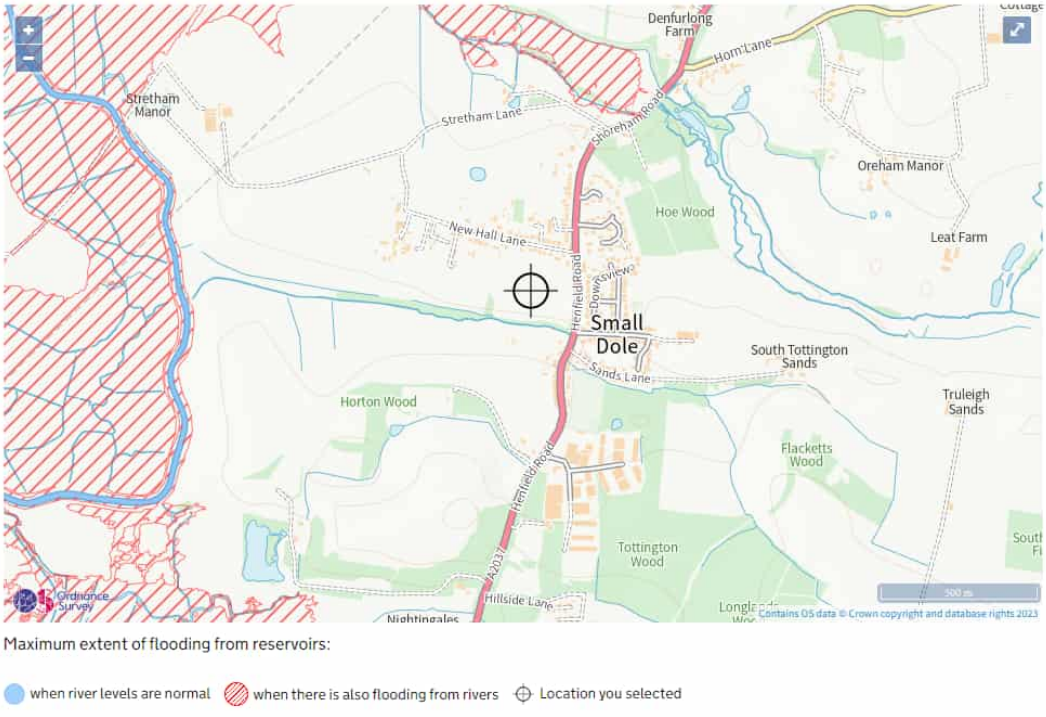
4.8.2 In accordance with the EA's *Long Term Flood Risk Information*, the development site is not at risk of flooding from failure of reservoirs.

4.8.3 Reservoir failures are extremely rare in the UK, as the *Reservoir Act* ensures strict inspection and maintenance of all structures above a certain threshold. Structures under the *Reservoir Act* are also covered by comprehensive emergency plans and warning systems developed in liaison with the relevant civil protection authorities to ensure populations potentially at risk can be safely evacuated in critical situations.

4.8.4 The development site is not located near any canals.

4.8.5 Canal failures are rare in the UK, as the Canal and River Trust regularly inspects and repairs structures and constantly monitors water levels and manages excess water in a number of passive and active ways (e.g. weirs, sluices, locks, restricted navigation, etc.).

Figure 4.4: Flood Risk from Reservoirs



4.8.6 Flood risk from infrastructure failure is mostly managed off-site by the competent authorities. The residual risk to the site is deemed low and adequately managed by measures proposed to deal with other sources of flooding.

5 FLOOD RISK MANAGEMENT

5.1 Sequential and Exception Tests

5.1.1 The sequential, risk-based approach to the location of development is designed to ensure that areas at little or no risk of flooding from any source are developed in preference to areas at higher risk. The aim is to keep development out of medium and high flood risk areas (Flood Zones 2 and 3) and other areas affected by other sources of flooding where possible.

5.1.2 Application of the sequential approach in the master planning process, in particular application of the *Sequential Test*, helps ensure that development can be safely and sustainably delivered, and developers do not waste resources promoting proposals which are inappropriate on flood risk grounds.

5.1.3 The *Sequential Test* ensures that a sequential approach is followed to steer new development to areas with the lowest probability of flooding. The aim is to steer new development to Flood Zone 1 (areas with a low probability of sea or river flooding). Where there are no reasonably available sites in Flood Zone 1, local planning authorities in their decision making should take into account the flood risk vulnerability of land uses and consider reasonably available sites in Flood Zone 2 (areas with a medium probability of sea or river flooding), applying the *Exception Test* if required. Only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in Flood Zone 3 (areas with a high probability of sea or river flooding) be considered, taking into account the flood risk vulnerability of land uses and applying the *Exception Test* if required.

5.1.4 Table 2 of the *Flood Risk and Coastal Change Guidance* categorises different types of uses and development according to their vulnerability to flood risk. Table 3 of the *Flood Risk and Coastal Change Guidance* (Table 5.1) maps these vulnerability classes against flood zones to indicate where development is appropriate and where it should not be permitted.

Table 5.1: Flood Risk Vulnerability and Flood Zone Compatibility

Flood Zone	Flood Risk Vulnerability				
	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test	✓	✓	✓
Zone 3a	Exception Test	×	Exception Test	✓	✓
Zone 3b	Exception Test	×	×	×	✓

Key:
✓ Development is appropriate
× Development should not be permitted

5.1.5 The site is located in Flood Zone 1 and at no significant risk of flooding from any potential source, thus following a sequential approach to steer development away from flood risk. The Exception Test is not required for more vulnerable development in Flood Zone 1.

5.1.6 The *Exception Test* is a method to demonstrate and help ensure that flood risk to people and property will be managed satisfactorily, while allowing necessary development to go ahead in situations where suitable sites at lower risk of flooding are not available.

5.1.7 The Exception Test is not required for more vulnerable development in Flood Zone 1.

5.2 Surface Water Flood Risk

5.2.1 The following surface water flood risk management measures have been incorporated in the proposed development's master plan.

5.2.2 Vulnerable development (classified as less or more vulnerable under the *Flood Risk and Coastal Change Guidance*) will be set at least 150mm above external ground levels and at least 300mm above maximum drainage water levels, which will be designed to safely route overland flows away from buildings and towards road drainage, rain gardens and the Horton Sewer watercourse, using less vulnerable parts of the proposed development such as public open spaces, parking areas and roads to convey and attenuate overland flows.

5.2.3 Off-site runoff reaching the development site from northern open space will be intercepted by a swale to the north of the proposed development and managed within the proposed development's surface water drainage system (Section 6) before discharge into the Horton Sewer.

5.2.4 The development has been designed to allow the existing flow paths through the site to be retained. The south west flowing off-site water will rejoin the Horton Sewer as prior to development.

5.2.5 The proposed surface water drainage strategy (Section 6) has been designed so that flooding does not occur on any part of the site for all events up to 30 AEP and flooding does not occur in any part of a building or utility plant susceptible to water for all events up to 100 AEP and 45 climate change allowance.

6 SURFACE WATER DRAINAGE STRATEGY

6.1 Existing Drainage

6.1.1 The undeveloped (greenfield) development site does not benefit from a formal surface water drainage system. Runoff generated within the site is expected to infiltrate into the ground or flow overland towards the Horton Sewer.

6.1.2 Greenfield runoff rates of 6.97 l/s/ha (100.0% AEP), 8.2 l/s/ha (Q_{BAR}), 18.85 l/s/ha (3.3% AEP) and 26.14 l/s/ha (1.0% AEP) have been established for the development site using the *FEH* methodology with *BFIHOST19 catchment descriptor, as agreed with the LLFA (West Sussex)*.

Table 6.1 Greenfield Run-off Rates

	Rate per ha (l/s/ha)	Site rate (l/s) – 0.83ha
Q1	6.97	5.79
Qbar	8.2	6.81
Q30	18.85	15.65
Q100	26.14	21.7

6.1.3 Greenfield runoff volume of 306m^3 have been estimated for the 1.0% AEP and 6 hour duration event using the FEH method, refer to **Appendix E**.

6.2 Hierarchy for Surface Water Disposal

6.2.1 The National Standards for Sustainable Drainage Systems (Defra, 2011) state that the following options must be considered in accordance with the hierarchy for surface water disposal:

6.2.2 Discharge to Ground (Infiltration)

6.2.3 Based on the available geologic and hydrogeological information (Section 2 of this report), infiltration drainage is deemed unfeasible at the development site. Therefore, an alternative solution is also proposed.

6.2.4 Discharge to Surface Water Body

6.2.5 As detailed in Section 2, there is an appropriate surface water body to the south of the site, into which it is proposed to discharge surface water. Part of this existing water course is within the client's title and therefore the client will be able to connect to the ditch without any 3rd party agreements and subject to an Ordinary Water Course Consent.

6.2.6 Discharge to Sewer

6.2.7 As discharge to surface water is proposed, discharge to sewer is not considered further.

6.3 Proposed Drainage Strategy

6.3.1 The proposed surface water drainage strategy has been designed in accordance with the *DCG* and *Building Regulations Part H* and in compliance with the *NPPF*, local requirements and current best practices, to collect, convey and attenuate runoff from all impermeable areas (0.843ha incl urban creep) before discharge into the Horton Sewer.

6.3.2 The proposed drainage strategy intends to collect runoff via a series of rainwater pipes, raingardens (bioretention areas) and swales before discharging into an attenuation basin which discharges into the Horton Sewer. In accordance with the surface water hierarchy, infiltration has been deemed unfeasible, therefore discharging to a watercourse is proposed.

6.3.3 Given the unfeasibility of infiltration drainage, the volume of runoff leaving the proposed development will be reduced to existing greenfield values that will not increase the flood risk downstream of the site. The proposed drainage strategy has been designed to limit discharge to the Q_{BAR} greenfield runoff rate of 6.6 l/s (8.2 l/s/ha of impermeable area) as agreed with HDC, **Appendix H**.

6.3.4 The proposed drainage strategy has been designed so that:

- Flooding does not occur on any part of the site for all events up to 3.3% AEP (1 in 30 years);
- Flooding does not occur in any part of a building or utility plant susceptible to water for all events up to 1.0% AEP (1 in 100 years) + 45% climate change allowance.

6.3.5 The performance of the proposed surface water drainage strategy has been tested for storm events with 100.0% AEP, 3.3% AEP and 1.0% AEP + 45% climate change and durations of 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960 and 1440.

6.3.6 The results of the simulations are included in **Appendix E** and demonstrate how the proposed surface water drainage strategy can manage surface water flood risk at the development site without increasing flood risk elsewhere for storm events up to the 1.0% AEP + 4540% climate change allowance.

6.4 Sustainable Drainage Systems (SuDS)

6.4.1 In accordance with the *NPPF*, (major) developments should incorporate sustainable drainage systems (SuDS) unless there is clear evidence that this would be inappropriate. In addition to water quantity control, SuDS should consider opportunities to provide water quality and amenity / biodiversity benefits (i.e. multifunctionality approach).

6.4.2 While the proposed drainage strategy is largely reliant on SuDS such as a swale, attenuation basin and rain gardens to manage runoff quantity, the table below shortlists other SuDS deemed compatible with the site's characteristics and which inclusion in the proposed development must be continuously assessed as the design progresses.

6.4.3 It is important to note the need to remove silt from runoff prior to discharge into SuDS features. SuDS such as filter drains, bioretention systems and pervious pavements are sustainable alternatives to proprietary treatment systems otherwise required to manage silt.

6.4.4 The proposed SuDS are presented on the drainage layout in **Appendix F**.

Table 6.2: Sustainable Drainage Systems (SuDS)

SuDS Component	Description and Opportunities
Filter Drains/Strips	Filter drains are trenches filled with stone/gravel that create temporary subsurface storage for the filtration, attenuation and conveyance of surface water runoff. Ideally, filter drains receive lateral inflow from adjacent impermeable surfaces pre-treated over a filter strip. Filter drains can help manage peak flows by naturally limiting rates of conveyance through the filter medium and by providing attenuation storage when the rate of flow at the outlet is controlled. Filter drains can be effectively incorporated into the landscape and public open spaces and can have minimal land-take requirements. The use of filter drains is typically restricted to flat sites (unless placed parallel to contours). Filter drains are best located adjacent to (small) impermeable surfaces such as car parks and roads / highways. The areas near shared parking areas offer opportunity for such structures.
Swales	Swales are shallow, flat bottomed, vegetated open channels designed to treat, convey and often attenuate surface water runoff. Swales can also provide aesthetic and biodiversity benefits. Swales can help reduce flow rates by facilitating infiltration and / or providing attenuation storage when flow at the outlet is controlled. Coarse to medium sediments and associated pollutants can be removed by filtration through surface vegetation and ground cover. Swales are well suited for managing runoff from linear features such as main roads / highways. Swales are generally difficult to incorporate into dense urban developments, where space is limited. The area north of the development offers opportunity for such structures.
Bioretention Systems Tree Pits	Bioretention systems (including rain gardens) are shallow landscaped depressions that can reduce runoff rates and volumes and treat pollution. They also provide attractive landscape features and biodiversity. Bioretention systems can help reduce flow rates from a site by promoting infiltration / evapotranspiration and providing some attenuation storage. Bioretention systems can also provide very effective treatment functionality. Bioretention systems are a very flexible surface water management component that can be integrated into a wide variety of developments / densities using different shapes, materials, planting and dimensions. Rain gardens are proposed throughout the site at low sides of roads directing overland flow.
Detention Basins	Detention basins are landscaped depressions that are normally dry expect during and immediately following storm events. They can be on-line components where surface runoff from regular events is routed through the basin or off-line components into which runoff is diverted once flows reach a specific threshold. Detention basins can be vegetated depressions (providing treatment in on-line components) or hard landscaped storage areas. Off-line basins will normally have an alternative principal use (e.g. amenity or recreational facility or urban (hard) landscaping). A detention basin is proposed in the south west of the site.

6.5 Exceedance Events

6.5.1 In the event of a storm event greater than the 1.0% AEP + 45% climate change, or a failure of the drainage system, exceedance flows generated from the proposed development will flow along the proposed roads to the existing water course along the southern boundary. The mitigation measures to protect more vulnerable parts of the site are discussed in Section 5.

6.5.2 The exceedance flow routes are shown in **Appendix G**.

6.6 Water Quality Management

6.6.1 The suitability of the proposed drainage strategy to manage the development's pollution risk has been assessed using the simple index approach in *The SuDS Manual* (2015), as summarized in the table below.

Table 6.3: Surface Water Quality Management (Simple Index Approach)

Runoff Route / Treatment Train 1				
Land Use / SuDS	Hazard Level	TSS	Metals	Hydrocarbons
Pollution Hazard Indices				
Residential roofs	Very Low	0.2	0.2	0.05
Driveways, residential car parks and low traffic roads	Low	0.5	0.4	0.4
SuDS Mitigation Indices				
Swale	-	0.5	0.6	0.6
Bioretention system	-	0.8	0.8	0.8
Detention Basin	-	0.5	0.5	0.6
Total SuDS Mitigation Index = SuDS type 1 + 0.5 (SuDS type 2)				
Total SuDS Mitigation Index	Low	1.8	1.9	2.0
Total SuDS Mitigation Index ≥ Pollution Hazard Index (for each contaminant type)				

Runoff Route / Treatment Train 2				
Land Use / SuDS	Hazard Level	TSS	Metals	Hydrocarbons
Pollution Hazard Indices				
Driveways, residential car parks and low traffic roads	Low	0.5	0.4	0.4
SuDS Mitigation Indices				
Swale	-	0.5	0.6	0.6
Pond	-	0.7	0.7	0.5
Total SuDS Mitigation Index = Suds type 1 + 0.5 (SuDS type 2)				
Total SuDS Mitigation Index	Low	1.2	1.3	1.1

Total SuDS Mitigation Index ≥ Pollution Hazard Index (for each contaminant type)

Table 6.3: Groundwater Quality Management (Simple Index Approach)

Runoff Route / Treatment Train 1				
Land Use / SuDS	Hazard Level	TSS	Metals	Hydrocarbons
Pollution Hazard Indices				
Residential roofs	Very Low	0.2	0.2	0.05
Driveways, residential car parks and low traffic roads	Low	0.5	0.4	0.4
SuDS Mitigation Indices				
Dense vegetation[1]	-	0.6	0.5	0.6
Soil[1]	-	0.4	0.3	0.3
Bioretention system[1]	-	0.8	0.8	0.8
Total SuDS Mitigation Index ≥ Pollution Hazard Index (for each contaminant type)				

1- See SuDS Manual 2015 for the full specification.

6.7 Operation and Maintenance

6.7.1 The function of the surface water drainage system must be understood by those responsible for maintenance, regardless of whether individual components are below ground or on the surface. In any system properly designed, monitored and maintained, performance deterioration can usually be minimised.

6.7.2 The long-term operation and maintenance of the proposed surface water drainage strategy will be the responsibility of entities, as detailed in the table below. Appropriate legal agreements defining maintenance responsibilities and access rights over the lifetime of the proposed development must be established prior to construction.

Table 6.4: Entities Responsible for SuDS Maintenance

SuDS Component	Location	Function	Responsible Entity
Swale	Roadsides	Store, convey and treat runoff	Local highways authority or private management company
Bioretention System	Roadside	Store & treat runoff	Local Highway Authority or private management company
Pond	Public open spaces	Store & treat runoff	Local authority, water company or private management company

6.7.3 Where the user / benefiter of a system is not responsible for maintenance, then it is important to ensure that they know when the SuDS are not functioning correctly and who to contact if any issue arises.

6.7.4 Maintenance plans are often required to clearly identify who is responsible for maintaining proposed SuDS as well as the maintenance regime to be applied. Maintenance plans can also form a useful tool for public engagement with SuDS and understanding their wider benefits. The maintenance requirements of the proposed surface water drainage strategy are summarised in the table below.

Table 6.5: Typical Operation and Maintenance Requirements

Operation and Maintenance Activity	SuDS Component			
	Filter Drain	Swale	Bioretention System	Pond
Inspection	■	■	■	■
Litter and debris removal	■	■	■	■
Grass cutting	■	■	■	■
Weed and invasive plant control	□			□
Shrub management (including pruning)		□	□	□
Shoreline vegetation management				□
Aquatic vegetation management				□
Occasional Maintenance				
Sediment management	■	■	■	■
Vegetation replacement		□	□	□
Vacuum sweeping and brushing				
Remedial Maintenance				
Structure rehabilitation/repair	□	□	□	□
Infiltration surface reconditioning	□	□	□	
Key: ■ Will be required □ May be required				

6.8 Drainage During Construction

6.8.1 Drainage is typically an early activity in the construction of a development, taking form during the earthworks phase as it is the responsibility of the contractor to manage all construction runoff rates and water quality. However, the connection of piped drainage system to SuDS components should not take place until the end of construction works, unless a robust strategy for silt removal prior to occupation of the site is implemented.

6.8.2 Silt-laden runoff from construction sites represents a common form of waterborne pollution and cannot enter SuDS components not specifically designed to manage this, as it can overwhelm the system and pollute receiving water features. Any gullies and piped systems

should be capped off during construction and fully jetted and cleaned prior to connection to SuDS components.

6.8.3 The three principal aspects of drainage during construction are conveying runoff, controlling runoff and trapping sediments:

- Conveyance of runoff can be achieved through small ditches / swales, channels and drains. Runoff control measures should be implemented to ensure that runoff does not overwhelm the temporary drainage system causing flooding on site or elsewhere.
- Control of runoff can be achieved through perimeter ditches or appropriate grading to ensure that any runoff from the construction site stays on site. Runoff rates leaving the site should be managed so they do not exceed the proposed rates stated in this report, based on pre-development conditions.
- Construction runoff should be directed to dedicated settlement basins with adequate upstream sediment and pollution control such as sediment basins, silt fences and straw bales prior to infiltration or off-site discharge.

6.8.4 Additional conveyance, control and treatment measures should be installed as needed during grading. Slope stability needs to be considered when using open water features to convey, control and treat runoff across the site. Any necessary surface stabilisation measures should be applied immediately on all disturbed areas where construction work is either delayed or incomplete.

6.8.5 Maintenance inspections should be performed weekly, and maintenance repairs should be made immediately after periods of rainfall.

6.8.6 All drainage infrastructure (namely underground features) must be protected from damage by construction traffic and heavy machinery through the implementation of measures such as protective barriers and storing construction materials away from the drainage infrastructure.

7 FOUL WATER DRAINAGE STRATEGY

7.1.1 Sewerage undertakers have a legal obligation under the Water Industries Act 1991 to provide developers with the right to connect to public (foul) networks. The Water Industries Act 1991 also contains safeguards to ensure that flows resulting from new developments do not cause detriment to the existing public sewerage networks by imposing a duty on sewerage undertakers to carry out works required to accommodate additional flows into their networks.

7.1.2 The existing site does not benefit from a formal foul water drainage system, but in accordance with records obtained from SW, the development immediately east of the site is served by a public network of foul sewers. The nearest public foul sewer is the 150 mm pipe along Henfield Road.

7.1.3 A pre-development enquiry has been undertaken with Southern Water. The feedback has been received and confirmed sufficient capacity within their network to accommodate the proposed development.

7.1.4 As invert levels of the existing public foul drainage network are not deep enough to allow gravity drainage from the site, on site pumping of foul flows will be required. The proposed foul water drainage strategy envisages a pumping station (designed to adoptable standards, with a cordon sanitaire of 15m to all dwellings) in the south west of the site. The proposed foul pumping station will be raised to 9.45m.

7.1.5 Once planning consent has been granted, it is recommended that this is forwarded to the water company to ensure that they are aware of the additional capacity required for the development.

8 CONCLUSIONS AND RECOMMENDATIONS

8.1.1 JNP Group has been commissioned by Wates Developments to prepare a Flood Risk Assessment and Drainage Strategy for the Land West of Shoreham Road development, Small Dole, Shoreham, West Sussex.

8.1.2 The site is greenfield and is approximately 5.453ha and is located in Small Dole. The proposed development comprises 45 dwellings (including affordable homes). A large proportion of the site is to remain permeable as per the existing site.

8.1.3 The site is not underlain by artificial ground apart from a small area at the northern entrance to the site. There are areas of artificial ground located close to the site however given the limited urban nature of the area, it is unlikely that the site is underlain by some Made Ground.

8.1.4 The site lies on predominantly on Lower Greensand Group bedrock with areas of superficial deposits of River Terrace Deposits (south boarder) and Head deposits (north boarder). All the strata underlying the site are non-cohesive in nature.

8.1.5 In accordance with DEFRA / EA's MAGiC, the site is not in a groundwater source protection zone.

8.1.6 Based on the available hydrogeological information, infiltration drainage is deemed unfeasible at the development site.

8.1.7 The nearest natural watercourse is the Horton Sewer which flows along the southern border of the development site, flowing east to west. The River Adur is located approximately 1km to the west of the site at its nearest point.

8.1.8 Discharge of surface water to a watercourse is deemed viable.

8.1.9 The Flood Risk Assessment section of this report demonstrates that the risk of flooding from all sources (fluvial, tidal, surface water, groundwater, sewer and reservoir) is low.

8.1.10 The EA predict a low risk of surface water flooding. It is proposed to mitigate this risk by SuDS features on site such as a swale, attenuation basin and rain gardens.

8.1.11 The site is currently completely greenfield and therefore development of the site will increase the impermeable area, however this will be controlled by SuDS features in order to not increase surface water run-off. There are existing surface water flow paths outside the site but these remain unaffected by the proposed development.

8.1.12 From the topographical information provided it appears that any existing runoff generated is intercepted offsite, mainly by the Horton Sewer.

8.1.13 There are a number of road gullies in the surrounding highways, which based on the records, discharge to the local surface water network shown on the sewer records.

8.1.14 The proposed drainage strategy intends to collect runoff via a series of rainwater pipes, raingardens and swales, discharging into a below ground drainage network which conveys the surface water to the onsite attenuation basin. In accordance with the surface water hierarchy, infiltration has been deemed unfeasible, therefore discharging to a watercourse is proposed.

8.1.15 The discharge rate is to be restricted to 6.6l/s using a Hydrobrake flow control (or similar approved), which maintains existing greenfield values as calculated using the Modified Rational Method. The agreed Qbar to be applied to the site is 8.2 l/s/he.

8.1.16 The proposed drainage strategy incorporates the following SuDS features:

- Swale
- Attenuation basin
- Rain gardens

8.1.17 Attenuation storage is to be provided in the form of an attenuation basin. A Quick Storage Estimate has been carried out, which requires an attenuation volume of 1000m^3.

8.1.18 The proposed surface water drainage strategy can manage surface water flood risk at the development site without increasing flood risk elsewhere for storm events up to the 1.0% AEP plus 45% climate change allowance.

8.1.19 Overland flows resulting from exceedance events are expected to leave the developed site via roads and greenspace directing flow southward towards the Horton Sewer. The far northern greenspace part of the site directs flow northward towards New Hall Lane, as currently occurs.

8.1.20 Water quality management is to be achieved through the treatment of the proposed rain gardens, swale and attenuation basin. The hazard level is very low, and the water quality treatment is considered acceptable following the completion of the simple index approach from the SuDS Manual.

8.1.21 The proposed foul water drainage strategy is to drain into the foul sewer network in the surrounding highway network. The STW records suggest the surrounding foul water network c.2m bgl and is therefore not deep enough to allow for a gravity connection. The proposed foul water network is to drain into the existing network via a pumped main, with the pumping station being located south west of the site.

8.1.22 The proposed foul water outfall is indicated to outfall to the sewer in Henfield Road to the east.

8.1.23 It is recommended a survey of the existing foul water drainage is carried out to confirm connectivity and outfall locations.

8.1.24 An operation and maintenance plan has been provided as part of this report in accordance with the SuDS Manual, which includes a review of all drainage elements, including SuDS features.

8.1.25 In conclusion, the proposed development is not at risk of flooding and does not increase flood risk off-site. Surface water runoff from the proposed development will be collected and managed on-site before discharging to the Horton Sewer at a maximum discharge rate of 6.6 l/s, which is in line with the agreed 8.2 l/s/he. The foul water drainage will discharge unrestricted to the existing sewer network.

8.1.26 Once planning consent has been granted, it is recommended that this is forwarded to the water company to ensure that the foul network remains to have enough capacity for the development.

8.1.27 Any connection to the public sewer is subject to a Section 106 application.

8.1.28 This report is intended for the use of the developer of the site in support of their planning application for the site only.

9 LIMITATIONS

9.1.1 The information, conclusions and recommendations presented within this report are deemed to be current at the time of issue. No guarantee can be given to the status of this information other than at the time of issuing. Where necessary, the user shall confirm the status of any applicable assessments and consents.

9.1.2 This report has been commissioned by Wates Developments. No third party may receive a copy of this report without first obtaining our permission in writing.

9.1.3 This report is confidential and has been prepared solely for the benefit of Wates Developments and those parties with whom a warranty agreement has been executed or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of this report, written approval must be sought from JNP Group and a charge may be levied against such approval. JNP Group accepts no responsibility or liability for the consequences of this document being used for any purpose or project other than for which it was commissioned, or this document being used by any third party with whom an agreement has not been executed.

9.1.4 The copyright of this report remains with JNP Group at all times.

APPENDIX A: LOCATION PLAN

N
W E
S

0 10m 20m

KEY

Site access

Borehole

NEW HALL LANE

Viewing Point

Community Orchard

Micro Allotments

Swale

Swale

Swale

Swale

Swale

LAP

Swale

SUDS Pond

Pumping Station

LAP

HENFIELD ROAD (A2037)

TOTTINGTON ROAD

architecture

Indicative Coloured Site Layout
Land West of Shoreham Road
Small Dole

23088 / C101E

Scale 1:500 @ A0 March 2025

OSP Architecture, Broadmede House, Farnham Business Park, Weydon Lane, Farnham, Surrey, GU9 8QT Tel: 01252 267878 . www.osparchitecture.com

APPENDIX B: TOPOGRAPHICAL SURVEY

Notes:

All information contained in this drawing (including digital data) should be checked and verified prior to any fabrication or construction.

Grid coordinates are based on an OS GNSS system on a plane grid with a scale factor of 1.0000.

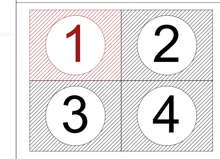
——— Original survey (completed by others)

INDICATIVE

Tree Schedule

Pt No	Spread	Bole	Height	Species
27	8.0	0.25	7.0	MAPLE
28	8.0	0.25	7.0	MAPLE
29	8.0	0.25	7.0	MAPLE
30	9.0	0.40	8.0	WILLOW
31	8.0	0.30	11.0	MAPLE
43	12.0	0.50	14.0	MAPLE
50	12.0	0.50	15.0	OAK
51	12.0	0.40	15.0	OAK
53	7.0	0.30	8.0	WILLOW
54	7.0	0.30	8.0	WILLOW
55	20.0	0.90	20.0	OAK
75	14.0	0.50	17.0	SYCAMORE
77	4.0	0.30	5.0	ROWAN
77	8.0	0.40	12.0	MAPLE
78	10.0	0.40	13.0	SYCAMORE
83	10.0	0.40	10.0	MAPLE
84	14.0	0.90	16.0	OAK
87	12.0	0.30	17.0	MAPLE
88	12.0	0.60	14.0	MAPLE
95	14.0	0.40	15.0	ASH
96	9.0	0.50	13.0	ASH
97	15.0	0.65	15.0	OAK
140	20.0	1.20	16.0	OAK
149	8.0	0.40	7.0	WILLOW
150	7.0	0.25	10.0	OAK
151	7.0	0.25	10.0	OAK
152	6.0	0.25	8.0	OAK
155	18.0	0.70	18.0	ASH
156	10.0	0.40	8.0	ASH
157	9.0	0.50	8.0	WILLOW
200	10.0	0.50	11.0	WILLOW

Sheet Layout



Legend:

Rev. Suffix	Date	Initial	Revision Details

Surveyor	MB	Verified By	MB	CAD Operator	ARL	Approved By	MB	Date	16.09.25

Levelling GNSS Datum OSGB36

To an OS GNSS Datum

Client

Wates

Location

New Hall Lane
Henfield

Drawing Title

Topographical
Survey - Sheet 1 of 4

Job No. 2506057	Old Job No.
Drawing Number W/2506057/1	Revision Suffix
Scale 1:200m (A0)	Date September 2025

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521360E 521380E 521400E 521420E 521440E 521460E 521480E 521500E 521520E 521540E

113280N 113260N 113240N 113220N 113200N 113180N 113160N 113140N

Brambles Ht=3.0m

Mixed Foliage Ave Ht=3.0m

Mixed Foliage Ave Ht=3.0m

Mixed Foliage Ave Ht=3.0m

Mixed Foliage Ave Ht=3.0m

Notes:

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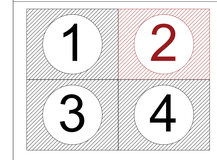
Grid coordinates are based on an OS GNSS system on a plane grid with a scale factor of 1.0000.

——— Original survey (completed by others)

INDICATIVE

Sheet Layout



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Rev. Suffix	Date	Initial	Revision Details

Surveyor	MB	Verified By	MB	CAD Operator	ARL	Approved By	MB	Date	16.09.25

Levelling GNSS Datum OSGB36

To an OS GNSS Datum

Client

Wates

Location

New Hall Lane
Henfield

Drawing Title

Topographical
Survey - Sheet 2 of 4

Job No. 2506057	Old Job No.
Drawing Number W/2506057/2	Revision Suffix
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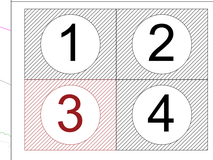
INDICATIVE

Sheet Layout



Legend:

Rev. Suffix	Date	Initial	Revision Details

Surveyor	MB	Verified By	MB	CAD Operator	ARL	Approved By	MB	Date	16.09.25

Levelling GNSS Datum OSGB36

To an OS GNSS Datum

Client

Wates

Location

New Hall Lane
Henfield

Drawing Title

Topographical
Survey - Sheet 3 of 4

Job No. 2506057	Old Job No.
Drawing Number W/2506057/3	Revision Suffix
Scale 1:200m (A0)	Date September 2025

CD SURVEYS LTD
LAND, BUILDING & SITE ENGINEERING
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Notes:

All information contained in this drawing (including digital data) should be checked and verified prior to any fabrication or construction.

Grid coordinates are based on an OS GNSS system on a plane grid with a scale factor of 1.0000.

—— Original survey (completed by others)

INDICATIVE

Sheet Layout

1	2
3	4

Legend:

Fences
Walls
Hedges
Trees
Buildings
Overhead Electric
Overhead Phone
Gate

Fences:	
Barbed Wire Fence	B/W
Corrugated Iron Fence	C/I
Closed Board Fence	C/B
Chestnut Paling Fence	C/P
Iron Railing Fence	I/R
Post and Chain Fence	P/C
Post and Rail Fence	P/R
Post Wire Fence	P/W
Interwoven	I/W
Chain Link Fence	C/L
Larch Lap Fence	L/L
Wire Mesh Fence	W/M

Abbreviations:

BOLLARD	BO	MARKER	MK
BRITISH TELECOM IC	BT	PARKING METER	PM
CONCRETE PAVING SLABS	CPS	ROAD NAME PLATE	RNP
COVER LEVEL	CL	ROAD SIGN	RS
DROP KERB	DK	RODDING EYE	RE
ELECTRICITY POLE	EP	RETAINING WALL	Rtw
FIRE HYDRANT	FH	RAINWATER PIPE	RPW
FLOWER BED	F/B	SOIL VENT PIPE	SVP
FOOTPATH	FP	STOP VALVE	SV
GAS VALVE	GV	TELEGRAPH POLE	TP
GULLY	GY	TRAFFIC LIGHT	TL
INSPECTION COVER	IC	UNABLE TO LIFT	UTL
PIPE INVERT LEVEL	IL	VENT PIPE	VP
KERB OUTLET	KO	WATER METER	WM
MAN HOLE	MH		

Rev. Suffix	Date	Initial	Revision Details

Surveyor	MB	Verified By	MB	CAD Operator	ARL	Approved By	MB	Date	16.09.25

Levelling GNSS Datum OSGB36

To an OS GNSS Datum

Client

Wates

Location

New Hall Lane
Henfield

Drawing Title

Topographical Survey - Sheet 4 of 4

Job No. 2506057	Old Job No.
Drawing Number W/2506057/4	Revision Suffix
Scale 1:200m (A0)	Date September 2025

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APPENDIX C: GROUND APPRAISAL REPORT

Geo-Environmental

GROUND APPRAISAL REPORT

for the site at

HENFIELD ROAD,

SMALL DOLE, HENFIELD,

BN5 9YH

on behalf of

WATES DEVELOPMENTS LIMITED

Report:	**GROUND APPRAISAL REPORT**
Site:	**LAND AT HENFIELD ROAD, SMALL DOLE, HENFIELD, BN5 9YH**
Client:	**WATES DEVELOPMENTS LIMITED**
Date:	**20th DECEMBER 2023**
Reference:	**GE22017 - GARv1JK231220**
Version:	**1.0**
Prepared by:	
	JASON KANELLIS BSc (Hons), MSc, FGS, MIEnvSc **PRINCIPAL ENGINEER**
Reviewed by:	
	JONATHAN TINGLEY CEnv, MSc, BEng (Hons), FGS, MIEnvSc **TECHNICAL DIRECTOR**
Approved by:	
	ANTHONY POTTER BSc (Hons), MSc, FGS **SENIOR ENGINEER**

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AMENDMENT RECORD

Revision ref.	Date	Reasons for amendment	Author	Reviewer
1.0	20/12/2023	First issue	JK	JT

CONTENTS

FIGURES

APPENDICES

EXECUTIVE SUMMARY		
Site Details	Site Address	Land at Henfield Road, Small Dole, Henfield, BN5 9YH
	Form of Development	The site was to be partially developed with a residential estate, with associated private gardens, areas of soft landscaping, access roads and utilities, and the creation of a SuDS pond, amenity spaces, woodland, playground and community orchard
	Scope of Works	An intrusive investigation to confirm the ground and groundwater conditions and support the development by providing geotechnical and geo-environmental assessments of the site in relation to the proposed redevelopment.
	Ground Conditions	The ground conditions comprised Topsoil and Made Ground overlying the bedrock of the Lower Greensand Group.
	Groundwater	Potential groundwater was encountered at depths of between 1.90m bgl and 2.48m bgl during the intrusive works. Groundwater seepages were also encountered at depths of between 1.30m bgl and 3.00m bgl during the intrusive works. During the three monitoring visits to date, water has been recorded at depths of between 0.10m bgl and 3.82m bgl; the well within WS04 was recorded as 'dry' at a depth of 4.00m bgl (depth of installation) for visits one and two. The well within WS05 was recorded as 'dry' at a depth of 2.50m bgl (depth of installation) for the third visit. A further nine groundwater depth monitoring visits were outstanding at the time of writing this report.
Geotechnical Considerations	Traditional Foundations	It is recommended that the NHBC Standards, Chapter 4.2 be adopted for the classification of volume change potential and the design foundation depth. On the basis of the results of the Atterberg Limit tests in conjunction with the ground conditions in the intrusive positions it is considered that the cohesive strata of the Lower Greensand Group up to 1.5m bgl be classified as medium volume change potential, requiring a minimum foundation depth of 0.90m, remote from trees. At depths greater than 1.5m bgl, the strata can be classified as low volume change potential. The sandstone may be considered non shrinkable. Foundations within shrinkable soils within the zone of moisture demand of existing, proposed or recently removed trees will require deepening. Where calculated foundation depths exceed 1.50m on account of trees, heave protection measures may be required. A net allowable bearing pressure of 125kPa is considered suitable for traditional trench foundations up to 1.50m in width taken down through any disturbed, desiccated or soft materials to bear upon the firm to stiff clays and silts of the Lower Greensand Group. Furthermore, foundations which span the clay, silt, siltstone and sandstone horizons of the Lower Greensand Group should be nominally reinforced to account for differential settlement.
	Excavations	Shallow excavations within any Made Ground should remain relatively stable in the short term. However, any longer deeper excavations within any deeper zones of Made Ground are likely to be unstable and require battering to a safe angle or temporary support. Shallow excavations above the water table within the Lower Greensand Group are likely to remain stable in the short to medium term. Deeper excavations within the Lower Greensand Group may be subject to instability particularly where taken below the groundwater table and would require some form of temporary support, battering back to a safe angle and groundwater control. Clays of the Lower Greensand Group will soften rapidly when exposed to water, as

		such, any foundation trenches should be concreted immediately. In addition, localised spalling and/or collapse may occur where foundation trenches intercept lenses of perched water and/or groundwater. Dewatering of trenches would be required in such circumstances.
	Soakaways	Traditional soakaways may perform satisfactorily on some higher, isolated parts of the site. However, the capacity of these soakaways may be limited due to groundwater depth and potential water seepages.
	Buried Concrete	Lower Greensand Group: DS-1 (AC-1).
	Pavements	Based on the laboratory and in-situ test results, a CBR value of 3% is recommended for pavements constructed upon the Lower Greensand Group across the site. Based on the results of the laboratory analysis, the Lower Greensand Group should be deemed frost susceptible throughout thus a minimum pavement thickness of 450mm would be appropriate.
Environmental Considerations	Human Health	Remedial measures to protect future end users of the proposed development from soils on site will not be required.
	Adjacent Land Users	Remedial measures to protect adjacent land users of the proposed development from soils on site will not be required.
	Soft Landscaping	Remedial measures to protect future and existing soft landscaping on the site will not be required.
	Built Environment	Barrier pipe is not considered to be necessary for potable water supply pipes on site.
	Surface Water	Remedial measures to protect the surface water feature (stream) on the southern boundary of the site will not be required.
	Groundwater	Measures to remediate the groundwater beneath the site are not considered necessary.
	Ground Gases	The results of the three monitoring visits to data are considered representative of British Standard CS1/NHBC Traffic Light Green, for which no ground gas protection measures would be required. A further three ground gas monitoring visits were outstanding at the time of writing this report. It is recommended that the results of these visits be obtained prior to designing the ground floor slabs.
	Waste Disposal	The Topsoil, Made Ground and Lower Greensand Group encountered on site would be classified as Non Hazardous waste. The results of the WAC analysis indicate the encountered Topsoil and Made Ground would be suitable for disposal at an inert waste facility.
	Discovery Strategy	A discovery strategy must 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.
Further Action: • Await results of on-going ground gas and groundwater depth monitoring visits. • Submit results of chemical testing to water utility company.		
This Executive Summary is intended to provide a brief summary of the main findings and conclusions of the investigation. For further information, reference should be made to the main report ref. GE22017 - GARv1JK231220.		

1.0 INTRODUCTION

1.1 General

Geo-Environmental Services Limited (Geo-Environmental) was instructed by Wates Developments Limited to undertake an investigation of the geotechnical and geo-environmental factors pertaining to proposed development of the site at Henfield Road, Small Dole, Henfield, BN5 9YH (herein referred to as 'the site'). The site's location is presented in Figure 1.

1.2 Form of Development

It was understood that the site was to be partially developed with a residential estate, with associated private gardens, areas of soft landscaping, access roads and utilities, and the creation of a SuDS pond, amenity spaces, woodland, playground and community orchard. An Illustrative Scheme is included in Figure 2 (ref. 23088 / SK02).

1.3 Site Description

The site comprised a broadly rectangular shaped parcel which was undeveloped agricultural land at the time of the site walkover in 2023.

The site was covered with low cut grass and other ruderals. The site sloped downwards to the north and south from a broadly central ridge running east/west.

The boundaries comprised mature and semi-mature hedgerows and trees with a stream noted on the site's southern boundary. Access to the site could be gained from Henfield Road to the east or from New Hall Lane to the north.

The surrounding area generally comprised residential properties and agricultural land.

A record of the photographs obtained during the site walkover survey are included in Appendix A.

1.4 Objectives

The investigation was to comprise a desk study of geotechnical and environmental factors pertaining to the site, including a site walkover survey, a review of available historical maps and an examination of other sources of geo-environmental and geotechnical information. Subject to the findings of the desk study, an intrusive investigation was to be undertaken into the geotechnical and geo-environmental conditions pertaining to the site.

The data from the geotechnical investigation was to form the basis of an interpretation with respect to foundation design, concrete specification, pavement design and excavation stability.

In terms of the environmental investigation a Preliminary Risk Assessment (PRA) was undertaken as part of the desk study in accordance with Land Contamination Risk Management (LCRM), in order to identify any specific requirement for and scope of any further assessment. The objective of the risk assessments was to evaluate the risks posed to the proposed redevelopment, adjacent land uses and the wider environment, in the context of likely planning requirements, immediate liabilities under the Environmental Protection Act 1990 and risks posed to Controlled Waters under the Water Resources Act from the current status of the site and in line with the proposed redevelopment.

1.5 Standards and Guidance

Where practicable, the ground investigation and subsequent geotechnical and environmental assessments were

undertaken in accordance with the following documents and guidance.

- British Standards Institute - Code of Practice for Earth Retaining Structures (BS8002:2015).
- British Standards Institute - Code of Practice for Site Investigations (BS5930:2015).
- British Standards Institute - Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings (BS8485:2015+A1:2019).
- British Standards Institute - Eurocode 7 – Geotechnical Design - Parts 1 & 2 (BS EN1997-1:2004 & BS EN1997-2:2007).
- British Standards Institute - Guidance on investigations for ground gas. Permanent gases and Volatile Organic Compounds (VOCs) (BS8576:2013).
- British Standards Institute - Investigation of Potentially Contaminated Sites - Code of Practice (BS10175:2011+A2:2017).
- British Standards Institute - Soils for Civil Engineering Purposes (BS1377:1990).
- British Standards Institute - Specification for Topsoil and Requirements for Use (BS3882:2015).
- Building Research Establishment - Soakaway Design - DG 365 (2016).
- Building Research Establishment - The Performance of Building Materials in Contaminated Land (BRE255) (1994).
- Construction Industry Research and Information Association - Assessing risks posed by hazardous ground gases to buildings (C665) (2007).
- Department for Environment Food and Rural Affairs and CL:AIRE - Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination (SP1010) (2014).
- Department of Environment - Industry Profiles (1995 - 1996).
- Environment Agency - Guidance for waste destined for disposal in landfills (2006).
- Environment Agency - Guidance on Requirements for Land Contamination Reports (2005).
- Environment Agency - Land Contamination Risk Management (LCRM) (2023).
- Ministry of Housing, Communities and Local Government - National Planning Policy Framework (2023).
- National House Building Council, Environment Agency & Chartered Institute of Environmental Health - Guidance for the Safe Development of Housing on Land Affected by Contamination (R&D Publication 66) (2008).
- National House Building Council - Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present (10627-R01[04]) (2007).
- National House Building Council – Standards, Chapter 4.1 Land Quality - Managing Ground Conditions (2023).

1.6 Conditions

This report does not purport to be a “Geotechnical Design Report” as defined in Clause 2.8 of Eurocode 7 (Geotechnical Design BS EN 1997-1:2004) and some of the data used to support this preliminary geotechnical assessment may not be fully compliant with that design code. It is considered possible that further detailed ground investigations could be required to facilitate the detailed geotechnical design process and should be carried out on a structure specific basis if necessary.

The data collected from the investigations have been used to provide an interpretation of the geotechnical and/or environmental conditions pertaining to the site. The recommendations and opinions expressed in this report are based on the data obtained. Geo-Environmental takes no responsibility for conditions that either have not been revealed in the available records, or that occur between or under points of physical investigation. Whilst every effort has been made to interpret the conditions, such information is only indicative and liability cannot be accepted for its accuracy.

It should be noted that in particular the concentrations and levels of mobile liquid and gaseous materials are likely to vary with time. Additionally, the absence of asbestos noted during the site walkover or within any soil samples analysed does not guarantee the absence of asbestos within buildings, within or bonded to concrete, as discrete burials, or within the soil mass elsewhere within a site. This report must not be taken as, or assumed to imply, any guarantee that a site is free of hazardous or potentially contaminative materials.

Information contained in this report is intended for the use of the Client and Geo-Environmental can take no responsibility for the use of this information by any party for uses other than that described in this report. Geo-Environmental makes no warranty or representation whatsoever express or implied with respect to the use of this information by any third party. Geo-Environmental does not indemnify the Client or any third parties against any dispute or claim arising from any finding or other result of this investigation report or any consequential losses.

Assessment criteria or other parameters developed for the evaluation of contamination on this site are based on a number of assumptions regarding exposure and toxicology. Exposure to contaminants and levels of adverse effects may therefore vary. Whilst reasonable care and expertise has been employed in the development of such criteria, no liability is accepted in this respect. Other criteria or guidance on the development of assessment criteria may be published in the future and no liability is accepted in this respect.

This report remains the property of Geo-Environmental and the Client has no rights to, or reliance upon this document or supporting documents until such time as payment has been received in full for all invoices for works undertaken in connection with this report.

2.0 DESK STUDY

The findings of the Phase I desk study are presented in the following section. A copy of the historical maps and other information obtained as part of the desk study are presented in Appendix A. Comments made in the following section regarding possible ground conditions on the site are based purely on the findings of the desk study.

2.1 Historical Mapping

Historical maps dating back to 1875 were obtained as part of the desk study. A summary of the apparent key features observed on the map extracts both on the site and within the local area is presented within Table 2.1.

Date	On-site	Off-site
1875	Mapping indicated the site to occupy part of an open field with the southern boundary demarcated by trees and a stream.	The surrounding area generally comprised open agricultural fields and areas of mixed woodland. Some very sparse residential properties were noted to the north and south of the site. Newhall Farm was labelled approximately 225m to the west of the site.
1879 - 1899	No changes noted.	No significant changes noted.
1911 - 1912	No changes noted.	No significant changes noted.
1947 - 1951	Aerial Photograph - No changes noted.	Aerial Photograph - Evidence of a quarry was noted 670m south of the site.
1958	A track was mapped running broadly east to west across the centre of the site.	Significant residential development was shown to the north, east and south-east. Residential properties with associated gardens were shown to the immediate north of the site. A number of glass-roofed structures were mapped approximately 140m to the west of the site boundary.
1961 - 1962	No changes noted.	The quarry was mapped to have expanded westward.
1976	No changes noted.	Further residential development was shown in the surrounding area. The quarry was labelled as a disused pit.
1978	No changes noted.	No significant changes noted.
1990	No changes noted.	Further residential development was shown to the north-east of the site boundary.
1994	No changes noted.	No significant changes noted.
1999	Aerial Photograph - No changes noted.	Aerial Photograph - No changes noted.
2000	No changes noted.	The quarry was in use as a landfill site.
2006	The track running across the site was no longer shown.	The landfill site was no longer labelled.
2023	No changes noted.	No significant changes noted.

Table 2.1 Summary of Historical Map Extracts

2.2 Geology

British Geological Survey (BGS) geological mapping indicated the geology of the site to comprise superficial River Terrace Deposits (north) and Head Deposits (south) overlying the bedrock of the Lower Greensand Group. There is also the potential for limited superficial Alluvium associated with the river on the souther boundary of the site.

Alluvium is the most recent river or estuarine deposit and generally comprises silty clays usually with an appreciable organic content. Lenses of sand and gravel are also commonly found, as are pockets of peat.

The rivers of the south-east of England, including the River Thames and its tributaries, have been subject to at least three changes of level since Pleistocene times. One result has been the formation of a complex series of River Terrace Deposits. The deposits are generally found at an elevation close to or higher than that of the existing rivers, and generally comprise sands and gravels of roughly bedded flint or chert gravels varying degrees of coarseness.

Head Deposits are drifts produced by solifluxion, the downslope movement of debris outwash during the periglacial period, and characteristically comprise poorly sorted sands gravels and chalk of local derivation.

The Lower Greensand Group is mainly comprised of sands and sandstones (varying from well-sorted fine-grained to poorly sorted medium- to coarse-grained) with silts and clays in some intervals. In southern England, erosional unconformity or disconformity at base of Atherfield Clay Formation: in most of area overlies Wealden Clay Formation, elsewhere Lower Greensand Group oversteps onto Jurassic rocks. Base of Gault; specifically in the Wealden area, base of a short interval of condensed facies beds at the base of the silty clays of the Gault above the sands of the Folkestone Formation.

2.3 Hydrogeology

With reference to Envirocheck data, the aquifer designations of the various geologies beneath the site are summarised in Table 2.2.

Geology	Aquifer Designation
Alluvium	Secondary Undifferentiated
River Terrace Deposits (superficial)	Secondary A
Head Deposits (superficial)	Secondary Undifferentiated
Lower Greensand Group (bedrock)	Principal

Table 2.2 Summary of Aquifer Designations

Secondary 'A' aquifers comprise permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

Secondary (undifferentiated) aquifers are assigned where an 'A' or 'B' designation could not be attributed due to variable characteristics of the strata. This aside, Secondary aquifers comprise permeable and lower permeable layers which can be capable of supporting water supplies at a local level or may yield limited amounts of groundwater within more permeable horizons.

Principal aquifers are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.

According to information provided within the Envirocheck dataset the site was not indicated to be within a Source Protection Zone (SPZ). Furthermore, no SPZs were identified within a 1km radius of the site boundary. An SPZ is a protection zone placed around a well or borehole that supplies groundwater of potable quality.

There were no groundwater abstractions, discharge consents or pollution incidents to ground/groundwater within 250m of the site.

The Envirocheck dataset indicated that the site was not located within an area at risk of flooding from groundwater.

2.4 Hydrology

With reference to the Envirocheck dataset, the nearest surface water feature was a stream situated to the immediate south of the site.

No surface water abstractions were recorded by the Envirocheck dataset within 250m of the site boundary.

A single pollution incident to controlled waters was recorded within a 250m radius of the site boundary, as summarised in Table 2.3.

Location / Distance	Property Type	Pollutant	Incident Date	Incident Severity
Tottington Drive, Small Dole; 19m S	Metal Industry	Oils – Other Oil	May 1998	Category 3 - Minor Incident

Table 2.3 Summary of Pollution Incidents within 250m of the Site

Five discharge consents to controlled waters were identified by the Envirocheck dataset within a 250m radius the site boundary, as summarised in Table 2.4.

Location / Distance	Property Type	Issue / Revocation Date	Discharge Type	Receiving Water
Tottington Drive, Small Dole; 6m SE	Pumping Station on Sewerage Network (Water Company)	March 2003 / August 2017	Sewage Discharges - Pumping Station - Water Company	Freshwater Stream/River
Tottington Drive, Small Dole; 6m SE	Pumping Station on Sewerage Network (Water Company)	September 2017 / Not supplied	Public Sewage: Storm Sewage Overflow	Freshwater Stream/River
Tottington Drive, Small Dole; 6m SE	Pumping Station on Sewerage Network (Water Company)	September 2017 / Not supplied	Sewage Discharges - Pumping Station - Water Company	Freshwater Stream/River
East Side of A2037 at Small Dole; 106m SE	Undefined Or Other	October 1978 / July 1991	Discharge Of Other Matter-Surface Water	Freshwater Stream/River
New Hall Lane, Small Dole; 231m NW	Domestic Property (Single) (incl Farm House)	May 1998 / Not supplied	Sewage Discharges - Final/Treated Effluent - Not Water Company	Freshwater Stream/River

Table 2.4 Summary of Discharge Consents within 250m of the Site

The site was indicated to be outside of any current indicative tidal or fluvial flood plain, or any associated flood warning area.

Small portions on the south, south-west and north of the site were indicated to be at varying degrees of risk of flooding from surface water (See Plate 1).

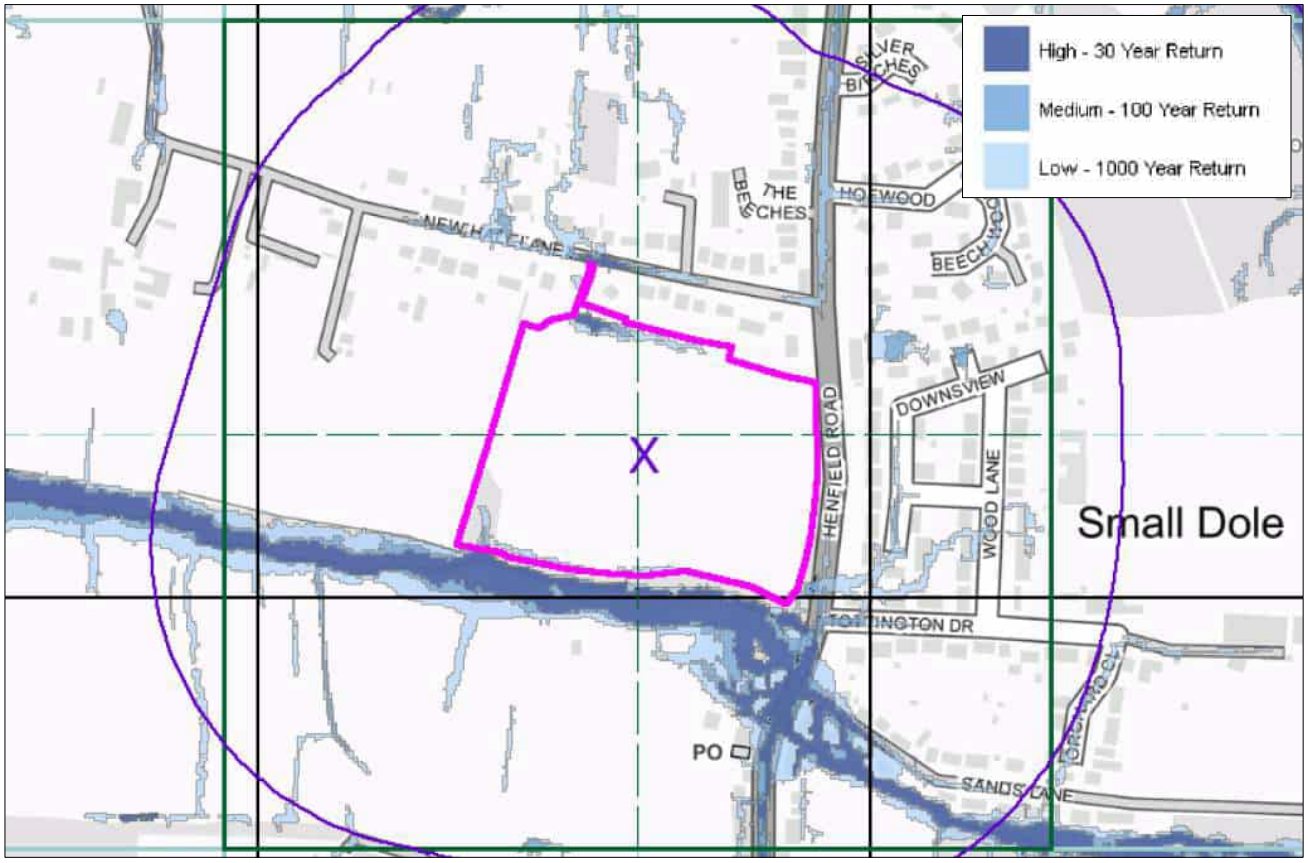


Plate 1 Risk of Flooding from Surface Water (mapping extract)

2.5 Radon

Reference has been made to the Envirocheck dataset which indicates the site to be situated in a lower probability radon area (<1% of homes are estimated to be at or above the Action Level).

The report indicates that radon protection measures are not required in the construction of new dwellings or extensions on site.

2.6 Environmental Data

Searches of other various environmental databases were made as part of the desk study, including air pollution control sites, Part IIA contaminated land, Integrated Pollution Control (IPC) and Integrated Pollution Prevention and Control (IPPC) site, registered radioactive substances, COMAH sites, explosives sites, Notification of Installations Handling Hazardous Substances (NIHHS) sites, planning permissions for sites involving hazardous substances, recent and historical industrial land uses and fuel station registers.

Three registered radioactive substances entries were identified by the desk study within a 250m radius of the site boundary, as summarised in Table 2.5. It should be noted that all three entries were from the same location.

Name	Location (Distance/Direction)	Date	Status
Vet Diagnostics Ltd	Victoria House, Small Dole (103m SE)	February 1999	Application has been authorised and any conditions apply to the operator
Vet Diagnostics	Victoria House, Small Dole	April 1999	Authorisation superseded by a substantial

Name	Location (Distance/Direction)	Date	Status
Ltd	(103m SE)		or non-substantial variation
Vet Diagnostics Ltd	Victoria House, Small Dole (103m SE)	October 2003	Application has been authorised and any conditions apply to the operator

Table 2.5 Summary of Radioactive Substances within 250m of the Site

Seven contemporary trade directory entries were identified within a 250m radius of the site boundary as summarised in Table 2.6.

Name	Location (Distance/Direction)	Classification	Status
A C T Pest Control	Tottington Drive, Small Dole (81m SE)	Pest & Vermin Control	Active
Vet Diagnostics	Victoria House, Small Dole (103m SE)	Laboratories	Inactive
Mr Ovenkleen	Downsview, Small Dole (131m E)	Oven cleaning	Inactive
Elite Property Services Ltd	Henfield Road, Small Dole (202m S)	Builders' Merchants	Inactive
Oscar Pet Foods	Henfield Road, Small Dole (230m S)	Pet Foods & Animal Feeds	Inactive
Trans 4 Mations	Henfield Road, Small Dole (241m S)	Garage Services	Inactive
Ionic Instruments Ltd	Henfield Road, Small Dole (242m S)	Precision Engineers	Inactive

Table 2.6 Summary of Contemporary Trade Directory Entries within 250m of the Site

No other such land uses or designations were identified within a 250m radius of the site boundary.

2.7 Soil Chemistry

A large portion of the UK's urban soils have naturally elevated concentrations of some potentially harmful chemicals. In some cases, these exceed Atkins' ATRISK Soils Screening Values (SSV) and/or DEFRA's Category 4 Screening Levels (C4SLs). A summary of the estimated urban soil chemistry for the area is presented in Table 2.7.

Determinand	Concentration (mg/kg)	In Excess of SSV/C4SL*?
Arsenic	<15 - 25	No
Cadmium	<1.8	No
Chromium	60 - 90	No
Lead	<100	No
Nickel	15 - 30	No

Table 2.7 Summary of Estimated Site Geochemistry

*Comparative threshold concentrations are for a residential end use with plant uptake and a soil organic matter content of 6%

It should be noted that these values are not necessarily representative of the site's soil chemistry and do not account for the site's historic use, or potential presence or condition of any Made Ground. Furthermore, screening values are dependent on pH and soil organic matter content. Therefore, concentrations of specific determinands and the utilised screening values cannot be determined without site specific investigation and analysis.

2.8 Sensitive Land Uses

A search was made of environmentally sensitive areas, including areas of green belt, scenic or natural beauty, parks, reserves, ancient woodland, nitrate zones, protected conservation and scientific areas.

Two areas of ancient and/or semi-natural woodland were identified within a 250m radius of the site boundary, as summarised int Table 2.8.

Feature	Distance / Location
Ancient and Semi-Natural Woodland	221m SE
Ancient and Semi-Natural Woodland	228m E

Table 2.8 Summary of Ancient Woodland within 250m of the Site

In addition, a local nature reserve, Tottington Wood, was identified 221m to the south-east of the site boundary, and a National Park, South Downs, was identified 220m to the east of the site.

No other such land uses or designations were identified by the Envirocheck dataset within a 250m radius of the site boundary.

2.9 Geotechnical Data

The site was shown to be in an area that might not be affected by coal mining.

National databases for several different geological hazards have been compiled by the BGS, and a summary of the hazard data pertaining to the site itself is presented in Table 2.9.

Hazard	Designation
Non-coal mining	Rare
Collapsible ground	Very Low
Compressible ground	Moderate
Ground dissolution	No hazard
Landslide	Very Low
Running sand	Low
Shrinking and Swelling clay	Very Low

Table 2.9 Summary of BGS Geological Hazards

With reference to the Envirocheck dataset, no BGS Mineral Sites, areas of mining instability, man-made mining cavities or natural cavities were identified within 250m of the site boundary.

2.10 Landfill and Waste Management Facilities

A search of BGS recorded landfill sites, IPC registered waste sites, licensed waste management facilities, local authority recorded landfill sites, other registered landfill sites, potentially infilled land (water and non-water), waste transfer stations, and other waste treatment or disposal sites was undertaken as part of the desk study. Such sites may form an artificial source of ground gases, such as carbon dioxide and methane, where wastes are buried or disposed of to landfill.

No such land uses or designations were identified by the Envirocheck dataset within a 250m radius of the site boundary.

2.11 Asbestos

Given the undeveloped nature of the site, the presence of asbestos on site is unlikely. Given the potential for windblown asbestos fibres from localised construction and demolition works, asbestos identification should be included within the suite of testing of contaminants on site. The absence of asbestos in soil samples analysed is not a guarantee of the absence of asbestos elsewhere on a site.

2.12 Previous Ground Investigations

A Phase 1 Desk Study was undertaken for the site in January 2015 (ref: 27000-064 R01 (00)) identifying the overall risk to the site as 'Low' and recommended an intrusive investigation with ground gas and water monitoring.

2.13 Unexploded Ordnance (UXO)

As part of the Desk Study process, a Preliminary UXO Risk Assessment was undertaken for the site using Zetica UXO Risk Maps.

The Zetica UXO risk mapping indicated the site was in a lower risk area for UXO.

For further details reference should be made to the Zetica UXO mapping in Appendix A.

2.14 Potential Contamination

The site comprised agricultural land from the earliest map extracts of 1875. The site was still in use as agricultural land at the time of the site walkover and intrusive investigation in 2023.

The surrounding land was generally undeveloped agricultural land and woodland prior to significant residential development from circa 1958.

The above land uses are not covered by the National House Building Council (NHBC), Environment Agency (EA) and Chartered Institute of Environmental Health (CIEH) publication 'Guidance for the Safe Development of Housing on Land Affected by Contamination' (2008), which provides a summary of industrial profiles (1995-1996) published by the former Department of the Environment (DoE) (now part of the Department for Environment, Food and Rural Affairs (DEFRA).

This aside, the near surface soils on site may have been impacted by pesticides, heavy metals, organic pollutants such as polyromantic hydrocarbons (PAH), petroleum hydrocarbons/oils and inorganic compounds through aerial deposition and/or direct placement.

2.15 Ground Gas and Vapour Summary

The desk study has not identified any potential viable sources of ground gases or vapours on the site or within 250m of the site boundary.

3.0 PRELIMINARY ASSESSMENT

Based on the findings of the desk study, the following sections summarise the anticipated geotechnical and environmental factors likely to impact the site.

3.1 Geotechnical Risk Assessment

3.1.1 Potential Geotechnical Hazards

Hazards identified as being potentially present on site could have implications for foundation design and construction. A summary of commonly occurring geotechnical hazards is given in Table 3.1. The following potential geotechnical hazards would all require confirmation by intrusive investigation.

Geotechnical Hazard	Probability	Justification/Engineering Implications
Lateral changes in ground conditions	Likely	It is considered likely that the varying geologies (River Terrace Deposits, Head Deposits and Lower Greensand Group) will vary laterally across the site and affect foundation design, construction and zoning.
Shrinkable soils	Low	It is possible that limited horizons of the superficial Alluvium, River Terrace Deposits and Head Deposits will be shrinkable, which may affect foundation design and construction depending on their depth.
Significant depths of Made Ground	Unlikely	The site has undergone no development, as such significant thicknesses of Made Ground are unlikely.
Aggressive chemical ground conditions (sulphates)	Low	The possible presence of naturally occurring aggressive chemical ground conditions which may affect foundation design and construction.
Compressible soils / Soils with low bearing pressures	Low	It is considered likely that any potential alluvial deposits associated with the river on the southern boundary of the site would comprise potentially compressible soils with a low bearing capacity. This would only impact on foundation design should it be encountered.
Suitability of Soakaways	Likely	The underlying bedrock geology (Lower Greensand Group) is anticipated to be granular and therefore suitable for soakaways. However, there is the potential for limited soakaway storage capacity due to high groundwater.
Shallow Groundwater	Likely	The superficial and bedrock geologies all have aquifer designations and a stream is present on the southern boundary of the site, as such the presence of shallow groundwater beneath the site is considered to be likely.

Table 3.1 Potential Geotechnical Hazards

3.2 Preliminary Environmental Conceptual Site Model & Risk Assessment

3.2.1 Methodology

A Preliminary Risk Assessment ('PRA') has been prepared in accordance with Land Contamination Risk Management (LCRM) based on information obtained as part of the desk study. Possible risks associated with potential sources of contamination and sensitive receptors identified have been qualitatively assessed following a source-pathway-receptor ('Pollutant Linkage') approach in accordance with current UK protocols.

A risk of harm may only exist where a plausible pollutant linkage is present, and where the quantity or concentration of a contaminant is sufficient so as to pose harm. Under the statutory definition, "Contamination" may only strictly exist where contaminants pose a risk of harm to a receptor. The risk classification has been assessed in accordance with CIRIA C552 (Rudland et al., 2001). A summary of how the risks are derived and their definitions is presented in Tables 3.2 and 3.3.

		Consequence			
		Severe	Medium	Mild	Minor
Probability	High Likelihood	Very high risk	High risk	Moderate risk	Moderate/low risk
	Likely	High risk	Moderate risk	Moderate/low risk	Low risk
	Low Likelihood	Moderate risk	Moderate/low risk	Low risk	Very low risk
	Unlikely	Moderate/low risk	Low risk	Very low risk	Very low risk

Table 3.2 Risk Ratings Matrix

Risk Rating	Definitions
Very high risk	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not already undertaken) and remediation are likely to be required.
High risk	Harm is likely to arise to a designated receptor from an identified hazard Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not already undertaken) is required and remediation works may be necessary in the short term and are likely over the longer term.
Moderate risk	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild.
Moderate to low risk	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is unlikely that any such harm would be severe, or if any harm were to occur it is probable that the harm would be relatively mild.
Low risk	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very low risk	There is low possibility that harm could arise to a receptor. In the event of such harm being realised it is likely to be minor.

Table 3.3 Risk Rating Definitions

3.2.2 Summary of Plausible Sources

Possible sources of contamination identified from the desk study are summarised in Table 3.4.

Source	Description	Contaminants
Made Ground and shallow natural soils	General background chemical quality of the near surface soils in the context of the former and current uses of the site.	Possible elevated metals, organic and inorganic contaminants, including asbestos and pesticides.

Table 3.4 Possible Sources of Contamination

3.2.3 Summary of Plausible Pathways

The plausible pathways are summarised in Table 3.5. These pathways are based on the proposed end use (residential with private gardens and soft landscaping).

Pathway	Description
Direct Contact	Ingestion of soil particles, inhalation of soil derived dust (including tracked back dust), dermal contact. Bioaccumulation and home grown produce consumption.
Inhalation	Inhalation of soil dust and vapour both inside and outside of buildings
Vertical & Lateral Migration	Contaminant movement both vertically through leaching/gravity and horizontally along preferential pathways, e.g. services trenches or fissures/cracks
Chemical Attack	Attack of buried plastics and concrete by aggressive ground conditions
Root Uptake	Root uptake of potentially phytotoxic contaminants

Table 3.5 Possible Contamination Pathways

3.2.4 Summary of Plausible Receptors

Plausible receptors associated with the site and its redevelopment, identified or otherwise discounted, are summarised in Table 3.6.

Receptor	Description	Comments	Plausible
End Users	Occupants of the proposed development.	The proposed residential development includes a private gardens and soft landscaping.	*Yes*
Adjacent Land Users	Sensitive land uses identified within the immediate vicinity.	Adjacent land users are generally commensurate with the proposed residential development.	*Yes*
Soft Landscaping	Areas of planting including lawns, shrubs, trees, etc.	Gardens, areas of soft landscaping, amenity space and woodland are proposed as part of the development.	*Yes*
Water Supply Pipes	Plastics for potable water supply pipes may be laid in contact with contaminated soils	Chemical degradation of the near surface soils may have taken place and limited Made Ground may be present on the site.	*Yes*
Buildings & Infrastructure	Buried concrete for foundations, etc. may be laid in contact with contaminated / aggressive soils	Foundations are likely to be constructed through Made Ground/near surface soils and into natural strata. Aggressive conditions may be present.	*Yes*
Surface Water	Controlled waters within lakes, rivers, ponds, etc., or coastal waters	A stream is present on the southern boundary of the site.	*Yes*
Groundwater	Controlled waters within the aquifer(s) beneath the site	The site overlies Secondary A, Secondary Undifferentiated and Principal aquifers. The site is not situated within a Source Protection Zone (SPZ).	*Yes*

Table 3.6 Possible Receptors of Contamination

Site workers involved in the preparation and construction of the development have not been considered further in this assessment as the Principal Contractor is duty bound under the current CDM Regulations to undertake their own risk assessments with respect to their employees.

Whilst the above sources and receptors have been identified, Table 3.7 summarises the identified plausible pollution linkages and a qualitative assessment of the risks based on the desk study research.

Potential Source/Media	Potential Receptors	Potential Pathways	Probability	Consequence	Risk and Justification
Shallow soils and shallow Made Ground	End users	Direct contact; Inhalation	Likely	Mild	**Moderate / Low** End users are likely to come into contact with soils via direct contact in gardens and areas of soft landscaping on the proposed residential development. Sampling and testing required to further assess the risk.
	Adjacent land users	Direct contact; Inhalation	Low	Mild	**Very Low** It is considered a low probability that adjacent land users will come into contact with soils on the subject site. Sampling and testing required to further assess the risk.
	Soft Landscaping	Root uptake	Likely	Minor	**Low** The proposed development will include areas of soft landscaping including private gardens, amenity space, woodland and orchards.
	Water supply pipes	Chemical attack	Likely	Mild	**Moderate / Low** Water supply pipes may come into contact with soils, though significant contamination is not anticipated. Sampling and testing required to further assess the risk.
	Buildings and infrastructure	Chemical attack	Likely	Minor	**Low** Foundations will be placed within potentially aggressive soils (e.g. sulphate). Sampling and testing required to further assess the risk.
	Surface Water	Vertical migration	Likely	Minor	**Low** Whilst a surface water feature is present on the site's southern boundary, significant contamination of soils and/or surface water is not anticipated. Sampling and testing required to further assess the risk.
	Groundwater	Vertical migration; lateral migration	Likely	Mild	**Moderate / Low** Groundwater will be present beneath the site. However, significant contamination of soils and/or groundwater is not anticipated. Sampling and testing required to further assess the risk.

Table 3.7 Plausible Pollutant Linkages & Qualitative Risk Assessment

3.3 Preliminary Environmental Risk Assessment Summary

The PRA and CSM developed from the information gathered as part of the desk study process have identified several plausible pollutant linkages that exist in relation to the proposed redevelopment of the site. However, the preliminary risk rating for each linkage has been classified as very low, low or moderate / low.

The potential pollutant linkages established within this desk study are not considered to prevent development on the subject site but could require investigation and assessment to support further characterisation, calibration of the CSM and where/if necessary, determine a remedial strategy to reduce, remove or otherwise control any risk within the site to key receptors.

In order to progress this assessment in line with the National Planning Policy Framework, to provide further characterisation of the site and refinement of the PRA and CSM, it is recommended that intrusive investigation and associated testing is undertaken to confirm the findings of the desk study and to provide a robust risk assessment for the site and proposed redevelopment.

3.4 Preliminary Geotechnical Risk Assessment Summary

The site is anticipated to be underlain by superficial River Terrace Deposits, Head Deposits and Alluvium (potentially), overlying the bedrock of the Lower Greensand Group. Given the site's development history the presence of significant depths of Made Ground are unlikely.

Conventional foundations (for a low-rise development) may be suitable on the site depending on depth of any encountered Made Ground, competence of the underlying strata and depth of groundwater.

Groundwater may be shallow on site, which may cause instability of foundation excavations. Dewatering of excavations may be required.

Soakaways may be suitable on site. However, their storage capacity may be limited by groundwater depth.

3.5 Scope of Works

In summary, the following scope of works for the intrusive investigation was agreed with the Client.

- The construction of up to six dynamic sampler boreholes (ref: WS01 to WS06) up to a depth of 4.0m below ground level (bgl) with regular sampling and in situ testing as appropriate to the conditions encountered.
- The installation of dual-purpose ground gas and groundwater monitoring standpipes within the dynamic sampler boreholes (ref: WS01 and WS06) to the maximum depth of the borehole.
- The construction of up to seven machine excavated trial pits up to a depth of 3.0m below ground level (bgl) with regular sampling and in situ testing as appropriate to the conditions encountered.
- Undertake trial pit soakage tests at six locations in general accordance with BRE Digest 365. BRE Digest 365 requires three consecutive filling and drainage cycles to be completed. Based on the anticipated ground conditions two days were allowed for the tests.
- Return groundwater depth monitoring from installed wells on twelve occasions at fortnightly intervals between November 2023 and April 2024. Confirmatory ground gas monitoring would also be undertaken at the same time during the first six visits.
- Laboratory based testing of soils for environmental and geotechnical parameters.

3.6 Investigation Strategy

The positioning of exploratory holes was determined to provide general coverage of the site, with the majority of locations positioned in the area of proposed residential development. Tables 3.8 and 3.9 summarise the strategy of the environmental and geotechnical investigations.

Environmental Area of Concern	Investigation	Positions
General background chemical quality of the near surface soils	Dynamic sampler boreholes and trial pits located across the site, coupled with sampling and laboratory analysis	All

Table 3.8 Summary of Environmental Investigation Strategy

Geotechnical Area of Concern	Investigation	Positions
Lateral changes in ground conditions	Dynamic sampler boreholes and trial pits located across the site, coupled with sampling and laboratory analysis	All
Shrinkable soils	Dynamic sampler boreholes and trial pits located across the site, coupled with sampling and laboratory analysis	All
Significant depths of Made Ground	Dynamic sampler boreholes and trial pits located across the site.	All
Aggressive chemical ground conditions (sulphates)	Laboratory analysis of samples obtained from dynamic sampler boreholes and trial pits from across the site	All
Compressible soils / Soils with low bearing pressures	Dynamic sampler boreholes and trial pits located across the southern portion of the site.	WS01 to WS03, TP01, TP02 & TP06
Suitability of Soakaways	Soakage testing within machine excavated trial pits.	TP01 to TP06
Shallow Groundwater	Observations within dynamic sampler boreholes and trial pits located across the site, and monitoring wells installed for return monitoring	All (monitoring wells in WS01 to WS06)

Table 3.9 Summary of Geotechnical Investigation Strategy

4.0 ENCOUNTERED CONDITIONS

A factual record of the conditions encountered during the physical investigation of the site is presented in the following sections.

For further details of the encountered ground conditions, reference should be made to the exploratory hole logs presented in Appendix B, the ground gas and groundwater monitoring data in Appendix C, the geotechnical testing results in Appendix D, and the chemical testing results in Appendix E.

The physical ground investigation works were undertaken on 9th and 10th November 2023. An intrusive location plan is included in Figure 3. Both geotechnical and contamination testing was undertaken by UKAS accredited laboratories.

Unless stated otherwise, all depths are reported as metres below ground level (m bgl).

4.1 Soils

The investigation encountered the anticipated geology of the Lower Greensand Group beneath variable thicknesses of Topsoil and Made Ground. No superficial deposits were encountered in the intrusive positions. A generalised summary of the encountered conditions within the intrusive positions is presented in Table 4.1.

Top (m bgl)	Base (m bgl)	Geology	Position
0.00	0.25 - 0.65	**Topsoil:** Dark brown, grey and dark greyish brown sandy silty clay and silty sandy clay with frequent rootlets, occasional flint gravel and rare flint cobbles and glass (WS03 only).	All
0.25 - 0.30	0.50 - 0.60	**Made Ground:** Reworked greenish brown and brown silty sandy clay with rare fine flint and rootlets.	WS03 & WS04
0.25 - 0.65	>4.00	**Lower Greensand Group:** Brown, reddish brown, orangish brown, greyish brown, light yellowish brown, grey, light grey, and dark greenish grey gravelly silty clayey SAND, clayey silty SAND, sandy SILT, very weak to weak SANDSTONE with occasional clay lenses and pockets, and firm to stiff silty sandy CLAY and gravelly silty sandy CLAY with frequent siltstone and sandstone inclusions and lenses, and occasional roots and rootlets. Gravel comprises sub-angular to sub-rounded flint, siltstone and sandstone, and occasional siltstone and sandstone cobbles.	All

Table 4.1 Summary of Ground Conditions

For further details of the ground conditions encountered, reference should be made to the borehole logs and section drawings presented in Appendix B.

Beneath any Topsoil and Made Ground, rootlets and roots were observed to varying depths within several of the intrusive positions undertaken on site. The observed depths of these roots and rootlets are summarised in Table 4.2.

Position	Roots/Rootlets	Maximum Observed Depth (m bgl)
TP01	Occasional rootlets	1.75
TP02	Occasional rootlets	1.30
TP03	Occasional rootlets	1.40

Position	Roots/Rootlets	Maximum Observed Depth (m bgl)
TP04	Occasional rootlets	0.70
TP05	Occasional rootlets	1.40
	Rare rootlets	2.30
TP06	Occasional rootlets	1.90
TP07	Frequent rootlets	2.20
WS01	Occasional rootlets and decaying rootlets	0.70
WS02	Rare roots (1mm)	0.80

Table 4.2 Summary of Observed Roots and Rootlets

4.2 Groundwater

Water was encountered within several of the investigative positions during the intrusive works on site, as summarised in Table 4.3.

Position	Depth of Strike/Seepage (m bgl)	Depth after x minutes (m bgl)	Comments
TP01	0.00	-	Seepage (surface water)
TP01	1.80	-	Seepage
TP01	2.10	2.05 (7 minutes)	Potential groundwater
TP02	0.20	-	Seepage (surface water)
TP02	1.30	-	Seepage
TP02	1.70	-	Seepage
TP02	2.00	1.90 (6 minutes)	Potential groundwater
TP03	2.65	2.62 (7 minutes)	Potential groundwater
TP06	2.50	2.48 (5 minutes)	Potential groundwater
WS02	0.00	-	Seepage (surface water)
WS03	3.00	-	Seepage

Table 4.3 Summary of Recorded Water Depths (m bgl) during Physical Site Investigation

Dual purpose groundwater and ground gas monitoring wells were installed within all six dynamic sampler boreholes (ref. WS01 to WS06), depths and construction of the wells are summarised in Table 4.4.

Position	Pipe Diameter (mm)	Response Zone (m bgl)	Base of Pipe (m bgl/m OD)
WS01	35	1.00 – 2.00	2.00 / 8.13
WS02	35	1.00 – 2.50	2.50 / 7.44
WS03	35	1.00 – 4.00	4.00 / 7.06
WS04	35	1.00 – 4.00	4.00 / 11.65
WS05	35	1.00 – 2.50	2.50 / 12.36
WS06	35	1.00 – 4.00	4.00 / 11.20

Table 4.4 Summary of Installed Monitoring Wells

At the time of preparing this report only three of the twelve winter groundwater monitoring visits had been completed. The results of the visits undertaken to date are summarised in Table 4.5.

Position Reference	Groundwater Depth (m bgl/m OD)		
	17/11/2023	24/11/2023	13/12/2023
WS01	0.90 / 9.23	0.65 / 9.48	0.39/9.74
WS02	0.56 / 9.38	0.11 / 9.83	0.10/9.84

WS03	0.78 / 10.28	0.83 / 10.23	0.33/10.73
WS04	Dry at 4.06 / Dry at 11.59	Dry at 4.06 / Dry at 11.59	3.82/11.83
WS05	0.97 / 13.89	2.37 / 12.49	Dry at 2.50/Dry at 12.36
WS06	1.25 / 13.95	1.33 / 13.87	1.18/14.02

Table 4.5 Summary of Recorded Water Depths (m bgl) within the Monitoring Wells

Changes in groundwater and perched water levels do occur for a number of reasons including seasonal effects and variations in drainage. Such fluctuations may only be recorded by the measurement of the groundwater level within a series of standpipes or piezometers installed within appropriate response zones.

4.3 Ground Gases & Vapours

Dual purpose ground gas and groundwater monitoring wells were installed to depths of between 2.0m and 4.0m bgl within WS01 to WS06. These positions were monitored for methane, carbon dioxide, oxygen and volatile organic compounds (VOC) on three occasions between November and December 2023.

During the monitoring visits, negligible methane concentrations up to 0.1% v/v were recorded. Carbon dioxide and oxygen were present in the range 0.0% v/v to 3.0% v/v and 12.5% to 21.6% v/v, respectively. Negligible volatile organic compounds (VOC) were recorded at concentrations ranging between 0.0ppm and 0.2ppm. No positive borehole flow rates were recorded during the monitoring visits. Atmospheric pressures of between 1004mb and 1022mb were recorded during the visits to date.

Where the groundwater level was higher than the response zone of the installed well, the gas results have been discounted as they are unlikely to be representative.

Due to shallow groundwater conditions, gas monitoring could only be undertaken on locations WS01 to WS03 during the third visits. A further three ground gas monitoring visits were outstanding at the time of preparing this report.

4.4 Obstructions

Artificial obstructions were not encountered during the intrusive investigation.

However, natural obstructions in the form of dense sand, siltstone and sandstone were encountered within the majority of intrusive positions at varying depths of between 2.05m bgl and 2.90m bgl.

It should be noted that siltstone and sandstone horizons of varying thicknesses may be encountered at varying depths within the Lower Greensand Formation.

4.5 Geotechnical Testing

The results of geotechnical testing undertaken as part of the ground investigation are summarised in Table 4.6, with test results presented in Appendix D.

Parameter		Lower Greensand Formation
Moisture content (%)		18 - 34
Plasticity Index (%)		15 - 30
Modified Plasticity Index (%)		10 - 29
Volume Change Potential (NHBC)		Low to Medium
	Very Coarse (%)	0.00

Parameter		Lower Greensand Formation
Particle Size Distribution	Gravel (%)	6.20 - 51.77
	Sand (%)	32.77 - 57.45
	Silt & Clay (%)	14.73 - 38.07
pH		6.8 - 7.2
Water soluble sulphate (mg/l)		<20 - 40

NOTE: Modified plasticity index is defined in NHBC Standards Chapter 4.2

Table 4.6 Summary of Geotechnical Laboratory Test Results

4.6 Geochemical Analysis

In order to assess the general chemical quality of the strata encountered, samples of soils recovered from the exploratory holes were submitted for analysis for a range of potential contaminants selected on the basis of the findings of the desk study and supported by the joint National House Building Council (NHBC), Environment Agency (EA) and Chartered Institute of Environmental Health (CIEH) publication, '*Guidance for the Safe Development of Housing on Land Affected by Contamination*' (2008).

Soil samples were placed into plastic containers for general inorganic analysis and into amber jars for organic analysis. Samples were stored in temperature controlled conditions from sampling until receipt at the laboratory from which time sample preparation and storage was determined by testing requirements and in line with the laboratory's protocols.

Ten soil samples from across the site were submitted for analysis for an analytical suite based upon determinands listed within the above guidance including speciated petroleum hydrocarbon analysis and asbestos screens.

Three soils samples from across the site were also submitted for a suite of organochlorine (OCL) pesticides.

Furthermore, samples of both the encountered Topsoil and Made Ground were submitted for waste classification analysis and waste acceptance criteria (WAC) analysis to aid in the designation of arisings for waste disposal.

In addition to the above, a single sample of groundwater from one of the monitoring wells installed on site was submitted for analysis for an analytical suite similar to that undertaken on the soils.

For further details reference should be made to the laboratory results in Appendix E.

5.0 ENGINEERING CONSIDERATIONS

Subsequent to intrusive investigation of the site and receipt of the laboratory test results, the following geotechnical assessments have been made.

5.1 Foundations

Based on the ground and groundwater conditions encountered in the intrusive positions, conventional shallow foundations may be considered for the site.

It is recommended that the NHBC Standards, Chapter 4.2 be adopted for the classification of volume change potential and the design foundation depth. On the basis of the results of the Atterberg Limit tests in conjunction with the ground conditions in the intrusive positions it is considered that the cohesive strata of the Lower Greensand Group up to 1.5m bgl be classified as medium volume change potential, requiring a minimum foundation depth of 0.90m, remote from trees. At depths greater than 1.5m bgl, the strata can be classified as low volume change potential. The sandstone may be considered non shrinkable. Foundations within shrinkable soils within the zone of moisture demand of existing, proposed or recently removed trees will require deepening. Where calculated foundation depths exceed 1.50m on account of trees, heave protection measures may be required.

A net allowable bearing pressure of 125kPa is considered suitable for traditional trench foundations up to 1.50m in width taken down through any disturbed, desiccated or soft materials to bear upon the firm to stiff clays and silts of the Lower Greensand Group. Furthermore, foundations which span the clay, silt, siltstone and sandstone horizons of the Lower Greensand Group should be nominally reinforced to account for differential settlement.

It is recommended that ground floor slabs be suspended due to the presence of shrinkable soils and the void heights should be derived in accordance with the NHBC Standards, Chapter 4.2 based on medium volume change potential soils.

5.2 Excavations

Shallow excavations within any Made Ground should remain relatively stable in the short term. However, any longer deeper excavations within any deeper zones of Made Ground are likely to be unstable and require battering to a safe angle or temporary support.

Shallow excavations above the water table within the Lower Greensand Group are likely to remain stable in the short to medium term. Deeper excavations within the Lower Greensand Group may be subject to instability particularly where taken below the groundwater table and would require some form of temporary support, battering back to a safe angle and groundwater control.

Clays of the Lower Greensand Group will soften rapidly when exposed to water, as such, any foundation trenches should be concreted immediately. In addition, localised spalling and/or collapse may occur where foundation trenches intercept lenses of perched water and/or groundwater. Dewatering of trenches would be required in such circumstances.

Ground works should be designed in such a manner to avoid personnel entry into unsupported excavations. Where this cannot be avoided, such entry should only be into supported excavations in accordance with a safe system of work and relevant legislation, e.g. Confined Spaces Regulations.

5.3 Soakaways

Soakage testing in accordance with BRE365 was attempted within five of the seven machine excavated trial pits. The results of the testing are summarised in Table 5.1.

Position	Infiltration (m/s) Run 1	Infiltration (m/s) Run 2	Infiltration (m/s) Run 3	Comments
TP01	-	-	-	Pit filled with water (surface water and seepages) - no soakage testing undertaken.
TP02	-	-	-	Soakage test attempted - Pit filled with water (surface water and seepages) over night.
TP03	6.0×10^{-7}	-	-	Insufficient drop in head to run multiple tests in pit. Data from first test extrapolated to obtain infiltration result.
TP04	1.5×10^{-6}	2.3×10^{-6}	-	Insufficient drop in head to run third test in pit. Data from both tests extrapolated to obtain infiltration results.
TP05	3.2×10^{-6}	5.6×10^{-6}	-	Insufficient drop in head to run third test in pit. Data from second test extrapolated to obtain infiltration result.
TP06	-	-	-	Insufficient drop in head to calculate infiltration rate (water rose during first test).
TP07	-	-	-	Insufficient drop in head to calculate infiltration rate (water rose during first test).

Table 5.1 Summary of Infiltration Rates

Based on the results of the soakage testing, it is considered that traditional soakaways may perform satisfactorily on some higher, isolated parts of the site. However, the storage capacity of these soakaways may be limited due to groundwater depth and potential water seepages.

5.4 Sub-Surface Concrete

The results of the water-soluble sulphate and pH analyses undertaken on samples of the Lower Greensand Group indicate that buried concrete should be designed in accordance with Class DS-1 of BRE Special Digest 1, with an ACEC class of AC-1.

The advice of this publication should be taken for the design and specification of all sub surface concrete.

5.5 Pavements

Mexicone tests (equivalent to CBR) were undertaken adjacent to locations in the southeastern corner of the site (WS02 to WS04 & TPT03 to TP06). A summary of results from the mexicone are presented in Table 5.2.

Location	CBR value (%)									
	0.0 – 0.075m	0.075 – 0.15m	0.15 – 0.225m	0.225 – 0.30m	0.30 – 0.375m	0.375 – 0.45m	0.45 - 0.525m	0.525 – 0.60m	0.600 – 0.675m	0.675 - 0.75m
TP03	0.2	1	1	2	6	3.5	3.5	3	3	3
TP04	1	1	3	3	4	12	Refusal			
TP05	1	1.5	2	2.5	3	2.5	3	4	4	3
TP06	1	1	1.5	2	3.5	2	6	Refusal		

WS02	0.5	1	1.5	3	6	4	6	3	3	3
WS03	1	2	2	1.5	2	2.5	3	3	4.5	4
WS04	1.5	1.5	2	2.5	4	4	11	Refusal		

Table 5.2 Summary of Mexicone Results

Made Ground

Made Ground of varying composition was encountered in isolated parts of the site. 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 variability of the Made Ground it would be prudent to assume the material to be deemed frost susceptible throughout thus a minimum pavement thickness of 450mm would be appropriate.

Lower Greensand Group

With reference to TRL LR1132, CBR values of 3% % is recommended for pavements constructed upon silty clays with modified plasticity indices of between 10 and 29, such as those of the clays of the Lower Greensand Group based on a high water table (<600mm bgl) and average construction conditions.

Based on the laboratory and in-situ test results, a CBR value of 3% is recommended for pavements constructed upon the Lower Greensand Group across the site. Based on the results of the laboratory analysis, the Lower Greensand Group should be deemed frost susceptible throughout thus a minimum pavement thickness of 450mm would be appropriate.

Any hard or soft spots in the formation level such as old foundations may induce reflective cracking in the pavement and allowance should be made for removing any slabs or other hard spots etc that may be present.

Furthermore, the sub-grade should be carefully proof rolled and any soft or loose zones replaced with compacted granular engineering fill.

6.0 ENVIRONMENTAL CONSIDERATIONS

A Generic Quantitative Risk Assessment (GQRA) incorporating the results of the desk study and ground investigation was undertaken, the findings of which are presented in the following sections.

6.1 Outline Risk Assessment

A number of plausible pollutant linkages were identified as part of the desk study. The investigation did not encounter conditions that warranted a revision of the Preliminary Risk Assessment.

6.2 Soil Contamination vs. End Users

Given the sensitivity of the proposed development, soil samples were submitted to a UKAS accredited laboratory for general chemical screening including common zootoxic and phytotoxic elements, speciated petroleum hydrocarbons, OCL pesticides and asbestos screening.

The presence of a possible contaminant does not necessarily imply that a site or area is contaminated or that there is any unacceptable risk to human health. A Preliminary Quantitative Risk Assessment has been undertaken in accordance with Land Contamination Risk Management (LCRM), in order to evaluate any unacceptable risks posed to human health with respect to the proposed redevelopment. It should be noted that this assessment is protective of the chronic long-term effects of contaminants, which is also likely to be protective of any possible immediate acute effects.

A quantitative risk assessment has been undertaken by comparing the results of the laboratory chemical testing of shallow soils against Soil Screening Values (SSV) generated using the Contaminated Land Exposure Assessment (CLEA) model v1.07 published by Atkins, or against the Category 4 Screening Levels (C4SLs) published by DEFRA. Although the C4SLs were released for Part 2A use, the associated policy companion document for the C4SLs indicated that they may also be used for planning. Although the C4SLs represent a marginally higher risk level than the SSACs (low risk rather than minimal risk) it is considered that the risk levels remain very low. Therefore, the final C4SLs are considered to be suitable to assess soils under the planning regime.

Not all OCL pesticides are covered by the above screening values. In lieu of UK standards, the Regional Screening Levels (RSLs) from the US EPA have been used. No exceedances of OCL pesticides were identified.

In the first instance, the laboratory results were compared individually against thresholds for a residential end use with plant uptake i.e. consumption of home grown produce. The results were all either below the laboratory detection limits or the relevant thresholds.

Furthermore, all samples submitted for asbestos screens were returned with no asbestos fibres identified.

As such, remedial measures to protect future end users of the proposed development from soils on site are not considered necessary.

6.3 Soil Contamination vs. Adjacent Land Users

Surrounding land uses were identified to generally comprise land uses commensurate with the proposed development, i.e. residential. Significant concentrations of potentially harmful mobile contaminants were not identified as part of the laboratory analysis.

Therefore, no specific remedial action is considered necessary to protect adjacent land users from soils on site.

This aside, it is recommended that dust suppression techniques, e.g. damping down exposed soils, are employed during the demolition and construction phases on site in order to minimise the potential for airborne migration of specific hazards and to manage potential nuisance issues for adjacent land users.

6.4 Soil Contamination vs. Soft Landscaping

British Standard BS3882:2015 *Specification for topsoil and requirements for use* provides assessment criteria for a number of potentially phytotoxic contaminants in terms of new planting.

The results of the chemical analysis for determinants known to pose a potential phytotoxic risk to plant growth are summarised in Table 6.1, together with the respective adopted Generic Assessment Criteria (GAC) for plant growth. The compliance criteria set out in BS3882:2015 are pH dependent and thus the GAC used relate to the pH range measured on samples recovered from the site.

Determinand	Phytotoxicity GAC (mg/kg)			GAC Exceedances
	pH <6.0	pH 6.0-7.0	pH >7.0	
Zinc	200	200	300	No
Copper	100	135	200	No
Nickel	60	75	110	No

Table 6.1 Summary of Plant Phytotoxicity Assessment

The phytotoxicity assessment did not identify any exceedances of the relevant thresholds. As such, remedial measures to protect proposed and present soft landscaping from soils on site are not considered necessary.

6.5 Soil Contamination vs. Built Environment

Recommendations with respect to pH and sulphate in relation to buried concrete are made in Section 5.4.

The current guidance on the 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 has 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. No such exceedances were identified within the encountered Made Ground or Lower Greensand Group. Given that water supply pipes would be installed at depth (>0.65m bgl) within clean, natural soils of the Lower Greensand Group, barrier pipe would not be considered necessary for potable water supply pipes on site.

As a matter of good practice and to maximise the protection to maintenance workers, it is recommended that clean, granular backfill is used in service runs and that marker tapes are used for all buried services.

6.6 Soil Contamination vs. Surface Water

The nearest surface water feature was a stream situated to the immediate south of the site. Based on the development history of the site and the surrounding area, the preliminary risk to surface water from soil contamination on site was considered to be low.

Given that significant concentrations of potentially mobile contamination were not encountered within the soils beneath the site, the risk to the surface water feature is considered to be negligible. As such, no remedial measures are considered necessary to protect surface water from soils on the subject site.

6.7 Soil Contamination vs. Groundwater

No superficial deposits were encountered on site during the intrusive investigation works. The bedrock geology beneath the site was classified as a Principal Aquifer. However, the site was situated outside of any Source Protection Zone (SPZ), and no SPZs were identified within a 1km radius of the site boundary.

The results of the chemical analysis undertaken on a sample of water obtained from the standpipe installed within WS03 were compared individually against Groundwater Threshold Values (Drinking Water) published in the 'The Water Framework Directive (Standards and Classification) Directions (England and Wales)' (2015).

The results indicated elevated concentrations of individual polycyclic aromatic hydrocarbons (PAHs) for naphthalene (0.67µg/l when compared against the threshold of 0.075µg/l) and benzo(a)pyrene (0.03µg/l when compared against the threshold of 0.0075µg/l). Furthermore, the concentration of total petroleum hydrocarbons (TPH) within the sample was recorded at 325µg/l which is significantly higher than the revoked Drinking Water Standard of 10µg/l, and marginally above the World Health Organisation threshold of 300µg/l.

It should be noted that these thresholds are considered highly conservative as they are drinking water standards with the compliance point taken as the consumer's tap i.e. after water treatment. Furthermore, there are no Source Protection Zones within a 1km radius of the site; nor are there any water abstraction points within 900m of the site boundary.

In addition, no sources of potential groundwater (or soil) contamination we identified on site or in the immediate surrounding area as part of the desk study, and significant concentrations of potentially mobile contamination were not encountered within the soils beneath the site as part of the investigation.

Therefore, it is considered that the determinand concentrations encountered within the sample obtained from site are representative of the local background groundwater chemical quality.

As such, measures to remediate the groundwater beneath the site are not considered necessary.

6.8 Ground Gases & Vapours

The desk study did not identify any potential sources of ground gases or vapours on the site or within 250m of the site boundary.

This aside, confirmatory ground gas and vapour monitoring visits were undertaken at the same time as the planned groundwater level monitoring.

Dual purpose ground gas and groundwater monitoring wells were installed to depths of between 2.0m and 4.0m bgl within WS01 to WS06. These positions were monitored for methane, carbon dioxide, oxygen and volatile organic compounds (VOC) on three occasions between November and December 2023.

During the monitoring visits, negligible methane concentrations up to 0.1% v/v were recorded. Carbon dioxide and oxygen were present in the range 0.0% v/v to 3.0% v/v and 12.5% to 21.6% v/v, respectively. Negligible volatile organic compounds (VOC) were recorded at concentrations ranging between 0.0ppm and 0.2ppm. No positive borehole flow rates were recorded during the monitoring visits. Atmospheric pressures of between 1004mb and 1022mb were recorded during the visits to date.

Where the groundwater level was higher than the response zone of the installed well, the gas results have been discounted as they are unlikely to be representative.

These preliminary results are considered representative of British Standard CS1/NHBC Traffic Light Green, for which no ground gas protection measures would be required. However, a further three ground gas monitoring visits were outstanding at the time of preparing this report. A supplementary report will be provided on completion of the monitoring period. It is recommended that the results of these visits be obtained prior to final design of the ground floor slabs.

6.9 Waste Disposal

6.9.1 Reuse of Material

In accordance with CL:AIRE Code of Practice (2011) materials are only considered waste if 'they are discarded, intended to be discarded or required to be discarded by the holder'.

The Code of Practice therefore allows soils to be reused on site where the following criteria are met:

- Pollution of the environment and harm to human health is prevented in reusing the excavated materials;
- The material is suitable for use (without any further processing);
- There is certainty of use; and
- The quantity that is absolutely necessary (and no more) is used.

In order to comply with the Code of Practice, a material management plan that confirms the above criteria are met has to be prepared. The material management plan must be reviewed by a 'Qualified Person' who then issues a declaration to the Environment Agency. Geo-Environmental can provide this service should it be required.

Where materials do not meet the required criteria, it may be possible to treat them under an environmental permit so that they may be re-used on site.

6.9.2 Reuse of Waste

Where material is discarded as waste, it may still be possible to reuse the waste on site under a standard rules environmental permit or a U1 waste exemption. However, strict limits on the volumes that can be reused apply in these cases.

6.9.3 Disposal to Landfill

Under current legislation, where wastes are to be disposed of to landfill they may, depending on their classification, require pre-treatment. Pre-treatment shall comprise a chemical, physical (including sorting), thermal or biological process. The pre-treatment is required to change the characteristics of the waste, reduce its volume, reduce its hazardous nature, and facilitate its handling and enhance its recovery.

6.9.4 Waste Classification

The following information is provided for preliminary guidance purposes as different facilities or operators may have differing acceptance criteria and further Waste Acceptance Criteria (WAC) analysis may be required to confirm the exact classification.

In the first instance, the laboratory results for all eleven samples of the recovered soils were assessed using the HazWasteOnline software which determines whether a generated waste is hazardous or non hazardous based on standard laboratory analysis. In addition, two of the samples were also submitted for Waste Acceptance Criteria (WAC) analysis. The results of the assessment are summarised in Table 6.2.

Location Ref.	Depth (m bgl)	Geology	HazWasteOnline Classification	Waste Acceptance Criteria (WAC)
TP01	0.40	Lower Greensand Formation	Non Hazardous	n/a
TP02	0.30	Topsoil	Non Hazardous	n/a
TP03	0.60	Topsoil	Non Hazardous	n/a
TP04	0.50	Lower Greensand Formation	Non Hazardous	n/a
TP07	0.20	Topsoil	Non Hazardous	n/a
WS01	0.20	Topsoil	Non Hazardous	Inert
WS02	0.20	Topsoil	Non Hazardous	n/a
WS03	0.40	Made Ground	Non Hazardous	Inert
WS04	0.20	Topsoil	Non Hazardous	n/a
WS05	0.20	Topsoil	Non Hazardous	n/a
WS06	0.30	Topsoil	Non Hazardous	n/a

Table 6.2 Summary of HazWasteOnline and WAC Assessments

Confirmation of the above assessments should be sought from the receiving landfill facility.

6.10 Discovery Strategy

Whilst an intrusive investigation has been undertaken on the site, it remains possible that unexpected ground and/or groundwater conditions may be encountered during the process of construction.

Should previously undiscovered contamination or unforeseen ground conditions be encountered during construction by the ground workers, this must be reported to the Site Manager immediately in order that the Consultant is notified. Where deemed necessary, the Consultant shall attend the site to inspect the discovery and provide recommendations on the further actions required, if any. Where necessary the regulatory authority shall be informed. Post any additional investigation or laboratory testing the results and any proposed remedial measures shall be reported to the regulatory authority or other appropriate organisation for consent, before proceeding or implementing the remedial measures.

A copy of the discovery strategy must be lodged on site, and provisions made to ensure that all workers are made aware of their responsibility to observe, report, and act on any potentially suspicious, abnormal, unforeseen or contaminated ground and/or groundwater conditions they may encounter.

Depending on the type, nature and extent of any such 'discovery', it may be necessary to halt works in that location until such time as the assessment has been completed. This shall be reviewed on a 'discovery' specific basis and in conjunction with consultation with the client, other technical personnel and/or regulatory/approval organisations.

As a general guide, where such unexpected conditions are encountered the following approach is required as a minimum:

- All discoveries are to be reported to the Site Manager immediately and works at that location are to halt until further notice;
- The Site Manager is to report any such discoveries to the Client and the Consultant;
- Following notification from the Site Manager, the Consultant shall discuss the discovery with the Local Authority and/or other relevant parties and if considered necessary, arrange to meet on site to view the discovery;
- The Consultant shall attend the site to record the location, extent and nature of the discovery and implement an appropriate sampling and analysis regime, taking due account of the type and nature of the discovery, known and probable land uses in that area of the site;
- Where remedial action is required, regulatory consultation and approval will be sought;
- A record will be produced by the Consultant and held on site (with copies held by the Consultant, Client and Local Authority/other relevant organisation), detailing the discovery, assessment works undertaken, findings thereof, confirmation either of no action required or detailing the remedial action taken and validation thereof.

The process is shown overleaf.

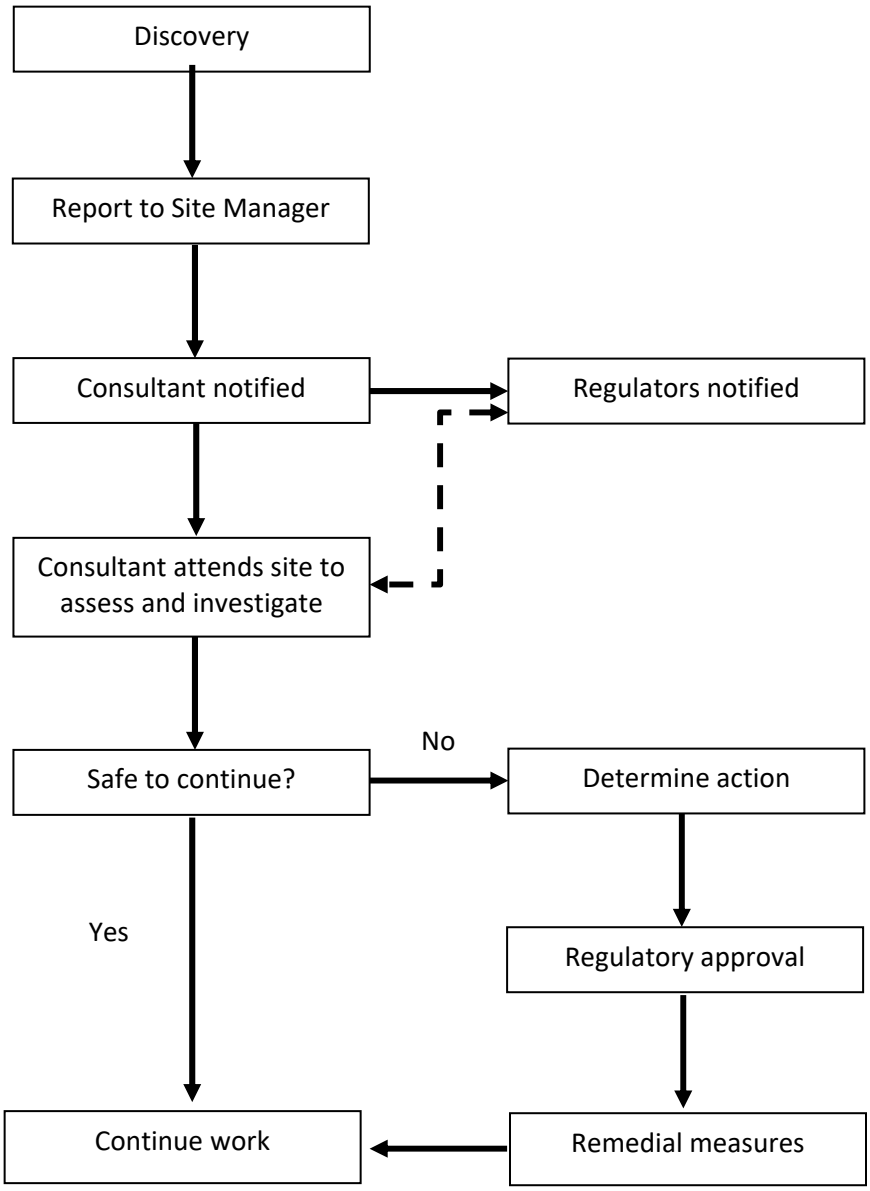


Chart 1 Discovery Strategy Process

A copy of the discovery strategy must be lodged on site and provisions made to ensure that all workers are made aware of their responsibility to observe, report and act on any potentially suspicious or contaminated materials they may encounter.

Geology 1:50,000 Maps Legends

Artificial Ground and Landslip

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	WGR	Worked Ground (Undivided)	Void	Not Supplied - Holocene
	MGR	Made Ground (Undivided)	Artificial Deposit	Not Supplied - Holocene

Superficial Geology

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	ALV	Alluvium	Clay, Silt, Sand and Gravel	Not Supplied - Holocene
	ALV	Alluvium	Clay, Silt, Sand And Peat	Not Supplied - Holocene
	AD1T2	River Terrace Deposits, 1-2 (Adur)	Sand and Gravel	Not Supplied - Quaternary
	HEAD	Head	Clay, Silt, Sand and Gravel	Not Supplied - Quaternary
	AD1	River Terrace Deposits, 1 (Adur)	Sand and Gravel	Not Supplied - Quaternary
	AD2	River Terrace Deposits, 2 (Adur)	Sand and Gravel	Not Supplied - Quaternary

Bedrock and Faults

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	NPCH	New Pit Chalk Formation	Chalk	Not Supplied - Turonian
	LECH	Lewes Nodular Chalk Formation	Chalk	Not Supplied - Turonian
	WMCH	West Melbury Marly Chalk Formation	Chalk	Not Supplied - Cenomanian
	ZZCH	Zig Zag Chalk Formation	Chalk	Not Supplied - Cenomanian
	HCK	Holywell Nodular Chalk Formation	Chalk	Not Supplied - Cenomanian
	GLT	Gault Formation	Mudstone	Not Supplied - Albian
	UGS	Upper Greensand Formation	Siltstone and Sandstone	Not Supplied - Albian
	LGS	Lower Greensand Group	Sandstone, Silty	Not Supplied - Aptian
	FO	Folkestone Formation	Sandstone	Not Supplied - Aptian
	WC	Weald Clay Formation	Mudstone	Not Supplied - Hauterivian
	WC	Weald Clay Formation	Limestone	Not Supplied - Hauterivian
	WC	Weald Clay Formation	Silicate-claystone	Not Supplied - Hauterivian
		Faults		

Geo-Environmental

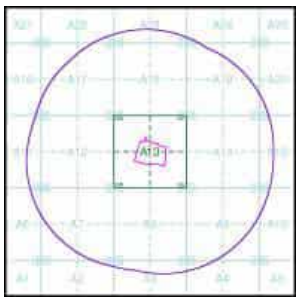
Geology 1:50,000 Maps

This report contains geological map extracts taken from the BGS Digital Geological map of Great Britain at 1:50,000 scale and is designed for users carrying out preliminary site assessments who require geological maps for the area around the site. This mapping may be more up to date than previously published paper maps.
The various geological layers - artificial and landslip deposits, superficial geology and solid (bedrock) geology are displayed in separate maps, but superimposed on the final 'Combined Surface Geology' map. All map legends feature on this page. Not all layers have complete nationwide coverage, so availability of data for relevant map sheets is indicated below.

Geology 1:50,000 Maps Coverage

Map ID:	**1**
Map Sheet No:	**318**
Map Name:	**Brighton and W**
Map Date:	**2006**
Bedrock Geology:	**Available**
Superficial Geology:	**Available**
Artificial Geology:	**Available**
Faults:	**Not Supplied**
Landslip:	**Available**
Rock Segments:	**Not Supplied**

Geology 1:50,000 Maps - Slice A



Order Details:

Order Number:	321564727_1_1
Customer Reference:	GE22017
National Grid Reference:	521320, 113120
Slice:	A
Site Area (Ha):	5.13
Search Buffer (m):	1000

Site Details:

Land off, Shoreham Road, Small Dole, West Sussex

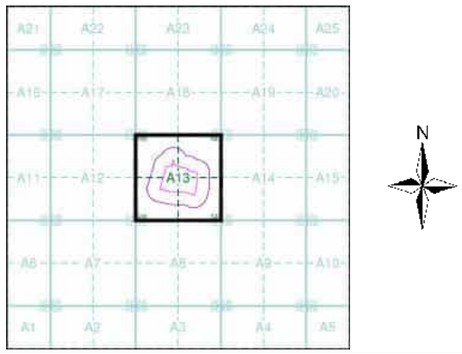
Geo-Environmental

Historical Aerial Photography

Published 1999

This aerial photography was produced by Getmapping, these vertical aerial photographs provide a seamless, full colour survey of the whole of Great Britain

Historical Aerial Photography - Segment A13



Order Details

Order Number:	321564727_1_1
Customer Ref:	GE22017
National Grid Reference:	521320, 113120
Slice:	A
Site Area (Ha):	5.13
Search Buffer (m):	100

Site Details

Land off, Shoreham Road, Small Dole, West Sussex

Landmark INFORMATION GROUP

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk

Geo-Environmental

Project No.	GE22017
Name	Shoreham Road, Small Dole
Client	Wates
Location	Small Dole
Engineer	
William Hughes	william.hughes@gesl.net
Date	13/12/2023, 15:11
Coordinates of Site	50° 54' 20.036" N 0° 16' 35.284" W
Version	1
Project Manager	
Jonathan Tingley	jonathan.tingley@gesl.net
Jason Kanellis	jason.kanellis@gesl.net
Features Noted	[ ] Signs of Landslide [ ] Signs of Subsidence [ ] ASTs [ ] USTs [ ] Retaining walls [X] Trees [ ] Hard/soft landscaping [ ] Hard Landscaping [X] Soft Landscaping [ ] Evidence of Surface Staining [ ] Evidence of Buried Services [ ] Overhead Services [ ] Evidence of Filled Ground [ ] Stockpiles [ ] Evidence of Fly Tipping [ ] Evidence of ACMs [ ] Evidence of Vegetation Die Back [X] Evidence of High Water Table [ ] Evidence of Dissolution Features [ ] Drums/Barrels [ ] Roof Materials [ ] Other
Current Site Use	Field
Approximate Site Area	
Shape of Site	Square
Topography	Undulating
Description of Topography	
Was Internal Inspection	

Possible	Yes
Site Overview Photographs	1 record

View from North facing South

View from East facing West

View from South facing North

View from West facing East

Descriptions of any Buildings

0 records

Trees

2 records

Trees	1
Description	Boundary
Photo	

Trees	2
Description	Boundary
Photo	

Soft Landscaping

1 record

Soft Landscaping	1
Description	Grass
Photo(s)	

Evidence of High Water Table

1 record

Evidence of High Water Table	1
Description	
Photo(s)	

Approved By

No users

UNEXPLODED BOMB RISK MAP

zeticaUXO

SITE LOCATION

Map Centre: 521333,113125

LEGEND

- **High:** Areas indicated as having a bombing density of 50 bombs per 1000acre or higher.
- **Moderate:** Areas indicated as having a bombing density of 15 to 49 bombs per 1000acre.
- **Low:** Areas indicated as having 15 bombs per 1000acre or less.

miltary	**industry**	**UXO find**
transport	**dock**	**Luftwaffe targets**
utilities	**Bombing decoy**	**other**

How to use your Unexploded Bomb (UXB) risk map?

The map indicates the potential for Unexploded Bombs (UXB) to be present as a result of World War Two (WWII) bombing.

You can incorporate the map into your preliminary risk assessment* for potential Unexploded Ordnance (UXO) for a site. Using this map, you can make an informed decision as to whether more in-depth detailed risk assessment* is necessary.

What do I do if my site is in a moderate or high risk area?

Generally, we recommend that a detailed UXO desk study and risk assessment is undertaken for sites in a moderate or high UXB risk area.

Similarly, if your site is near to a designated Luftwaffe target or bombing decoy then additional detailed research is recommended.

More often than not, this further detailed research will conclude that the potential for a significant UXO hazard to be present on your site is actually low.

Never plan site work or undertake a risk assessment using these maps alone. More detail is required, particularly where there may be a source of UXO from other military operations which are not reflected on these maps.

If my site is in a low risk area, do I need to do anything?

If both the map and other research confirms that there is a low potential for UXO to be present on your site then, subject to your own comfort and risk tolerance, works can proceed with no special precautions.

A low risk really means that there is no greater probability of encountering UXO than anywhere else in the UK.

If you are unsure whether other sources of UXO may be present, you can ask for one of our **pre-desk study assessments (PDSA)**

If I have any questions, who do I contact?

tel: **+44 (0) 1993 886682**

email: **uxo@zetica.com**

web: **www.zeticauxo.com**

The information in this UXB risk map is derived from a number of sources and should be used in conjunction with the accompanying notes on our website: **(https://zeticauxo.com/downloads-and-resources/risk-maps/)**

It is important to note that this map is not a UXO risk assessment and should not be reported as such when reproduced.

*Preliminary and detailed UXO risk assessments are advocated as good practice by industry guidance such as CIRIA C681 'Unexploded Ordnance (UXO), a guide for the construction industry'.

APPENDIX D: PROPOSED DEVELOPMENT

Brooklands

Dei-Gratia

Trewidden

Hill Cary

Allotments

Trevanion

Treventure

Lindmead

Tredyn

Corbyn Cottage

Mere Cottage

HENFIELD ROAD

A 2037

Stepping Stones

LAP

SUDs Pond

Swale

Turning Head

Plots 9-10 Borehole

Plots 1-8 Borehole

Plot 1 Pump

CC

V

Plot 10 Plot 11 Plot 12 Plot 13 Plot 14 Plot 15 Plot 16 Plot 17 Plot 18 Plot 19 Plot 20 Plot 21 Plot 22 Plot 23 Plot 24 Plot 25 Plot 26 Plot 27 Plot 28 Plot 29 Plot 30 Plot 31 Plot 32 Plot 33 Plot 34 Plot 35 Plot 36 Plot 37 Plot 38 Plot 39 Plot 40 Plot 41 Plot 42 Plot 43 Plot 44 Plot 45

N

W E

S

0 10m 20m

Site Plan Details

- 1.8m high timber c/b fence
- 1.8m high brick retaining wall
- Plot 59 — Plot Number
- 10/2 — Car Parking Ref
- RCP — Refuse Collection Point
- Footpath
- Badger Sett Buffer Zone
- Proposed Raingardens

LANDSCAPING DETAILS: -

- Existing Trees to be retained
- Proposed Trees
- Root Protection Area

REV.	DATE	REVISIONS:	BY
A	17.12.24	Changed to client's comments	RPO
B	28.01.25	Suds added plots moved	RPO
C	19.02.25	Amended landscape design added	AL
D	19.03.25	Amended landscape design added	AL
E	07.10.25	Amended to landscaper comments, updated basin incorporated	AL
F	14.10.25	Pumping station updated	AL

REV. / DATE / REVISIONS: / BY — (none)

REV. / DATE / REVISIONS: / BY — (none)

STATUS: **Planning**

CLIENT:	Wates Developments	PROJECT:	Shoreham Road, Small Dole, BN5 9YH
SCALE:	1:500 (A1 ORIGINAL)	DRAWING:	Indicative Site Plan
DRAWN: RPO DATE: 17.01.24	23088	P101	F

architecture planning masterplanning
Broadmede House, Farnham Business Park,
Weydon Lane, Farnham, Surrey GU9 8QT.
info@osparchitecture.com www.osparchitecture.com
Tel: 01252 267878
OSP Architecture Limited. Company Registration No. 2878351

APPENDIX E: MICRODRAINAGE CALCULATIONS

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	10	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	1.500
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.009	5.00	14.628	1200	521403.532	113097.311	1.449
2	0.044	5.00	14.296	1200	521380.024	113103.479	1.425
3	0.038	5.00	13.917	1200	521351.167	113108.927	1.497
4			13.778	1200	521337.650	113104.777	1.442
5			14.002	1200	521317.473	113114.429	1.798
6	0.012	5.00	13.873	1200	521293.739	113114.217	1.809
7	0.035	5.00	13.131	1200	521275.722	113110.105	1.425
8	0.031	5.00	12.032	1200	521256.037	113101.182	1.425
9	0.044	5.00	10.942	1200	521239.575	113087.523	1.825
10	0.070	5.00	10.000		521396.170	113019.804	0.500
11	0.153	5.00	10.315	1350	521398.643	113027.051	1.706
12	0.090	5.00	9.967	1350	521363.554	113033.357	1.948
13	0.023	5.00	10.138	1350	521342.026	113036.383	2.173
14	0.065	5.00	12.314	1200	521329.437	113077.743	2.507
15	0.072	5.00	10.282	1350	521327.371	113043.755	2.358
16	0.023	5.00	9.852	1350	521312.431	113038.368	1.967
17	0.023	5.00	9.415	1350	521295.789	113036.074	1.572
18	0.070	5.00	9.031	1350	521273.477	113036.618	1.243
19	0.006	5.00	9.247	1350	521250.960	113041.198	1.516
20	0.010	5.00	9.400	1350	521249.315	113047.659	1.686
22			9.000	1500	521226.638	113056.022	1.421
23			9.000	1500	521224.925	113047.599	1.439
24			9.000	1500	521212.247	113027.507	1.500
21	0.011	5.00	10.000		521331.616	113032.100	0.829
25	0.011	5.00	14.600		521419.285	113107.796	1.650
26	0.067	5.00	14.600		521404.729	113105.590	1.724
27	0.026	5.00	13.800		521308.787	113124.338	1.724
28	0.025	5.00	13.000		521272.616	113118.824	1.724
29	0.011	5.00	10.900		521234.460	113096.107	1.724
J1		5.00	8.900		521274.795	113032.918	0.773
J2		5.00	9.940		521358.651	113031.342	1.568

Links

Name	US Node	DS Node	Length (m)	US IL (m)	DS IL (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
2.000	1	2	24.304	13.179	12.871	78.9	225	5.27	50.0
2.001	2	3	29.367	12.871	12.420	65.1	225	5.58	50.0
2.002	3	4	14.140	12.420	12.336	168.3	225	5.81	50.0
2.003	4	5	22.367	12.336	12.204	169.4	225	6.18	50.0
2.004	5	6	23.735	12.204	12.064	169.5	225	6.58	50.0
2.005	6	7	18.480	12.064	11.706	51.6	225	6.75	50.0
2.006	7	8	21.613	11.706	10.607	19.7	225	6.87	50.0
2.007	8	9	21.391	10.607	9.117	14.4	225	6.97	50.0
1.005	9	22	34.054	9.117	7.879	27.5	225	7.20	50.0
3.000_1	11	12	35.651	8.609	8.069	66.0	400	5.26	50.0
3.001_1	12	13	21.740	8.019	7.965	402.6	450	5.62	50.0
3.002	13	15	16.405	7.965	7.924	400.1	450	5.89	50.0
5.000	14	15	34.051	9.807	8.224	21.5	150	5.26	50.0
3.003	15	16	15.882	7.924	7.885	407.2	450	6.15	50.0
3.004	16	17	16.799	7.885	7.843	400.0	450	6.43	50.0
3.005	17	18	22.319	7.843	7.788	405.8	450	6.80	50.0
3.006	18	19	22.978	7.788	7.731	403.1	450	7.18	50.0
3.007	19	20	6.667	7.731	7.714	392.2	450	7.29	50.0
3.008	20	22	24.170	7.714	7.654	402.8	450	7.69	50.0
3.000	22	23	8.595	7.579	7.561	477.5	525	7.83	50.0
3.001	23	24	30.021	7.561	7.500	492.1	525	8.33	50.0
6.000	10	21	65.715	9.500	9.171	200.0	500	5.47	50.0
1.000	25	26	14.722	12.950	12.876	200.0	500	5.10	50.0
1.001	26	27	97.757	12.876	12.076	122.2	500	5.64	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
2.000	1.473	58.6	1.7	1.224	1.200	0.009	0.0	26	0.652
2.001	1.623	64.5	9.6	1.200	1.272	0.053	0.0	58	1.172
2.002	1.005	39.9	16.5	1.272	1.217	0.091	0.0	101	0.958
2.003	1.001	39.8	16.5	1.217	1.573	0.091	0.0	101	0.954
2.004	1.001	39.8	16.5	1.573	1.584	0.091	0.0	101	0.954
2.005	1.825	72.6	18.7	1.584	1.200	0.103	0.0	78	1.537
2.006	2.964	117.8	25.0	1.200	1.200	0.138	0.0	70	2.362
2.007	3.471	138.0	30.6	1.200	1.600	0.169	0.0	72	2.803
1.005	2.504	99.6	63.7	1.600	0.896	0.353	0.0	131	2.654
3.000_1	2.325	292.2	27.6	1.306	1.498	0.153	0.0	82	1.485
3.001_1	1.007	160.1	43.9	1.498	1.723	0.243	0.0	160	0.863
3.002	1.010	160.6	48.1	1.723	1.908	0.266	0.0	168	0.887
5.000	2.181	38.5	11.7	2.357	1.908	0.065	0.0	57	1.915
3.003	1.001	159.2	72.8	1.908	1.517	0.403	0.0	213	0.979
3.004	1.010	160.7	77.0	1.517	1.122	0.426	0.0	219	1.000
3.005	1.003	159.5	95.8	1.122	0.793	0.530	0.0	252	1.047
3.006	1.006	160.0	108.5	0.793	1.066	0.600	0.0	272	1.078
3.007	1.020	162.3	109.5	1.066	1.236	0.606	0.0	271	1.092
3.008	1.007	160.1	111.3	1.236	0.896	0.616	0.0	277	1.084
3.000	1.018	220.4	175.0	0.896	0.914	0.969	0.0	355	1.124
3.001	1.003	217.1	175.0	0.914	0.975	0.969	0.0	359	1.110
6.000	2.354	1959.4	12.7	0.050	0.379	0.070	0.0	35	0.598
1.000	2.354	1959.4	2.0	1.200	1.274	0.011	0.0	12	0.309
1.001	3.015	2509.7	14.1	1.274	1.274	0.078	0.0	32	0.735

Links

Name	US Node	DS Node	Length (m)	US IL (m)	DS IL (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.002	27	28	36.589	12.076	11.276	45.7	500	5.77	50.0
1.003	28	29	44.407	11.276	9.176	21.1	500	5.87	50.0
6.001	21	17	36.047	9.171	8.143	35.1	150	5.82	50.0
1.004	29	9	9.992	9.176	9.117	169.4	225	6.04	50.0
7.000	J1	18	3.928	8.127	8.088	100.7	150	5.07	50.0
4.000	J2	12	5.301	8.372	8.319	100.0	150	5.09	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.002	4.936	4109.1	18.8	1.274	1.274	0.104	0.0	29	1.130
1.003	7.265	6048.4	23.3	1.274	1.274	0.129	0.0	26	1.575
6.001	1.705	30.1	14.7	0.679	1.122	0.081	0.0	74	1.697
1.004	1.002	39.8	25.2	1.499	1.600	0.139	0.0	130	1.057
7.000	1.001	17.7	0.0	0.623	0.793	0.000	0.0	0	0.000
4.000	1.005	17.8	0.0	1.418	1.498	0.000	0.0	0	0.000

SuDS Carriers

Link	US Node	DS Node	Link Type	Safety Factor
6.000	10	21	Swale	2.0
1.000	25	26	Swale	2.0
1.001	26	27	Swale	2.0
1.002	27	28	Swale	2.0
1.003	28	29	Swale	2.0

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)	
Rainfall Events	Singular	Skip Steady State	x	Check Discharge Rate(s)	x
Summer CV	1.000	Drain Down Time (mins)	240	Check Discharge Volume	x
Winter CV	1.000	Additional Storage (m³/ha)	20.0		

Storm Durations

15	30	60	120	180	240	360	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	0	0	0
100	0	0	0
100	45	0	0

Node 23 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	7.561	Product Number	CTL-SHE-0116-6600-1300-6600
Design Depth (m)	1.300	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	6.6	Min Node Diameter (mm)	1200

Node 22 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	7.579
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	768.9	0.0	1.300	768.9	0.0	1.301	0.0	0.0

Node J1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	8.800
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	66.0	66.0	0.100	66.0	68.9

Node J1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	8.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Time to half empty (mins)	6

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	66.0	66.0	0.790	66.0	88.8	0.800	0.0	88.8

Node J2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	9.800
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	21.0	21.0	0.100	21.0	22.6

Node J2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	8.800
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Time to half empty (mins)	2

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	21.0	21.0	0.800	21.0	34.0	0.801	0.0	34.0

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.85%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	11	13.205	0.026	1.7	0.0331	0.0000	OK
15 minute summer	2	10	12.930	0.059	9.9	0.1025	0.0000	OK
15 minute summer	3	11	12.528	0.108	16.8	0.1764	0.0000	OK
15 minute summer	4	11	12.442	0.106	16.6	0.1195	0.0000	OK
15 minute summer	5	11	12.309	0.105	16.7	0.1189	0.0000	OK
15 minute summer	6	11	12.146	0.082	18.7	0.1035	0.0000	OK
15 minute summer	7	11	11.778	0.072	24.6	0.1166	0.0000	OK
15 minute summer	8	11	10.678	0.071	30.0	0.1108	0.0000	OK
15 minute summer	9	12	9.243	0.126	56.0	0.2036	0.0000	OK
15 minute summer	10	11	9.535	0.035	13.2	0.0978	0.0000	OK
15 minute summer	11	10	8.692	0.083	28.6	0.2677	0.0000	OK
15 minute summer	12	11	8.206	0.187	45.0	0.4392	0.0000	OK
15 minute summer	13	11	8.184	0.219	47.1	0.3606	0.0000	OK
15 minute summer	14	10	9.866	0.059	12.2	0.0969	0.0000	OK
15 minute summer	15	11	8.171	0.247	70.5	0.5036	0.0000	OK
15 minute summer	16	12	8.144	0.259	73.3	0.4315	0.0000	OK
15 minute summer	17	12	8.118	0.275	86.9	0.4749	0.0000	OK
15 minute summer	18	12	8.074	0.286	97.4	0.7313	0.0000	OK
15 minute summer	19	12	8.016	0.285	97.9	0.4302	0.0000	OK
15 minute summer	20	12	7.973	0.259	98.7	0.4021	0.0000	OK
360 minute summer	22	288	7.837	0.258	48.5	198.9129	0.0000	OK
360 minute summer	23	288	7.837	0.276	6.5	0.4877	0.0000	OK
15 minute summer	24	1	7.500	0.000	4.6	0.0000	0.0000	OK
15 minute summer	21	12	9.240	0.069	14.6	0.0178	0.0000	OK
15 minute summer	25	10	12.962	0.012	2.1	0.0016	0.0000	OK

US Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1	1.7	0.329	0.029	0.1309	
2	9.7	0.733	0.150	0.3952	
3	16.6	0.897	0.416	0.2619	
4	16.7	0.914	0.419	0.4081	
5	16.5	1.061	0.414	0.3703	
6	18.4	1.560	0.254	0.2211	
7	24.4	2.267	0.207	0.2332	
8	29.8	1.851	0.216	0.3560	
9	56.1	2.525	0.564	0.7571	
10	12.7	0.436	0.007	2.2440	
11	28.3	1.182	0.097	1.0009	
12	43.0	0.694	0.269	1.5088	
13	45.9	0.574	0.286	1.3589	
14	12.0	1.904	0.311	0.2144	
15	69.2	0.789	0.435	1.4566	
16	71.3	0.769	0.444	1.6480	
17	87.1	0.843	0.546	2.3201	
18	97.1	0.915	0.607	2.4386	
19	97.2	0.968	0.599	0.6689	
20	97.7	1.151	0.610	2.0565	
22	6.5	0.172	0.029	0.9480	
23	6.5				174.5
21	12.7	1.625	0.421	0.2814	
25	2.1	0.167	0.001	0.1911	

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.85%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	26	11	12.909	0.033	14.6	0.0256	0.0000	OK
15 minute summer	27	11	12.104	0.028	18.8	0.0085	0.0000	OK
15 minute summer	28	12	11.301	0.025	22.4	0.0072	0.0000	OK
15 minute summer	29	13	9.301	0.125	23.8	0.0154	0.0000	OK
15 minute summer	J1	1	8.127	0.000	0.0	0.0000	0.0000	OK
15 minute summer	J2	1	8.372	0.000	0.0	0.0000	0.0000	OK

US Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
26	14.2	0.784	0.006	1.7694	
27	18.0	1.171	0.004	0.5646	
28	22.1	0.483	0.004	2.7258	
29	22.2	1.038	0.558	0.2266	
J1	0.0	0.000	0.000	0.0000	
J2	0.0	0.000	0.000	0.0000	

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.95%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	10	13.221	0.042	4.5	0.0524	0.0000	OK
15 minute summer	2	10	12.968	0.097	25.5	0.1693	0.0000	OK
15 minute summer	3	11	12.675	0.255	43.3	0.4182	0.0000	SURCHARGED
15 minute summer	4	11	12.555	0.219	41.9	0.2476	0.0000	OK
15 minute summer	5	12	12.397	0.193	41.3	0.2186	0.0000	OK
15 minute summer	6	11	12.207	0.142	46.5	0.1804	0.0000	OK
15 minute summer	7	11	11.830	0.124	62.3	0.2005	0.0000	OK
15 minute summer	8	11	10.726	0.119	76.4	0.1860	0.0000	OK
15 minute summer	9	13	9.553	0.436	102.6	0.7032	0.0000	SURCHARGED
15 minute summer	10	11	9.559	0.059	33.8	0.1664	0.0000	OK
15 minute summer	11	12	8.775	0.166	73.3	0.5350	0.0000	OK
15 minute summer	12	11	8.753	0.734	116.0	1.7277	0.0000	SURCHARGED
15 minute summer	13	11	8.718	0.753	110.3	1.2374	0.0000	SURCHARGED
15 minute summer	14	11	9.910	0.103	31.2	0.1693	0.0000	OK
15 minute summer	15	11	8.688	0.764	170.6	1.5596	0.0000	SURCHARGED
15 minute summer	16	11	8.616	0.731	176.0	1.2163	0.0000	SURCHARGED
15 minute summer	17	12	8.533	0.690	211.3	1.1903	0.0000	SURCHARGED
15 minute summer	18	12	8.397	0.609	240.3	1.5583	0.0000	SURCHARGED
15 minute summer	19	12	8.252	0.521	214.8	0.7844	0.0000	SURCHARGED
15 minute summer	20	12	8.176	0.462	219.1	0.7157	0.0000	SURCHARGED
360 minute winter	22	352	8.150	0.571	64.9	439.7878	0.0000	SURCHARGED
360 minute winter	23	352	8.150	0.589	6.9	1.0401	0.0000	SURCHARGED
15 minute summer	24	1	7.500	0.000	6.4	0.0000	0.0000	OK
15 minute summer	21	13	9.318	0.147	37.7	0.0380	0.0000	OK
15 minute summer	25	10	12.971	0.021	5.3	0.0028	0.0000	OK

US Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1	4.4	0.426	0.075	0.2595	
2	25.1	0.867	0.389	0.8235	
3	41.9	1.053	1.048	0.5601	
4	41.3	1.092	1.038	0.8468	
5	41.3	1.303	1.037	0.7448	
6	46.2	1.930	0.637	0.4512	
7	62.1	2.854	0.527	0.4710	
8	76.3	2.201	0.553	0.6526	
9	100.4	2.750	1.008	1.3543	
10	32.8	0.546	0.017	5.5518	
11	72.8	1.188	0.249	3.1062	
12	99.8	0.716	0.623	3.4446	
13	109.3	0.690	0.681	2.5993	
14	31.0	2.314	0.803	0.5183	
15	165.5	1.045	1.040	2.5164	
16	173.9	1.097	1.082	2.6617	
17	209.2	1.320	1.311	3.5363	
18	212.6	1.342	1.329	3.6407	
19	215.3	1.359	1.327	1.0563	
20	220.3	1.490	1.376	3.4266	
22	6.9	0.172	0.031	1.8568	
23	6.6				194.5
21	28.9	1.842	0.959	0.6330	
25	5.2	0.223	0.003	0.3585	

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.95%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	26	11	12.932	0.056	37.5	0.0435	0.0000	OK
15 minute summer	27	11	12.126	0.050	48.6	0.0148	0.0000	OK
15 minute summer	28	11	11.320	0.044	59.7	0.0126	0.0000	OK
15 minute summer	29	14	9.606	0.430	64.0	0.0529	0.0000	SURCHARGED
15 minute summer	J1	13	8.354	0.227	26.2	4.4847	0.0000	SURCHARGED
15 minute summer	J2	11	8.750	0.378	9.6	0.0000	0.0000	SURCHARGED

US Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
26	36.7	1.061	0.015	3.3900	
27	48.3	1.616	0.012	1.0950	
28	59.2	0.572	0.010	17.5280	
29	62.4	1.625	1.568	0.3974	
J1	-26.2	-1.486	-1.479	0.0692	
J2	-9.6	-0.546	-0.542	0.0933	

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.90%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	10	13.225	0.046	5.6	0.0584	0.0000	OK
15 minute summer	2	11	12.988	0.117	31.9	0.2052	0.0000	OK
15 minute summer	3	11	12.898	0.478	54.4	0.7832	0.0000	SURCHARGED
15 minute summer	4	12	12.732	0.396	49.2	0.4481	0.0000	SURCHARGED
15 minute summer	5	12	12.490	0.286	48.6	0.3238	0.0000	SURCHARGED
15 minute summer	6	12	12.226	0.162	54.8	0.2046	0.0000	OK
15 minute summer	7	11	11.844	0.138	74.4	0.2234	0.0000	OK
15 minute summer	8	11	10.748	0.141	92.0	0.2208	0.0000	OK
30 minute summer	9	21	9.721	0.604	110.1	0.9750	0.0000	SURCHARGED
15 minute summer	10	11	9.567	0.067	42.4	0.1886	0.0000	OK
15 minute summer	11	12	9.075	0.466	91.9	1.5013	0.0000	SURCHARGED
15 minute summer	12	12	9.034	1.015	136.9	2.3907	0.0000	SURCHARGED
15 minute summer	13	12	8.990	1.025	127.8	1.6845	0.0000	SURCHARGED
15 minute summer	14	12	10.314	0.507	39.1	0.8366	0.0000	SURCHARGED
15 minute summer	15	12	8.947	1.023	198.0	2.0881	0.0000	SURCHARGED
15 minute summer	16	12	8.848	0.963	207.5	1.6036	0.0000	SURCHARGED
15 minute summer	17	12	8.734	0.891	241.5	1.5362	0.0000	SURCHARGED
15 minute summer	18	12	8.549	0.761	276.0	1.9458	0.0000	SURCHARGED
15 minute summer	19	12	8.349	0.618	250.3	0.9321	0.0000	SURCHARGED
360 minute winter	20	360	8.313	0.599	50.9	0.9280	0.0000	SURCHARGED
360 minute winter	22	360	8.313	0.734	80.0	565.3214	0.0000	SURCHARGED
360 minute winter	23	360	8.313	0.752	6.9	1.3279	0.0000	SURCHARGED
15 minute summer	24	1	7.500	0.000	6.6	0.0000	0.0000	OK
15 minute summer	21	14	9.389	0.218	47.5	0.0565	0.0000	SURCHARGED
15 minute summer	25	10	12.974	0.024	6.6	0.0031	0.0000	OK

US Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1	5.5	0.448	0.094	0.3246	
2	31.5	0.930	0.489	0.8912	
3	49.2	1.237	1.232	0.5624	
4	48.6	1.223	1.221	0.8896	
5	48.8	1.334	1.226	0.8342	
6	54.9	2.010	0.757	0.5152	
7	74.1	2.891	0.629	0.5581	
8	90.9	2.490	0.658	0.7054	
9	106.9	2.740	1.073	1.3543	
10	41.3	0.567	0.021	9.3316	
11	85.3	1.181	0.292	4.4631	
12	116.5	0.736	0.728	3.4446	
13	128.1	0.809	0.798	2.5993	
14	35.5	2.296	0.922	0.5995	
15	196.5	1.240	1.234	2.5164	
16	208.1	1.313	1.295	2.6617	
17	241.9	1.527	1.517	3.5363	
18	247.6	1.563	1.547	3.6407	
19	250.5	1.581	1.544	1.0563	
20	50.2	0.850	0.313	3.8296	
22	6.9	0.173	0.032	1.8568	
23	6.6				188.3
21	30.9	1.849	1.026	0.6346	
25	6.5	0.240	0.003	0.4195	

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.90%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	26	11	12.939	0.063	46.9	0.0493	0.0000	OK
15 minute summer	27	11	12.132	0.056	61.1	0.0168	0.0000	OK
15 minute summer	28	11	11.326	0.050	75.3	0.0144	0.0000	OK
30 minute summer	29	22	9.772	0.596	80.0	0.0734	0.0000	SURCHARGED
30 minute summer	J1	21	8.493	0.366	32.2	7.2356	0.0000	SURCHARGED
15 minute summer	J2	12	9.046	0.674	15.8	1.5514	0.0000	SURCHARGED

US Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
26	46.2	1.138	0.018	3.9753	
27	61.1	1.740	0.015	1.2862	
28	75.0	0.582	0.012	30.1627	
29	69.0	1.736	1.733	0.3974	
J1	-32.2	-1.827	-1.818	0.0692	
J2	17.2	0.977	0.969	0.0933	

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 99.77%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	12	13.526	0.347	8.1	0.4364	0.0000	SURCHARGED
15 minute summer	2	12	13.517	0.646	43.7	1.1296	0.0000	SURCHARGED
15 minute summer	3	12	13.346	0.925	66.2	1.5167	0.0000	SURCHARGED
15 minute summer	4	12	13.070	0.734	62.6	0.8296	0.0000	SURCHARGED
15 minute summer	5	13	12.687	0.482	61.6	0.5455	0.0000	SURCHARGED
15 minute summer	6	12	12.324	0.260	69.0	0.3292	0.0000	SURCHARGED
15 minute summer	7	12	11.955	0.249	97.9	0.4032	0.0000	SURCHARGED
15 minute summer	8	12	11.159	0.552	120.7	0.8650	0.0000	SURCHARGED
30 minute summer	9	22	10.054	0.937	142.9	1.5111	0.0000	SURCHARGED
15 minute summer	10	11	9.582	0.082	61.5	0.2305	0.0000	OK
15 minute summer	11	12	9.941	1.332	133.5	4.2960	0.0000	SURCHARGED
15 minute summer	12	12	9.848	1.829	193.3	4.3069	0.0000	FLOOD RISK
15 minute summer	13	12	9.766	1.801	178.2	2.9588	0.0000	SURCHARGED
15 minute summer	14	12	12.015	2.207	56.7	3.6424	0.0000	FLOOD RISK
15 minute summer	15	12	9.682	1.758	272.0	3.5892	0.0000	SURCHARGED
15 minute summer	16	12	9.491	1.606	288.6	2.6746	0.0000	SURCHARGED
15 minute summer	17	12	9.271	1.428	317.9	2.4612	0.0000	FLOOD RISK
15 minute summer	18	12	8.950	1.162	367.4	2.9716	0.0000	FLOOD RISK
1440 minute winter	19	1380	8.735	1.004	22.2	1.5124	0.0000	SURCHARGED
1440 minute winter	20	1380	8.735	1.021	22.5	1.5829	0.0000	SURCHARGED
1440 minute winter	22	1380	8.735	1.156	37.1	890.6348	0.0000	FLOOD RISK
1440 minute winter	23	1380	8.735	1.174	6.7	2.0738	0.0000	FLOOD RISK
15 minute summer	24	1	7.500	0.000	6.6	0.0000	0.0000	OK
30 minute summer	21	23	9.549	0.378	64.9	0.0979	0.0000	SURCHARGED
15 minute summer	25	10	12.979	0.029	9.6	0.0039	0.0000	OK

US Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1	13.3	0.456	0.228	0.9666	
2	36.6	0.939	0.568	1.1680	
3	62.6	1.574	1.567	0.5624	
4	61.6	1.548	1.547	0.8896	
5	61.3	1.540	1.539	0.9440	
6	68.6	2.139	0.946	0.7350	
7	94.7	2.849	0.804	0.8596	
8	112.5	2.828	0.815	0.8507	
9	117.7	2.959	1.182	1.3544	
10	59.9	0.607	0.031	20.3258	
11	118.1	1.177	0.404	4.4631	
12	162.3	1.024	1.013	3.4446	
13	178.9	1.129	1.114	2.5993	
14	43.3	2.460	1.124	0.5995	
15	272.6	1.721	1.713	2.5164	
16	289.1	1.825	1.799	2.6617	
17	318.4	2.009	1.996	3.5363	
18	324.9	2.051	2.030	3.6407	
19	22.1	0.576	0.136	1.0563	
20	22.4	0.564	0.140	3.8296	
22	6.7	0.171	0.030	1.8568	
23	6.6				532.6
21	31.6	1.842	1.047	0.6346	
25	9.5	0.270	0.005	0.5450	

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 99.77%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	26	10	12.954	0.078	68.2	0.0605	0.0000	OK
15 minute summer	27	11	12.145	0.069	88.6	0.0206	0.0000	OK
15 minute summer	28	11	11.338	0.062	109.8	0.0177	0.0000	OK
30 minute summer	29	24	10.092	0.916	135.6	0.1127	0.0000	SURCHARGED
30 minute summer	J1	22	8.805	0.678	43.6	13.6000	0.0000	FLOOD RISK
15 minute summer	J2	12	9.824	1.452	36.0	5.5641	0.0000	FLOOD RISK

US Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
26	67.1	1.273	0.027	5.1605	
27	89.2	1.953	0.022	1.6716	
28	109.6	0.573	0.018	61.7739	
29	81.5	2.048	2.046	0.3974	
J1	-43.6	-2.476	-2.464	0.0692	
J2	-36.0	-2.046	-2.029	0.0933	

APPENDIX F: DRAINAGE LAYOUT

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Legend

- Indicative site boundary
- FFL XX.XXX — Indicative plot finished floor level (FFL)
- Indicative road contour levels (0.1m intervals)
- Proposed surface water sewer
- Proposed foul water sewer
- Headwall
- Proposed foul water rising main
- Existing foul water sewer
- Proposed conveyance swale
- Proposed attenuating swale (water retention for BNG)
- Attenuation basin
- RPA Category B
- RPA Category C
- Rain Gardens

General Notes

1. Where this drawing has been issued in electronic .dwg format, it has been done so in good faith. JNP Group do not take any responsibility for any inaccuracies in the electronic data, which should be checked against the paper (or .pdf) drawing issue. Any apparent discrepancies should be immediately reported to JNP Group. The electronic .dwg file should not be assumed to be to scale and should not be used for 'overlaying', setting out or checking of any third party information. All dimensions should be taken from the paper (or .pdf) version of the drawing. Electronic drawings may contain third party information. JNP Group take no responsibility for this information, which should be checked against the originators paper drawing(s).
2. All dimensions are millimetres (mm), and levels are in metres (m) unless noted otherwise and should be checked on site prior to construction/fabrication.
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6. This drawing should only be used for construction if the drawing status is "A4 - Approved/Stage Complete". JNP Group takes no responsibility for construction works undertaken to drawings that are not marked with this status.

Health & Safety Note

The details on this drawing have been prepared on the assumption that a competent contractor will be carrying out the works. If the contractor(s) considers that there is insufficient Health and Safety information on this drawing, this should immediately be brought to the attention of the designer.

HAZARD IDENTIFICATION BOX

This table is provided to assist the Principal Contractor to fulfil their obligations under the CDM Regulations 2015

Hazard Ref	Hazard Type (Construction/Maintenance/ Cleaning/Demolition/Adaptation)	Hazard Description	Mitigation Measures/ Residual Risk
1			

Drainage Strategy Notes

1. The proposals shown on this drawing are indicative only and subject to detailed design.
2. Drainage network has been designed in Flow based on the following parameters:
   - FEH Rainfall Data
   - Impermeable Area +10% urban creep: 0.84hectares

Rev.	Date	Description	Drn / Chk'd / App'd
P05	16/10/2025	Basin extents amended to LLFA comments	AI/RSH/RSH
P04	11/06/2025	Pipe 3.001 and outfall HW4 location amended	OB/RSH/RSH
P03	03/04/2025	Updated with latest site boundary and proposed still water swale	OB/RSH/RSH
P02	24/02/2025	Updated with latest site layout and topo, foul water rising main MH added as per rev cloud	OB/RSH/RSH
P01	07/02/2025	Issued for information	OB/RSH/RSH

Suitability: S3 - Suitable for Review & Comment

Client Logo: Wates DEVELOPMENTS

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Hartlepool ● Sheffield ● Warwick
www.jnpgroup.co.uk

Client: Wates Developments Ltd

Job: Land West of Shoreham Road, Small Dole

Title: Proposed Drainage Strategy

Classification: FI_60_20
Scale @ A1: 1:500

Project - Originator - Volume/System - Level/Location - Type - Discipline - Number: BR31013-JNP-92-XX-DR-C-2001
Document/Drawing Number
Revision: P05

JNP Group Internal Project Number: BR31013

APPENDIX G: OVERLAND FLOWS

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Flood Routing Legend

- Indicative site boundary
- Indicative overland route of on-site exceedance flood flows
- Proposed surface water sewer
- FFL XX.XXX — Indicative plot finished floor level (FFL)
- Proposed conveyance swale
- Proposed attenuating swale (water retention for BNG)
- Indicative road contour levels (0.1m intervals)
- Proposed head wall
- Rain Gardens
- Attenuation basin
- Xm^3 — Surface water network hydraulic model overflow point and flooded volume for 1:100yr + 45% climate change storm event

Basin
IL 7.361
850m³
TWL 8.700
Top of bank 9.000

SW Flow Control
Flow restriction: 6.6 l/s
CL 8.700
IL 7.284

HW1 CL 9.000 IL 7.540
HW2 CL 9.000 IL 7.540
HW3 CL 9.000 IL 7.311
HW4 CL 7.500 IL 7.209

SW01 CL 14.628 IL 13.179
SW02 CL 14.296 IL 12.871
SW03 CL 13.917 IL 12.420
SW04 CL 13.778 IL 12.336
SW04 CL 14.002 IL 12.204
SW06 CL 13.873 IL 12.064
SW07 CL 13.131 IL 11.706
SW08 CL 12.032 IL 10.607
SW09 CL 10.942 IL 9.517
SW11 CL 10.315 IL 8.609
SW12 CL 9.967 IL 8.317
SW13 CL 10.138 IL 8.263
SW14 CL 12.314 IL 9.807
SW15 CL 10.282 IL 8.222
SW16 CL 9.852 IL 8.183
SW17 CL 9.415 IL 7.770
SW18 CL 9.031 IL 7.715
SW19 CL 9.247 IL 7.658
SW20 CL 9.400 IL 7.641

3201 CL 14.31 IL 11.32
4201 CL 14.46 IL 10.83
4101 CL 15.61 IL 13.86
4003 CL 9.31 IL 5.97

Dei-Gratia, Colliure, Travanion, Treventure, Lindmead, Treelyn, Trewidden, Dayton Cottage, New Cottage, South Cottage, Hill Cary, Stepping Stones, A 2037

General Notes

1. Where this drawing has been issued in electronic .dwg format, it has been done so in good faith. JNP Group do not take any responsibility for any inaccuracies in the electronic data, which should be checked against the paper (or .pdf) drawing issue. Any apparent discrepancies should be immediately reported to JNP Group. The electronic .dwg file should not be assumed to be to scale and should not be used for 'overlaying', setting out or checking of any third party information. All dimensions should be taken from the paper (or .pdf) version of the drawing. Electronic drawings may contain third party information. JNP Group take no responsibility for this information, which should be checked against the originators paper drawing(s).
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3. Do not scale from this drawing. Only figured dimensions are to be relied upon. Don't hesitate to get in touch with JNP Group if additional information is required.
4. Any discrepancies between drawings of different scales and between drawings and specifications, where appropriate, to be reported to JNP Group for decision.
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6. This drawing should only be used for construction if the drawing status is "A4 - Approved/Stage Complete". JNP Group takes no responsibility for construction works undertaken to drawings that are not marked with this status.

Health & Safety Note

The details on this drawing have been prepared on the assumption that a competent contractor will be carrying out the works. If the contractor(s) considers that there is insufficient Health and Safety information on this drawing, this should immediately be brought to the attention of the designer.

HAZARD IDENTIFICATION BOX

This table is provided to assist the Principal Contractor to fulfil their obligations under the CDM Regulations 2015

Hazard Ref	Hazard Type (Construction/Maintenance/ Cleaning/Demolition/Adaptation)	Hazard Description	Mitigation Measures/ Residual Risk
1			

Rev	Date	Description	Drn / Chk'd / App'd
P05	16/10/2025	Updated to revised SW calculations	OB/RSH/RSH
P04	11/06/2025	Site outfall pipe and HW location amended	OB/RSH/RSH
P03	03/04/2025	Updated with latest site boundary and proposed still water swale	OB/RSH/RSH
P02	24/02/2025	Updated with latest site layout and topo	OB/RSH/RSH
P01	07/02/2025	Issued for information	OB/RSH/RSH

Suitability: S3 - Suitable for Review & Comment

Client Logo: Wates DEVELOPMENTS

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Client: Wates Developments Ltd

Job: Land West of Shoreham Road, Small Dole

Title: Exceedance Flow Routing

Classification: FI_60_20
Scale @ A1: 1:500

Project - Originator - Volume/System - Level/Location - Type - Discipline - Number
BR31013- JNP - 92 -XX- DR -C- 2002
Document/Drawing Number
Revision: P05

JNP Group Internal Project Number: BR31013

APPENDIX H: CORRESPONDANCE

Ola Bidas
Wates Developments Limited
Whitefirars, Lewins Mead
Bristol
BS1 2NT

Your ref
19667

Our ref
DSA000042009

Date
25 March 2025

Contact
Tel 0330 303 0119

Dear Miss Bidas,

Level 1 Capacity Check Enquiry: Land West of Shoreham Road, Small Dole, Henfield, BN5 9YH

We have completed the capacity check for the above development site and the results are as follows:

Foul Water

The enquiry has been reassessed to determine the capacity available for 6.0 l/s at manhole reference TQ21134101 (Grid Reference: 521471 , 113128).

There is currently adequate capacity in the local sewerage network to accommodate a foul flow of 6.0 l/s for the above development at manhole reference TQ21134101. Southern Water will not permit a surface water connection into the foul network. Please refer to our surface water management policy.

Please note, the assessment that has been undertaken using an assumed flow/pump rate of 6.0 l/s. This has been calculated using Southern Water's modelling specifications.

Connecting to our network

It should be noted that this information is only a hydraulic assessment of the existing sewerage network and does not grant approval for a connection to the public sewerage system. A formal Sewer Connection (S106) application is required to be completed and approved by Southern Water Services. To make an application visit: developerservices.southernwater.co.uk

Please note the information provided above does not grant approval for any designs/drawings submitted for the capacity analysis. The results quoted above are only valid for 12 months from the date of issue of this letter.

Please get in touch via the Get Connected customer dashboard if you have any queries.

Yours sincerely,

Future Growth Planning Team
Developer Services

southernwater.co.uk/developing-building/planning-your-development

From: Eleanor Read
Sent on: 18 March 2024 12:55:19
To: Anthony Scoones
CC: Ryan Horngren
Subject: RE: Flood Risk and Drainage Pre-Application Advice - Land West of Shoreham Road, Small Dole

Good afternoon Anthony,

I can confirm discharging to watercourse at Qbar is fine as infiltration is not viable. We encourage use of source control features to reduce reliance on end of pipe design (basins) and to increase multi-functional benefits of SuDS compared to traditional piped systems.

Kind regards,
Ellie

Eleanor Read
Assistant Flood Risk Management Officer | Planning Policy & Infrastructure
West Sussex County Council, Ground Floor, Northleigh, County Hall, Chichester PO19 1RH
Internal Phone: 227048| External Phone: 03302 227048
Email: eleanor.read@westsussex.gov.uk | Web: www.westsussex.gov.uk

---

From: Anthony Scoones <Anthony.Scoones@jnpgroup.co.uk>
Sent: Monday, March 18, 2024 12:48 PM
To: Eleanor Read <Eleanor.Read@westsussex.gov.uk>
Cc: Ryan Horngren <Ryan.Horngren@jnpgroup.co.uk>
Subject: RE: Flood Risk and Drainage Pre-Application Advice - Land West of Shoreham Road, Small Dole

****EXTERNAL****

Hi Eleanor,

Please could we have an update on the below?

Kind regards,

Anthony Scoones
MEng (Hons)
Civil Engineer

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Whitefriars, Lewins Mead, Bristol, BS1 2NT
t: 01494 771221 **dd:** 01172 350152 **w:** jnpgroup.co.uk

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From: Anthony Scoones
Sent: Monday, February 26, 2024 12:51 PM
To: Eleanor Read <Eleanor.Read@westsussex.gov.uk>
Cc: Ryan Horngren <Ryan.Horngren@Jnpgroup.co.uk>
Subject: RE: Flood Risk and Drainage Pre-Application Advice - Land West of Shoreham Road, Small Dole [Filed 26 Feb 2024 12:51]

Hi Eleanor,

Could we have an update on the below please?

Many thanks,

Anthony Scoones
MEng (Hons)
Civil Engineer

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From: Anthony Scoones
Sent: Monday, February 19, 2024 12:46 PM
To: Eleanor Read <Eleanor.Read@westsussex.gov.uk>
Cc: Ryan Horngren <Ryan.Horngren@Jnpgroup.co.uk>
Subject: RE: Flood Risk and Drainage Pre-Application Advice - Land West of Shoreham Road, Small Dole [Filed 19 Feb 2024 12:46]

Hi Eleanor,

I hope you're well and had a good weekend

Please could I have an update on the below?

Many thanks!

Anthony Scoones
MEng (Hons)
Civil Engineer

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t: 01494 771221 **dd:** 01172 350152 **w:** jnpgroup.co.uk

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From: Anthony Scoones
Sent: Tuesday, February 13, 2024 9:44 AM
To: Eleanor Read <Eleanor.Read@westsussex.gov.uk>
Cc: Ryan Horngren <Ryan.Horngren@Jnpgroup.co.uk>
Subject: RE: Flood Risk and Drainage Pre-Application Advice - Land West of Shoreham Road, Small Dole [Filed 13 Feb 2024 09:44]

Hi Eleanor,

Just chasing on the below

Many thanks,

Anthony Scoones
MEng (Hons)
Civil Engineer

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From: Anthony Scoones
Sent: Monday, February 5, 2024 5:28 PM
To: Eleanor Read <Eleanor.Read@westsussex.gov.uk>
Cc: Ryan Horngren <Ryan.Horngren@Jnpgroup.co.uk>
Subject: RE: Flood Risk and Drainage Pre-Application Advice - Land West of Shoreham Road, Small Dole [Filed 05 Feb 2024 17:26]

Hi Eleanor,

I hope you are well.

Have you had a chance to review my query below?

Kind regards,

Anthony Scoones
MEng (Hons)
Civil Engineer

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From: Anthony Scoones
Sent: Monday, December 18, 2023 9:27 AM
To: Eleanor Read <Eleanor.Read@westsussex.gov.uk>
Cc: Ryan Horngren <Ryan.Horngren@Jnpgroup.co.uk>
Subject: FW: Flood Risk and Drainage Pre-Application Advice - Land West of Shoreham Road, Small Dole [Filed 18 Dec 2023 09:25]

Hi Ellie,

I hope you had a weekend.

We've had the next set of results back, please see below:

Position Reference	Groundwater Depth (m bgl/m OD)
WS01	0.39/9.74
WS02	0.10/9.84
WS03	0.33/10.73

WS04	3.82/11.83
WS05	Dry at 2.50/Dry at 12.36
WS06	1.18/14.02

From the above and below data, we have concluded that discharge via infiltration will be unviable on this site, and propose to discharge to the watercourse in the south of the site at the restricted rate of 8.2 L/s/Ha. Please could you confirm this approach is acceptable in principle?

Kind regards,

Anthony Scoones
MEng (Hons)
Civil Engineer

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From: Anthony Scoones
Sent: Thursday, December 7, 2023 11:23 AM
To: Eleanor Read <Eleanor.Read@westsussex.gov.uk>; Ryan Horngren <Ryan.Horngren@Jnpgroup.co.uk>
Subject: RE: Flood Risk and Drainage Pre-Application Advice - Land West of Shoreham Road, Small Dole [Filed 08 Dec 2023 09:07]

Hi Ellie,

I hope you're well

Thanks for confirming the below.

Geo works are ongoing on the site, and we have had the initial results from the groundwater monitoring back – please see the table below and attached location plan.

Position Reference	Groundwater Depth (m bgl/m OD)	
	17/11/2023	24/11/2023
WS01	0.90 / 9.23	0.65 / 9.48
WS02	0.56 / 9.38	0.11 / 9.83
WS03	0.78 / 10.28	0.83 / 10.23
WS04	Dry at 4.06 / Dry at 11.59	Dry at 4.06 / Dry at 11.59
WS05	0.97 / 13.89	2.37 / 12.49
WS06	1.25 / 13.95	1.33 / 13.87

As you'll appreciate, the monitoring has found shallow groundwater – very shallow in some areas. We therefore have concluded that discharge via infiltration will be unviable on this site, and propose to discharge to the watercourse in the south of the site at the restricted rate of 8.2 L/s/Ha. Please could you confirm this approach is acceptable in principle?

Monitoring is still ongoing and we will continue to review the results.

Many thanks,

Anthony Scoones
MEng (Hons)
Civil Engineer

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From: Eleanor Read <Eleanor.Read@westsussex.gov.uk>
Sent: Wednesday, November 29, 2023 8:50 AM
To: Ryan Horngren <Ryan.Horngren@Jnpgroup.co.uk>
Cc: Anthony Scoones <Anthony.Scoones@jnpgroup.co.uk>
Subject: RE: Flood Risk and Drainage Pre-Application Advice - Land West of Shoreham Road, Small Dole [Filed 29 Nov 2023 09:23]

Hi Ryan,

Yes I can confirm FEH using BFIHOST19 descriptor is required, as this is the most up to date parameters.

Ellie

Eleanor Read
Assistant Flood Risk Management Officer | Planning Policy & Infrastructure
West Sussex County Council, Ground Floor, Northleigh, County Hall, Chichester PO19 1RH
Internal Phone: 227048| External Phone: 03302 227048
Email: eleanor.read@westsussex.gov.uk | Web: www.westsussex.gov.uk

---

From: Ryan Horngren <Ryan.Horngren@Jnpgroup.co.uk>
Sent: 03 November 2023 12:50
To: Eleanor Read <Eleanor.Read@westsussex.gov.uk>
Cc: Anthony Scoones <Anthony.Scoones@jnpgroup.co.uk>
Subject: RE: Flood Risk and Drainage Pre-Application Advice - Land West of Shoreham Road, Small Dole

****EXTERNAL****

Hi Eleanor,

Thanks for your email and your comments. Anthony is away on leave at the moment so I am picking up while he is off.

Regarding your first point, I have had a look at using the FEH methodology to calculate the greenfield runoff rate. As you know, the BFIHOST catchment descriptor was updated to BFIHOST19.

I've put together a comparison table showing the greenfield rate calculated using the FEH method using both BFIHOST descriptors for our site:

Method	Qbar greenfield runoff rate (L/s/Ha)
FEH (using old BFIHOST)	7.6
FEH (using BFIHOST19)	8.2

Please could you confirm that you would like us to use the FEH methodology using the latest BFIHOST19 descriptor? We can then updated our drainage strategy accordingly

Many thanks,

Ryan Horngren
Associate

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From: Eleanor Read <Eleanor.Read@westsussex.gov.uk>
Sent: Thursday, October 26, 2023 2:31 PM
To: Anthony Scoones <Anthony.Scoones@jnpgroup.co.uk>
Subject: RE: Flood Risk and Drainage Pre-Application Advice - Land West of Shoreham Road, Small Dole [Filed 26 Oct 2023 15:20]

Good afternoon,

The below is ok in principle however there's a couple things that would be advised to look at before planning submission:

- Use of out of data parameters-IoH24 has been superseded by FEH
- Increased use of source control measures is suggested instead of reliance on end of pipe design

Kind regards,
Eleanor on behalf of the Flood Risk Management Team

Eleanor Read BSc (Hons) MSc
Assistant Flood Risk Management Officer | Flood Risk Management Team | Planning Policy & Infrastructure
West Sussex County Council, Ground Floor, Northleigh, County Hall, Chichester PO19 1RH
Internal Phone: 227048| External Phone: 03302 227048
Email: eleanor.read@westsussex.gov.uk | Web: www.westsussex.gov.uk

---

From: Anthony Scoones <Anthony.Scoones@jnpgroup.co.uk>
Sent: 23 October 2023 09:55
To: Flood Risk Management <FloodRiskManagement@westsussex.gov.uk>; Flood Risk Management <FloodRiskManagement@westsussex.gov.uk>
Cc: Ryan Horngren <Ryan.Horngren@Jnpgroup.co.uk>; Lorea Johnston <Lorea.Johnston@wates.co.uk>
Subject: RE: Flood Risk and Drainage Pre-Application Advice - Land West of Shoreham Road, Small Dole

****EXTERNAL****

Good morning,

Please could I have an update on the attached/below

Many thanks,

Anthony Scoones
MEng (Hons)
Civil Engineer

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From: Anthony Scoones
Sent: Monday, October 16, 2023 10:35 AM
To: FRM@westsussex.gov.uk
Cc: Ryan Horngren <Ryan.Horngren@Jnpgroup.co.uk>; Lorea Johnston <Lorea.Johnston@wates.co.uk>
Subject: RE: Flood Risk and Drainage Pre-Application Advice - Land West of Shoreham Road, Small Dole [Filed 16 Oct 2023 10:36]

Good morning,

Please could I have an update on the attached/below

Many thanks,

Anthony Scoones
MEng (Hons)
Civil Engineer

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From: Anthony Scoones
Sent: Monday, October 9, 2023 10:59 AM
To: FRM@westsussex.gov.uk
Subject: RE: Flood Risk and Drainage Pre-Application Advice - Land West of Shoreham Road, Small Dole [Filed 09 Oct 2023 10:59]

Good morning,

Please could I have a response on the below?

Many thanks,

Anthony Scoones
MEng (Hons)
Civil Engineer

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From: Anthony Scoones
Sent: Thursday, September 28, 2023 4:25 PM
To: FRM@westsussex.gov.uk
Subject: FW: Flood Risk and Drainage Pre-Application Advice - Land West of Shoreham Road, Small Dole [Filed 28 Sep 2023 16:25]

Good afternoon,

Please can you confirm you have received the below and attached?

Please could you let us know when we can expect a response?

Kind regards,

Anthony Scoones
MEng (Hons)
Civil Engineer

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From: Anthony Scoones
Sent: Tuesday, September 26, 2023 5:39 PM
To: FRM@westsussex.gov.uk
Subject: Flood Risk and Drainage Pre-Application Advice - Land West of Shoreham Road, Small Dole [Filed 26 Sep 2023 17:39]

Good afternoon,

We are working on behalf of Wates Developments who are preparing an outline planning application for a development of 40 new dwellings at Land West of Shoreham Road, Small Dole, Henfield, West Sussex, BN5 9YH. Please see the attached site location plan.

We are preparing a flood risk assessment and drainage strategy for the proposed development and wanted to submit an initial strategy for comment. Please see attached. Please note this layout is an early-stage layout and will be developed further prior to the application submission.

Flood Risk

The EA's flood map for planning shows that the site is located in Flood Zone 1. The EA's long term flood risk mapping shows that the majority of the site is at very low risk of surface water flooding, although there is a small overland flow route indicated to the north of the site. As shown on the layout, this is outside of the development area.

An ordinary watercourse (Horton Sewer) forms the site's southern boundary. This flows westwards and discharges into the River Adur approximately 950m west of the site via a sluice. The River Adur is tidal at this location, but due to the sluice, the Horton Sewer is not considered to be tidally influenced at the site. The Horton Sewer is not modelled.

There is an area of high surface water flood risk immediately to the south of the site, on the southern side of the Horton Sewer. This corresponds with the site-specific topographical survey (attached). Due to vegetation, much of the ditch wasn't accessible, but the areas that have been surveyed show the southern bank of the ditch is much lower than the northern (development-side) bank of the ditch. The lowest proposed FFL is indicatively 9.40m AOD. The lowest surveyed top of bank level to the north of the ditch is 7.65m AOD. Meanwhile, the lowest surveyed top of bank level to the south of the ditch is 5.57m AOD. Therefore, if the ditch was to become blocked, any exceedance flows would leave the ditch via the southern boundary and flow southwards, away from the site without posing any flood risk to the proposed development. We therefore believe the ditch poses a low risk of flooding to the site and no detailed flood modelling of the ditch is required.

Infiltration

A desktop study has indicated the site is underlain by Greensands (described as sand and sandstone in the BGS Lexicon of Named Rock Units) and therefore infiltration drainage may be feasible. Testing will be undertaken to establish the appropriate infiltration rate. The required storage volume for a range of infiltration rates is indicated on the drawing. The client is also undertaking winter groundwater monitoring, but the results won't be available until after the application submission.

There would be no damage or inconvenience as a consequence of failure, so the factor of safety to be applied to the infiltration rate is 1.5.

Due to the water neutrality situation in West Sussex, the site is proposed to have two abstraction boreholes to provide a private water supply. All proposed infiltration will be at least 50m away from the boreholes, so no environmental permit will be required.

Discharge to watercourse

In the event that the tested infiltration rate is too low to be viable, we have proposed an alternative surface water drainage solution. Surface water runoff would be attenuated in the basin in the south west corner and discharged at greenfield rate into the ditch. The greenfield Qbar runoff rate has been calculated to be 5.8 L/s/ha, using the IH124 method with ICP adjustment for small catchments. I have attached the calculations, showing the values used to calculate this rate. The proposed impermeable area has been estimated to be 0.84 ha and hence the proposed discharge rate is 4.9 L/s. As the proposals develop further, the impermeable area will be confirmed, and the discharge rate amended to suit.

As shown on the drawing, badger sets have been identified along the southern boundary of the site, between the proposed development and the ditch. There are also multiple RPAs along the site's southern boundary. We are currently working with the project ecologist and arboriculturist to find the best solution to connect to the ditch.

Water Quality

We have reviewed the potential pollutants from the site using the Simple Index Approach from the SuDS Manual. As the tables below show, the proposed attenuation basin will provide adequate water quality treatment to runoff from the development, whether we discharge via infiltration or to the watercourse.

Pollutant Indices				
Land Use	**Hazard Level**	**TSS**	**Metals**	**Hydro--Carbons**
Residential Roofs	Very Low	0.20	0.20	0.05
Driveways, residential car parks and low traffic roads	Low	0.50	0.40	0.40

SuDS Mitigation Indices – discharge via infiltration			
SuDS Component	**TSS**	**Metals**	**Hydro--Carbons**
Basin (a layer of dense vegetation underlain by a soil with good contaminant attenuation potential of at least 300mm in depth	0.60	0.50	0.60
Total SuDS Mitigation Index ≥ Pollution Hazard Index (for each contaminant type)			

SuDS Mitigation Indices – discharge to watercourse			
Land Use	**TSS**	**Metals**	**Hydro--Carbons**
Attenuation Basin	0.50	0.50	0.60
Total SuDS Mitigation Index ≥ Pollution Hazard Index (for each contaminant type)			

Hydraulic and design parameters

In accordance with best practice and local requirements, we will use FEH data for all hydraulic calculations, and Cv values of 1 for summer and winter storms.

As the site is within the Adur and Ouse Management Catchment, an allowance of 45% (upper end allowance) for climate change will be made to the 1% annual exceedance rainfall event.

The proposed basin will have a maximum depth of 1.3m. The freeboard will be a minimum of 300mm. The basin banks will be no steeper than 1 in 3. A 3m maintenance margin will be provided around the basin.

Foul drainage

It is proposed to drain foul sewage from the development via gravity to a pumping station in the south west of the site. The wet well will be located at least 15m away from any dwellings. The pumping station is not shown on the layout and will be added in due course. This pumping station will discharge foul sewage via a rising main to the adopted sewer network in Henfield Road. A pre-development enquiry will be submitted to Southern Water

Please feel free to give me a call if you would like to discuss. If helpful, we could arrange a Teams meeting to discuss further.

Kind regards,

Anthony Scoones
MEng (Hons)
Civil Engineer

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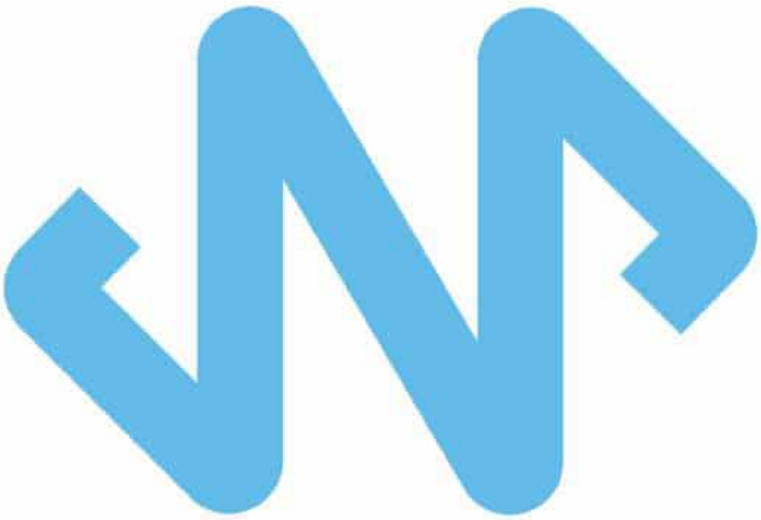

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