SOUTH STREET CAR PARK, LANCING, WEST SUSSEX

PROPOSED RESIDENTIAL DEVELOPMENT

Drainage Strategy

Prepared on Behalf of

Sunninghill Construction

D2227/DS1.2

January 2024

BP Civils – Transport Planning and Civil Engineering Consultants T: 03333 583260 www.bpcivils.co.uk
Unit 2, West Barn, Norton Lane, Chichester, West Sussex, PO20 3AF
BP Civils is a trading name of RGP Design Limited | Registered in England No: 09674169 | Unit 2, West Barn, Norton Lane, Chichester, PO20 3AF

DOCUMENT CONTROL

Project: South Street Car Park, Lancing, West Sussex
Proposed Residential Development

Document: Drainage Strategy

Client: Sunninghill Construction

Reference: D2227/DS1.2

Document Checking:

Author: L Foord **Date:** 02/01/2024

Checked by: M Akmenkalns **Date:** 02/01/2024

Approved by: M Akmenkalns **Date:** 02/01/2024

Status:

Issue	Date	Status	Issued by
1.1	02/01/2024	FINAL	LDF
1.2	03/01/2024	FINAL	LDF

© Copyright BP Civils 2024
No part of this publication may be reproduced by any means without the prior permission of BP Civils.

CONTENTS

1 INTRODUCTION 5

1.1 Background 5

2 SITE LOCATION AND DESCRIPTION 6

3 GROUND CONDITIONS 7

3.2 Groundwater 9

4 EXISTING DRAINAGE 12

5 PROPOSED DEVELOPMENT 14

5.1 Description of Development 14

6 PROPOSED DRAINAGE STRATEGY 15

6.1 Surface Water 15

6.2 Treatment 16

6.3 Foul Water Drainage 17

6.4 Climate Change 18

7 MAINTENANCE 19

8 OFFSITE IMPACTS 21

9 SUMMARY 22

DRAWINGS

PL100	Site Location Plan
PL101	Topographical Survey with Contours
PL200	Impermeable Areas
201	Proposed Drainage and Levels
250	Drainage Construction Details Sheet 1 of 2
251	Drainage Construction Details Sheet 2 of 2

APPENDICES

Appendix A	Architectural Development Proposals
Appendix B	Topographical Survey
Appendix C	Site-specific Intrusive Investigation
Appendix D	BGS Borehole Records
Appendix E	Southern Water Public Sewer Records
Appendix E	Wallingford Greenfield Calculations
Appendix F	Causeway Flow Hydraulic Calculations
Appendix G	Ultiporous maintenance recommendations

1 INTRODUCTION

1.1 Background

1.1.1 BP Civils is instructed by Sunninghill Construction to prepare a drainage strategy to accompany an application to discharge a planning condition related to approved planning application referenced AWDM/0118/23 for a proposed residential development at South Street Car Park, Lancing, West Sussex.

1.1.2 This report has been undertaken in accordance with National Planning Policy Framework (NPPF) and The Planning Practice Guidance on the use of SuDS for achieving sustainable development in addition to the specific requirements of Adur District Council and West Sussex County Council.

1.1.3 This report respects the drainage strategy submitted with the planning application and provide further information and clarifications.

1.1.4 The proposed development will involve the redevelopment of the existing car park to provide 7 No. dwellings for emergency and temporary accommodation with associated works, as demonstrated by the architectural development proposal as contained with **Appendix A**.

1.1.5 In preparing this report, BP Civils has referred to the following documents and information:

- Adur District Council drainage records
- British Geological Survey information and records
- Environment Agency Flood Maps for Planning
- Long-Term Flood Risk Maps
- Southern Water public sewer records
- Ashdown Site Investigation site specific intrusive geotechnical investigation and testing

1.1.6 This document has been prepared to assess drainage constraints and opportunities and propose a drainage strategy that is appropriate for the development, without causing off-site impacts from run-off in a design event.

1.1.7 This report has been prepared for the benefit of the named client only.

2 SITE LOCATION AND DESCRIPTION

2.1.1 The site measures 1,324m^2 (0.1Ha) and is currently an operational car park located to the rear of 71-81 South Street in Lancing, West Sussex. A site location plan is included within this report (drawing **PL100**).

2.1.2 The site is bound to the north, south and west by existing residential properties, whilst to the east is bound by an existing builders yard and residential garages.

2.1.3 A topographical survey has been undertaken by CD Surveys Ltd, dated April 2022, contained within **Appendix B**.

2.1.4 The topographical survey demonstrates levels in the range of 6.95m AOD to 7.90m AOD. The northern half of the site falls from 7.75m AOD to 7.20m AOD, broadly falling to the east/north-east. Central areas fall from 7.55m AOD to 7.15m AOD to the east, whilst the southern half of the site falls from 7.90m AOD to 6.95m AOD to the east/south-east. Drawing **PL101** has been prepared to illustrate the existing trends in topography.

2.1.5 In its existing use, the site is fully impermeable to an area of 1,324m^2 (0.13Ha).

3 GROUND CONDITIONS

3.1.1 Ashdown Site Investigation has produced a Combined Geotechnical and Ground Contamination Risk Assessment report for the site.

3.1.2 8 No. boreholes (BH01, BH02, BH03, BH04, BH05 BH06, STB01 and STB02) were sunk to depths in the range of 2.00m to 5.00m below ground level in addition to the excavation of 4 No. trial pits (STP01, STP02, TP03 and TP04) to depths in the range of 0.45m to 0.60m below ground level.

3.1.3 Beneath the asphalt surface finish, Made Ground has been encountered at all locations, to varying depths ranging from 0.45m to 2.10m below ground level.

3.1.4 River Terrace Deposits of variable CLAY composition was encountered within BH01, BH02 and STB01 from 0.60m below ground level (STB01), 1.80m below ground level (BH01) and 2.10m below ground level (BH02).

3.1.5 Variable SAND River Terrace Deposits were encountered within BH01 and STB01 from 2.90m to 4.50m below ground level (BH01) and from 1.00m to 2.00m below ground level (STB01).

3.1.6 Reference has also been made to the British Geological Survey (BGS) website.

3.1.7 The BGS Geology of Britain Viewer identifies a bedrock geology of 'Newhaven Chalk Formation – Chalk'.

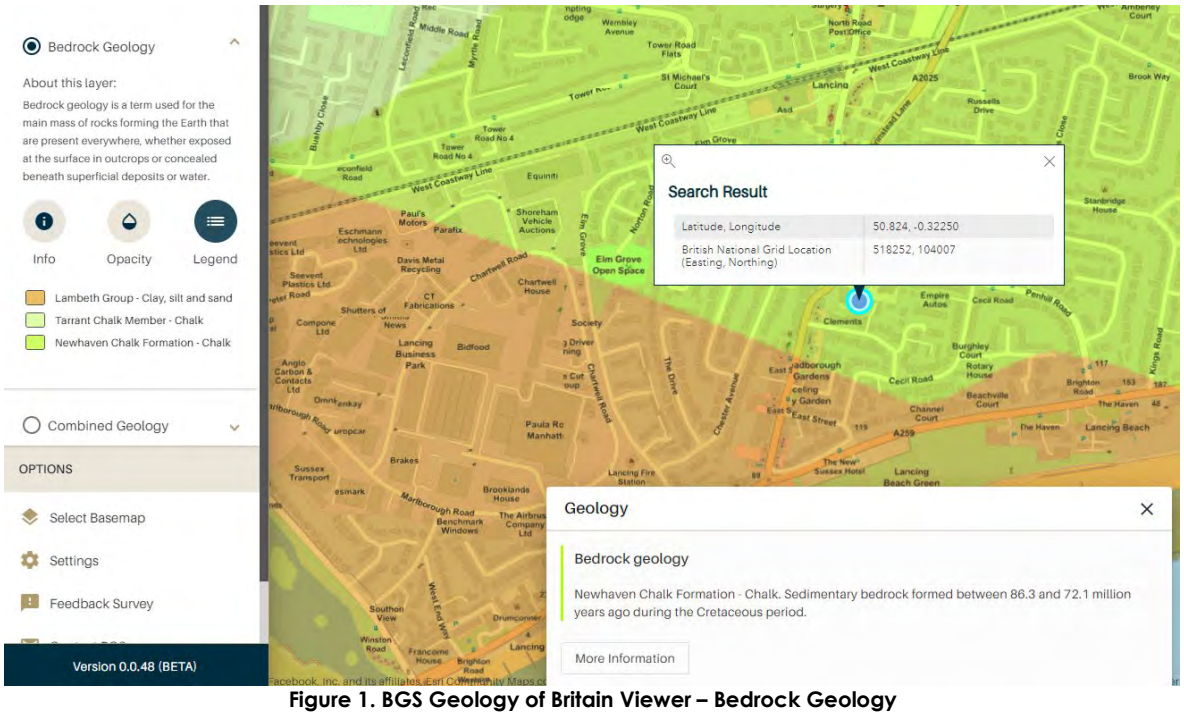


Figure 1. BGS Geology of Britain Viewer – Bedrock Geology

3.1.8 Superficial Deposits are recorded as 'River Terrace Deposits – Sand, silt and clay'.

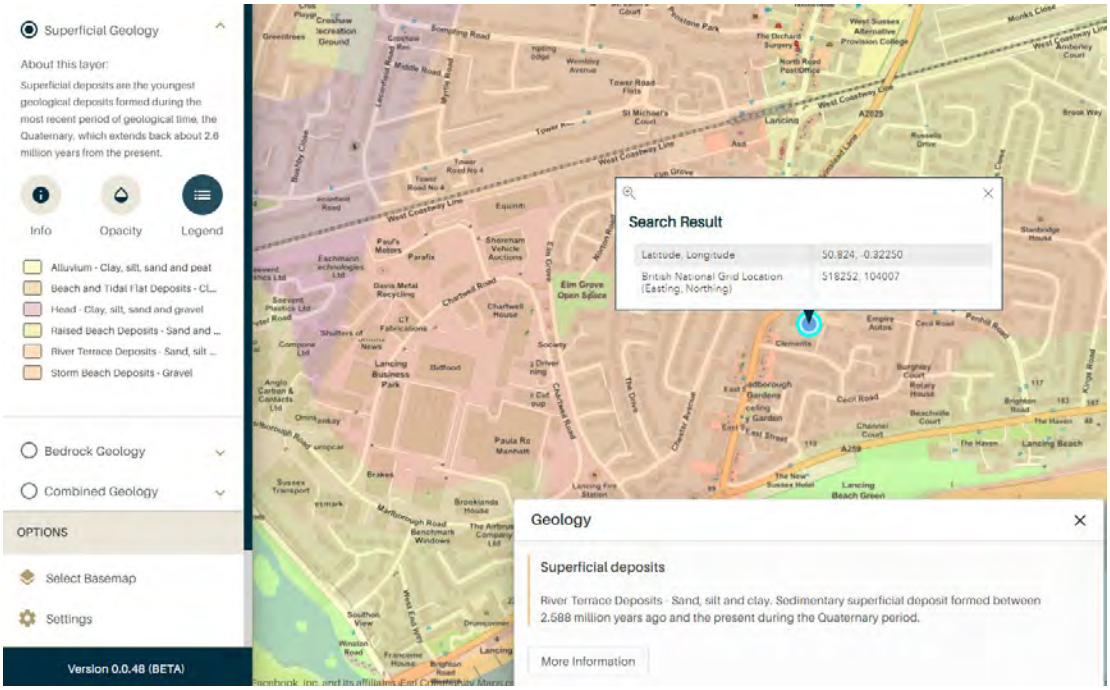


Figure 2. BGS Geology of Britain Viewer – Superficial Geology

3.1.9 Historic borehole records from the Single Onshore Boreholes Index (SOBI) on the BGS website have also been reviewed in the absence of a site-specific geotechnical investigation.



Figure 3. BGS Borehole Locations

3.1.10 The nearest borehole to the site with detailed records of the encountered geology is located to the

south-east of the site, on Cecil Road (TQ10SE30).

3.1.11 The records confirm 'Sand and gravel', underlain by 'Chalk and flints', which is consistent with the expected geology in view of the BGS' bedrock ('Newhaven Chalk Formation – Chalk') and superficial deposits ('River Terrace Deposits – Sand, silt and clay') mapping.

3.1.12 A copy of the BGS records reviewed can be found within **Appendix D**.

3.2 Groundwater

3.2.1 The borehole logs and trial pit logs provided by Ashdown Site Investigation confirm that, with the exception of STB02, all boreholes and trial pits remained dry upon completion. In relation to STB02, water was noted at the base of the borehole upon completion (2.00m below ground level).

3.2.2 Winter groundwater monitoring is currently being undertaken, with Ashdown Site Investigation confirming that groundwater has been recorded as peaking at 2.82m and 4.10m below ground level during the monitoring undertaken to date within the deeper standpipes. Water was recorded at shallow depths within the shallow standpipes, stated to likely be perched water within the made ground.

3.2.3 Mapping managed by MAGIC (magic.defra.gov.uk) provides geographic information concerning the natural environment from across government. This mapping tool has been referred to in order to confirm whether the site is located within either any groundwater source protection zones or groundwater vulnerability zones.

3.2.4 The site falls within a 'Principal' and/or 'Secondary A' bedrock aquifer, and a 'Secondary B' superficial drift aquifer.

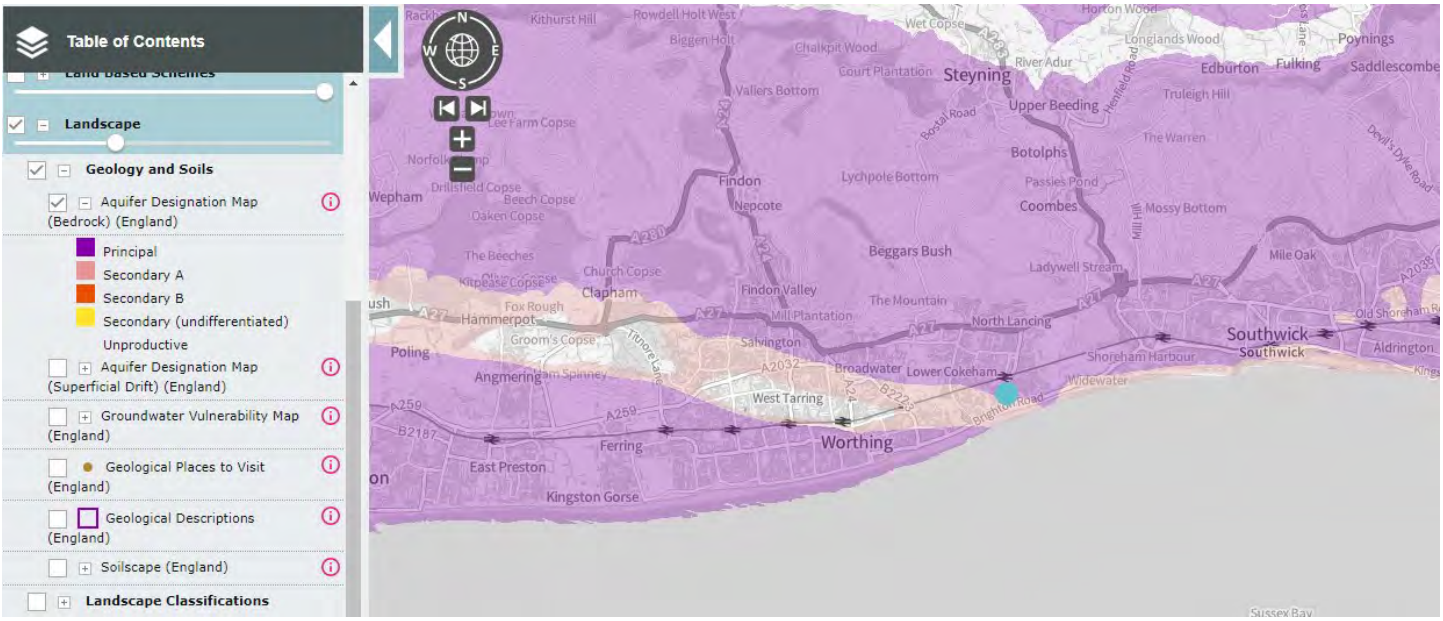


Figure 4. Bedrock Aquifer Designation Map (DEFRA)

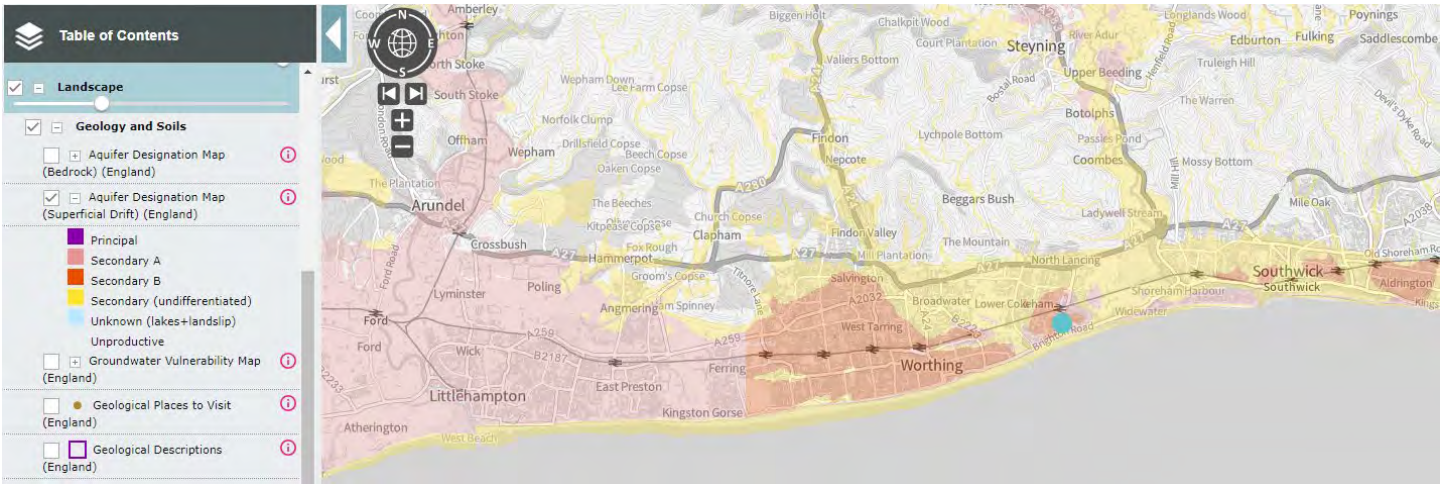


Figure 5. Bedrock Aquifer Designation Map (DEFRA)

3.2.5 Principal and secondary aquifers provide significant quantities of drinking water, and water for business needs. They may also support rivers, lakes and wetlands.

3.2.6 Secondary A aquifers comprise permeable layers that can support local water suppliers, and may form an important source of base flow to rivers.

3.2.7 Secondary B aquifers are mainly lower permeability layers that may store and yield limited amounts of groundwater through characteristics like thin cracks and openings or eroded layers.

3.2.8 The Groundwater Vulnerability Map confirms that the northern half of the site falls within a 'Medium' groundwater vulnerability zone, whilst the southern half of the site falls within a 'Medium-High' groundwater vulnerability zone. A 'Soluble Rock Risk' is identified across the entirety of the site.

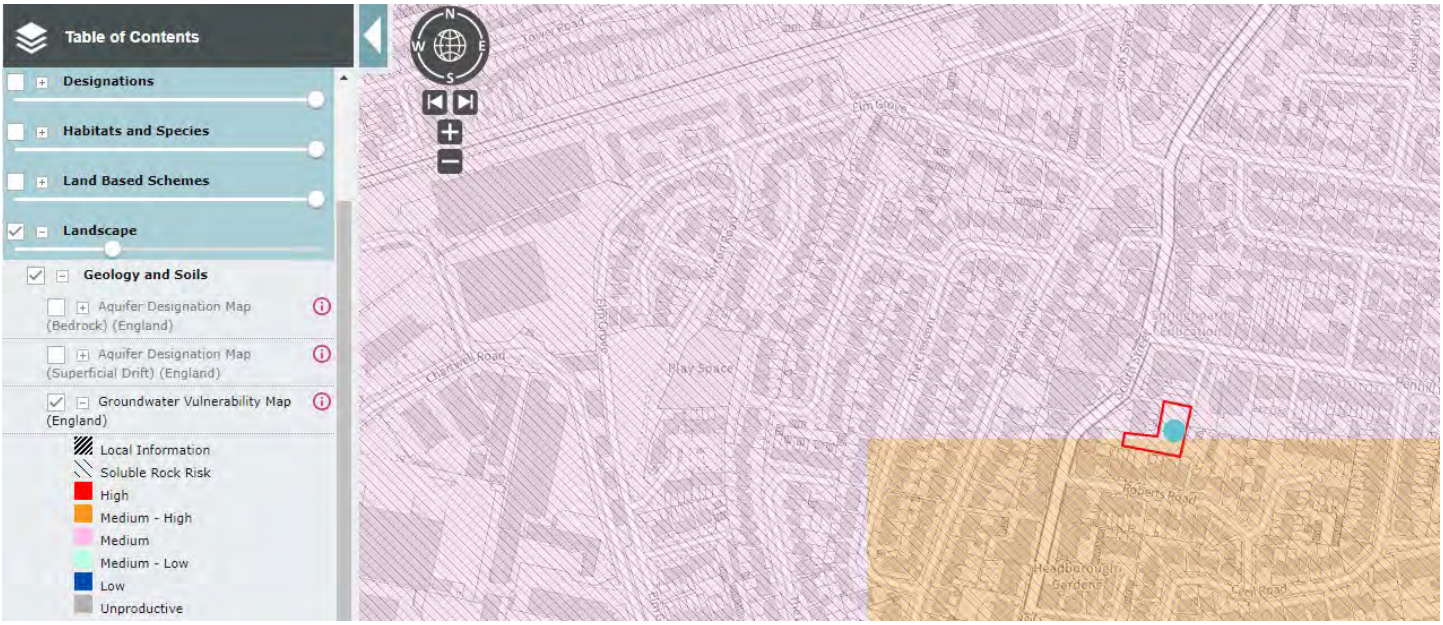


Figure 6. Groundwater Vulnerability Map (DEFRA)

3.2.9 Medium zones offer 'some' groundwater protection, whilst High zones are defined as areas that can easily transmit pollution to groundwater; characterised by high-leaching soils and the absence of low-permeability superficial deposits.

3.2.10 A 'Soluble Rock Risk' is defined as an area where solution features that enable rapid movement of a pollutant may be present.

3.2.11 The site is not indicated as within or in the vicinity of any Drinking Water Protected Areas (Surface Water), Drinking Water Safeguard Zones (Groundwater or Surface Water) or Source Protection Zones.

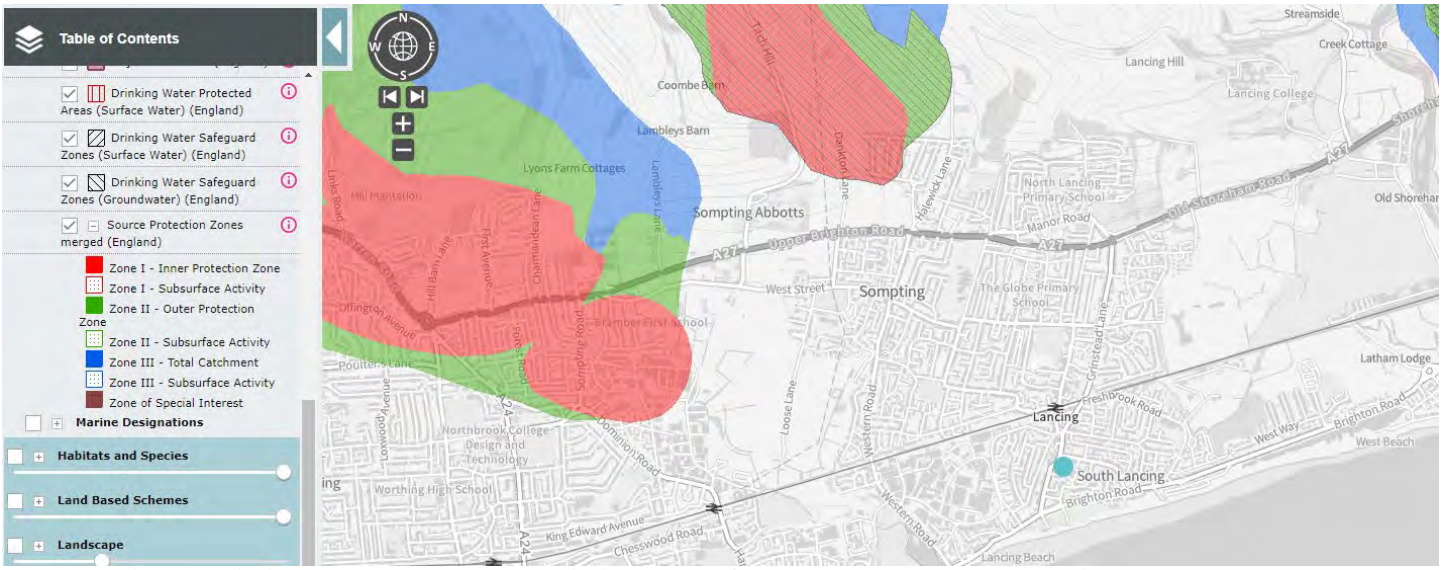


Figure 7. Drinking Water Protected Areas, Drinking Water Safeguard Zones and Source Protection Zones Map (DEFRA)

4 EXISTING DRAINAGE

4.1.1 The local sewerage authority is Southern Water. Public sewer records have been obtained from Southern Water, as contained within **Appendix E**.

4.1.2 Surface Water:

- The Southern Water public sewer records indicate that there are no public surface water sewers within the vicinity of the site.
- The existing car park is served by gullies which collect run-off from the car park, which discharge to soakaways on site.
- There are no main rivers and/or ordinary watercourses located within the vicinity of the site.
- Greenfield run-off has been calculated to be 0.02l/s (QBAR), based on the overall site area of 1,324m^2 (0.13Ha), utilising IH124 methodology.

	Greenfield Run-off Rate
QBAR (l/s)	0.02
1 in 1 Year (l/s)	0.02
1 in 30 Year (l/s)	0.05
1 in 100 Year (l/s)	0.07
1 in 200 Year (l/s)	0.09

- In view of the fact that the site in its existing form is entirely impermeable, run-off generated by the site is likely to exceed that of the greenfield run-off rate as established above.
- An existing brownfield rate of run-off has been determined using a 'flat rainfall rate' methodology. With a rainfall intensity of 50mm an hour, the existing run-off from the site in its current use is 18.38l/s (based on an area of 1,324m^2).

4.1.3 Foul Water:

- The Southern Water public sewer records indicate a 300mm dia. public foul water sewer located to the east of the site in South Street. This sewer is shown to flow in a northerly direction. The depth of this sewer at this manhole is not confirmed.

- An un-mapped 150mm dia. public foul water sewer has been identified in the vicinity of the site, to the rear of 71-81 South Street. This flows in a northerly direction before diverting west, discharging to the mapped 300mm dia. public sewer in South Street at manhole 2001.

- Southern Water has provided a response to a pre-development enquiry regarding capacity within its sewer network. In the response provided, it is confirmed that capacity exists within the network.

5 PROPOSED DEVELOPMENT

5.1 Description of Development

5.1.1 The proposed development will involve the redevelopment of the existing car park to provide 7 No. dwellings for emergency and temporary accommodation with associated works, as demonstrated by the architectural development proposal as contained with **Appendix A**.

5.1.2 The proposed development will result in a reduction in the overall impermeable area at the site of 344m^2 - reducing from 1,324m^2 to 1,069m^2 (19% reduction).

5.1.3 In addition to the overall reduction in impermeable area at the site, SuDS methods and techniques will be implemented on site to assist in the management of post-development run-off appropriate to the constraints and opportunities presented by the development.

5.1.4 The post-development impermeable area will amount to 1,069m^2 (0.1Ha).

5.1.5 The specific drainage proposals associated with the proposed development are detailed in **Section 7** of this report.

6 PROPOSED DRAINAGE STRATEGY

6.1 Surface Water

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

i. Infiltration techniques

ii. Attenuate rainwater in ponds or open water features for gradual release

iii. Attenuate rainwater by storing in tanks or sealed water features for gradual release

iv. Discharge rainwater direct to a watercourse

v. Discharge rainwater to a surface water sewer/drain

vi. Discharge rainwater to a combined sewer

SUDS Technique	Suitable	Comments
Living Roof	No	As the method of disposal is infiltration, the benefits of a living roof are less pronounced.
Basins and Ponds (such as Wetlands, Balancing Ponds, Detention Basins, Retention Ponds)	No	Spatial constraints on site dictate that the use of such features will restrict development of the site in view of the development proposals
Filter strips and swales	No	Spatial constraints on site will restrict the use of such features in view of the development proposals
Infiltration Devices - Soakaways - Infiltration trenches and basins	Yes	Infiltration testing undertaken by Ashdown Site Investigation has confirmed that a layer of drainable strata exists to the south of the site, where infiltration has been proven to be viable. As a result, infiltration methods and techniques will be utilised to support the proposed development.

Permeable surfaces and filter drains (such as gravelled areas and porous block paving	Yes	Permeable surfacing is to be encouraged to support the proposed development.
Tanked systems (such as oversized pipes or cellular tanks)	Yes	No initial constraints identified.

6.1.2 The proposed development will be served by soakaways as a means of dealing with surface water generated by the areas of hardstanding on site.

6.1.3 Intrusive ground investigation and infiltration testing has been undertaken at the site by Ashdown Site Investigation. An infiltration rate of $1.61x10^{-5}$ has been established, and has been utilised for design purposes.

6.1.4 Winter groundwater monitoring is currently being undertaken. In relation to BH01, located to the south of the site where proposed infiltration features will be located, groundwater has not risen above 4.00m below ground level.

6.1.5 Permeable paving ($409m^2$) will be introduced to provide a self-draining surface for the access drive and parking areas on site. The permeable paving will be tanked (lined) owing to the underlying geology at shallow depths (Made Ground). The permeable paving will discharge to the on-site piped surface water system, which will in turn discharge to a soakaway, penetrating the drainable strata.

6.1.6 Roof water will be collected by an on-site piped surface water system, which will discharge to communal soakaway(s) located to the south of the site.

6.1.7 2 No. soakaways are proposed. 1 No. soakaway will serve the roof area associated with Plots 1-5 whilst also serving as a method of discharge for the permeable paving.

6.1.8 The second soakaway will serve the roof area associated with Plots 6 & 7.

6.1.9 Both soakaways will be 2.1m dia. The soakaway serving the larger catchment will be 3.50m deep, with the smaller catchment soakaway being 1.50m deep. In both instances, the soakaways will drain to the drainable strata (SAND).

6.1.10 The surface water drainage system has been designed to accommodate up to a 1 in 100-year storm event, inclusive of an allowance of 45% for climate change (peak rainfall intensity allowance).

6.1.11 West Sussex County Council's Policy for the Management of Surface Water (November 2018) requires an allowance for urban creep where proposed development is concerned.

6.1.12 It is recognised that, across the life time of a development, the conversion of permeable surfaces to impermeable surfaces can occur, resulting in an increase in run-off which could impact upon the effectiveness of the associated drainage system.

6.1.13 An allowance has been made for the potential impact of urban creep across the lifetime of the development. A 10% uplift in impermeable area has been applied to roofs and parking area where this is potential for these areas to be increased.

6.2 Treatment

6.2.1 In accordance with the CIRIA SuDS Manual C753 regarding methods for managing pollution risks, the risk posed by surface water run-off to the receiving environment depends on the pollution hazard at the

site (the source), SuDS treatment techniques (the pathway), and the sensitivity of the environment (the receptor).

6.2.2 The SuDS Manual outlines three categories of pollution hazard identification, which vary depending on proposed land use, which are as follows:

- Total Suspended Solids (TSS).
- Metals (M).
- Hydrocarbons (H).

6.2.3 The simple index approach considers whether SuDS techniques are appropriate for the site. This states that for SuDS components to deliver adequate treatment, the total pollution mitigation index for each contaminant type should equal or exceed the pollution hazard index.

6.2.4 In accordance with C753 Table 26.2, the proposed land uses at the site are categorised as follows:

- Residential Roofs – Very Low/TSS=0.2/M=0.2/H=0.05
- Individual property driveways, residential car parks, low traffic roads (e.g. cul-de-sacs, home zones and general access roads) – Low/ TSS=0.5/M=0.4/H=0.4

6.2.5 The use of permeable paving will ensure that run-off that it receives will be provided with a level of treatment required by the SuDS Manual, with hydrocarbons being filtered by the aggregate and geotextile layers.

6.2.6 In accordance with C753 Table 26.3, the values of SuDS Mitigation indices are provided for permeable paving:

- Permeable Pavement – TSS=0.7/M=0.6/H=0.7

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

6.3 Foul Water Drainage

6.3.1 It is proposed that the development will establish a new connection to the 150mm dia. public foul water sewer located to the rear of 71-81 South Street. An existing manhole is located to the north-east of 71 South Street, within the confines of the site, to which a connection will be made (subject to approval from Southern Water).

6.3.2 Post development, there will be an estimated increase in peak foul water flows to 0.32l/s (based on Sewer Sector Guidance, Appendix C – Design and Construction Guidance).

6.3.3 OFWAT Charging Rules place the onus on the sewerage undertaker to reinforce their network should there no longer be sufficient capacity to serve the new development. Funding for this is provided by revised charging arrangements for infrastructure and connection charges for each dwelling constructed comprising a Network Reinforcement Charge and Site-Specific Charges. The revised

charging arrangement (funded by the developer) covers alterations to the Existing Sewer Network and the sewerage undertaker remains responsible for the cost of reinforcing their Strategic Assets. The developer is responsible for connecting the development to the public sewer network.

6.3.4 Southern Water has provided a response to a pre-development enquiry regarding capacity within its sewer network. In the response provided, it is confirmed that capacity exists within the network.

6.4 Climate Change

6.4.1 Gov.uk provides guidance for local planning authorities preparing strategic flood risk assessments and developers and their agents preparing flood risk assessments for planning applications, and development consent orders for nationally significant infrastructure projects.

6.4.2 Climate change allowances are predictions of anticipated change for peak river flow, peak rainfall intensity, sea level rise and offshore wind speed and extreme wave height.

6.4.3 Allowance for climate change shall be provided in the undertaking of site-specific flood risk assessments where new development is proposed to minimise vulnerability and provide resilience to flooding and coastal change.

6.4.4 The 'Peak Rainfall Allowances Map' shows anticipated changes in peak rainfall intensity.

6.4.5 Based on the latest allowances, for the 3.3% annual exceedance rainfall event, an increase of 40% should be applied to peak rainfall in relation to the proposed development.

6.4.6 For the 1% annual exceedance rainfall event, an increase of 45% should be applied to peak rainfall in relation to the proposed development.

6.4.7 There may be circumstances where local evidence supports using other data or allowances. For example, the impact of climate change on peak river flow may not be the same for all rivers in a management catchment.

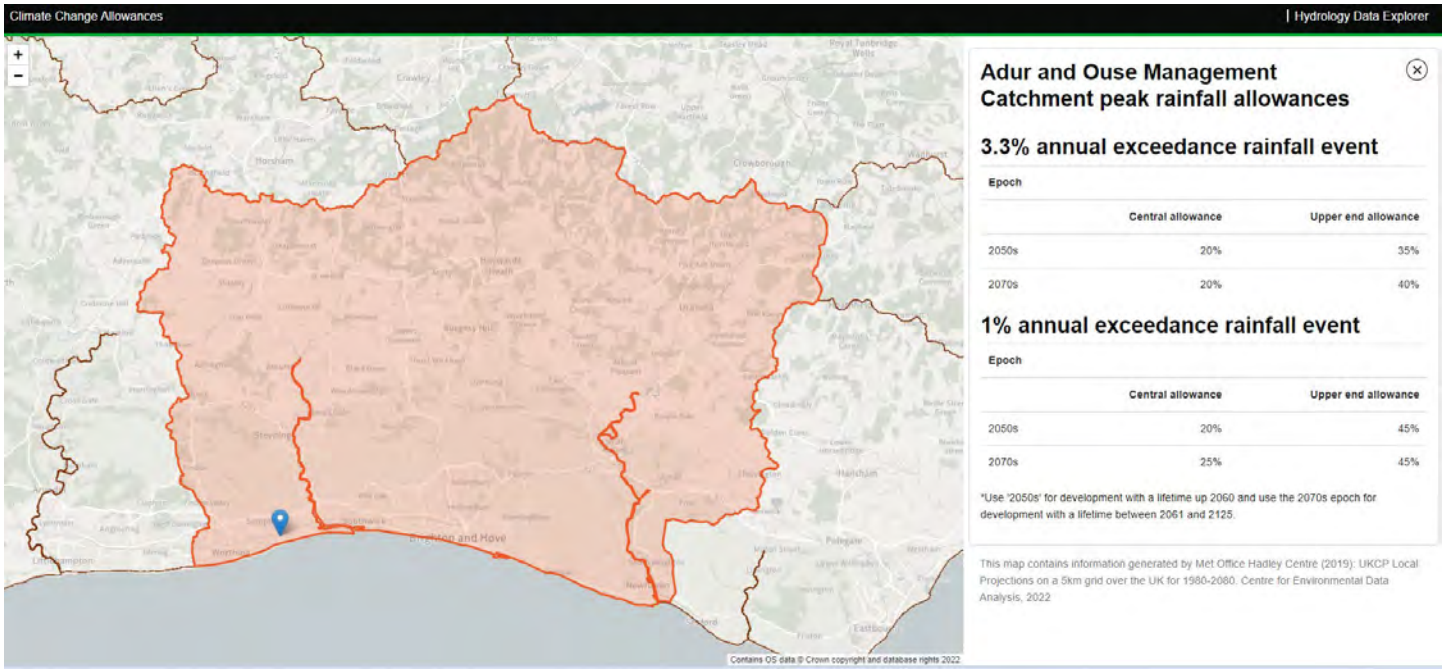


Figure 12. Peak Rainfall Allowance Map – Climate Change Allowances (Gov.uk)

7 MAINTENANCE

7.1.1 Maintenance is required to ensure the long-term operational performance of the proposed surface water drainage system.

7.1.2 The drainage system has been designed to minimise maintenance requirements, however a number of key tasks will need to be undertaken so that the system remains in optimal condition. These operations are summarised in the table below, along with the required frequency of works.

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

7.1.3 The responsibility of maintenance regime will be determined by the developer, by agreed appointment.

Permeable Paving

7.1.4 The areas of permeable paving are designed to allow infiltration of surface water run-off through the joints in the block paving surface course and into the sub-base below. The water is then collected and discharged into the positive drainage system.

7.1.5 The areas of permeable paving will require additional maintenance measures to ensure they operate as designed. Failure in carrying out this maintenance, could increase the risk of flooding. The additional measures are as follow:

- Periodic surface sweeping to reduce silt and debris accumulation. The permeable surfaces should be swept at least every eight to twelve weeks with additional sweeps in the autumn to clear fallen leaves
- Management/removal of weed growth, as required. Typically, once or twice a year for regularly used areas
- Periodic silt removal from permeable surfaces as described by the manufacturer.
- Catchpits upstream of any diffuser units, should be emptied and inspected on the same regime as all catchpits specified previously set out in this document

Remedial/Repair Actions

7.1.6 Significant storm events may cause considerable damage to SuDS and their associated components.

As such, it may be necessary to inspect and carry out essential recovery works to return the feature to full working order.

7.1.7 Resetting of uneven blocks by lifting block area, removing bedding material and relaying to match original design are all actions which may need to be undertaken.

Accidental Spillages

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

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

Future Alterations to the Development

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

8 OFFSITE IMPACTS

8.1.1 The proposed surface water drainage system will mimic the existing surface water drainage arrangements; surface water will be managed through the use of infiltration methods and techniques. As a result, there will be no run-off which will be taken off-site, with surface water managed fully within the confines of the site. As such, there will be no increase in flood risk off-site.

8.1.2 Post-development, new foul water flows will be introduced which will discharge to Southern Water's public sewer network. Peak foul water flows will total 0.32l/s, based on Sewer Sector Guidance, Appendix C – Design and Construction Guidance. A pre-development enquiry has been submitted to Southern Water to ascertain current capacity levels within the public sewer network within the vicinity of the site.

8.1.3 The effects of climate change have been considered in the design of the proposed surface water drainage system, to ensure there is no off-site impact. An allowance of 45% has been provided within calculations in view of peak rainfall intensity climate change allowances.

9 SUMMARY

9.1.1 In preparing this report, BP Civils has referred to the following documents and information; Adur District Council drainage records, British Geological Survey information and records, Environment Agency Flood Maps for Planning, Long-Term Flood Risk Maps and Southern Water public sewer records and Ashdown Site Investigation site specific intrusive geotechnical investigation and testing.

9.1.2 The site measures 1,324m^2 (0.13Ha) and is currently an operational car park located to the rear of 71-81 South Street in Lancing.

9.1.3 A topographical survey has been undertaken by CD Surveys Ltd, dated April 2022. The survey demonstrates levels in the range of 6.95m AOD to 7.90m AOD. The northern half of the site falls from 7.75m AOD to 7.20m AOD, broadly falling to the east/north-east. Central areas fall from 7.55m AOD to 7.15m AOD to the east, whilst the southern half of the site falls from 7.90m AOD to 6.95m AOD to the east/south-east. Drawing **PL101** has been prepared to illustrate the existing trends in topography.

9.1.4 The site is located in Flood Zone 1 and the overall risk of flooding has been assessed as being 'Very Low' to 'Low'.

9.1.5 The proposed development will involve the redevelopment of the existing car park to provide 7 No. dwellings for emergency and temporary accommodation with associated works.

9.1.6 The proposed development will result in a reduction in the overall impermeable area at the site of 344m^2 - reducing from 1,324m^2 to 1,069m^2 (19% reduction).

9.1.7 Post-development surface water drainage will mimic existing methods. The existing site is served by soakaways. It is proposed the development will utilise tanked permeable paving for the access/parking areas, with soakaways discharging collected run-off to ground. The surface water drainage system has been designed to accommodate a 1 in 100-year storm event.

9.1.8 Allowances in the surface water drainage design have been made for both climate change (45%) and also urban creep (10%).

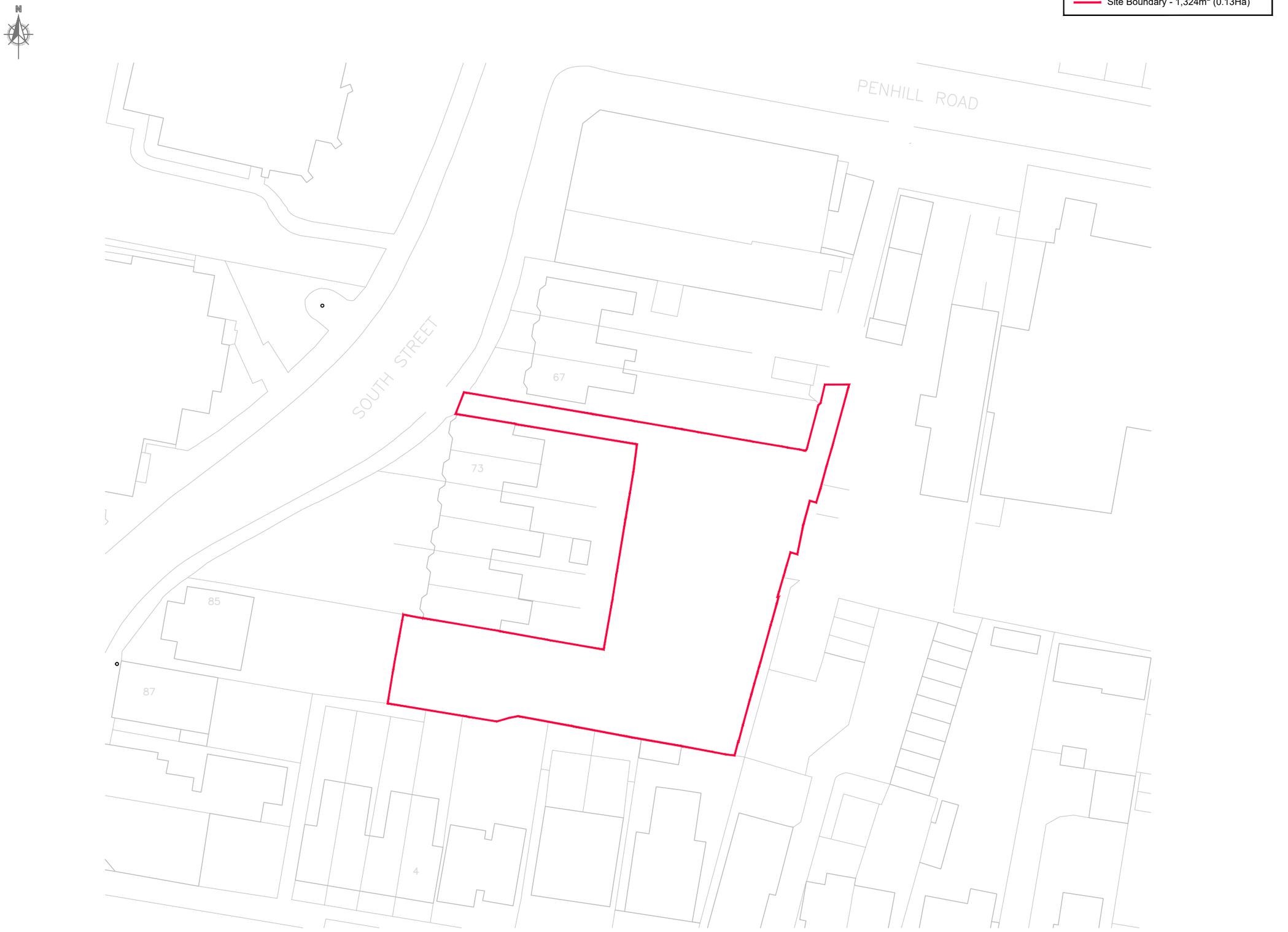
9.1.9 The wastewater from the proposed development will discharge to the 150mm public foul water sewer which discharges to the 300mm public foul water sewer located in South Street, to the west of the site. Southern Water has confirmed that capacity exists within the sewer network in response to a pre-development enquiry submitted.

9.1.10 The completion of the development will not increase flood risk on or off-site.

9.1.11 In conclusion, this development is suitable with regards to flood risk and surface water drainage.

DRAWINGS

PL100	Site Location Plan
PL101	Topographical Survey with Contours
PL200	Impermeable Areas
201	Proposed Drainage and Levels
250	Drainage Construction Details Sheet 1 of 2
251	Drainage Construction Details Sheet 2 of 2



NOTES

A3

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

PLANNING

This map is based on or reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the controller of Her Majesty's Stationary Office (c)
Crown Copyright. Licence Number: 100022432

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

Rev.	Amendments	Date
-	-	-

BP CIVILS
Transport Planning and Infrastructure Design Consultants
2 West Barn, Norton Lane, Chichester, West Sussex PO20 3AF
Tel: 0333 358 3260
www.bpcivils.co.uk enquiries@bpcivils.co.uk

Drawing Status	PLANNING
Client	Adur and Worthing Councils
Project	South Street, Lancing
Drawing Title	Site Location Plan

Scale	Date	Drawn By	Checked By
1:500	Oct 22	JHL	MJA

Drawing No.	Rev.
D2112 PL100	-



-EXISTING SITE KEY-

- Site Boundary (1,324 m^2 - 0.13Ha.)
- 134.11 Existing Spot Level
- Existing Contour (Primary)
- Existing Contour (Secondary)
- Overland Flow Arrow
- LP Site Low Point

Contours are only as accurate as the initial land survey information. Contours are approximate only and spot levels may vary slightly on site.

NOTES

A3

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

PLANNING

This map is based on or reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the controller of Her Majesty's Stationary Office (c) Crown Copyright. Licence Number: 100022432

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

Rev.	Amendments	Date
-	-	-

BP CIVILS
Transport Planning and Infrastructure Design Consultants
2 West Barn, Norton Lane, Chichester, West Sussex PO20 3AF
Tel: 0333 358 3260
www.bpcivils.co.uk enquiries@bpcivils.co.uk

Drawing Status: PLANNING

Client: Adur and Worthing Councils

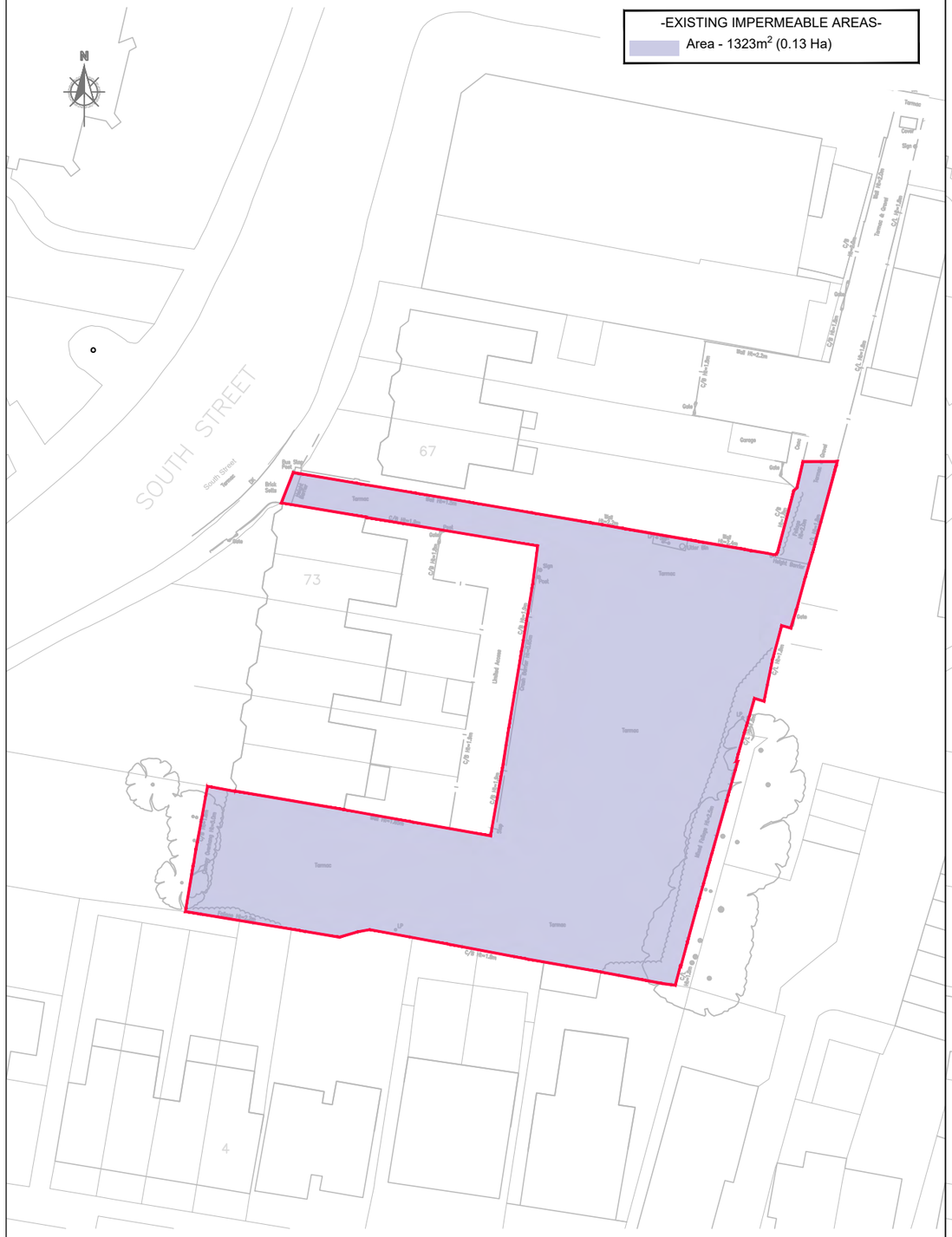
Project: South Street, Lancing

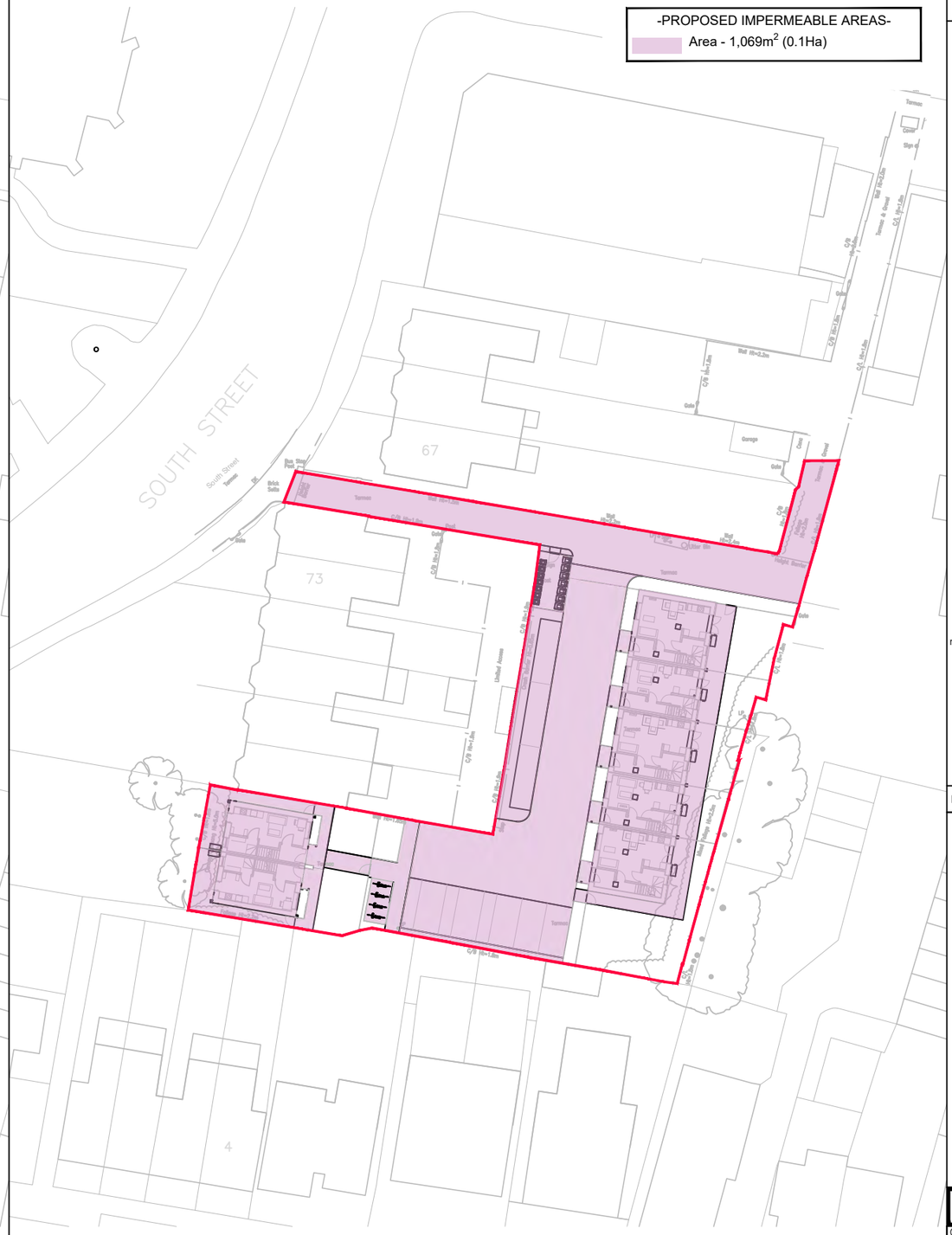
Drawing Title: Topographical Survey with Contours

Scale	Date	Drawn By	Checked By
1:500	Oct 22	JHL	MJA

Drawing No.: D2112-PL101

Rev.: -





1:500 @ A3 — 0 5 10 15 20 m

NOTES

A3

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

PLANNING

This map is based on or reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the controller of Her Majesty's Stationary Office (c) Crown Copyright. Licence Number: 100022432

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

Rev.	Amendments	Date
A	Minor layout adjustment	16/12/2022

BP CIVILS
Transport Planning and Infrastructure Design Consultants
2 West Barn, Norton Lane, Chichester, West Sussex PO20 3AF
Tel: 0333 358 3260
www.bpcivils.co.uk enquiries@bpcivils.co.uk

Drawing Status: PLANNING

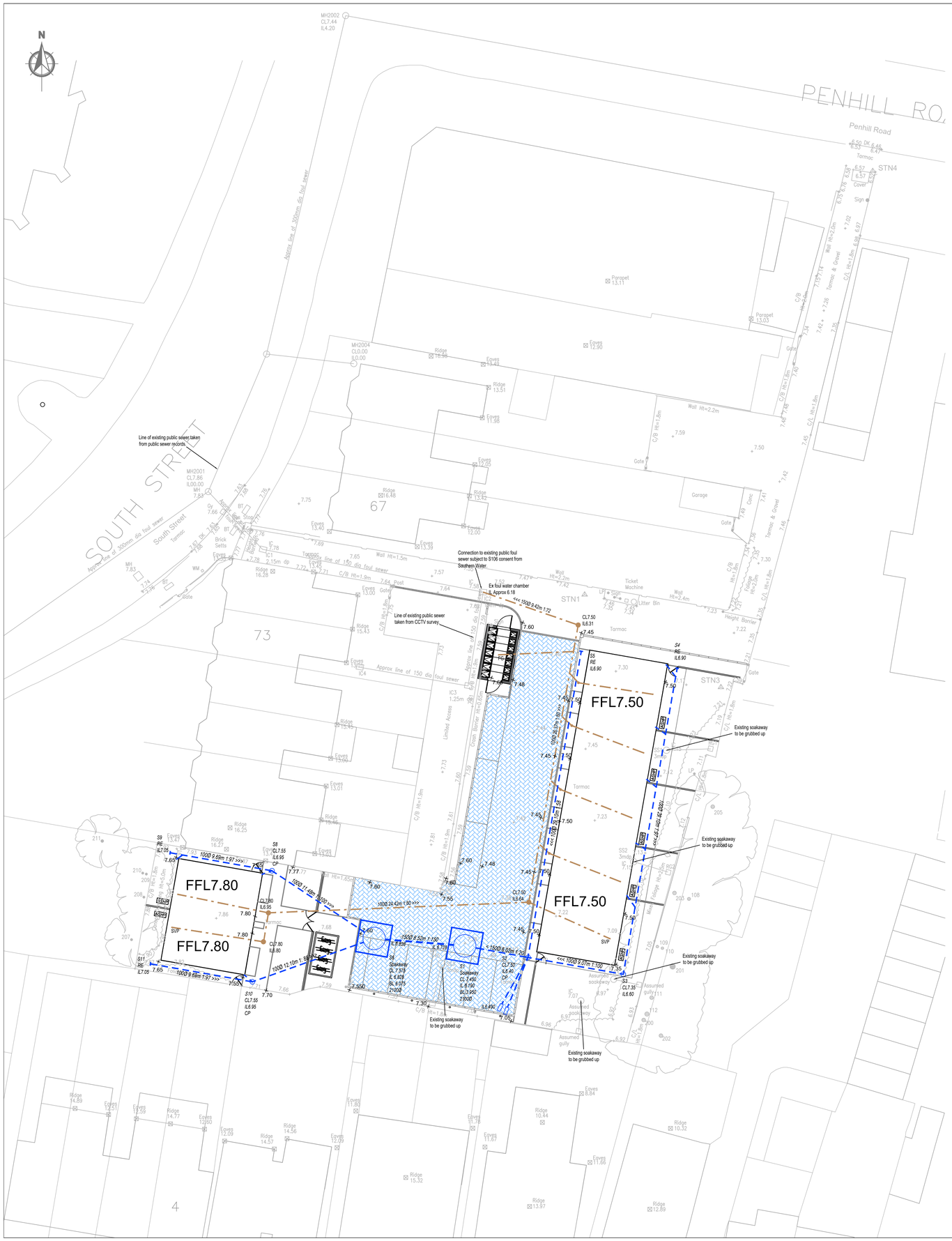
Client: Adur and Worthing Councils

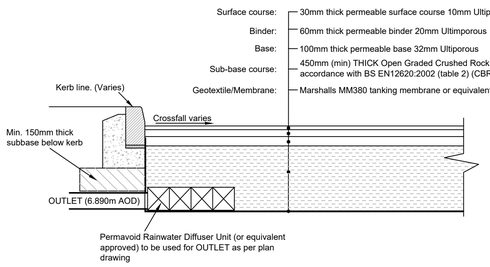
Project: South Street, Lancing

Drawing Title: Impermeable Areas

Scale	Date	Drawn By	Checked By
1:500	Oct 22	JHL	MJA

Drawing No.: D2112 PL200 — Rev.: A


N
PENHILL RO
Penhill Road
Tarmac
STN4
Cover
Sign
Approx line of 300mm dia foul sewer
MH2002
CL7.44
IL4.20
Parapet
13.11
Parapet
13.03
Eaves
12.90
MH2004
CL0.00
IL0.00
Ridge
16.38
Eaves
13.42
Ridge
13.51
Eaves
11.98
Wall Ht=2.2m
C/B Ht=1.5m
C/L Ht=1.8m
Gate
Garage
Ridge
13.42
Eaves
12.05
Ridge
12.00
Ridge
16.48
67
Eaves
13.40
Eaves
13.39
Line of existing public sewer taken from public sewer records
MH2001
CL7.86
IL00.00
MH
7.83
SOUTH STREET
South Street
Tarmac
Approx line of 300mm dia foul sewer
Brick Setts
Stop
Kerb
Gully
Access
Gate
Wall Ht=1.5m
Approx line of 150 dia foul sewer
C/B Ht=1.9m
Eaves
13.00
Ridge
16.28
Eaves
13.01
Ridge
15.43
73
Eaves
13.01
Ridge
16.25
Eaves
13.03
Ridge
15.46
Eaves
13.00
Ridge
15.43
Eaves
13.01
Ridge
16.27
Eaves
13.03
Ridge
15.46
Eaves
13.00
Ridge
15.43
4
Ridge
14.89
Eaves
12.51
Ridge
14.77
Eaves
12.09
Eaves
12.08
Ridge
14.56
Ridge
14.57
Eaves
12.09
Eaves
11.80
Eaves
11.78
Eaves
11.67
Ridge
15.32
Ridge
10.44
Eaves
11.88
Ridge
13.97
Eaves
8.84
Ridge
10.32
Ridge
12.89
Connection to existing public foul sewer subject to S106 consent from Southern Water.
Ex foul water chamber
IL Approx 6.18
<<< 1500 9.42m 1:72
Line of existing public sewer taken from CCTV survey
CL7.50
IL6.31
7.60
7.48
Tarmac
S4
RE
IL6.90
S5
RE
IL6.90
FFL7.50
Existing soakaway to be grubbed up
1000 24.42m 1:80 >>>
1000 11.48m 1:100 >>>
FFL7.80
FFL7.50
S9
RE
IL7.05
S8
CL7.55
IL6.95
CP
1000 9.68m 1:97 >>>
CL7.80
IL6.95
SVP
ASVP
FFL7.80
S11
RE
IL7.05
1000 9.68m 1:97 >>>
S10
CL7.55
IL6.95
CP
1000 12.10m 1:121 >>>
CL7.80
IL6.80
S6
Soakaway
CL 7.375
IL 6.925
BL 6.075
2100Ø
1500 8.92m 1:150
IL 6.775
S1
Soakaway
CL 7.450
IL 6.150
BL 3.950
2100Ø
IL6.490
<<< 1500 9.07m 1:100
S2
CL7.50
IL6.40
CP
S3
CL7.35
IL6.60
Existing soakaway to be grubbed up
Assumed gully
Assumed soakaway
Ticket Machine
Litter Bin
Height Barrier
Limited Access
Crown Barrier
Access Gate
Gate
Sign
Wall Ht=2.4m
Wall Ht=2m
Wall Ht=2.0m
Wall Ht=2.0m
C/L Ht=1.8m
C/B Ht=1.8m
C/B Ht=1.9m
C/B Ht=1.8m
C/B Ht=1.8m
C/B Ht=1.8

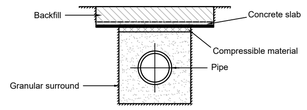


PHASING NOTE:
It is recommended that the construction of the permeable access/car parking system takes place at the end of the development construction period to help avoid premature clogging. Alternatively they system must be robustly protected in accordance with the manufacturers recommendations.

NOTE:
Porous paving system to be installed in strict accordance with the manufacturers recommendation and instructions.

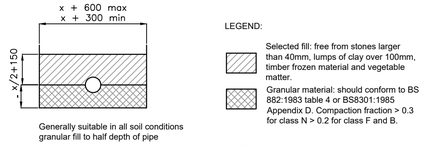
SHARED ACCESS ROAD/PARKING BAYS - POROUS PAVING

(TANKED)
(Scale 1:20)
(Cars and infrequent commerical use)



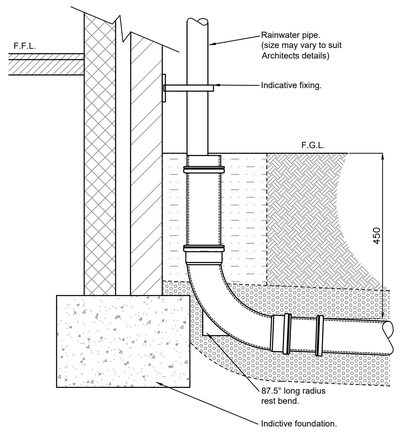
PROTECTION FOR PIPES LAID A SHALLOW DEPTHS

Depth of cover less than 0.60m under private gardens and 0.90m under private drives
(Scale 1:20)



PIPE BEDDING DETAIL UNDER DRIVES AND GARDENS

Min depth of cover 0.6m under private gardens and 0.9m under private drives

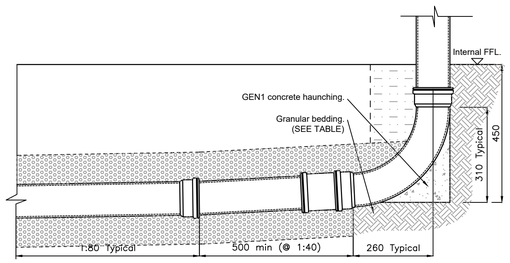


DETAIL OF RAINWATER PIPE

(Scale 1:20)

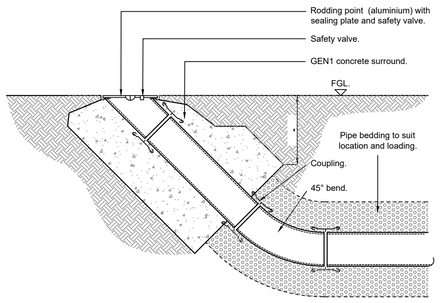
TYPICAL SECTION PIPE PASSING THROUGH WALL PIPE THROUGH LINTELLED OPENING

(Scale 1:20)



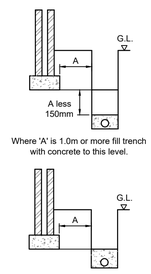
DETAIL OF FOUL REST BEND

(Scale 1:20)



DETAIL OF RODDING EYE

(Scale 1:20)



DETAIL OF PIPE RUNS NEAR BUILDINGS

(Not to Scale)

DRAINAGE NOTES:

1. All drainage works to be constructed in strict accordance with specification of the Local Authority, Building Regulations, Design and Construction Guidence (published by Water UK)& BSEN.752.
2. Any existing drainage found crossing the site is to be investigated, and if found to be 'live', it should be diverted in consultation with BP Civils.
3. For location and setting out of building drainage points refer to architects drawings.
4. All pipe runs near buildings to comply with the Building Regulations 2015 part H1. Where a pipe is within 1m of a foundation the trench shall be filled with class GEN3 concrete up to the lowest level of the foundation. Where the trench is further than 1m from the foundation, the trench shall be filled with class GEN3 concrete to a level below the lowest level for the foundation equal to the distance from the foundation less 150mm. In both cases the pipe shall be bedded and surrounded in 150mm thick class GEN3 concrete.
5. Where pipes, external to the structures, have a depth to soffit from ground level of less than 450mm they shall have a class GEN3 concrete encasement (150mm thick).
6. Where pipes have less than the minimum recommended cover, as stated in Building Regulations (Document H) Table 8, 9 or 10, the pipes should be protected by a reinforced concrete cover slab with a flexible filler and at least 75mm of granular material between the top of the pipe and the underside of the flexible filler below the slabs.
7. Where a pipe, under a vehicular area other than a carriageway has a depth of cover if less than 0.9m the pipe shall be protected with a concrete slab set above it.
8. In any circumstances where pipes are bedded and surrounded in concrete flexible joints should be provided. compressible boards (fibreboard or polystyrene) shall be provided at a maximum of 8m centres (coinciding with pipe joints). the boards shall be pre-cut to pipe diameter and to a height and width equal to the concrete cross section. a board thickness of 18mm for pipes up to 450mm nominal diameter and 36mm for pipes over 450mm nominal diameter.
9. All private building drainage shall be constructed in strict accordance with BS EN.752. Foul drainage beneath the floor slab shall be laid, shall be laid no flatter than 1:40. Unless otherwise specified below ground building drainage external to the building shall be 100mm diameter and shall be laid at a minimum gradient of (<1l/s = 1 in 40/>1l/s = 1 in 80) for foul drains and 1 in 80 for surface water drains.
10. All building drains shall be laid in accordance with the details shown, and Building Regulations (Document H) Diagram 10 (Bedding for pipes).
11. All pipes, bends and junction for private building drainage shall be UPVC conforming to BS4660, BSEN13598 and BSEN1401 as appropriate and shall be laid in accordance with the manufacturer's specification.
12. All back inlet gullies to be roddable or connected to inspection chambers.
13. All gully connections other than at manholes to be 'y' junctions.
14. All road gully connections to be 150mm diameter.
15. All stub stacks to be fitted with air admittance valves where branch drain exceeds 12m except at the head of the run. Soil vent pipes located at the head of a run to terminate to fresh air.
16. No low point shall be without a method of drainage.
17. All connections to be soffit to soffit unless otherwise noted.
18. All concrete and concrete products to be in accordance with BRE 363 for sulphates.
19. The locations of all building drainage points shall be cross referenced against the architects drawings during setting out and any discrepancies reported immediately.
20. Before connections are made to existing public sewers an application under S106 must be made to relevant sewerage undertaker.
21. The precise depth and location and size of existing pipes or manholes where connections or diversion are proposed must be confirmed and reported to the engineer before works commence on site.
22. Any existing drains to be abandoned to be decommissioned in accordance with the Building Regulations by either grubbing, infilling or sealing.
23. Should ground water be encountered on site during construction BP Civils shall be informed to determine if additional measures are required.
24. The drainage system shall be fully cleansed on completion of the project using methods that ensure pollution off site does not occur.
25. Any existing land drains severed during construction shall be reinstated.
26. Any live uncharted drainage found during construction shall be recorded and reported to the engineer for further instructions.

NOTES

A1

1. This drawing is to be read in conjunction with all other BP Civils drawings, and with all relevant Architect's and Engineer's drawings and specification. Any discrepancies found are to be reported immediately to the Engineer.
2. BP Civils accepts no responsibility for inaccuracies in data provided by third parties such as topographic surveys or Ordnance Survey mapping.
3. Do not scale, work to figured dimensions only. All dimensions are in millimeters unless noted otherwise and all levels are in metres from the topographic survey datum.
4. Any information given regarding existing underground services is given in good faith after consultation with the relevant authority, however accuracy is not certain. The main contractor is responsible for checking all information on site prior to work commencing and taking due care whilst undertaking the works.
5. All dimensions to be checked on site. All details and dimensions relating to sub-contractors work must be checked and agreed between the sub-contractor or supplier and the general contractor.
6. The electronic information from this drawing can not be guaranteed as dimensionally drawn exact. Figured dimensions must be used for setting out and detailing. BP Civils logos and company information must be removed from copies if information is re-used.

PLANNING
NOT FOR CONSTRUCTION

Rev.	Amendments	Date
-	-	-

BP CIVILS
Transport Planning and Infrastructure Design Consultants
2 West Barn, Norton Lane, Chichester, West Sussex PO20 3AF
Tel: 0333 358 3260
www.bpcivils.co.uk enquiries@bpcivils.co.uk

Drawing Status	PLANNING
Client	Sunninghill Construction
Project	South Street, Lancing
Drawing Title	Drainage Construction Details Sheet 1 of 2

Scale	Date	Drawn By	Checked By
As shown	Jan 24	SPB	MJA

Drawing No.	Rev.
D2227-250	-

Table 11 Minimum dimensions for access fittings and inspection chambers

Type		Depth to invert from cover level (m)	Internal sizes: Length x width (mm x mm)	Internal sizes: Circular (mm)	Cover sizes: Length x width (mm x mm)	Cover sizes: Circular (mm)
Rodding eye		As drain but min. 100				Same size as pipework [1]
Access fitting						
small	150 diam.	0.6 or less, except where situated in a chamber	150 x 100	150	150 x 100 [1]	Same size as access fitting
large	225 x 100		225 x 100	225	225 x 100 [1]	
Inspection chamber						
	shallow	0.6 or less	225 x 100	190 [2]	–	190 [1]
		1.2 or less	450 x 450	450	Min. 430 x 430	430
	deep	> 1.2	450 x 450	450	Max. 300 x 300 [3]	Access restricted to max. 350 [3]

Notes:

1. The clear opening may be reduced by 20mm in order to provide proper support for the cover and frame.
2. Drains up to 150mm.
3. A larger clear opening cover may be used in conjunction with a restricted access. The size is restricted for health and safety reasons to deter entry.

BUILDING REGULATIONS MINIMUM DIMENSIONS FOR ACCESS FITTINGS AND INSPECTION CHAMBERS

Table 12 Minimum dimensions for manholes

Type	Size of largest pipe (DN)	Min. internal dimensions [1]: Rectangular length and width	Min. internal dimensions [1]: Circular diameter	Min. clear opening size [1]: Rectangular length and width	Min. clear opening size [1]: Circular diameter
Manhole					
< 1.5m deep to soffit	≤ 150	750 x 675 [1]	1000 [1]	750 x 675 [2]	na [3]
	225	1200 x 675	1200	1200 x 675 [2]	
	300	1200 x 750	1200		
	>300	1800 x (DN+450)	The larger of 1800 or (DN+450)		
>1.5m deep to soffit	≤ 225	1200 x 1000	1200	600 x 600	600
	300	1200 x 1075	1200		
	375-450	1350 x 1225	1200		
	>450	1800 x (DN+775)	The larger of 1800 or (DN+775)		
Manhole shaft [4]					
> 3.0m deep to soffit of pipe	Steps [5]	1050 x 800	1050	600 x 600	600
	Ladder [5]	1200 x 800	1200		
	Winch [6]	900 x 800	900	600 x 600	600

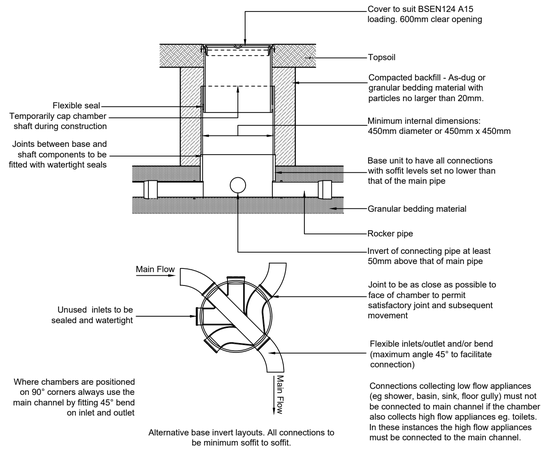
Notes:

1. Larger sizes may be required for manholes on bends or where there are junctions.
2. May be reduced to 600 by 600 where required by highway loading considerations, subject to a safe system of work being specified.
3. Not applicable due to working space needed.
4. Minimum height of chamber in shafted manhole 2m from benching to underside of reducing slab.
5. Min. clear space between ladder or steps and the opposite face of the shaft should be approximately 900mm.
6. Winch only – no steps or ladders, permanent or removable.
7. The minimum size of any manhole serving a sewer (i.e. any drain serving more than one property) should be 1200mm x 675mm rectangular or 1200mm diameter.

BUILDING REGULATIONS MINIMUM DIMENSIONS FOR MANHOLES

DRAINAGE NOTES:

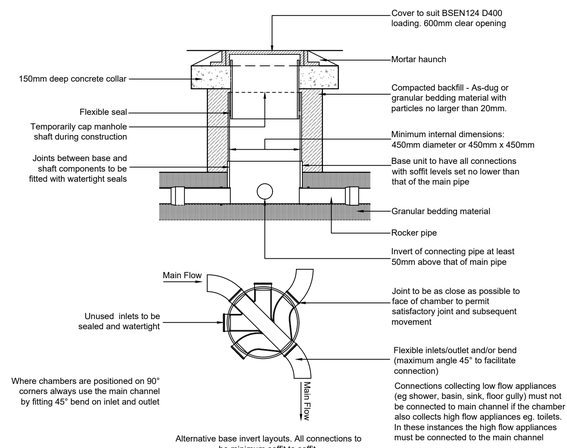
1. All drainage works to be constructed in strict accordance with specification of the Local Authority, Building Regulations, Design and Construction Guidence (published by Water UK)& BSEN.752.
2. Any existing drainage found crossing the site is to be investigated, and if found to be 'live', it should be diverted in consultation with BP Civils.
3. For location and setting out of building drainage points refer to architects drawings.
4. All pipe runs near buildings to comply with the Building Regulations 2015 part H1. Where a pipe is within 1m of a foundation the trench shall be filled with class GEN3 concrete up to the lowest level of the foundation. Where the trench is further than 1m from the foundation, the trench shall be filled with class GEN3 concrete to a level below the lowest level for the foundation equal to the distance from the foundation less 150mm. In both cases the pipe shall be bedded and surrounded in 150mm thick class GEN3 concrete.
5. Where pipes, external to the structures, have a depth to soffit from ground level of less than 450mm they shall have a class GEN3 concrete encasement (150mm thick).
6. Where pipes have less than the minimum recommended cover, as stated in Building Regulations (Document H) Table 8, 9 or 10, the pipes should be protected by a reinforced concrete cover slab with a flexible filler and at least 75mm of granular material between the top of the pipe and the underside of the flexible filler below the slabs.
7. Where a pipe, under a vehicular area other than a carriageway has a depth of cover if less than 0.9m the pipe shall be protected with a concrete slab set above it.
8. In any circumstances where pipes are bedded and surrounded in concrete flexible joints should be provided. compressible boards (fibreboard or polystyrene) shall be provided at a maximum of 8m centres (coinciding with pipe joints). the boards shall be pre-cut to pipe diameter and to a height and width equal to the concrete cross section. a board thickness of 18mm for pipes up to 450mm nominal diameter and 36mm for pipes over 450mm nominal diameter.
9. All private building drainage shall be constructed in strict accordance with BS EN.752. Foul drainage beneath the floor slab shall be laid, shall be laid no flatter than 1:40. Unless otherwise specified below ground building drainage external to the building shall be 100mm diameter and shall be laid at a minimum gradient of (<1l/s = 1 in 40/>1l/s = 1 in 80) for foul drains and 1 in 80 for surface water drains.
10. All building drains shall be laid in accordance with the details shown, and Building Regulations (Document H) Diagram 10 (Bedding for pipes).
11. All pipes, bends and junction for private building drainage shall be UPVC conforming to BS4660, BSEN13598 and BSEN1401 as appropriate and shall be laid in accordance with the manufacturer's specification.
12. All back inlet gullies to be roddable or connected to inspection chambers.
13. All gully connections other than at manholes to be 'y' junctions.
14. All road gully connections to be 150mm diameter.
15. All stub stacks to be fitted with air admittance valves where branch drain exceeds 12m except at the head of the run. Soil vent pipes located at the head of a run to terminate to fresh air.
16. No low point shall be without a method of drainage.
17. All connections to be soffit to soffit unless otherwise noted.
18. All concrete and concrete products to be in accordance with BRE 363 for sulphates.
19. The locations of all building drainage points shall be cross referenced against the architects drawings during setting out and any discrepancies reported immediately.
20. Before connections are made to existing public sewers an application under S106 must be made to relevant sewerage undertaker.
21. The precise depth and location and size of existing pipes or manholes where connections or diversion are proposed must be confirmed and reported to the engineer before works commence on site.
22. Any existing drains to be abandoned to be decommissioned in accordance with the Building Regulations by either grubbing, infilling or sealing.
23. Should ground water be encountered on site during construction BP Civils shall be informed to determine if additional measures are required.
24. The drainage system shall be fully cleansed on completion of the project using methods that ensure pollution off site does not occur.
25. Any existing land drains severed during construction shall be reinstated.
26. Any live uncharted drainage found during construction shall be recorded and reported to the engineer for further instructions.



Alternative base invert layouts. All connections to be minimum soffit to soffit.

INSPECTION CHAMBER DETAIL (LANDSCAPED AREAS)

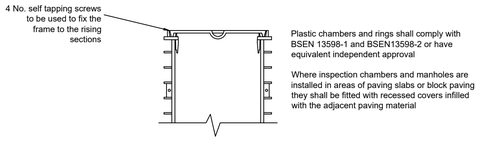
1.2m MAXIMUM DEPTH TO FROM COVER TO PIPE INVERT. LOCATED IN LANDSCAPED AREAS



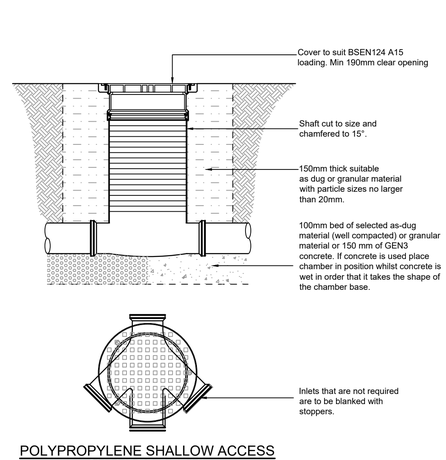
Alternative base invert layouts. All connections to be minimum soffit to soffit.

INSPECTION CHAMBER DETAIL (FOOTPATHS AND PRIVATE DRIVES)

1.2m MAXIMUM DEPTH TO FROM COVER TO PIPE INVERT. LOCATED IN AREAS SUBJECT TO LIGHT VEHICLES AND FOOTPATHS

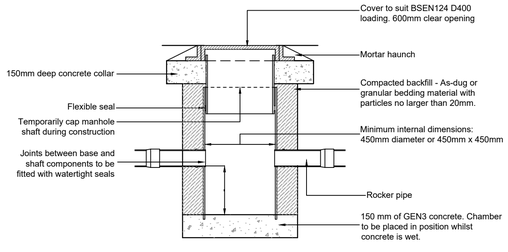


ACCESS CHAMBER FRAME FIXING (LANDSCAPED AREAS)



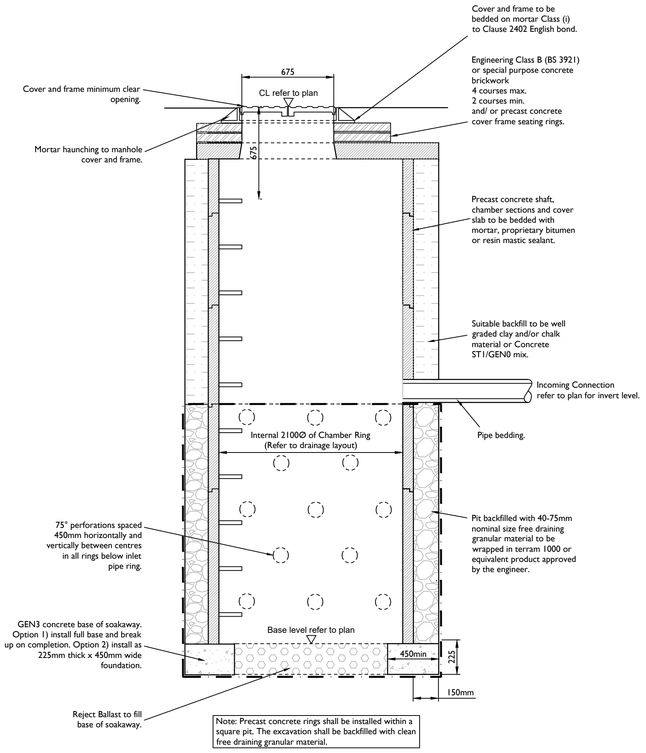
POLYPROPYLENE SHALLOW ACCESS CHAMBER DETAIL

0.6m MAXIMUM DEPTH TO FROM COVER TO PIPE INVERT. LOCATED IN LANDSCAPED AREAS



TYPICAL CATCHTPIT DETAIL (450mm DIA) (FOOTPATHS AND PRIVATE DRIVES)

1.2m MAXIMUM DEPTH TO FROM COVER TO PIPE INVERT. LOCATED IN AREAS SUBJECT TO LIGHT VEHICLES AND FOOTPATHS



Note: Precast concrete rings shall be installed within a square pit. The excavation shall be backfilled with clean free draining granular material.

DETAIL OF PRECAST CONCRETE PERFORATED RING SOAKAWAY

(Scale 1:20)

NOTES

A1

1. This drawing is to be read in conjunction with all other BP Civils drawings, and with all relevant Architect's and Engineer's drawings and specification. Any discrepancies found are to be reported immediately to the Engineer.
2. BP Civils accepts no responsibility for inaccuracies in data provided by third parties such as topographic surveys or Ordnance Survey mapping.
3. Do not scale, work to figured dimensions only. All dimensions are in millimeters unless noted otherwise and all levels are in metres from the topographic survey datum.
4. Any information given regarding existing underground services is given in good faith after consultation with the relevant authority, however accuracy is not certain. The main contractor is responsible for checking all information on site prior to work commencing and taking due care whilst undertaking the works.
5. All dimensions to be checked on site. All details and dimensions relating to sub-contractors work must be checked and agreed between the sub-contractor or supplier and the general contractor.
6. The electronic information from this drawing can not be guaranteed as dimensionally drawn exact. Figured dimensions must be used for setting out and detailing. BP Civils logos and company information must be removed from copies if information is re-used.

PLANNING

NOT FOR CONSTRUCTION

Rev.	Amendments	Date
A	Soakaway detail clarified	03/01/24

BP CIVILS

Transport Planning and Infrastructure Design Consultants

2 West Barn, Norton Lane, Chichester, West Sussex PO20 3AF

Tel: 0333 358 3260

www.bpcivils.co.uk enquiries@bpcivils.co.uk

Drawing Status	PLANNING
Client	Sunninghill Construction
Project	South Street, Lancing
Drawing Title	Drainage Construction Details Sheet 2 of 2

Scale	Date	Drawn By	Checked By
As shown	Jan 24	SPB	MJA

Drawing No.	Rev.
D2227-251	A

APPENDICES

Appendix A Architectural Development Proposals

T0718

- This drawing is the copyright of HNW Architects Ltd No. 3589904
- All dimensions must be verified on site prior to construction.
- Do not scale this drawing except for Planning Application purposes.
- Ordnance Survey Licence No. 100000200
- Only PDF issues of this drawing are controlled. All other formats of this drawing (e.g. dwg Autocad or .rvt Revit files) are un-controlled and are used at your own risk.
- This drawing must not be copied , transmitted or passed to a third party, without written consent

Rev	Amendments	By	Chkd	Date
P01	Issued for Planning	LS	HNW	14/12/2022

SOUTH STREET

+7.63

Entrance

Exit

+7.42

+7.64

+7.50

71

73

75

77

79

81

SEATON TERRACE

Timber enclosed bin store

Shared Surface

Living Dining Kitchen 24.50 m²

WC 4.73 m²

Living Dining Kitchen 19.26 m²

WC 3.30 m²

Living Dining Kitchen 24.50 m²

WC 4.73 m²

Living Dining Kitchen 19.26 m²

WC 3.30 m²

Living Dining Kitchen 24.50 m²

WC 4.73 m²

Living Dining Kitchen 20.00 m²

WC 4.64 m²

WC 4.64 m²

Living Dining Kitchen 20.00 m²

Private Amenity 40.5m²

Private Amenity 26.5m²

Private Amenity 26.8m²

Private Amenity 19.2m²

Private Amenity 55m²

Private Amenity 60m²

Private Amenity 93.9m²

existing chain link fencing to be replaced with 2.1m high timber fencing

Secure & covered bike store

22.0m

15.0m

1.1m

N

Landscape Key

(To be read in conjunction with the schedule in Design and Access Statement)

Soft Landscape

1. Turf
2. Planting
3. Climbers and shrubs

Hard Landscape

4. Shared Surface - permeable small set paviers
5. Large set concrete paviers to rear patios
6. Parking Spaces - permeable small set paviers
7. Road - Tarmac
8. Small set concrete paviers

Symbols

E Electric Charging Point

Please refer to Design and Access Statement for further information on Bin Store and Bike Store

Existing chain link fencing to be replaced by 2.1m high timber fencing, the remaining boundaries are to be retained as existing.

0m 1m 2.5m 5m 10m

Scale Bar 1:100 @A1

Project
Adur District Council
South Street Car Park, Lancing, West Sussex

Drawn by	Checked by	HNW Project No.	Date Created
LS	GP	22015	12/09/2022

Scale
A1- 1 : 100

Drawing Title
Proposed Ground Floor Plan

Drawing status
Planning

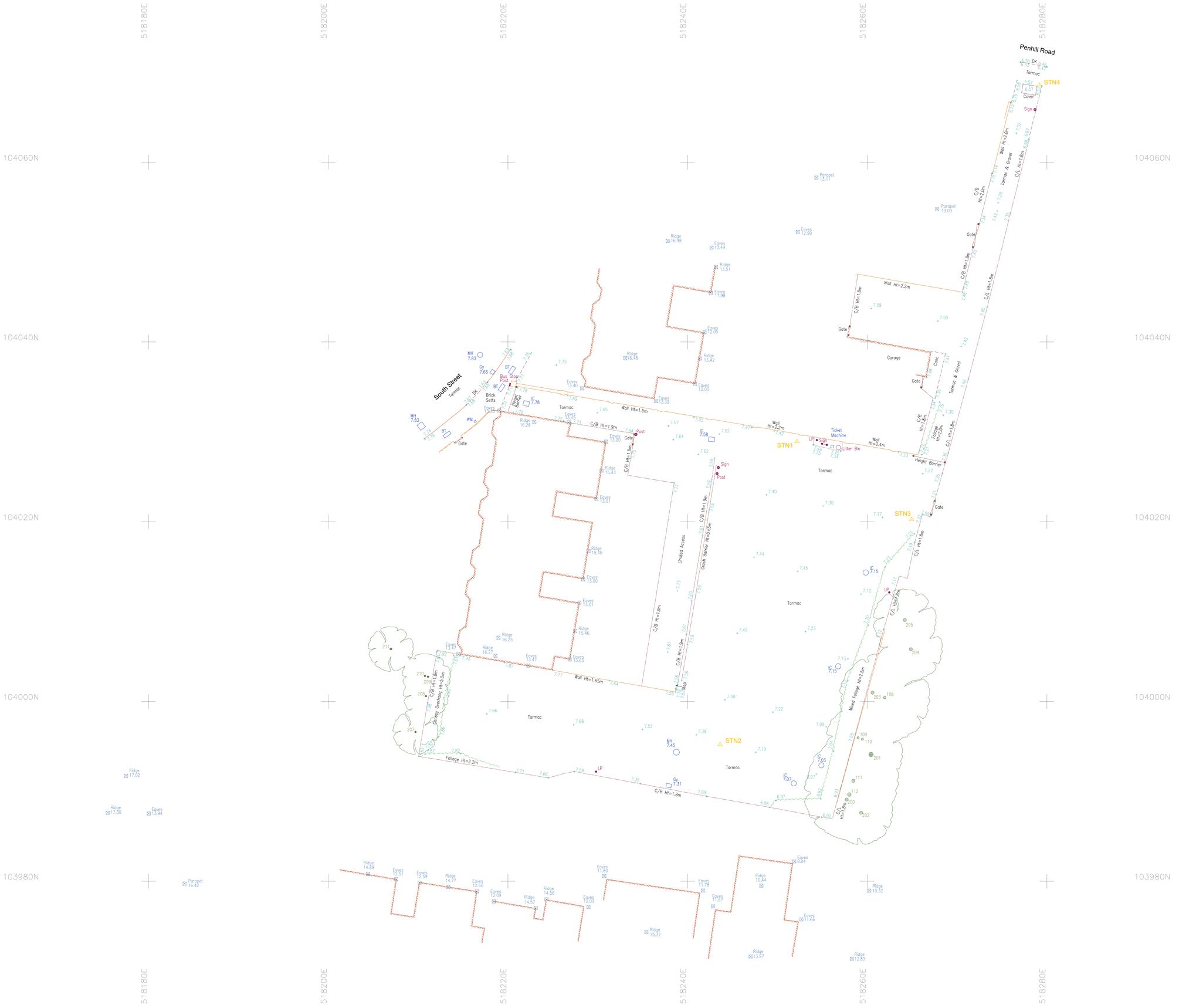
Revision
P01

Drawing Name
22015-HNW-ZZ-00-DR-A-2200

61 North Street, Chichester, West Sussex, PO19 1NB

hnw architects

Appendix B Topographical Survey



Notes:

Whilst every effort has been made to correctly identify species of trees on the site, we advise that an arboriologist be consulted before any final decisions are made.

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.

Legend:

Fences, Walls, Hedges, Trees, Buildings, Overhead Electric, Overhead Phone, Gate

Fences:

Barbed Wire Fence	B/W
Corrugated Iron Fence	C/I
Chain Link Fence	C/L
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
Lynch 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
KERB RAISED	KR	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		

Tree Schedule

Pt No	Spread	Bole	Height	Species
108	10.0	0.30	9.0	SYCAMORE
109	7.0	0.30	9.0	SYCAMORE
110	7.0	0.30	9.0	SYCAMORE
111	10.0	0.30	9.0	SYCAMORE
112	10.0	0.40	11.0	SYCAMORE
200	7.0	0.30	9.0	TREE UNKNOWN
201	7.0	0.30	9.0	TREE UNKNOWN
202	7.0	0.30	9.0	TREE UNKNOWN
203	7.0	0.30	9.0	TREE UNKNOWN
204	7.0	0.30	9.0	TREE UNKNOWN
205	7.0	0.30	9.0	TREE UNKNOWN
207	5.0	0.20	8.5	TREE UNKNOWN
208	5.0	0.20	8.5	TREE UNKNOWN
209	5.0	0.20	9.0	TREE UNKNOWN
210	5.0	0.20	9.0	TREE UNKNOWN
211	5.0	0.25	9.0	TREE UNKNOWN

Coordinate Table

Stn	Easting	Northing	Level
STN1	518252.174	104028.919	7.367
STN2	518243.613	103995.193	7.303
STN3	518264.947	104020.247	7.180
STN4	518279.169	104068.579	6.535

Rev. Suffix	Date	Initial	Revision Details
A	10.05.22	TJH	Additonal survey information added

Surveyor	Verified By	CAD Operator	Approved By	Date
LW	LW	TJH	ARL	06.05.22

Levelling GNSS Datum OSGB36

To an OS GNSS Datum

Client

Adur & Worthing Councils

Location

South Street, Lancing
Worthing

Drawing Title

Topographical Survey

Job No. 2203069	Old Job No.
Drawing Number AWC/2203069	Revision Suffix A
Scale 1:200m (A1)	Date April 2022

CD SURVEYS LTD
LAND, BUILDING & SITE ENGINEERING
PENTIRE - STABLE 1
FORDBRIDGE ROAD,
SUNBURY-ON-THAMES
MIDDLESEX, TW16 6AX
Tel (01932) 761196
Fax (01932) 786419
Email: mail@cdsurveys.com
Visit us at: www.cdsurveys.com

Appendix C Site-specific Intrusive Investigation

South Street
Lancing
West Sussex

Combined Geotechnical and Ground Contamination Risk Assessment

Report Beneficiary:
Adur District Council
Worthing Town Hall
Chapel Road
Worthing
West Sussex
BN11 1HA

Project Reference: P15791

Report Reference: R15446

Document Control			
Issue No.	Status	Issue Date	Notes
1	Final	24th November 2022	

Report Section	Prepared By	Approved By
Preliminary Ground Contamination Risk Assessment	Adam Cormack HNC FGS	Alex Minchell-Bewick BSc MSc DIC AIEMA MIEnvSc CEnv
Factual Section	Adam Cormack HNC FGS	Rebecca Webb BSc FGS
Geotechnical Assessment	Adam Cormack HNC FGS	Rebecca Webb BSc FGS
Quantitative Ground Contamination Risk Assessment	Adam Cormack HNC FGS	Alex Minchell-Bewick BSc MSc DIC AIEMA MIEnvSc CEnv

Head Office
Unit 3
The Old Grain Store
Ditchling Common Business Park
Ditchling
East Sussex
BN6 8SG
Tel: 01273 483119
www.ashdownsi.co.uk

Limitations

This report was prepared specifically for the Client's project and may not be appropriate to alternative schemes. The copyright for the report and licence for its use shall remain vested in Ashdown Site Investigation Limited (the Company) who disclaim all responsibility or liability (whether at common law or under the express or implied terms of the Contract between the Company and the Client) for any loss or damage of whatever nature in the event that this report is relied on by a third party, or is issued in circumstances or for projects for which it was not originally commissioned.

This report is not intended to be either an ecological, archaeological or flood risk assessment. An appropriate specialist should be consulted about any concerns that may arise in this regard.

EXECUTIVE SUMMARY

The following presents a summary of the main findings of the report. It is emphasised that no reliance should be placed on any individual point until the whole of the report has been read as other sections of the report may put into context the information contained herein.

It is proposed to redevelop the site at South Street, Lancing to provide a series of townhouses with associated parking and soft landscaped garden areas.

The site currently comprises an asphalt surfaced car park, with a builders merchant to the east and housing to the north, west and south.

The site comprised undeveloped land at the time of the earliest inspected historical map, dated 1873; a glasshouse was shown on the 1898 revision in the north east corner of the site. The site was labelled as a car park on the 1975 revision. A large brick field was located to the east of the site.

Reference to geological datasets indicates that the site is expected to be underlain by the River Terrace Deposits overlying the White Chalk Subgroup. The ground investigation confirmed the underlying soils to comprise a variable and locally significant thickness of made ground soils, overlying the River Terrace Deposits; the White Chalk Subgroup was not encountered.

The River Terrace Deposits are classified as a Secondary B Aquifer with the White Chalk Subgroup being classed as a Principal Aquifer. The site does not lie within an Environment Agency Source Protection Zone. In general, the exploratory holes were noted to be dry during the intrusive works. During the interim monitoring period, groundwater was recorded to peak at depths of 2.82m and 4.10m below ground level within the deeper standpipes installed. Shallower water was noted within the shallow standpipes, possibly representing perched water bodies within the made ground. Longer term monitoring is currently ongoing and the results will be included in a later update of this report.

The preliminary contamination risk assessment identified potential pollutant linkages relating to both proposed end users of the site and controlled waters.

The investigation recorded the made ground soils to contain concentrations of lead and PAH compounds above the published screening values for a residential development. Remedial works will be required within proposed areas of soft landscaping within the development.

Precautions against shrinkage and heave for any new foundation system should assume a medium volume change potential for the fine-grained River Terrace Deposits. The undisturbed sand and gravel soils of the River Terrace Deposits may be considered to be non-plastic and hence non-shrinkable.

A net allowable bearing capacity of 100kN/m^2 may be assumed for spread (pad or strip) foundations up to 1.00m across bearing within the River Terrace Deposits of at least firm consistency. An increased bearing capacity of 150kN/m^2 may be assumed for similar sized foundations founded within the River Terrace Deposits of at least stiff consistency or medium dense relative density, typically encountered at depths of between 1.00m and 2.50m at most exploratory hole positions.

Ground floors should be suspended unless the conditions set out within this report can be met.

A DS-1 Design Sulfate Class and an AC-1 ACEC classification should be assumed as a minimum for the design of concrete in contact with the ground.

Design equilibrium California bearing ratios and moduli of subgrade reaction are presented in the report. The subgrade is likely to be susceptible to frost heave.

Infiltration tests indicate that the soils beneath the site possess poor to moderate infiltration characteristics.

TABLE OF CONTENTS

1. INTRODUCTION 1

2. SITE WALKOVER SURVEY 2

3. ENVIRONMENTAL AND GEO-ENVIRONMENTAL DATA REVIEW 3
- 3.1 Geological Data Review 3
- 3.2 Hydrogeological and Hydrological Data Review 5
- 3.3 Geo-Environmental Data Review 6

4. HISTORICAL MAP REVIEW 9

5. PRELIMINARY CONTAMINATION RISK ASSESSMENT 10
- 5.1 Introduction 10
- 5.2 Contaminant Pathways Identified 10
- 5.3 Potential Contamination Sources Identified 10
- 5.4 Preliminary Conceptual Model 11

6. GROUND INVESTIGATION 12
- 6.1 Introduction 12
- 6.2 Exploratory Holes 12
- 6.3 Sampling 12
- 6.4 In-situ Testing 13
- 6.5 Installations 14
- 6.6 Laboratory Testing 14

7. GROUND CONDITIONS 15
- 7.1 Stratigraphy 15
- 7.2 Stability 15
- 7.3 Groundwater Conditions 15
- 7.4 Existing Foundations 16

8. GEOTECHNICAL ASSESSMENT 17
- 8.1 Foundations 17
- 8.2 Ground Floors 20
- 8.3 Groundwater 20
- 8.4 Stability of Excavations 21
- 8.5 Aggressivity to Concrete 21
- 8.6 Pavement Design 22
- 8.7 Stormwater Infiltration Systems 23

9. QUANTITATIVE CONTAMINATION ASSESSMENT 25
- 9.1 Assessment Strategy 25
- 9.2 Analysis of Contamination Test Results 25
- 9.3 Analysis of Ground Gas Monitoring Results 27
- 9.4 Quantitative Contamination Risk Assessment 29
- 9.5 Risks to Other Potential Receptors 29
- 9.6 Recommendations 29
- 9.7 Discovery Strategy 29

FIGURES AND APPENDICES

FIGURES

Figure 1 Site Location Plan
Figure 2 Site Plan
Figure 3 Foundation Details

APPENDIX A

Proposed Development Layout

APPENDIX B

Classification of Probability, Consequence and Risk

APPENDIX C

Preliminary Conceptual Model

APPENDIX D

Exploratory Hole Notes
Exploratory Hole Records
DPSH-B Dynamic Probe Records
In-situ TRL Cone Penetrometer (CBR) Test Results
Summary of Borehole Falling Head Soakage Test Results
Summary of Trial Pit Falling Head Soakage Test Results
Gas Concentration and Groundwater Monitoring Results

APPENDIX E

Geotechnical Laboratory Test Results
Contamination Laboratory Test Results

APPENDIX F

Summary of In Situ CBR Test Results
Graph of Subgrade Surface Modulus vs Depth
Graph of CBR vs Depth

APPENDIX G

Quantitative Conceptual Model

APPENDIX H

Groundsure Enviro+Geo Insight Report
Historical Maps

1. INTRODUCTION

It is proposed to redevelop the site at South Street, Lancing to provide a series of townhouses with associated parking and soft landscaped garden areas. A copy of the proposed development layout is presented in Appendix A.

Ashdown Site Investigation Ltd was requested to undertake a ground investigation, to provide advice to assist with the structural design and to undertake a preliminary and quantitative contamination risk assessment.

The specific objectives of the works were to:

a) Establish the expected geology, hydrogeology and hydrology at the site;
b) Ascertain the development history and current site use;
c) Develop a preliminary conceptual model of the site identifying potential pollutant linkages relating to end users of the proposed development works, to controlled waters beneath and in the vicinity of the site, or to other off-site sensitive receptors, if identified;
d) Investigate the shallow ground and groundwater conditions prevailing at the site;
e) Investigate the form of foundations to existing structures;
f) Provide advice to assist others in undertaking design of spread foundations, ground floors, road pavements and soakaways;
g) Test for the presence of contaminants identified by the preliminary conceptual model; and
h) Develop a quantitative conceptual model of the site, refining the preliminary model to identify any pollutant linkages that may be present.

The scope of the works covered by this report, and the terms and conditions under which they were undertaken, were set out within the offer letter Q12210, dated 8th August 2022. The instruction to proceed was received from HOP Consulting Civil and Structural Engineers on behalf of the client, Adur Borough Council.

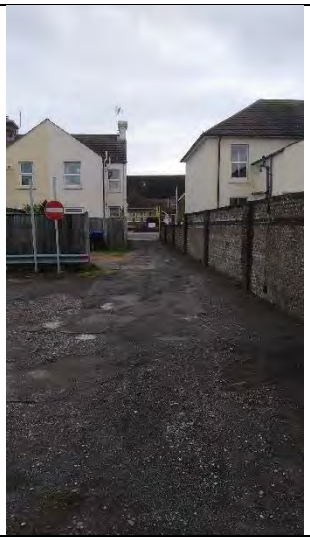
As a potential risk from ground gases was identified following the original instruction, the scope of the investigation works was expanded from that originally proposed. These additional instructed works were set out within offer latter Q12405, dated 7th October 2022.

Copies of the historical maps and geo-environmental data referred to in this report are presented within Appendix H.

2. SITE WALKOVER SURVEY

The site comprises an irregular shaped plot of land located at South Street, Lancing, West Sussex, and is centred on the approximate Ordnance Survey national grid reference 518251 104008. A site location plan and site plan are presented as Figure 1 and Figure 2, respectively.

The site comprised an asphalt surfaced car park, accessible via driveways leading off Penhill Road to the north and South Street to the west. No buildings were present on the site.

Looking west along the access drive	Looking west along the southern boundary	Looking south from the northern edge of the site
		

The site was located within a largely residential area with housing bounding the site to the north, west and south. A builders merchants lay beyond the northern half of the eastern boundary. The ground level beyond the boundary was some 1m below that of the site. A series of aggregate bays were located immediately adjacent to the site boundary.

South eastern corner of the site and housing beyond	Aggregate bays associated with the builders merchant, left photo as viewed looking down from site, right photo view looking up towards site.	
		

3. ENVIRONMENTAL AND GEO-ENVIRONMENTAL DATA REVIEW

3.1 Geological Data Review

3.1.1 Expected Geology and Aquifer Designation

The stratigraphic succession that may be expected to underlie the site is presented in the following table.

Table 1. Expected Strata and Aquifer Designation

Type	Stratum	Aquifer Designation
Superficial	River Terrace Deposits (Brickearth)	Secondary B Aquifer
Bedrock	White Chalk Subgroup	Unproductive Stratum

The River Terrace Deposits in this area were formerly denoted as the Brickearth and comprise brown sandy (fine) silt or clay largely originating from the solution weathering of the previously existing chalk. The material will have been reworked by water flow to produce some lateral variability in the grain size of the soil (sand and gravel) and can be expected to contain a variable content of flint.

The White Chalk Subgroup comprises a weak, white chalk locally with flint bands together with scattered nodular flints. The chalk can be expected to have a deeply convoluted upper surface as a result of solution weathering and erosion. It is noted that solution features in the chalk may be infilled with material significantly weaker than the surrounding chalk.

3.1.2 Natural Ground Subsidence

Table 2. Natural Ground Subsidence from Groundsure Data

Section	Risk Assessment
Soil Volume Change Potential (Shrink-Swell)	Low
Running Sands	Low
Compressible Deposits	Negligible
Collapsible Deposits	Low
Landslides	Very Low
Ground Dissolution of Soluble Rocks	Very low

It should be noted that the assessment provided within the data represents a generic assessment only. Detailed assessment of the geotechnical characteristics of the soils encountered at the site is presented in Section 8 of this report.

3.1.3 Mining, Ground Workings and Natural Cavities

Table 3. Mining, Extraction and Natural Cavities from Groundsure Data

Section	Risk Assessment
Natural Cavities	No natural cavity records are identified within 500m of the site.
BritPits	Two BritPits entries within 250m lie 82m east and 159m north east. These refer to Yewtree Farm Brick Field and South Lancing Brick Field, respectively. Although these items only record point locations, other data indicates that these brickfields cover a large area which bound the site to the east.
Surface Ground Workings	Large areas of brick fields are identified immediately to the east of the site.
Underground Workings	No underground workings are identified within 250m of the site.
Historical Mineral Planning Areas	No records are identified within 500m of the site.
Non-Coal Mining	The data states that "the site is located in an area where sporadic underground mining of restricted extent occurred." However, it goes on to state that "Potential for difficult ground conditions are unlikely and localised and are at a level where they need not be considered."
Mining Cavities	No records are identified within 500m of the site.
Johnson Poole and Bloomer	No records are identified on the site.
Coal Mining	No records are identified on the site.
Brine Areas	No records are identified on the site.
Gypsum Areas	No records are identified on the site.
Tin Mining	No records are identified on the site.
Clay Mining	No records are identified on the site.

The presence of natural cavities in the chalk is very rare and solution features, if present, can be expected to be infilled with Quaternary deposits such as the River Terrace Deposits. The infill material may be significantly weaker than the surrounding chalk. Solution features can comprise pipes extending to several metres deep into the chalk or conical depressions and basin shaped structures.

Historically, chalk deposits were often mined locally. Most commonly historical mines characteristically comprise a narrow shaft with a number of chambers radiating from the base. These structures are colloquially known as "deneholes", "chalk-wells" or "chalkangles".

The depth of the features reflects the depth to the underlying chalk bedrock. The shaft width was commonly in the order of 2m to 3m, widening out into galleries at depth. The chalk was extracted for soil improvement and was usually applied directly to fields though sometimes the chalk was processed, typically by burning in kilns where the chalk was used to produce quicklime (calcium oxide).

Once they had reached their limits the mines were commonly capped. Various capping techniques were used; examples include the use of upturned trees or brick arching. Records pertaining to the distribution of these localised mines are incomplete, usually being limited to features marked as shafts or the occurrence of circular depressions on historic Ordnance Survey maps. In the field they are most likely to be visible as shallow depressions, if at all.

Inspection of historical maps extending back in time to 1873 does not reveal the presence of any significant mining features at the site, although adjacent to the site a brickfield is denoted.

Therefore, given the reasons noted above, the presence of mining features at the site cannot be fully discounted.

Further assessment of the natural ground and mining hazards can be undertaken, if required, to provide more detailed comment specific to the site.

3.1.4 Radon

Table 4. Radon

Section	Risk Assessment
Radon Affected Areas	The site is reported to be within an area where between 1% and 3% of properties are above the action level requiring radon gas protection measures to be installed in new buildings.
Radon Protection Measures	No radon protection measures are reported by the British Geological Survey to be necessary in the construction of new dwellings or extensions.

3.1.5 Soil Chemistry

The estimated background soil chemistry does not pose an unacceptable risk in the context of the site. However, this does not refer to data taken from the site itself and higher contaminant concentrations could be present as a result of site activities.

3.2 Hydrogeological and Hydrological Data Review

3.2.1 Groundwater Abstractions

No active groundwater abstraction licences are indicated within 2km of the site.

3.2.2 Surface Water Abstractions

No surface water abstraction licences are indicated within 2km of the Site.

3.2.3 Potable Abstractions

No potable abstraction licences are indicated within 2km of the site.

3.2.4 Groundwater Source Protection Zones

The site does not lie within an Environment Agency Source Protection Zone.

3.2.5 Surface Water Features

No significant surface water features are recorded within 250m of the site.

There is no Environment Agency information on river quality within 250m of the site.

3.2.6 Flood Risk

The table below summarises the flood risk data provided by the Groundsure report.

Table 5. Flood Risk

	On Site	Within 50m of the Site
Risk of Flooding from Rivers and Seas (RoFRaS)	None Identified	None Identified
Historical Flood Events	None Identified	None Identified
Flood Defences	None Identified	None Identified
Areas Benefitting from Flood Defences	None Identified	None Identified
Flood Storage Areas	None Identified	None Identified
Environment Agency Flood Zone 2	None Identified	None Identified
Environment Agency Flood Zone 3	None Identified	None Identified
Surface Water Flooding	Highest Risk: Negligible	Highest Risk: 1 in 30 year, 0.30m to 1.00m.
Groundwater Flooding	Highest Risk: Moderate	Highest Risk: Moderate-High

3.3 Geo-Environmental Data Review

3.3.1 Historical Industrial Sites

The following table summarises past land uses of the site and the surrounding area extracted from 1:10,000 and 1:10,560 historical maps.

Table 6. Historical Industrial Sites

Section	Remarks
Historical Industrial Land Uses Identified from 1:10,560 and 1:10,000 scale mapping	The adjacent historical brick field is identified. A Fire station is also identified 39m to the west. Given the distance from the site (it's 39m from the western end of the access road, so closer to 60m from the main site) this is not considered to represent a potential source of contamination.
Historical Tank Database Identified from 1:1,250 and 1:2,500 scale mapping	An unspecified tank is noted 72m to the north of the site in 1898. Given the distance from the site this is not considered to represent a potential source of contamination.
Historical Energy Features Identified from 1:1,250 and 1:2,500 scale mapping	No energy features are identified within 100m of the site.
Historical Petrol Stations Identified from 1:1,250 and 1:2,500 scale mapping	No historical petrol stations are identified within 100m of the site.

Section	Remarks
Historical Garages Identified from 1:1,250 and 1:2,500 scale mapping	No historical garages are identified within 100m of the site.
Historical Military Sites	No historical military sites are identified within 100m of the site.

3.3.2 Landfill and Other Waste Sites

The following table summarises the location of waste sites either on the site or within the surrounding area (within 250m of the site).

Table 7. Landfill and Other Waste Sites

Section	Remarks
Active or Recent Landfills	No active or recent landfills are identified within 250m of the site.
Historical Landfill (BGS Records/LA/Mapping Records EA Records)	No historical landfills are identified within 250m of the site.
Historical Waste Sites	No historical waste sites are identified within 250m of the site.
Licensed Waste Sites	No licensed waste sites are identified within 250m of the site.
Waste Exemptions	No waste exemptions are identified within 250m of the site.

3.3.3 Current Industrial Land Use

The relevant current industrial land uses are discussed in the table below.

Table 8. Current Industrial Land Uses

Section	Remarks
Recent Industrial Land Use	The only features identified within 100m refer to retail premises nearby. These are not considered to represent a potential source of contamination.
Current or Recent Petrol stations	No current or recent petrol stations are identified within 100m of the site.
Electricity Cables / Gas Pipelines	No underground high voltage cables or high-pressure pipes are identified within 100m of the site.
Sites determined as Contaminated Land	No sites determined as contaminated land are identified within 100m of the site.
Control of Major Accident Hazards (COMAH) Sites	No COMAH sites are identified within 100m of the site.
Regulated Explosive Sites	No regulated explosive sites are identified within 100m of the site.
Hazardous Substance Storage/Usage	No consents have been granted for hazardous substance storage/usage within 100m of the site.
Historical Licenced Industrial Activities (IPC)	No records are identified within 100m of the site.
Licenced Industrial Activities (Part A(1))	No records are identified within 100m of the site.
Licenced Pollutant Release (Part A(2)/B)	No records are identified within 100m of the site.

Section	Remarks
Radioactive Substance Authorisations	No records are identified within 100m of the site.
Licenced Discharges to Controlled Waters	No records are identified within 100m of the site.
Pollutant Release to Surface Water / Public Sewer	No records are identified within 100m of the site.
List 1 / List 2 Dangerous Substances	No records are identified within 100m of the site.
Pollution Incidents (EA/NRW)	No pollution incidents are identified within 100m of the site.
Pollution Inventory Substances / Waste Transfers / Radioactive Waste	No records are identified within 100m of the site.

3.3.4 Sensitive Land Use

No sensitive land uses considered to be at risk from the proposed development are identified on the site.

3.3.5 Railway Infrastructure and Projects

A historical railway and sidings are identified 149m to the east of the site. Given the distance this is not considered to represent a potential source of contamination.

4. HISTORICAL MAP REVIEW

Historical Ordnance Survey maps covering the area of the site have been reviewed and are summarised in the following table.

It is noted that each map presents information applicable at the time of the survey (or revision date) and is subject to surveying and cartographic errors and/or advances. Revisions to maps are made at irregular intervals and it is possible that significant developments may have taken place on or within the vicinity of the site that are not shown on the maps.

'In the Vicinity of the Site' generally refers to features of relevance within approximately 250m of the site boundary but may also include more distant features if considered to be pertinent to the assessment of the development history.

Table 9. Summary of Significant Features Identified on Historical Maps

Map Details	On-Site	In the Vicinity of the Site
1873 1:2,500	The site comprises undeveloped land.	The area immediately east of the site is labelled as a Brick Field. A large area of excavation is located immediately to the east, with a second area ~60m to the north east. Buildings associated with Yewtree Farm are located ~50m north and a road bounds the north western corner of the site to the west.
1898 1:2,500	A glass house is shown in the north east corner of the site. It appears the southern extent of the site is part of a residential garden.	The brick field to the east has expanded further towards the east. Contour lines to the south east suggest that the majority of the field has been excavated. Penhill Road is now shown to the north east, with some housing present to the north and south. Further north of the housing, the brick field is still labelled, with contour lines also indicating a significant area of excavation.
1912 1:2,500	No significant changes noted.	The area to the east is no longer labelled as a Brick Field. Buildings are now shown immediately to the east. Terraced houses are now shown immediately to the west of the site on the footprint of the existing buildings. Several large glasshouses are shown ~90m to the east.
1932 1:2,500	No significant changes noted.	More buildings are shown to the east of the site in the area of the former brick field. A fire station is labelled ~40m west of the site.
1973-75 1:1,250	The site is labelled as a car park.	The area of glasshouses to the east has been developed for housing.

5. PRELIMINARY CONTAMINATION RISK ASSESSMENT

5.1 Introduction

The risk assessment considers the potential sources of contamination identified, the receptors that may be present in view of the development proposals and the contaminant pathways by which these may be linked. A complete pollutant linkage is only deemed to exist where all three are present and a site is considered suitable for use where no complete pollutant linkages are identified.

Where a complete pollutant linkage is deemed to be present, an assessment of the level of risk associated with the pollutant linkage has been carried out in line with current guidance[1].

The level of risk is determined using the risk matrix presented in the following table. Classifications of probability, consequence and risk are presented in Appendix B.

Table 10. Risk Assessment Matrix

		Probability			
		Very Low	Low	Moderate	High
Consequence	Very Minor	Negligible	Very Low	Low	Low/Moderate
	Minor	Very Low	Low	Low/Moderate	Moderate
	Moderate	Low	Low/Moderate	Moderate	High
	Severe	Low/Moderate	Moderate	High	Very High

5.2 Contaminant Pathways Identified

The development is to comprise new residential buildings together with areas of private gardens. As such, pathways associated with gas and vapour intrusion into new buildings are considered to be valid, along with direct contact and dust related pathways, and pathways associated with the consumption of home grown produce.

Should the proposed development plans be altered, a revised risk assessment may be required.

The site is expected to be underlain by the River Terrace Deposits, which in turn overly the White Chalk Subgroup which is classed as a Principal Aquifer. Although the site is not located within a source protection zone, and is located within an urban area, pathways relating to controlled waters may be reasonably considered to be present.

5.3 Potential Contamination Sources Identified

The following potential sources of contamination have been identified by the preliminary contamination risk assessment:

- Made Ground associated with the existing car park
- Gases arising from potential backfilling of the adjacent brick field.

[1] Contaminated Land Risk Assessment: A guide to good practice, CIRIA C552, 2001.

5.4 Preliminary Conceptual Model

The preliminary conceptual model for the proposed development is presented in Appendix C.

6. GROUND INVESTIGATION

6.1 Introduction

The ground investigation comprised the drilling of a series of dynamic sampler boreholes and the excavation of hand dug pits, with accompanying in-situ geotechnical testing. Gas and groundwater monitoring standpipes were installed in selected exploratory holes and monitored on subsequent site visits. The intrusive work was carried out over two occasions on 23rd September 2022 and 21st October 2022. The exploratory hole locations are shown on Figure 2.

Descriptions of the strata encountered and comments on groundwater conditions are shown in the exploratory hole records given in Appendix D, together with notes to assist in their interpretation.

6.2 Exploratory Holes

6.2.1 Dynamic Sampler Boreholes

Eight boreholes, designated BH01 to BH06 and STB01 and STB02 were drilled to depths of between 2.00m and 5.00m below ground level.

Dynamic sampler boreholes are formed by a series of 1.0m long, open ended, hollow steel tubes of up to 100mm diameter, each containing a removable plastic liner. The tubes, progressively reducing in diameter, are driven into the ground by means of a track-mounted drop weight. Each tube is extracted from the ground using a hydraulically operated jack and the enclosed sample is recovered in its plastic liner.

The system enables sub-samples to be taken for detailed examination and laboratory testing.

6.2.2 Trial Pits

Three trial pits, designated CBR01, STP01 and STP02, were dug using hand tools to depths of between 0.45m and 0.65m below ground level to enable in-situ testing to be carried out.

6.2.3 Foundation Inspection Pits

Two pits, designated TP03 and TP04, were excavated using hand-tools to depths of between 0.60m and 0.55m below ground level, respectively, to investigate the foundations to existing structures. TP01 and TP02 were omitted from the investigation due to no obvious structures being present at the location of the test pits.

6.3 Sampling

Disturbed samples of soil were taken at the depths shown in the exploratory hole records and were collected in plastic bags, plastic tubs and amber jars fitted with gas tight lids.

On collection the amber jars were stored in cool boxes with cooling blocks to maintain temperatures below 4°C until transferred to refrigerators upon return to the office and subsequently forwarded to the external accredited chemical testing laboratory.

6.4 In-situ Testing

The depths of in-situ testing, together with the test results, are either given on the exploratory hole records or are summarised separately in Appendix D.

6.4.1 DPSH Dynamic Probe (Super Heavy) Testing

Continuous dynamic probe tests were undertaken adjacent to boreholes BH01 to BH06 and STB01. These tests were conducted to depths of between 3.50m and 5.00m below ground level using a super heavy DPSH-B[2] probing geometry. In addition, a DPSH dynamic probe was undertaken some 300mm away from the back face of the retaining wall in the base of trial pit TP03 to a depth of 2.00m to investigate any potential obstructions that may be representative of the foundation to the structure.

The DPSH-B configuration is similar to that of the standard penetration test (SPT); the main differences being that the tip comprises a 90° cone, the driving rods are lighter than those used for SPT testing and the blow counts are recorded over 100mm increments rather than 300mm, as is the case for the SPT.

The blow counts recorded and the calculated dynamic point resistances, which account for inertia of the anvil and driving rods, are presented on the borehole records and separately in Appendix D.

6.4.2 Perth Penetrometer Tests

Perth penetrometer tests[3] were undertaken at the base of trial pits TP03 and TP04. The penetrometer refused within TP03.

6.4.3 Undrained Shear Strength

Undrained shear strength determinations were made in-situ within the fine-grained soils using a Geonor hand shear vane.

Additionally, undrained shear strength determinations were made within samples of the fine-grained soils held in the dynamic sampler liners using a hand penetrometer.

6.4.4 California Bearing Ratio Tests

Testing to determine the in-situ California Bearing Ratio (CBR) of soils was conducted at shallow depths within exploratory holes CBR01, BH04, BH05 and BH06 using a Transport Research Laboratory (TRL) cone penetrometer.

[2] As defined by BS EN ISO 22476-2:2005.
[3] Testing was carried out in accordance with Australian Standard AS 1289:6.3.3-1997, Method of Testing Soils for Engineering Purposes; no equivalent European or British Standard having been published to date.

6.4.5 Soakage Testing

Falling head soakage tests were undertaken in boreholes STB01 and STB02 with the holes at a depth of 2.00m. The tests were carried out in general accordance with Kent County Council guidance[4].

In addition, infiltration testing was conducted at shallow depths within trial pits STP01 and STP02 in general accordance with BRE guidance[5], other than the pits were of limited size and one of the pits could only be filled once rather than the three times suggested by the digest due to the slow draining nature of the soils encountered.

6.5 Installations

Gas monitoring standpipes were installed to depths of between 1.00m and 3.00m in boreholes BH02, BH03, BH06 and STB01. Descriptions of the installations are shown on the exploratory hole records in Appendix D.

The concentrations of gases, and depth to groundwater, were recorded within the standpipes on three occasions between 26th October 2022 and 8th November 2022. The readings are presented in Appendix D.

A groundwater data logger was installed within the standpipe constructed within borehole BH01 to a depth of 5.00m below ground level. The results of the interim monitoring programme are included in Appendix D. The results of the long term groundwater monitoring will be included in an update to this report.

6.6 Laboratory Testing

Laboratory testing was scheduled by Ashdown Site Investigation Ltd. Results from the laboratory tests are provided in Appendix E.

6.6.1 Geotechnical Testing

Geotechnical testing was undertaken by Ashdown Site Investigation Ltd in accordance with the methods given in BS1377[6]. Chemical testing to enable classification of the chemical environment of soils in accordance with BRE SD1[7] was undertaken by an external UKAS accredited laboratory.

6.6.2 Chemical Testing

Chemical (contamination) testing of selected samples was undertaken by a laboratory with recognised (UKAS and MCERTS) accreditation for quality control.

[4] The Soakaway Design Guide published by Kent County Council, 2000.
[5] Section 3.2.3 of Building Research Establishment (BRE) Digest 365, 2016.
[6] BS1377:1990 Parts 1 to 8, Methods of test for soils for civil engineering purposes.
[7] BRE Special Digest 1:2005 Concrete in Aggressive Ground.

7. GROUND CONDITIONS

7.1 Stratigraphy

7.1.1 Surface Covering

Each of the exploratory holes was excavated through a surface cover of asphalt some 70mm to 100mm in thickness.

7.1.2 Made Ground

Made ground, generally comprising sandy gravel/gravelly sand and/or slightly gravelly slightly sandy clay, was recorded to the full depths of the shallow trial pits and to depths of between 0.30m and 2.10m below ground level in the remaining boreholes. The gravel fraction comprised variable quantities of concrete, flint, clinker-like material, brick, glass, chalk and metal.

Generally, the deeper made ground was encountered towards the eastern part of the site, possibly associated with backfilling/levelling of the site at the edge of the brickworks area to the east, as denoted on the historical mapping data.

7.1.3 River Terrace Deposits

Beneath the made ground, where penetrated, the dynamic sampler boreholes encountered generally firm varying stiff clay soils containing a variable proportion of flint gravel, sand and silt. These clay soils were recorded to the full depth of borehole BH02 and to depths of between 1.00m and 2.90m in boreholes BH01, BH03, BH04, BH05, BH06 and STB01.

Underlying the clay soils, the boreholes progressed into generally medium dense sand and gravel soils. A further clay layer was noted in borehole BH01 below 2.90m, continuing to full depth of the borehole of 5.00m.

These soils are considered to be representative of the River Terrace Deposit soils indicated on the published geology map.

7.2 Stability

Each of the exploratory holes was recorded to remain stable during the course of drilling/excavation.

7.3 Groundwater Conditions

With the exception of borehole STB02, each of the exploratory holes were recorded to be dry during the short period of the intrusive works. Groundwater was noted at the base of borehole STB02 at 2.00m below ground level.

Whilst the installations were primarily for gas monitoring, groundwater depths were also recorded within the gas monitoring standpipes. These recorded groundwater at various depths of between 0.35m and 2.82m below ground level within boreholes BH02, BH05 and STB01,

possibly representing perched water bodies within the made ground given the relatively shallow depth of these standpipes.

An interim download of the data being stored on the data logger in BH01 has shown that groundwater was recorded at a peak of 4.10m below ground level at the beginning of November.

The results of the groundwater monitoring will be provided as an update to this report on completion of the monitoring period.

7.4 Existing Foundations

Details of the foundations exposed within the foundation inspection pits are included as Figure 3 of this report.

8. GEOTECHNICAL ASSESSMENT

The geotechnical assessment has been prepared in connection with the development proposals shown on the drawing included in Appendix A.

In summary the proposed development is understood to comprise the construction of residential townhouses with associated driveways and private gardens. At the time of writing, no details were available concerning the specific loads likely to be applied to the foundations.

8.1 Foundations

8.1.1 Soil Shrinkage/Heave Potential

The fine-grained soils of the River Terrace Deposits have been classified as clays and with plasticity indices in the range of 17% to 24%, the soils may be expected to exhibit up to a medium volume change potential.

It is recommended that the design of precautions against shrinkage and heave for any new foundation system (spread footings, piles and ground beams etc.) should assume a medium volume change potential for the fine-grained River Terrace Deposits soils and take into account current guidance such as that given by the Building Research Establishment (BRE)[8] or the National House Builders Council (NHBC)[9].

The undisturbed sands and gravels of the River Terrace Deposits encountered at depth may be considered to be non-plastic and hence non-shrinkable.

Whilst this report has been prepared to provide advice to assist designers in undertaking detailed design, the report itself does not represent a detailed design statement. Detailed foundation design, including assessment of foundation type, minimum founding depths for spread foundations, and requirements for placement of void formers et cetera, should take into account the findings of this report and the presence of trees (previous, present and proposed). In connection with the latter, it is recommended that an arboricultural survey of the site that identifies the species and maturity of the existing or recently felled trees in the areas of the proposed new buildings should be provided to engineers responsible for the foundation design. Information on proposed planting schemes that may affect foundation design should also be provided.

8.1.2 Spread Foundations

8.1.2.1 Foundation Depths for Spread Foundations

Foundations should be constructed to bear below soils that are likely to be affected by significant soil volume changes caused by seasonal changes in moisture content to avoid damage to foundations that could otherwise arise. In addition, all made ground and any soils disturbed by the construction or removal of any previously existing foundations or services should be regarded as being variable in nature and state of compaction and, as such, unsuitable as a founding medium for shallow footings. New footings should be constructed so as to bear below made ground/disturbed natural soils and soil subject to seasonal soil volume changes, whichever is the deeper, and onto undisturbed, competent, natural deposits.

[8] www.bre.co.uk : BRE Digests 240, 241 and 242, Low rise buildings on shrinkable clay soils, parts 1, 2 and 3; and BRE Digest 298 , The influence of trees on house foundations in clay soils and BRE Digest 412, Desiccation in clay soils.
[9] http://www.nhbc.co.uk/ : NHBC Standards, Chapter 4.2.

Summary guidance on suitable minimum foundation depths to protect against the effects of seasonal soil volume changes is presented in the table below but designers undertaking detailed design of foundations should follow the detailed guidance provided within Chapter 4.2 of the NHBC Standards.

Table 11. Indicative Minimum Foundation Depths

Tree Type	Water Demand of Tree	Tree Distance to Tree Height Ratio (D/H)									
		0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.80	1.00	1.25
		Minimum Foundation Depth Required in Medium Volume Change Potential Soils (m)									
Broad Leaf	High	†			2.50	2.35	2.20	2.00	1.70	1.35	0.90*
	Moderate	2.00	1.85	1.70	1.60	1.45	1.30	1.15	0.90*	0.90*	0.90*
	Low	1.50	1.40	1.30	1.15	1.05	0.90*	0.90*	0.90*	0.90*	0.90*
Coniferous	High	†		2.30	1.95	1.60	1.25	0.90*	0.90*	0.90*	0.90*
	Moderate	2.00	1.70	1.40	1.10	0.90*	0.90*	0.90	0.90*	0.90*	0.90*

* Minimum foundation depth required to protect against soil volume changes.
† Foundations deeper than 2.50m require specialist design to protect against soil volume changes.

Where specialist foundation design is required (foundation depths exceeding the maximum permitted by the guidance) then piled foundations are likely to be needed, though commercial considerations may also dictate that piled foundations may be more economic even in comparison with conventional spread foundations constructed to depths less than the maximum permitted by guidance. Further works including deep boreholes would be required if structural engineers or quantity surveyors decide that piled foundations should be adopted.

Details on the water demand and mature height of common trees is given within Table 3 of Chapter 4.2 of the NHBC standards which should be referred to when assessing minimum foundation depths required for the proposed development. A summary is provided in the table below.

Table 12. Indicative Summary of Water Demand and Mature Height of Common Trees

Tree Type	High Water Demand		Moderate Water Demand		Low Water Demand	
	Tree	Height (m)	Tree	Height (m)	Tree	Height (m)
Broad Leaf	Elm	18 – 24*	Acacia	18	Birch	14
	Oak	16 – 24*	Alder	18	Elder	10
	Poplar	15 – 28*	Apple	10	Fig	8
	Willow	16 – 24*	Ash	11 – 23*	Hazel	8
	Eucalyptus	18	Laurel	10	Holly	12
	Hawthorn	10	Beech	20	Honey Locust	14
			Blackthorn	8	Hornbeam	17
			Cherry	8 – 17*	Laburnum	12
			Chestnut	20 – 24*	Magnolia	9
			Lime	22	Mulberry	9
			Maple	8 – 18*	Tulip Tree	20

Tree Type	High Water Demand		Moderate Water Demand		Low Water Demand	
	Tree	Height (m)	Tree	Height (m)	Tree	Height (m)
			Pear	12		
			Plane	26		
			Plum	10		
			Sycamore	22		
			Tree of Heaven	20		
			Walnut	18		
			Whitebeam	12		
Coniferous	Cypress	18 – 20*	Cedar	20		
			Douglas Fir	20		
			Larch	20		
			Monkey Puzzle	18		
			Pine	20		
			Spruce	18		
			Wellingtonia	30		
			Yew	12		

* Dependent on particular species.

8.1.2.2 Bearing Capacity for Spread Foundations

For design purposes, a net allowable bearing capacity of 100kN/m^2 may be assumed for spread (pad or strip) foundations up to 1.00m across bearing within the River Terrace Deposits of at least firm consistency. An increased bearing capacity of 150kN/m^2 may be assumed for similar sized foundations founded within the River Terrace Deposits of at least stiff consistency or medium dense relative density, typically encountered at depths of between 1.00m and 2.50m at most exploratory hole positions. The quoted bearing capacities are expected to limit settlement to less than 25mm.

Attention is drawn to the presence of interbedded fine-grained soils and coarse-grained soils beneath the site. As there is the potential for mixed soil conditions to be present beneath footings, designers should consider the need for foundations to be reinforced due to the potential for differential cracking to develop as a result of coarse-grained and fine-grained soils settling at different rates under loading.

Care must be taken to ensure that new foundations do not undermine or impose additional loading (vertical or lateral) on existing foundations/structures. Similarly, the construction of new foundations should be undertaken carefully and monitored in those situations where temporary works could affect existing foundations/structures.

In view of the generic risk associated with the underlying geology at the site for potential natural ground and mining hazard, it is recommended that all stripped formation levels should be inspected by a suitably qualified person for evidence of historical backfilled shafts and/or dissolution features as a precaution.

It is also recommended that, where a bearing capacity in excess of 100kN/m^2 is to be considered, the foundation formations should be inspected by suitably qualified persons to confirm the consistency/relative density of the soils at formation level. In this connection it is noted that the

soils in BH06 were found to become weaker with depth (below 2.60m) and as such an allowable bearing pressure in excess of 100kN/m^2 is unlikely to be available in this part of the site.

8.2 Ground Floors

In view of the variable and significant thickness of made ground, and the presence of soils of medium volume change potential underlying the site, it is recommended that ground floors should be suspended.

Current guidance[10] suggests that ground bearing floor slabs may, however, be considered where:

1. All made ground is removed from beneath the building footprint;
2. The depth of foundations required to protect against seasonal soil volume changes close to trees is less than 1.5m; and
3. Further works demonstrate that close to the time of construction, no significant soil desiccation is present.

Where the above criteria cannot be met ground floors should be suspended.

If ground bearing floors are adopted it is recommended that the potential for differential movement, both between the floor slab and walls and across the floor slab itself, should be anticipated. Such floors should be fully debonded from walls. Formations should be adequately proof rolled and any excessively soft materials excavated and replaced with a suitable, well graded granular fill. The depth of any fill should be limited to a maximum of 600mm unless placed to an engineering specification designed to limit internal settlement of the fill materials to a tolerance to be advised by the designer. The detailing of services through, or under, ground-bearing floors should incorporate flexible connections and, where appropriate, enhanced falls.

8.3 Groundwater

At the time of the intrusive works the majority of the exploratory holes were recorded to be dry during drilling/excavation.

Within the deeper standpipes installed on site, groundwater has been recorded at depths peaking at 2.82m and 4.10m below ground level during the monitoring carried out to date. Within the shallow standpipes water was recorded at shallow depths, likely representing perched water bodies within the made ground. Longer term monitoring is currently ongoing and the results will be included in a later update of this report on completion of the winter monitoring period.

Where excavations are proposed to extend below the water table, groundwater control will be required to maintain adequately dry working conditions and excavation stability. In such circumstances it is recommended that trial pumping from proposed formation depths should be undertaken in advance of detailed design to fully establish requirements for groundwater control at this site.

For excavations made above the water table, the ingress of perched water and/or surface run of during heavy precipitation would be expected to be adequately managed by either pumping from sumps or natural drainage, or a combination of the two.

[10] http://www.nhbc.co.uk/ : NHBC Standards, Chapter 4.2.

8.4 Stability of Excavations

All made ground or coarse-grained natural soils exposed in excavations should be assumed to be unstable, even in the short term. Whilst fine-grained natural soils may remain stable for a short period of time if not subjected to surcharge loads (such as may be imposed by existing foundations, traffic or storage of materials), the stability of these deposits if left unsupported should be assumed to have the potential to deteriorate. Where stable excavations are required, excavations should either be suitably supported or, where space permits, side slopes could be battered back to a safe angle of repose.

All excavations requiring human entry must be shored or battered as necessary to conform to current best practice, as accepted by the Health and Safety Executive (HSE)[11]. Current legislation requires that where personnel access is required into any excavation a competent person must inspect excavation supports or battering of slopes at the start of the working shift and at other specified times. No work should take place until the excavation is safe. Excavations should also be inspected after any event that may have affected their stability, such as a significant weather event, changes in surcharge loadings imposed by temporary storage of materials or changes in site traffic plans or alteration of support systems. Inspections should be formally recorded and any faults that are found should be corrected immediately.

Particular attention must be paid to ensuring the stability of nearby structures, services and neighbouring sites.

8.5 Aggressivity to Concrete

The aggressivity of the soils to concrete has been assessed in accordance with guidance published by the BRE[12].

In consideration of the soils encountered beneath the site, particularly the deep made ground, it is recommended that 'brownfield ground conditions' should be assumed for the purpose of assessing the aggressivity of the chemical environment for concrete classification (ACEC class). Given the noted occurrence of groundwater 'mobile groundwater' conditions should be assumed.

The following table summarises the characteristic values indicated from the chemical analysis of the soils present beneath the site.

Table 13. Assessment of the Chemical Analysis of the Soil

	Characteristic Value	Design Sulfate Class	ACEC Classification
pH	7.6	-	-
Water Soluble Sulphate (mg/l as SO4) *	0	DS-1	AC-1
Water Soluble Sulphate including mineral acids (mg/l as SO4)	N/A as pH >5.5	-	-

Notes: * Characteristic value rounded to nearest 100.

[11] Relevant guidance is given on the HSE website, www.hse.gov.uk
[12] BRE Special Digest 1:2005 Concrete in Aggressive Ground.

In accordance with the guidance, a DS-1 Design Sulfate Class and an AC-1 ACEC classification should be assumed as a minimum for the design of concrete in contact with the ground.

8.6 Pavement Design

Current guidance[13] suggests that pavement design should be based on the design subgrade surface modulus, determined as being equal to the lower of the short-term subgrade modulus and the long-term subgrade modulus. The subgrade surface modulus can be related to California bearing ratio using the formula, $E = 17.6(CBR)^{0.64}$, where E is the subgrade modulus expressed in MPa.

Cone penetrometer tests undertaken to establish the California bearing ratio (CBR) of the in-situ soils at the time of the investigation. The range of values determined is presented on the test result records within Appendix D, and the table and graphs contained within Appendix F. A summary of the in situ test data is presented below. It is noted that in situ CBR values are, in part, dependent on the moisture content of the tested soils and are consequently subject to seasonal variation.

Table 14. In Situ CBR Values (At Time of Ground Investigation Works)

	CBR (%)	Modulus of Subgrade Reaction E (Mpa)
Minimum	1.9	26.7
Average	22.4	117.3
Maximum	238.5	585.0
10%ile	6.4	57.7
20%ile	8.3	68.2
50%ile (Median)	12.7	89.7

Equilibrium CBR values can be derived from knowledge of soil classification data (plasticity index for soils exhibiting cohesion (clay type) and particle size distribution for granular soils) and pavement thickness. Historical guidance[14] suggests the following design equilibrium CBR values would be applicable to the River Terrace Deposits soils and derived made ground for the construction of pavement. The subgrade moduli calculated from these design equilibrium CBR values can be reasonably considered to be representative of long-term subgrade modulus using the formula given above.

Table 15. Long-term CBR Values

Stratum	Design Equilibrium CBR Value (%)			†Modulus of Subgrade Reaction E (Mpa)
		Thin Road* Pavement	Thick Road* Pavement	
Fine grained River Terrace Deposits and Derived Made Ground	Minimum	3.6	4.6	40.0
	Average	3.8	5.0	41.3
	Maximum	4.0	5.3	42.7

* Thin pavement being 300mm sub-base, thick pavement being 1200mm sub-base. †Modulus based on average of all calculated moduli based on CBR values for thin sub-base.

[13] Highways England Design Manual for Roads and Bridges CD 225 Rev1; Design for new pavement foundations.
[14] Highways England Design Manual for Roads and Bridges Interim Advice Note 73/09 Rev1; now withdrawn.

Designers will need to select an appropriate design equilibrium CBR value/modulus of subgrade reaction taking account of proposed pavement thickness, expected winter groundwater conditions, the standard to which pavement is to be designed and any local authority or other regulatory/warrantor requirements together with construction conditions likely to prevail at the time of construction.

The subgrade should be assumed to be susceptible to frost heave.

8.7 Stormwater Infiltration Systems

In-situ infiltration testing[15] was undertaken in boreholes STB01 and STB02. From the test results, calculations were made to estimate the infiltration rate that could be expected for soakaways constructed to discharge into the underlying soils within the test zone.

In-situ infiltration testing[16] was also carried out in trial pits STP01 and STP02.

For the first test carried out in trial pit STP02 the soil infiltration rate (f) was calculated by dividing the volume of water lost between 75% and 25% of the initial test depth by the sum of the average surface area of the sides of the trial pit in contact with the water during the test monitoring period, and its base area. This figure was then divided by the test duration (time taken for the water level to fall between 75% and 25% of the initial test depth) to give the soil infiltration rate in metres per second.

During the first test performed within trial pit STP01 and the second test within STP02, the water level within the test pit started to rise due to heavy precipitation. The subsequent tests are based on the fall of this water level once the precipitation had stopped infilling the pits. As the water levels during these tests did not fall below between 75% and 25% of the initial test depth, calculation of the soil infiltration rate in accordance with the BRE digest was not possible. Where possible, the soil infiltration rate has therefore been calculated by dividing the volume of water lost during the test by the product of the average surface area of the trial pit in contact with water during the test period and the test duration in seconds.

The infiltration rates derived from the tests are summarised in the following table.

Table 16. Calculated Infiltration Rates

Exploratory Hole	Test Response Zone Depth (m)		Stratum	Infiltration Rate (f) (m/sec)	Driving Head of Water (m)
	Top	Bottom			
STB01 Test 1	1.00	2.00	River Terrace Deposits	1.61×10^{-5}	1.2
				3.74×10^{-6}	0.9
				6.81×10^{-7}	0.7
STB02 Test 1	1.00	2.00	Reworked Soils	2.50×10^{-5}	1.5
				2.00×10^{-5}	1.3
				1.09×10^{-5}	0.8
STB02 Test 2	1.00	2.00	Reworked Soils	1.34×10^{-5}	1.2

[15] Conducted in accordance with The Soakaway Design Guide, published by Kent County Council, July 2000.
[16] Conducted in general accordance with the requirements of BRE 365, Soakaway Design.

Exploratory Hole	Test Response Zone Depth (m)		Stratum	Infiltration Rate (f) (m/sec)	Driving Head of Water (m)
	Top	Bottom			
				9.46×10^{-6}	0.8
				6.49×10^{-6}	0.6
STB02 Test 3	1.00	2.00	Reworked Soils	2.00×10^{-5}	1.4
				1.30×10^{-5}	1.2
				6.18×10^{-6}	0.8
STP01 Test 1	0.20	0.45	Made Ground	n/a – water level rose during test due to heavy precipitation.	
STP01 Test 2	0.12	0.45	Made Ground	1.52×10^{-6} based on fall in water level after heavy precipitation.	
STP02 Test 1	0.21	0.45	Made Ground	1.13×10^{-4}	
STP02 Test 2	0.21	0.45	Made Ground	2.50×10^{-5} based on first 5 minutes after which water level rose due to heavy precipitation.	
STP02 Test 3	0.23	0.45	Made Ground	1.03×10^{-5} based on fall in water level after heavy precipitation.	

The value 'f' is equivalent to the soil infiltration coefficient 'q' quoted in the Construction Industry Research and Information Association (CIRIA) Report 156.

The results from the infiltration tests indicate that the soils beneath the site possess variably poor to moderate infiltration characteristics. The results from the infiltration tests should be provided to engineers responsible for the design of the drainage system.

To comply with building regulations[17], point discharging infiltration systems (conventional ring or trench soakaways) are required to be constructed a minimum of 5.0m away from proposed or existing buildings.

[17] The Building Regulations 2010; Part H; Drainage and Waste Disposal

9. QUANTITATIVE CONTAMINATION ASSESSMENT

9.1 Assessment Strategy

The investigation comprised a spread of non-targeted sampling positions across the accessible areas of the site. The density of the positions is considered sufficient to allow a quantitative assessment of the sources of contamination identified by the preliminary contamination risk assessment.

Gas monitoring standpipes were installed in selected exploratory boreholes across the site to assess the risk of ground gases to end users.

9.2 Analysis of Contamination Test Results

9.2.1 Method of Assessment

For the assessment of risk to end users, comparison of the results of the laboratory testing has been made against published soil screening values (SSV) comprising the 'Suitable For Use Levels' (S4UL)[18] or, in lieu of an S4UL being developed for lead, the Category 4 Screening Level (C4SL)[19].

In view of the development proposal, the SSV utilised in this assessment are those calculated for the generic "Residential" land use[20]. The critical receptor for this land use is considered to be a young female child resident on site from birth to age 6. Exposure routes that are considered include the potential for direct ingestion of the soil, the outdoor and indoor ingestion of dust, the potential inhalation of dust and vapours, ingestion of site grown vegetables and ingestion of soil attached to vegetables.

For the assessment of risk to controlled waters a qualitative assessment has been undertaken based upon the concentrations of contaminants recorded within the soil samples and the information obtained about the sensitivity of the underlying strata or nearby surface water receptors.

9.2.2 Heavy Metals & Polycyclic Aromatic Hydrocarbon (PAH) Compounds

The following table summarises the SSV along with the maximum and minimum concentrations of the heavy metals and PAH compounds tested for.

Table 17. Summary of Test Results – Heavy Metals and PAH Compounds

Contaminant	SSV (mg/kg)	No. of Samples	Minimum Concentration (mg/kg)	Maximum concentration (mg/kg)	Limit of Detection (mg/kg)	No of exceedances
Arsenic	37	6	10	15.4	1	0
Cadmium	11	6	<LOD	0.5	0.5	0
Chromium	910	6	25.2	72.9	5	0

[18] Nathanail, C.P, et al., The LQM/CIEH S4ULs for Human Health Risk Assessment, 2015, Land Quality Press, Nottingham. Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3071.
[19] SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination. Final Project Report, published by DEFRA, 2014.
[20] As defined within Science Report SC050021/SR3, January 2009, with the amendments discussed in the LQM/CIEH report.

Contaminant	SSV (mg/kg)	No. of Samples	Minimum Concentration (mg/kg)	Maximum concentration (mg/kg)	Limit of Detection (mg/kg)	No of exceedances
Copper	2400	6	20.7	48.7	5	0
Lead	200	6	39.7	275	5	2
Mercury	40	6	<LOD	<LOD	0.5	0
Nickel	180	6	18.4	37.2	5	0
Selenium	250	6	<LOD	<LOD	1	0
Zinc	3700	6	73.8	251	5	0
Hexavalent Chromium	6	6	<LOD	<LOD	0.8	0
Water Soluble Boron	290	6	<LOD	1.3	0.5	0
Naphthalene	2.3	6	<LOD	0.2	0.1	0
Acenaphthylene	170	6	<LOD	0.6	0.1	0
Acenaphthene	210	6	<LOD	5.5	0.1	0
Fluorene	170	6	<LOD	3.8	0.1	0
Phenanthrene	95	6	<LOD	25.5	0.1	0
Anthracene	2400	6	<LOD	8.4	0.1	0
Fluoranthene	280	6	<LOD	32.7	0.1	0
Pyrene	620	6	<LOD	25.3	0.1	0
Benz(a)anthracene	7.2	6	<LOD	12.2	0.1	1
Chrysene	15	6	<LOD	11.9	0.1	0
Benzo(b)fluoranthene	2.6	6	<LOD	10.8	0.1	2
Benzo(k)fluoranthene	77	6	<LOD	11.7	0.1	0
Benzo(a)pyrene	2.2	6	<LOD	12.1	0.1	3
Indeno(123-cd)pyrene	27	6	<LOD	7.2	0.1	0
Dibenz(ah)anthracene	0.24	6	<LOD	0.9	0.1	3
Benzo(ghi)perylene	320	6	<LOD	6.7	0.1	0

Concentrations of lead and several PAH compounds have been recorded in excess of their respective SSV. The shallow soils are therefore considered to pose an unacceptable risk to end users where they may remain within areas of proposed soft landscaping.

At the concentrations recorded, none of the contaminants would be expected to exhibit any significant mobility within the soils and are therefore not considered to pose an unacceptable risk to controlled waters beneath the site.

9.2.3 Asbestos

No suspected asbestos materials were noted within any of the exploratory holes undertaken at the site. Six samples of the made ground were screened for the presence of asbestos, of which none recorded the presence of any asbestos materials.

There is not considered to be an unacceptable risk to end users from asbestos materials within soils. However, due to the heterogeneity of made ground, there will always remain the potential for localised asbestos materials to be encountered during construction works, though the likelihood of this is considered to be very low. All workers at the site should be made aware of what actions to take in the event that suspected asbestos materials are identified at any time during the development works.

9.2.4 Petroleum Hydrocarbons

The following table lists the screening values for petroleum hydrocarbon equivalent carbon weight fractions calculated for 1% organic content.

Whilst full speciation of the concentrations of petroleum hydrocarbons by aromatic and aliphatic fractions was not undertaken, the results of the testing undertaken can still be compared with the more stringent of the screening values for the respective equivalent carbon weight fraction and, where the concentration recorded is found to be lower, it can be reasonably concluded that no significant risk is present.

Table 18. Soil Screening Values for petroleum hydrocarbon equivalent carbon weight fractions

Petroleum Hydrocarbon Fraction	SSV (mg/kg)	Petroleum Hydrocarbon Fraction	SSV (mg/kg)
Aliphatic EC 5-6	42	Aromatic EC 5-7	70
Aliphatic EC >6-8	100	Aromatic EC >7-8	130
Aliphatic EC >8-10	27	Aromatic EC >8-10	34
Aliphatic EC >10-12	130	Aromatic EC >10-12	74
Aliphatic EC >12-16	1100	Aromatic EC >12-16	140
Aliphatic EC >16-35	65000	Aromatic EC >16-21	260
Aliphatic EC >35-44	65000	Aromatic EC >21-35	1100
		Aromatic EC >35-44	1100

None of the samples recorded concentrations of individual weight fractions in excess of the more conservative SSV. The concentrations present are not considered to pose an unacceptable risk to end users via direct contact, dust or vapour pathways.

At the low concentrations recorded, and in the absence of any ongoing source of petroleum hydrocarbon contamination, there is not considered to be an unacceptable risk to controlled waters.

Comparison of the test results with screening criteria for water supply pipes[21] indicates that the protection of water supply services is likely to be required. Notwithstanding the above it is strongly recommended that designers consult with the proposed water supply company to ascertain if further laboratory testing and assessment specific to proposed routes of services is required.

9.3 Analysis of Ground Gas Monitoring Results

Monitoring of the gas concentrations within the standpipes in the boreholes BH02, BH03, BH06, and STB01 was carried out on three occasions.

Atmospheric pressures varied between 1000mb and 1015mb during the monitoring period, and readings were taken during periods of both rising and falling atmospheric pressure.

Assessment of the results of the monitoring has been carried out in general accordance with current CIRIA guidance[22].

[21] Set out within Table 3.1 of the Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites, UK Water Industry Research, 2010.
[22] CIRIA document C665, Assessing risks posed by hazardous ground gases to buildings, 2007.

The guidance provides a methodology for assessing the risk from ground gases by the calculation of site-specific gas screening values (GSV) for carbon dioxide and methane. These are calculated by multiplying the concentration (percentage/volume) of a gas by a gas flow rate (l/hr).

An initial assessment has been carried out by calculating the GSV using the highest consistent flow rate recorded multiplied by the highest gas concentration recorded. This is considered to represent a highly conservative assessment of the risk posed by ground gases.

Where no detectable gas concentrations or flow rates are recorded, the GSV are calculated assuming values equal to the limit of detection of the instrument are present.

The peak concentration of carbon dioxide recorded was 3.9% by volume. No detectable concentrations of methane and no detectable gas flow rates were recorded within any of the boreholes.

The following table summarises the calculated GSV:

Table 19. Calculated GSV for Carbon Dioxide and Methane

Gas	GSV
Carbon Dioxide	0.036 x 0.1 = 0.0036
Methane	0.001 x 0.1 = 0.0001

For "typical" 2 storey housing, the guidance references a characterisation system which compares either the calculated GSV or typical maximum values to generic "traffic light" scenarios.

For the calculated GSV Table 8.7 of the CIRIA document would classify the site as "Green" and, provided that a well-ventilated sub floor void is installed, no other specific gas protection measures are considered to be necessary.

9.4 Quantitative Contamination Risk Assessment

9.4.1 Contamination Sources Identified

The following source of contamination has been identified by the quantitative contamination risk assessment:

- Made ground soils across the site containing elevated levels of lead, PAH Compounds and Petroleum Hydrocarbons.

9.4.2 Quantitative Conceptual Model

The quantitative conceptual model for the proposed development is presented in Appendix G.

9.5 Risks to Other Potential Receptors

All construction workers must undertake their own risk assessment, based upon the works to be carried out and the proposed method by which this will be achieved, in accordance with current health and safety legislation. Their assessment should take into account all available information about the site, including that present within this report.

Appropriate working procedures and PPE should be adopted to ensure the health and safety of the site operatives. Instruction should be given in the recognition of potentially hazardous materials. All site personnel should be appropriately briefed on the discovery strategy, presented below, and what actions they must take in the event that further evidence of contamination is identified or suspected.

9.6 Recommendations

As complete pollutant linkages relating to end users have been identified at the site, it is considered that remedial measures will be required as part of the proposed development.

Given the sources of contamination identified to pose a risk to human health, it is considered that the remedial works likely to be necessary would comprise provision of a cover system of suitable soils overlying the contaminated soils that are to remain within all proposed soft landscaped areas.

The remediation works ultimately adopted should be detailed within a separate remediation strategy, along with a verification plan. This should be produced once this risk assessment report has been reviewed and approved by the appropriate authority.

9.7 Discovery Strategy

If, during the course of the site clearance and development works, any materials not previously identified by the investigation that are suspected of being 'contaminants' are encountered, then the following procedure should apply:

- All works in that area should cease and the site manager should be informed.
- Advice should be sought from suitably qualified and experienced personnel as to whether any further site inspection, sampling, testing and/or assessment is deemed necessary.

- If required, the conclusions of any assessment and any proposed remedial works (if required) should be agreed by the local authority.
- If necessary, full details of any remedial works should be included in the verification report for the site.

Suspected 'contamination' may take the following form, though it is noted that this list is not exhaustive and site operatives should ask if they are at all unsure of any findings:

- Soil or water looks oily and/or has an oily odour
- Soil or water has a solvent type of odour
- Significant quantities of man-made materials within fill such as paint cans, car parts, glass fragments
- Suspected asbestos containing materials (insulating boards, cement, loose fibres etc.)
- Significant volumes of clinker like or ashy material
- Sand bags, and/or subsurface concrete structures
- Animal carcasses or evidence of animal burial pits

Ashdown Site Investigation Ltd.

ASHDOWN SITE INVESTIGATION LIMITED
E-mail: contact@ashdownsi.co.uk
Web: www.ashdownsi.co.uk
Tel: 01273 483119

Site Name: South Street, Lancing, West Sussex

Job Number: P15791

Start Date: 23/09/2022

End Date: 23/09/2022

Borehole Number: **BH01** Sheet 1 of 1

Standpipe	Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Dynamic Probe 0 5 10 15 20 25 30	Legend	Depth	Stratum Description
							0.00	Asphalt.
							0.07	MADE GROUND: Yellow brown gravelly sand. Gravel is subangular to subrounded fine to coarse flint.
	J T	0.30					0.20	MADE GROUND: Brown slightly gravelly slightly sandy silty clay. Gravel is subangular to subrounded fine to coarse ash-like material, glass, chalk, brick, concrete, clinker-like material and metal.
	D	0.50						
	J T	0.90						
	J T	1.20						
	D	1.50						
	J T	1.80					1.80	Firm to stiff orange brown slightly gravelly slightly sandy silty CLAY. Gravel is subangular to subrounded fine to coarse flint. (River Terrace Deposits)
	J T	2.10						
	H	2.10		140				
	D	2.50						becoming stiff below 2.50m depth.
	H	2.50		90				
	H	2.70		140				
	D	2.80					2.90	Medium dense grey and orange brown gravelly silty SAND. Gravel is subangular to subrounded fine to coarse flint. (River Terrace Deposits)
	D	3.10						
	D	3.80						becoming very gravelly with depth.
	D	4.10					4.50	Stiff to very stiff light yellow brown slightly gravelly silty CLAY. Gravel is subangular to subrounded fine to coarse flint and fine chalk. (River Terrace Deposits)
	D	4.80					5.00	End of borehole at 5.00m

Remarks

Groundwater: Borehole dry on completion.

Stability: Borehole stable on completion.

Notes: Standpipe installed to 5.00m depth; 5.00m to 2.00m slotted pipe with gravel surround; 2.00m to ground level plain pipe with bentonite seal; completed with end cap, data logger and security cover concreted flush with ground surface.

Excavation Method: WLS

Borehole Diameter: Various

Made By: TM

ASHDOWN SITE INVESTIGATION
L•I•M•I•T•E•D
E-mail: contact@ashdownsi.co.uk
Web: www.ashdownsi.co.uk
Tel: 01273 483119

Site Name: South Street, Lancing, West Sussex

Job Number: P15791

Start Date: 23/09/2022

End Date: 23/09/2022

Borehole Number: **BH02**

Standpipe	Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Dynamic Probe 0 5 10 15 20 25 30	Legend	Depth	Stratum Description
							0.00	Asphalt.
							0.10	MADE GROUND: Brown slightly gravelly slightly sandy silty clay. Gravel is subangular to subrounded fine to coarse ash-like material and brick.
	J T	0.30						
	J T	0.50						
	D	0.80						
	J T	0.90						
	D	1.50						with ceramic fragments at 1.40m depth.
	D	2.00						
							2.10	Firm to stiff orange brown with black speckling slightly sandy silty CLAY with occasional decayed rootlets. (River Terrace Deposits)
	D	2.50						
	H	2.50		140				becoming stiff below 2.50m depth.
	D	3.00					3.00	
	H	3.00		115				End of borehole at 3.00m

Remarks

Groundwater: Borehole dry on completion.

Stability: Borehole stable on completion.

Notes: Standpipe installed to 3.00m depth; 3.00m to 1.00m slotted pipe with gravel surround; 1.00m to ground level plain pipe with bentonite seal; completed with gas tap and security cover concreted flush with ground surface.

Excavation Method: WLS

Borehole Diameter: Various

Made By: TM

ASHDOWN SITE INVESTIGATION LIMITED
E-mail: contact@ashdownsi.co.uk
Web: www.ashdownsi.co.uk
Tel: 01273 483119

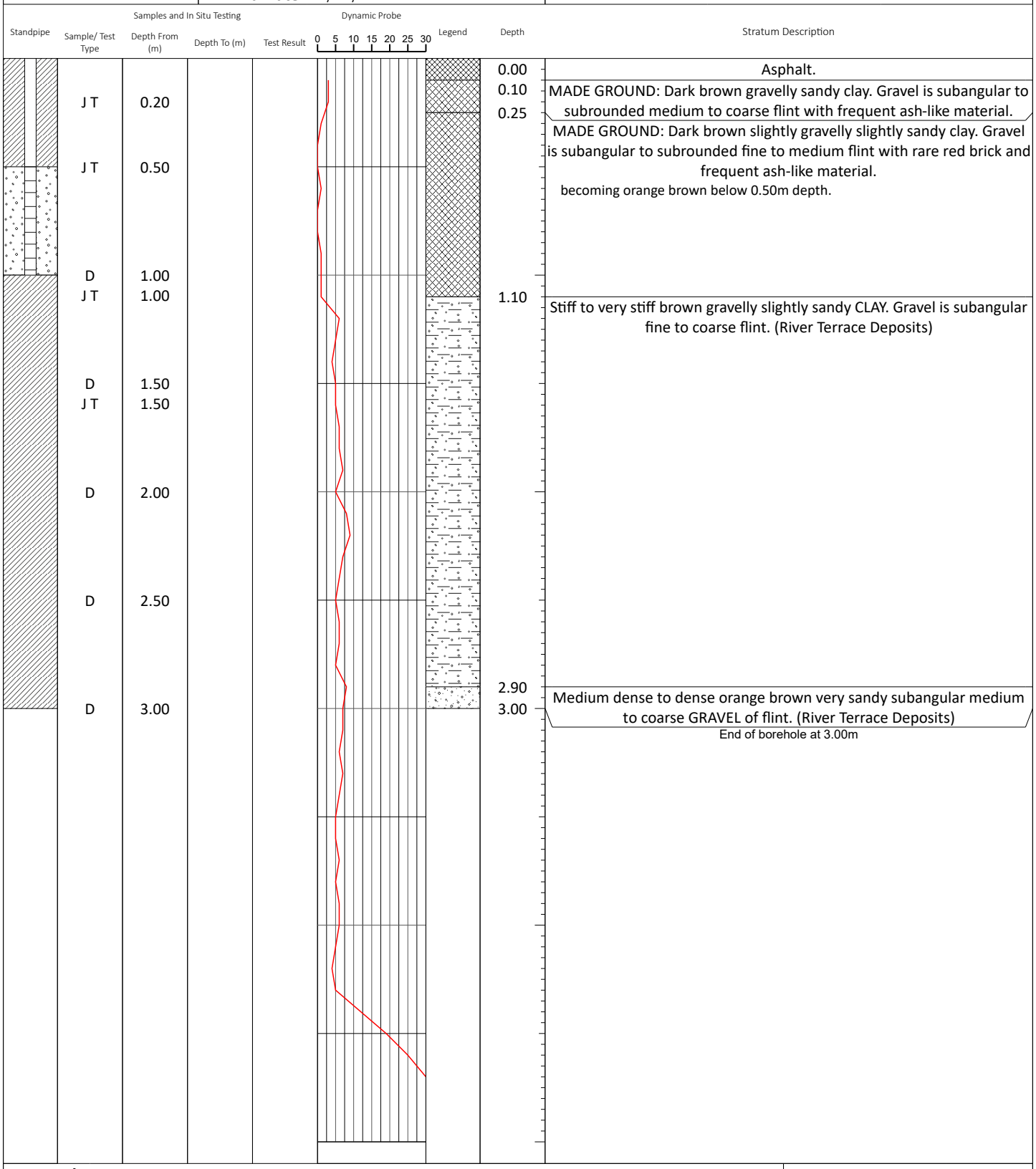
Site Name: South Street, Lancing, West Sussex

Job Number: P15791

Start Date: 21/10/2022

End Date: 21/10/2022

Borehole Number: **BH03** Sheet 1 of 1



Asphalt.

MADE GROUND: Dark brown gravelly sandy clay. Gravel is subangular to subrounded medium to coarse flint with frequent ash-like material.

MADE GROUND: Dark brown slightly gravelly slightly sandy clay. Gravel is subangular to subrounded fine to medium flint with rare red brick and frequent ash-like material.

becoming orange brown below 0.50m depth.

Stiff to very stiff brown gravelly slightly sandy CLAY. Gravel is subangular fine to coarse flint. (River Terrace Deposits)

Medium dense to dense orange brown very sandy subangular medium to coarse GRAVEL of flint. (River Terrace Deposits)

End of borehole at 3.00m

Remarks

Groundwater: Borehole dry on completion.

Stability: Borehole stable on completion.

Notes: Standpipe installed to 1.00m depth; 3.00m to 1.00m bentonite seal; 1.00m to 0.50m slotted pipe with gravel surround; 0.50m to ground level plain pipe with bentonite seal; completed with gas tap and security cover concreted flush with ground surface.

Excavation Method: WLS

Borehole Diameter: Various

Made By: JN

ASHDOWN SITE INVESTIGATION LIMITED
E-mail: contact@ashdownsi.co.uk
Web: www.ashdownsi.co.uk
Tel: 01273 483119

Site Name: South Street, Lancing, West Sussex

Job Number: P15791

Start Date: 21/10/2022

End Date: 21/10/2022

Borehole Number: **BH04**

Standpipe	Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Dynamic Probe 0 5 10 15 20 25 30	Legend	Depth	Stratum Description
							0.00	Asphalt.
	J T	0.20					0.10	MADE GROUND: Dark brown gravelly sandy clay. Gravel is subangular to subrounded medium to coarse flint with frequent ash-like material.
							0.30	Firm to stiff orange brown slightly gravelly slightly sandy CLAY. Gravel is subangular to subrounded fine to medium flint. (River Terrace Deposits)
	J T	0.50						
	H	0.50		60				
	D	1.00						
	J T	1.00						
	H	1.00		90				
	V	1.00		90				
	D	1.50						
	H	1.50		75				
	J T	1.70						
	D	2.00						becoming gravelly sandy CLAY below 1.90m depth.
	J T	2.20					2.10	Medium dense yellow brown very sandy subangular to subrounded fine to medium GRAVEL of flint. (River Terrace Deposits)
							2.30	Orange fine to medium SAND. (River Terrace Deposits)
	D	2.50						
	D	3.00					3.00	End of borehole at 3.00m

Remarks

Groundwater: Borehole dry on completion.

Stability: Borehole stable on completion.

Notes: n/a

Excavation Method: WLS

Borehole Diameter: Various

Made By: JN

ASHDOWN SITE INVESTIGATION
L•I•M•I•T•E•D
E-mail: contact@ashdownsi.co.uk
Web: www.ashdownsi.co.uk
Tel: 01273 483119

Site Name: South Street, Lancing, West Sussex

Job Number: P15791

Start Date: 21/10/2022

End Date: 21/10/2022

Borehole Number: **BH05**

Standpipe	Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Legend	Depth	Stratum Description
						0.00	Asphalt.
	J T	0.20				0.10	MADE GROUND: Dark brown gravelly sandy clay. Gravel is subangular to subrounded medium to coarse flint with frequent ash-like material.
						0.25	MADE GROUND: Dark brown slightly gravelly slightly sandy clay. Gravel is subangular to subrounded fine to medium flint with rare ash-like material and brick.
	D	0.50					
	J T	0.50					
	H	0.50		90		0.70	Firm to stiff orange brown slightly gravelly slightly sandy silty CLAY. Gravel is subangular to subrounded fine to medium flint. (River Terrace Deposits)
	D	1.00					
	J T	1.00					
	H	1.00		100			
	D	1.50					
	J T	1.50					
	H	1.50		90			
	D	2.00					
	H	2.00		60			
	D	2.50				2.60	Medium dense orange brown very sandy silty subangular to subrounded fine to medium GRAVEL of flint. (River Terrace Deposits)
							becoming dense to very dense towards base.
	D	3.00				3.00	End of borehole at 3.00m

Dynamic Probe: 0 5 10 15 20 25 30

Remarks

Groundwater: Borehole dry on completion.

Stability: Borehole stable on completion.

Notes: n/a

Excavation Method: WLS

Borehole Diameter: Various

Made By: JN

ASHDOWN SITE INVESTIGATION
L•I•M•I•T•E•D
E-mail: contact@ashdownsi.co.uk
Web: www.ashdownsi.co.uk
Tel: 01273 483119

Site Name: South Street, Lancing, West Sussex

Job Number: P15791

Start Date: 21/10/2022

End Date: 21/10/2022

Borehole Number: **BH06**

Standpipe	Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Dynamic Probe 0 5 10 15 20 25 30	Legend	Depth	Stratum Description
							0.00	Asphalt.
	J T	0.20					0.10	MADE GROUND: Yellow brown gravelly sandy clay. Gravel is subangular to subrounded medium to coarse flint with frequent ash-like material.
							0.25	MADE GROUND: Dark brown gravelly slightly sandy clay. Gravel is subangular to subrounded fine to medium flint with rare brick and ash-like material.
	J T	0.50						
	H	0.60		50				
	D	1.00						
	J T	1.00						
							1.20	Firm to stiff orange brown slightly gravelly slightly sandy silty CLAY. Gravel is subangular to subrounded fine to medium flint. (River Terrace Deposits)
	D	1.50						
	J T	1.50						
	H	1.50		115				
	D	2.00						
	H	2.00		90				
	D	2.50						with no gravel content below 2.50m depth.
	H	2.50		100				becoming firm below 2.60m depth.
							2.90	
	D	3.00					3.00	Orange brown gravelly sandy CLAY. Gravel is subangular medium to coarse flint. (River Terrace Deposits)
								End of borehole at 3.00m

Remarks

Groundwater: Borehole dry on completion.

Stability: Borehole stable on completion.

Notes: Standpipe installed to 1.00m depth; 3.00m to 1.00m bentonite seal; 1.00m to 0.50m slotted pipe with gravel surround; 0.50m to ground level plain pipe with bentonite seal; completed with gas tap and security cover concreted flush with ground surface.

Excavation Method: WLS

Borehole Diameter: Various

Made By: JN

ASHDOWN SITE INVESTIGATION
L•I•M•I•T•E•D
E-mail: contact@ashdownsi.co.uk
Web: www.ashdownsi.co.uk
Tel: 01273 483119

Site Name: South Street, Lancing, West Sussex

Job Number: P15791

Start Date: 23/09/2022

End Date: 23/09/2022

Borehole Number: **STB01**

Standpipe	Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Dynamic Probe 0 5 10 15 20 25 30	Legend	Depth	Stratum Description
							0.00	Asphalt.
	J T	0.20					0.07	MADE GROUND: Grey brown sandy subangular to subrounded fine to coarse gravel of flint.
	D	0.30						
	J T	0.40					0.35	MADE GROUND: Grey sandy silty clay with rare gravel of brick and ash-like material.
	D	0.70					0.60	Firm to stiff brown slightly gravelly sandy CLAY. Gravel is subangular to subrounded fine to coarse flint. (River Terrace Deposits)
	H	0.70		90				becoming very gravelly at 0.85m depth.
	J T	0.80						
	D	0.95					1.00	Dense to very dense orange brown gravelly silty fine to coarse SAND. Gravel is subangular to rounded fine to coarse flint. (River Terrace Deposits)
	D	1.20						
	D	1.80					2.00	End of borehole at 2.00m

Remarks

Groundwater: Borehole dry on completion.

Stability: Borehole cased to 1.00m depth.
Borehole stable on completion.

Notes: Standpipe installed to 1.20m depth; 1.20m to 1.00m slotted pipe with gravel surround; 1.00m to ground level plain pipe with bentonite seal; completed with gas tap and security cover concreted flush with ground surface.

Excavation Method: WLS

Borehole Diameter: Various

Made By: TM

ASHDOWN SITE INVESTIGATION
L•I•M•I•T•E•D
E-mail: contact@ashdownsi.co.uk
Web: www.ashdownsi.co.uk
Tel: 01273 483119

Site Name: South Street, Lancing, West Sussex

Job Number: P15791

Start Date: 23/09/2022

End Date: 23/09/2022

Borehole Number: **STB02**

Standpipe	Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Dynamic Probe 0 5 10 15 20 25 30	Legend	Depth	Stratum Description
	J T	0.10					0.00	Asphalt.
							0.05	MADE GROUND: Grey brown sandy subangular to subrounded fine to coarse gravel of flint.
	J T	0.40					0.25	MADE GROUND: Brown grey slightly gravelly slightly sandy silty clay. Gravel is subangular to subrounded fine to coarse ash-like material and chalk.
	J T	0.80					0.60	MADE GROUND/ REWORKED: Brown slightly gravelly slightly sandy silty clay. Gravel is subangular to subrounded fine flint. (Possible Reworked River Terrace Deposits)
	D	0.90						
	H	0.90		60				
	V	1.00		130				
	D	1.20						
	H	1.20		60				
	H	1.50		75				
	D	1.80						
	H	1.80		40				gravel becoming fine to coarse below 1.90m depth.
							2.00	End of borehole at 2.00m

Remarks

Groundwater: Water noted at base of borehole on completion.

Stability: Borehole cased to 1.00m depth.
Borehole stable on completion.

Notes: n/a

Excavation Method: WLS

Borehole Diameter: Various

Made By: TM

ASHDOWN SITE INVESTIGATION LIMITED
E-mail: contact@ashdownsi.co.uk
Web: www.ashdownsi.co.uk
Tel: 01273 483119

Site Name: South Street, Lancing, West Sussex

Job Number: P15791

Start Date: 23/09/2022

End Date: 23/09/2022

Trial Pit Number: **STP01**

Samples and In Situ Testing				Legend	Depth/ Reduced Level	Stratum Description
Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result			
					0.00	Asphalt.
					0.07	MADE GROUND: Grey brown sandy subangular to subrounded fine to coarse gravel of flint.
					0.35	MADE GROUND: Grey sandy silty clay with rare gravel of brick and ash-like material.
					0.45	End of trial pit at 0.45m

Remarks

Groundwater: Trial pit dry on completion.

Stability: Trial pit stable on completion.

Notes: n/a

Excavation Method: HDP

Pit Length: 0.30m

Pit Width: 0.30m

Made By: TM

ASHDOWN SITE INVESTIGATION LIMITED
E-mail: contact@ashdownsi.co.uk
Web: www.ashdownsi.co.uk
Tel: 01273 483119

Site Name: South Street, Lancing, West Sussex

Job Number: P15791

Start Date: 23/09/2022

End Date: 23/09/2022

Trial Pit Number: **STP02**

Samples and In Situ Testing				Legend	Depth/ Reduced Level	Stratum Description
Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result			
					0.00	Asphalt.
					0.05	MADE GROUND: Grey brown sandy subangular to subrounded fine to coarse gravel of flint.
					0.25	MADE GROUND: Brown grey slightly gravelly slightly sandy silty clay. Gravel is subangular to subrounded fine to coarse ash-like material and chalk.
					0.45	End of trial pit at 0.45m

Remarks

Groundwater: Trial pit dry on completion.

Stability: Trial pit stable on completion.

Notes: n/a

Excavation Method: HDP

Pit Length: 0.30m

Pit Width: 0.30m

Made By: TM

ASHDOWN SITE INVESTIGATION LIMITED
E-mail: contact@ashdownsi.co.uk
Web: www.ashdownsi.co.uk
Tel: 01273 483119

Site Name: South Street, Lancing, West Sussex

Job Number: P15791

Start Date: 23/09/2022

End Date: 23/09/2022

Trial Pit Number: **TP03**

Samples and In Situ Testing				Legend	Depth/ Reduced Level	Stratum Description
Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result			
					0.00	Asphalt.
					0.10	MADE GROUND: Yellow brown very gravelly sand. Gravel is subangular to subrounded fine to coarse flint and occasional brick.
P*	0.60	0.80	71		0.60	End of trial pit at 0.60m

Remarks

Groundwater: Trial pit dry on completion.

Stability: Trial pit stable on completion.

Notes: P* - blow count for 200mm penetration only, including seating blows.

Excavation Method: HDP

Pit Length: n/a

Pit Width: n/a

Made By: TM

ASHDOWN SITE INVESTIGATION LIMITED
E-mail: contact@ashdownsi.co.uk
Web: www.ashdownsi.co.uk
Tel: 01273 483119

Site Name: South Street, Lancing, West Sussex

Job Number: P15791

Start Date: 21/10/2022

End Date: 21/10/2022

Trial Pit Number: **TP04**

Samples and In Situ Testing				Legend	Depth/ Reduced Level	Stratum Description
Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result			
					0.00	Asphalt
					0.10	MADE GROUND: Dark brown gravelly sandy clay. Gravel is subangular to subrounded fine to medium flint with frequent ash-like material and rare brick and glass.
J T	0.30					
D	0.55				0.55	
P	0.55	1.00	43			End of trial pit at 0.55m

Remarks

Groundwater: Trial pit dry on completion.

Stability: Trial pit stable on completion.

Notes: n/a

Excavation Method:	HDP
Pit Length:	0.30m
Pit Width:	0.30m
Made By:	JN

ASHDOWN SITE INVESTIGATION LIMITED
E-mail: contact@ashdownsi.co.uk
Web: www.ashdownsi.co.uk
Tel: 01273 483119

Site Name: South Street, Lancing, West Sussex

Job Number: P15791

Start Date: 23/09/2022

End Date: 23/09/2022

Trial Pit Number: **CBR01**

Samples and In Situ Testing				Legend	Depth/ Reduced Level	Stratum Description
Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result			
					0.00	Asphalt.
					0.05	MADE GROUND: Grey brown sandy subangular to subrounded fine to coarse gravel of flint.
					0.25	MADE GROUND: Brown grey slightly gravelly slightly sandy silty clay. Gravel is subangular to subrounded fine to coarse ash-like material, flint and chalk.
					0.65	End of trial pit at 0.65m

Remarks

Groundwater: Trial pit dry on completion.

Stability: Trial pit stable on completion.

Notes: n/a

Excavation Method: HDP

Pit Length: n/a

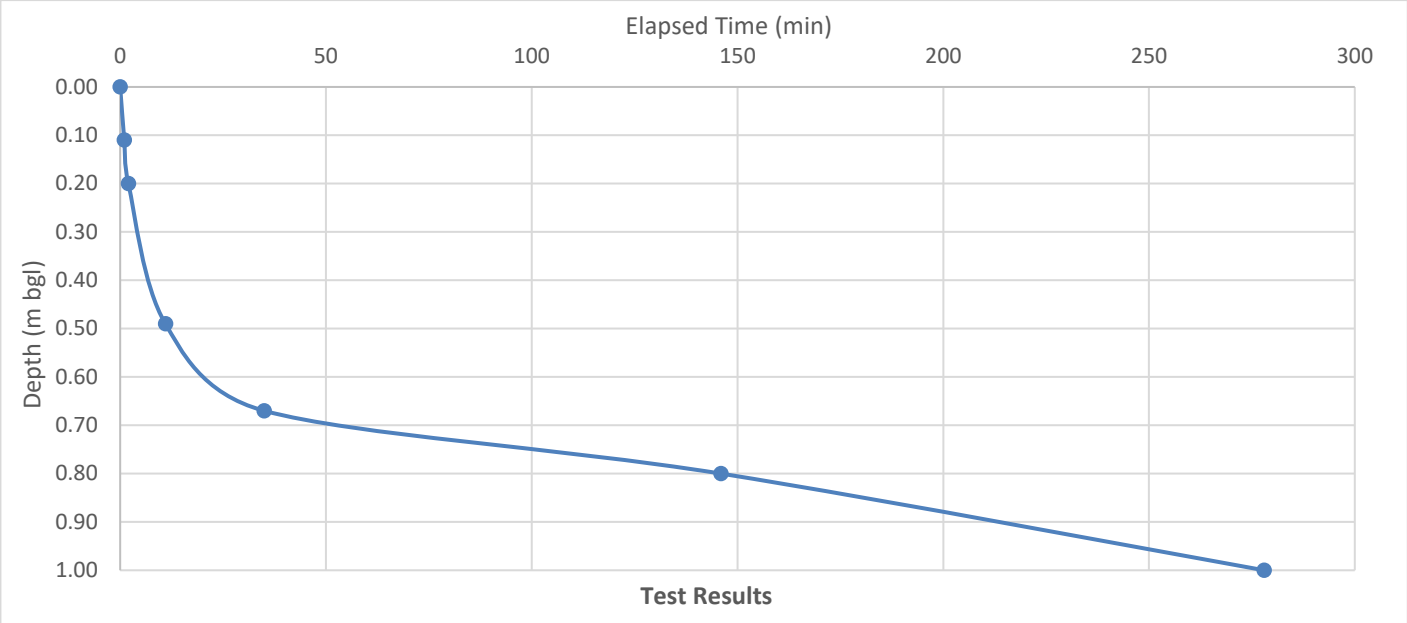
Pit Width: n/a

Made By: TM

Infiltration Test Results

Test Position	STB01
Test No.	1
Project No.	P15791
Project Name	South Street, Lancing

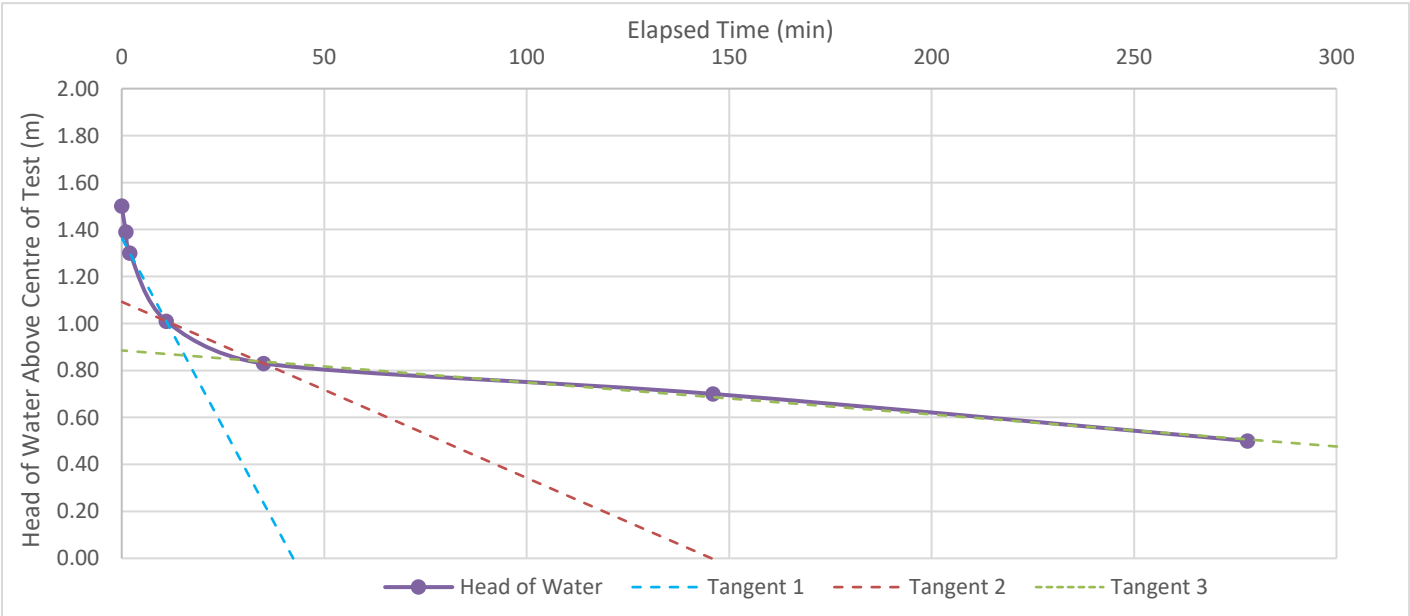
Casing Depth	1.00	m blg
Borehole Depth	2.00	m bgl
Casing Diameter	0.105	m
Average Borehole Diameter	0.092	m



Length of Test Zone	1.00	m	L
Depth to Center of Test Zone	1.50	m	X
Water level at start of test	0.00	m	
Water level at end of test	1.00	m	
Duration of test	278	min	
Average Depth Of Water	1.50	m	
Average Drained Area	0.44	m^2	
Volume of Water Lost	0.01	m^3	

Driving Head	**1.2**	**0.9**	**0.7**	**m**
Infiltration rate	**1.61E-05**	**3.74E-06**	**6.81E-07**	**m/sec**

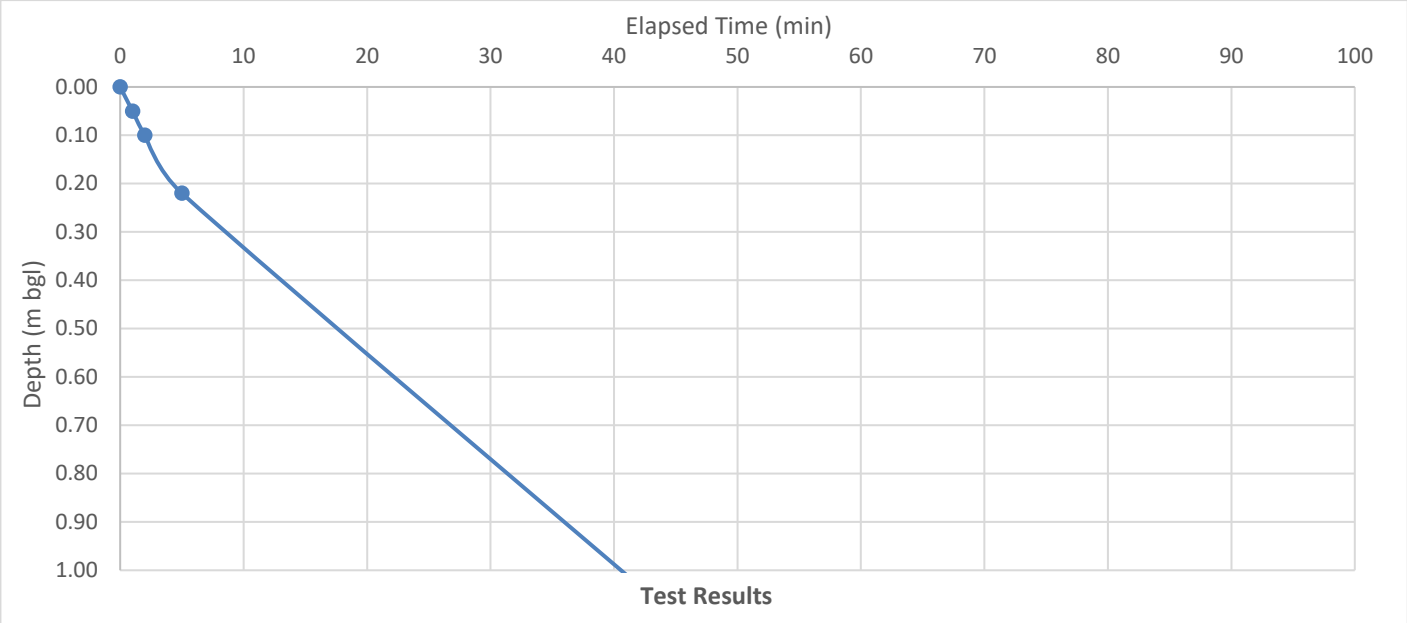
Calculation method: Calculated in accordance with The Soakaway Design Guide, published by Kent County Council, July 2000.



Infiltration Test Results

Test Position	STB02
Test No.	1
Project No.	P15791
Project Name	South Street, Lancing

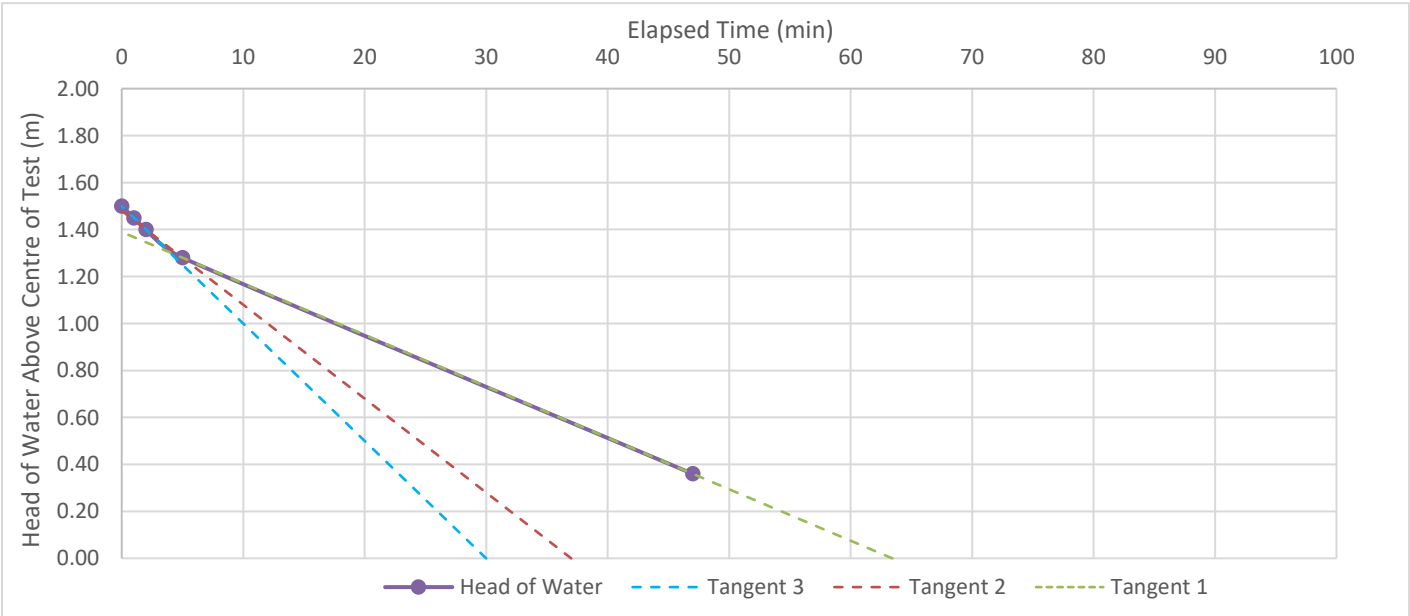
Casing Depth	1.00	m blg
Borehole Depth	2.00	m bgl
Casing Diameter	0.105	m
Average Borehole Diameter	0.092	m



Length of Test Zone	1.00 m	L
Depth to Center of Test Zone	1.50 m	X
Water level at start of test	0.00 m	
Water level at end of test	1.14 m	
Duration of test	47 min	
Average Depth Of Water	1.43 m	
Average Drained Area	0.42 m^2	
Volume of Water Lost	0.01 m^3	

Driving Head	**1.5**	**1.3**	**0.8**	**m**
Infiltration rate	**2.50E-05**	**2.00E-05**	**1.09E-05**	**m/sec**

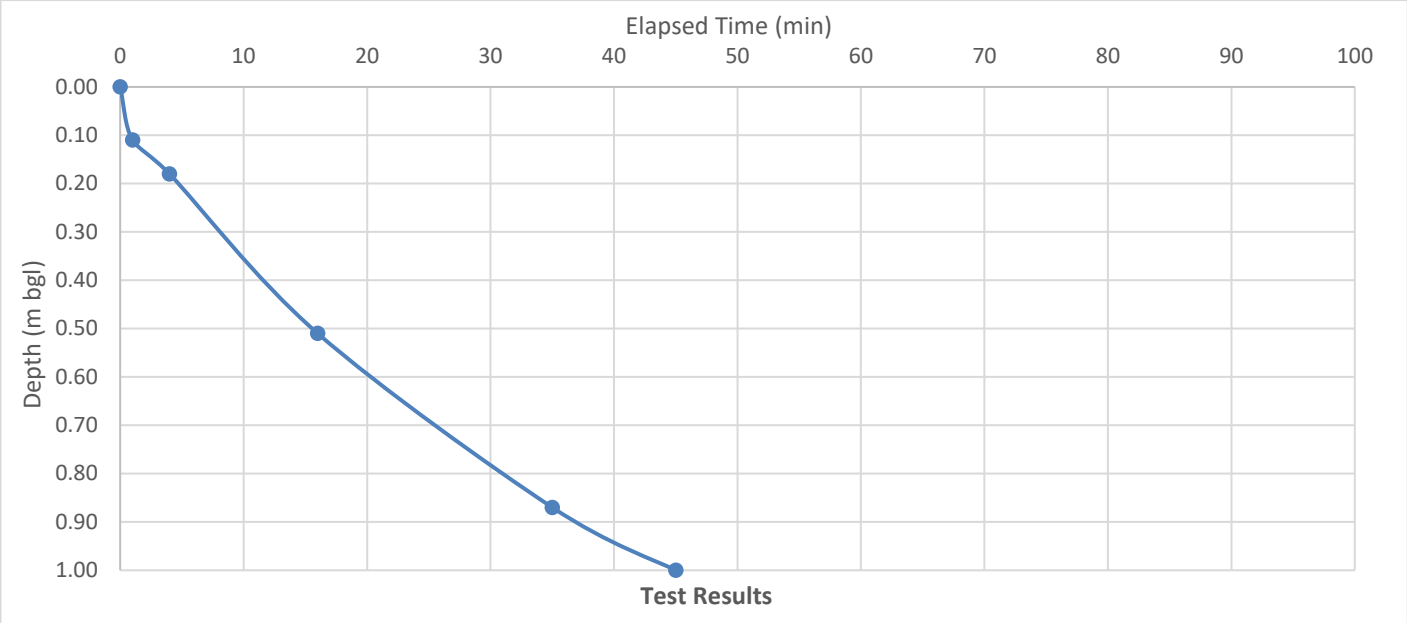
Calculation method: Calculated in accordance with The Soakaway Design Guide, published by Kent County Council, July 2000.



Infiltration Test Results

Test Position	STB02
Test No.	2
Project No.	P15791
Project Name	South Street, Lancing

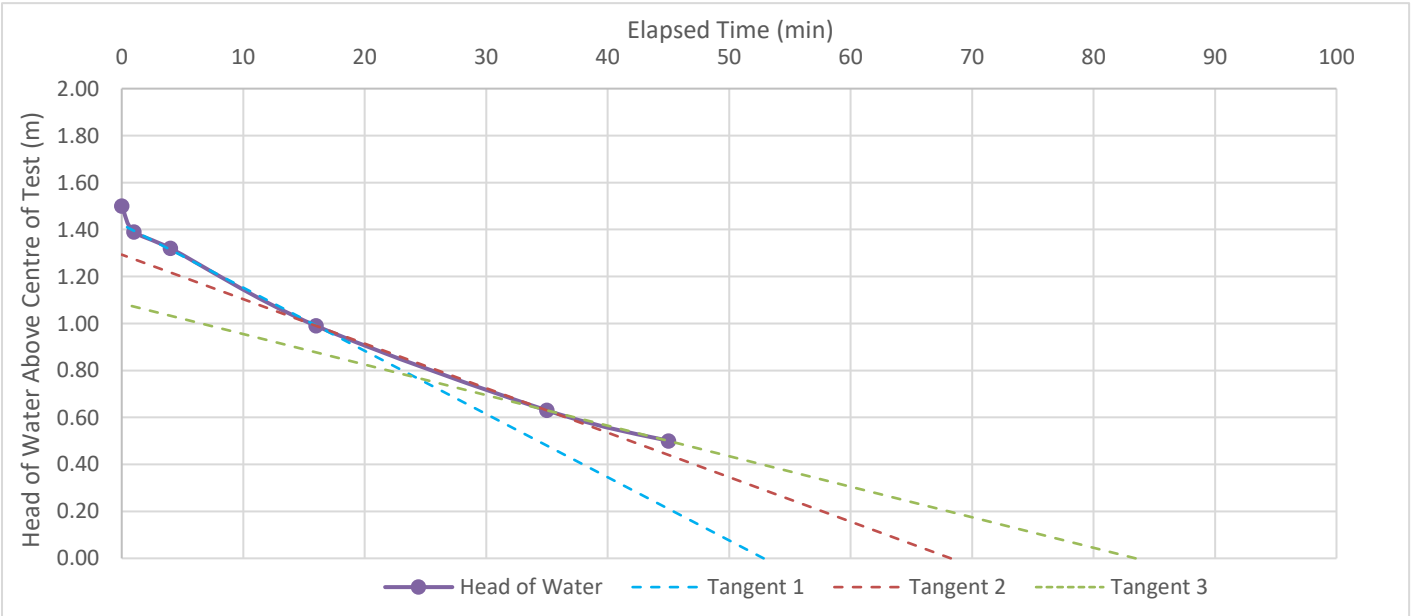
Casing Depth	1.00	m blg
Borehole Depth	2.00	m bgl
Casing Diameter	0.105	m
Average Borehole Diameter	0.092	m



Length of Test Zone	1.00	m	L
Depth to Center of Test Zone	1.50	m	X
Water level at start of test	0.00	m	
Water level at end of test	1.00	m	
Duration of test	45	min	
Average Depth Of Water	1.50	m	
Average Drained Area	0.44	m^2	
Volume of Water Lost	0.01	m^3	

Driving Head	**1.2**	**0.8**	**0.6**	**m**
Infiltration rate	**1.34E-05**	**9.46E-06**	**6.49E-06**	**m/sec**

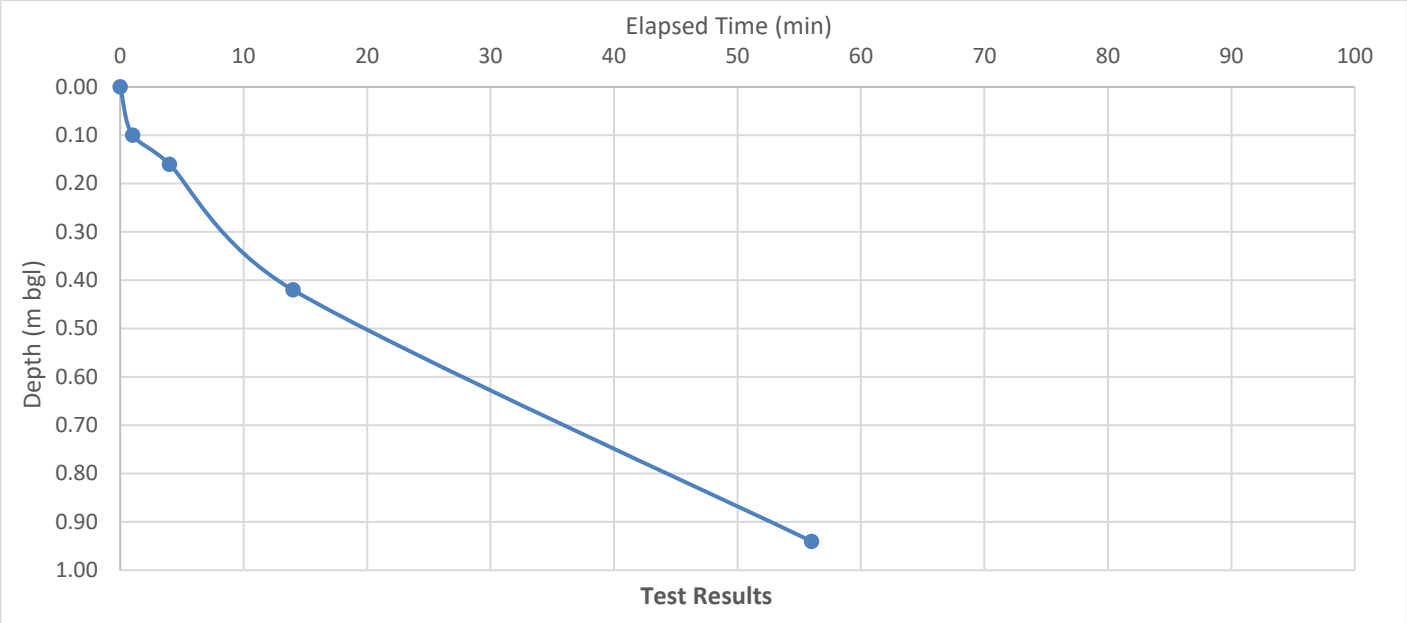
Calculation method: Calculated in accordance with The Soakaway Design Guide, published by Kent County Council, July 2000.



Infiltration Test Results

Test Position	STB02
Test No.	3
Project No.	P15791
Project Name	South Street, Lancing

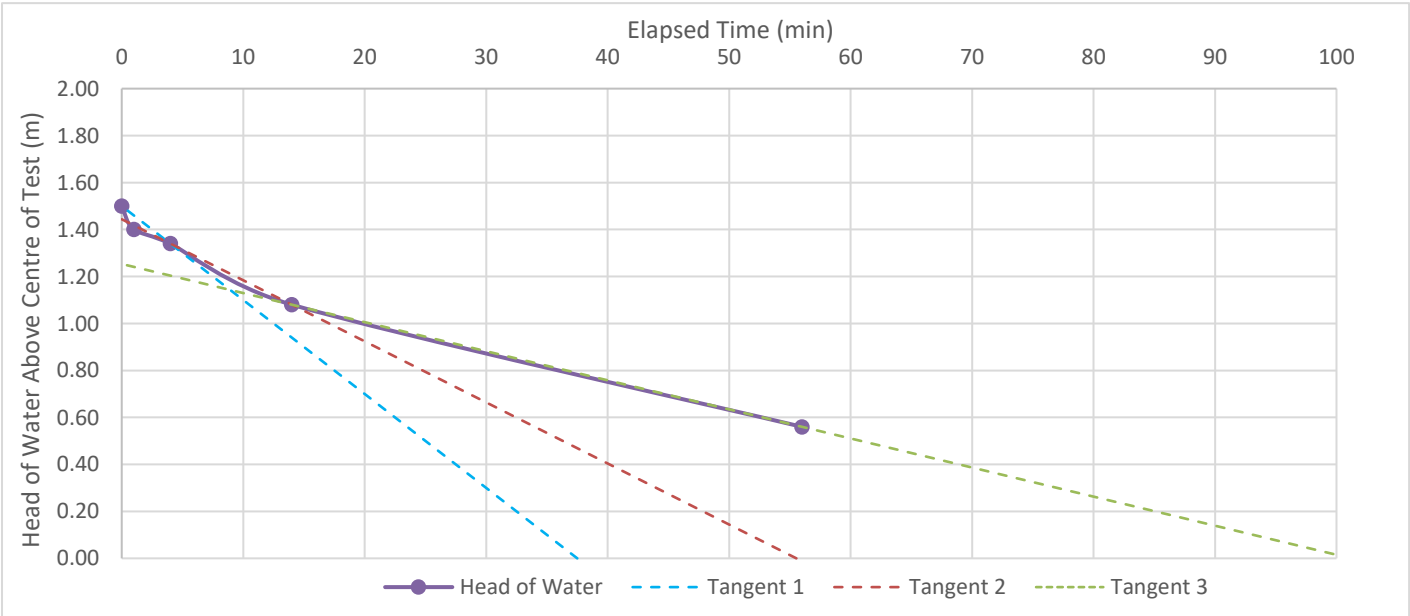
Casing Depth	1.00	m blg
Borehole Depth	2.00	m bgl
Casing Diameter	0.105	m
Average Borehole Diameter	0.092	m



Length of Test Zone	1.00	m	L
Depth to Center of Test Zone	1.50	m	X
Water level at start of test	0.00	m	
Water level at end of test	0.94	m	
Duration of test	56	min	
Average Depth Of Water	1.53	m	
Average Drained Area	0.45	m^2	
Volume of Water Lost	0.01	m^3	

Driving Head	**1.4**	**1.2**	**0.8**	**m**
Infiltration rate	**2.00E-05**	**1.30E-05**	**6.18E-06**	**m/sec**

Calculation method: Calculated in accordance with The Soakaway Design Guide, published by Kent County Council, July 2000.

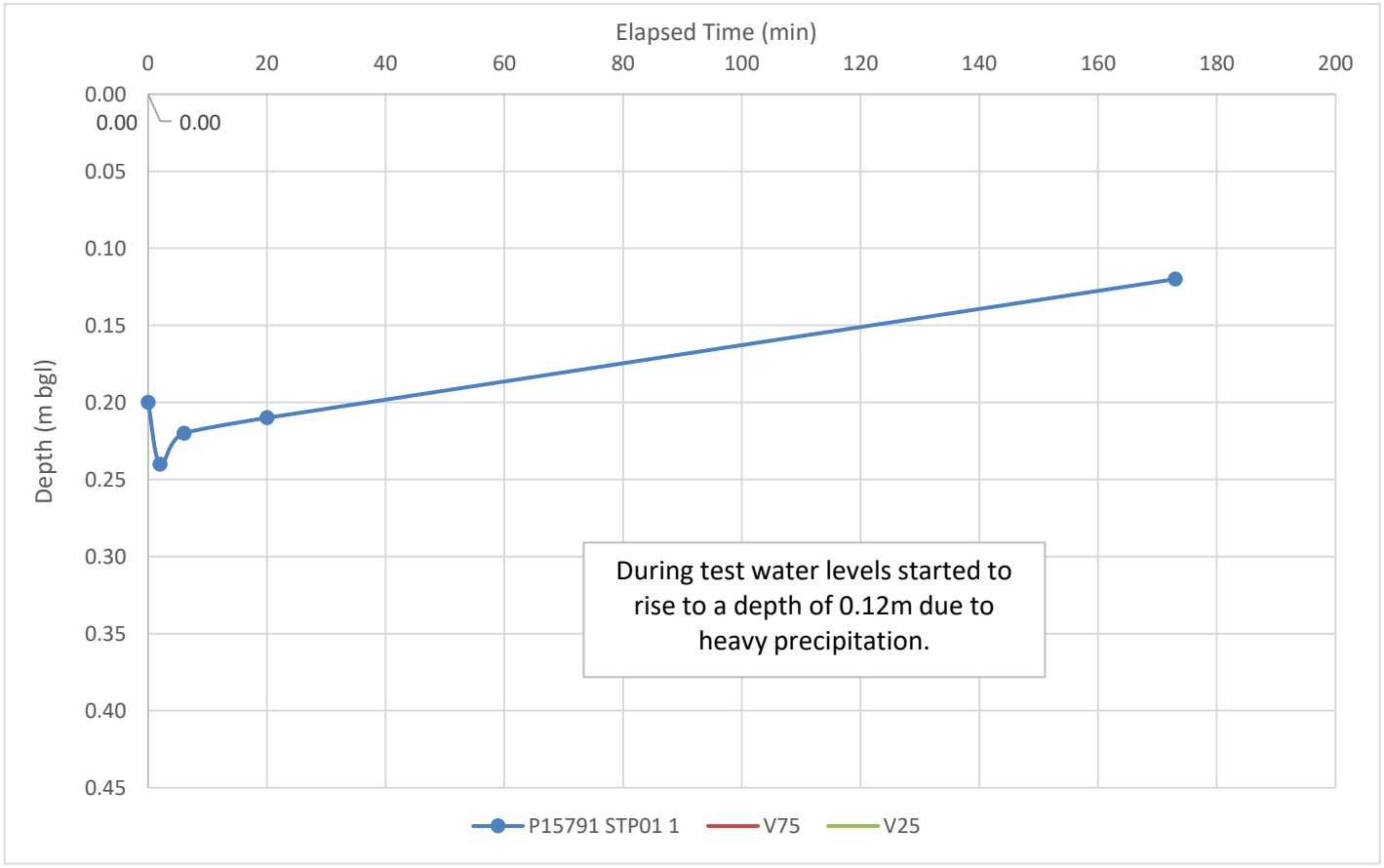


Infiltration Test Results

STP01	STP01
Test No.	1
Project No.	P15791
Project Name	South Street, Lancing, West Sussex

Width of Pit	0.30	m	W
Length of Pit	0.30	m	L
Depth of Pit	0.45	m	D
Pit type	Open		
Volume of water introduced into pit	0.023	m^3	
Initial head of water	0.25	m	h_o
Water level at start of test	0.20	m	
Water level at end of test	0.24	m	
Volume of water discharged from pit	n/a	m^3	
Duration of test	173	min	
Average soaked surface area	n/a	m^2	
Time for water level to fall to 75% of initial head	Not reached	min	t_{p75}
Time for water level to fall to 25% of initial head	Not reached	min	t_{p25}
Depth to water at 75% of initial head	Not reached	m	d_{75}
Depth to water at 25% of initial head	Not reached	m	d_{25}
Time for the water level to fall from 75% to 25% of initial head	Not reached	min	t_{p75-25}
Effective storage volume of water in the soakage trial pit between 75% and 25% of initial head	Not reached	m^3	V_{p75-25}
Internal surface area of the soakage trial pit up to 50% of initial head and including the base area	n/a	m^2	a_{s50}
Infiltration rate	**n/a**	**m/sec**	**f**

Calculation method: n/a

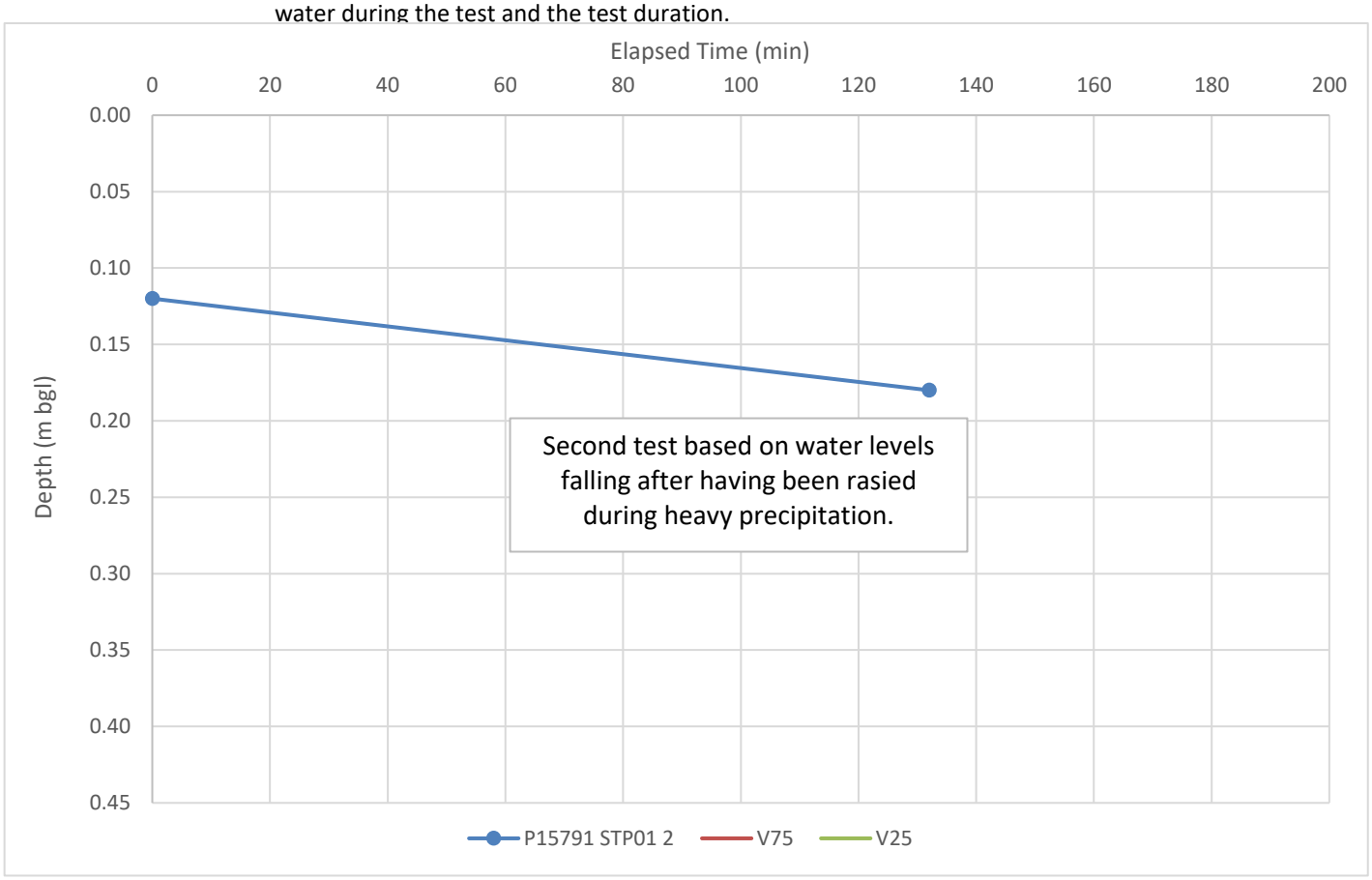


Infiltration Test Results

STP01	STP01
Test No.	2
Project No.	P15791
Project Name	South Street, Lancing, West Sussex

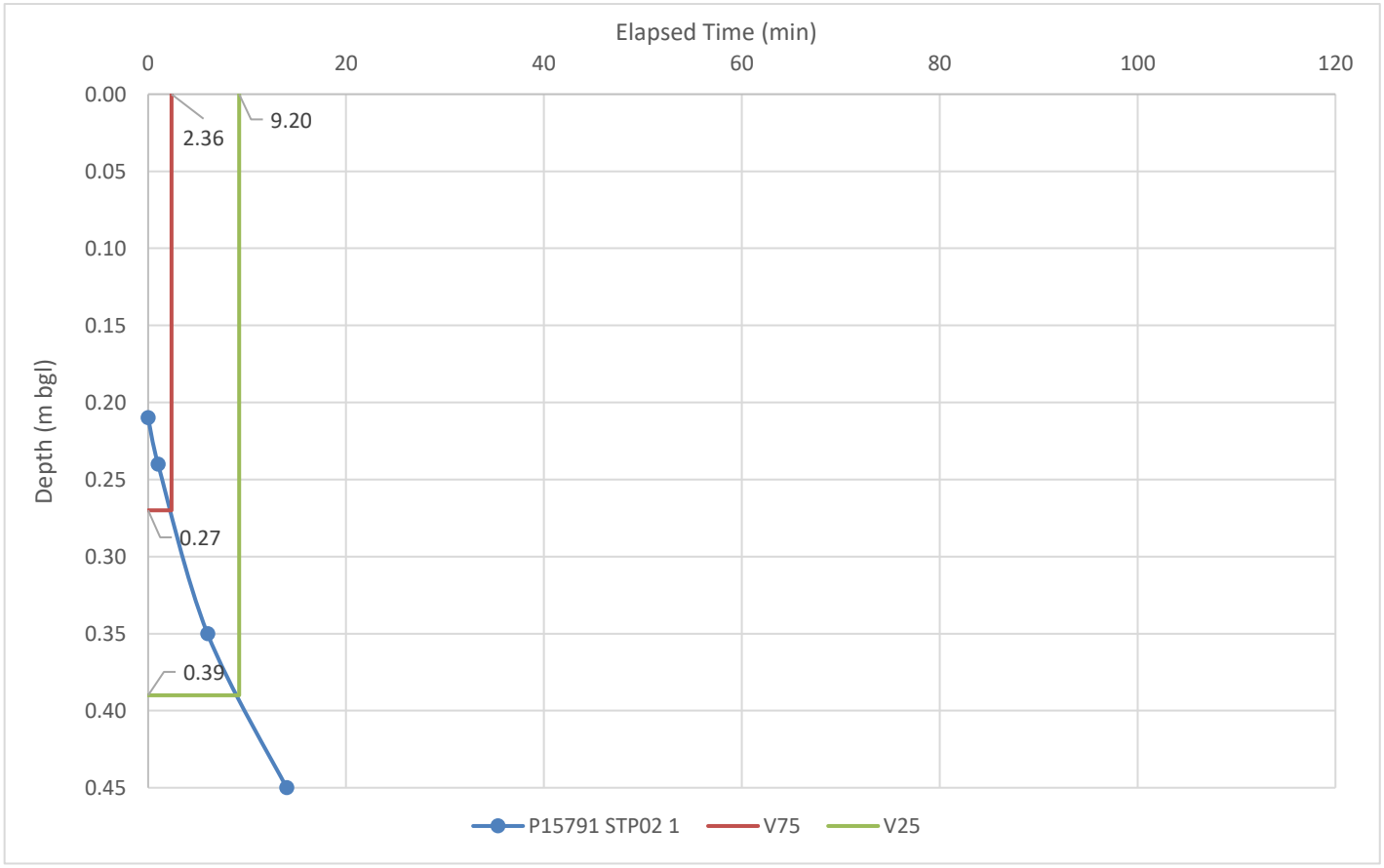
Width of Pit	0.30	m	W
Length of Pit	0.30	m	L
Depth of Pit	0.45	m	D
Pit type	Open		
Volume of water introduced into pit	0.030	m^3	
Initial head of water	0.33	m	h_o
Water level at start of test	0.12	m	
Water level at end of test	0.18	m	
Volume of water discharged from pit	0.005	m^3	
Duration of test	132	min	
Average soaked surface area	0.45	m^2	
Time for water level to fall to 75% of initial head	Not reached	min	t_{p75}
Time for water level to fall to 25% of initial head	Not reached	min	t_{p25}
Depth to water at 75% of initial head	Not reached	m	d_{75}
Depth to water at 25% of initial head	Not reached	m	d_{25}
Time for the water level to fall from 75% to 25% of initial head	Not reached	min	t_{p75-25}
Effective storage volume of water in the soakage trial pit between 75% and 25% of initial head	Not reached	m^3	V_{p75-25}
Internal surface area of the soakage trial pit up to 50% of initial head and including the base area	0.29	m^2	a_{s50}
Infiltration rate	**1.52E-06**	**m/sec**	**f**

Calculation method: The water level did not fall below 25% of the effective storage depth. 'f' has been calculated by dividing the volume of water lost during the test by the product of the average surface area in contact with water during the test and the test duration.



Infiltration Test Results

STP02	STP02			
Test No.	1			
Project No.	P15791			
Project Name	South Street, Lancing, West Sussex			
Width of Pit		0.30	m	W
Length of Pit		0.30	m	L
Depth of Pit		0.45	m	D
Pit type		Open		
Volume of water introduced into pit		0.022	m^3	
Initial head of water		0.24	m	h_o
Water level at start of test		0.21	m	
Water level at end of test		0.45	m	
Volume of water discharged from pit		0.022	m^3	
Duration of test		14	min	
Average soaked surface area		0.23	m^2	
Time for water level to fall to 75% of initial head		2.36	min	t_{p75}
Time for water level to fall to 25% of initial head		9.20	min	t_{p25}
Depth to water at 75% of initial head		0.27	m	d_{75}
Depth to water at 25% of initial head		0.39	m	d_{25}
Time for the water level to fall from 75% to 25% of initial head		6.84	min	t_{p75-25}
Effective storage volume of water in the soakage trial pit between 75% and 25% of initial head		0.011	m^3	V_{p75-25}
Internal surface area of the soakage trial pit up to 50% of initial head and including the base area		0.23	m^2	a_{s50}
Infiltration rate		**1.13E-04**	**m/sec**	**f**
Calculation method:	BRE 365			

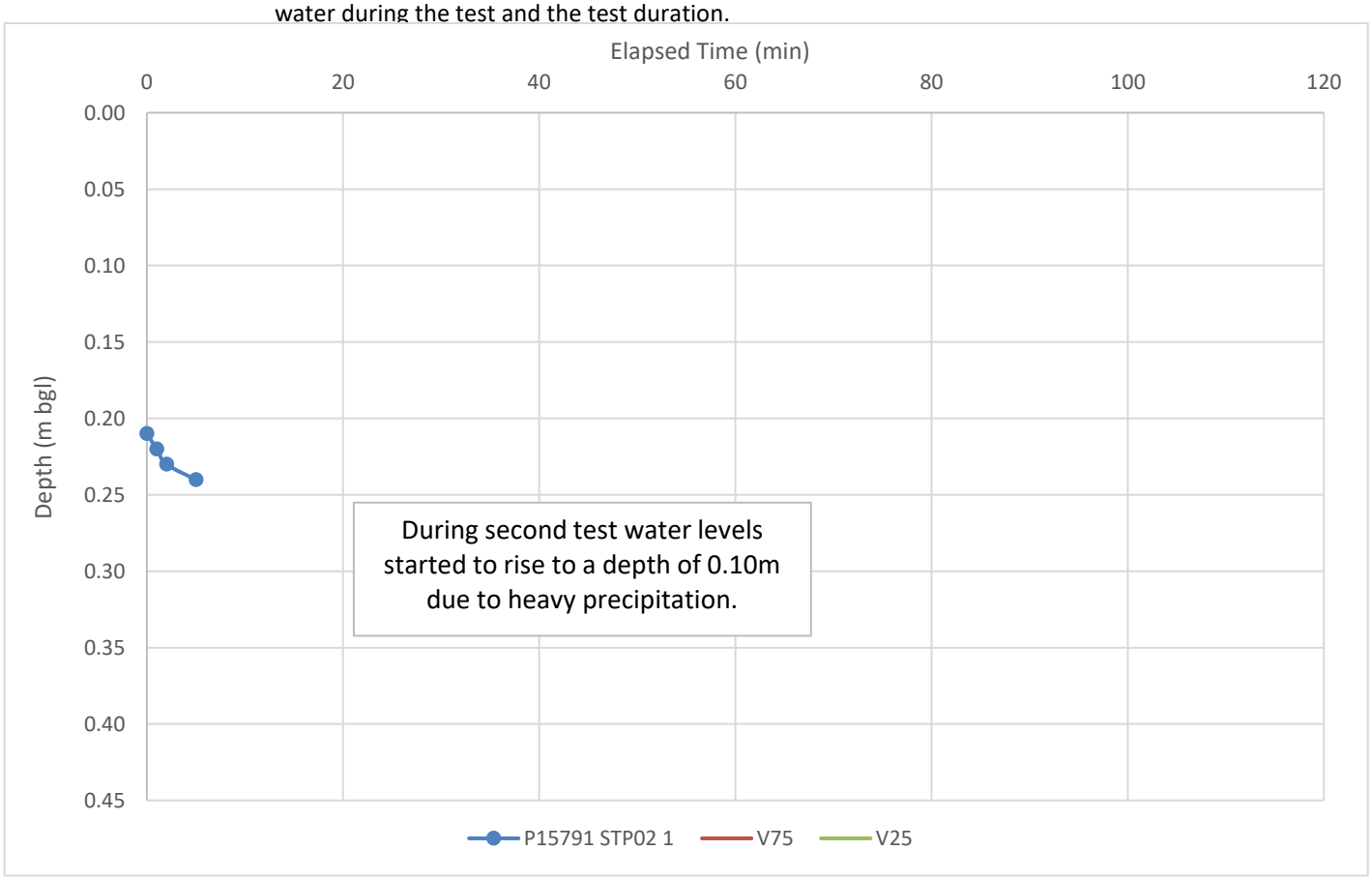


Infiltration Test Results

STP02	STP02
Test No.	2
Project No.	P15791
Project Name	South Street, Lancing, West Sussex

Width of Pit	0.30	m	W
Length of Pit	0.30	m	L
Depth of Pit	0.45	m	D
Pit type	Open		
Volume of water introduced into pit	0.022	m^3	
Initial head of water	0.24	m	h_o
Water level at start of test	0.21	m	
Water level at end of test	0.24	m	
Volume of water discharged from pit	0.003	m^3	
Duration of test	5	min	
Average soaked surface area	0.36	m^2	
Time for water level to fall to 75% of initial head	Not reached	min	t_{p75}
Time for water level to fall to 25% of initial head	Not reached	min	t_{p25}
Depth to water at 75% of initial head	Not reached	m	d_{75}
Depth to water at 25% of initial head	Not reached	m	d_{25}
Time for the water level to fall from 75% to 25% of initial head	Not reached	min	t_{p75-25}
Effective storage volume of water in the soakage trial pit between 75% and 25% of initial head	Not reached	m^3	V_{p75-25}
Internal surface area of the soakage trial pit up to 50% of initial head and including the base area	0.23	m^2	a_{s50}
Infiltration rate	**2.50E-05**	**m/sec**	**f**

Calculation method: The water level did not fall below 25% of the effective storage depth. 'f' has been calculated by dividing the volume of water lost during the test by the product of the average surface area in contact with water during the test and the test duration.



Infiltration Test Results

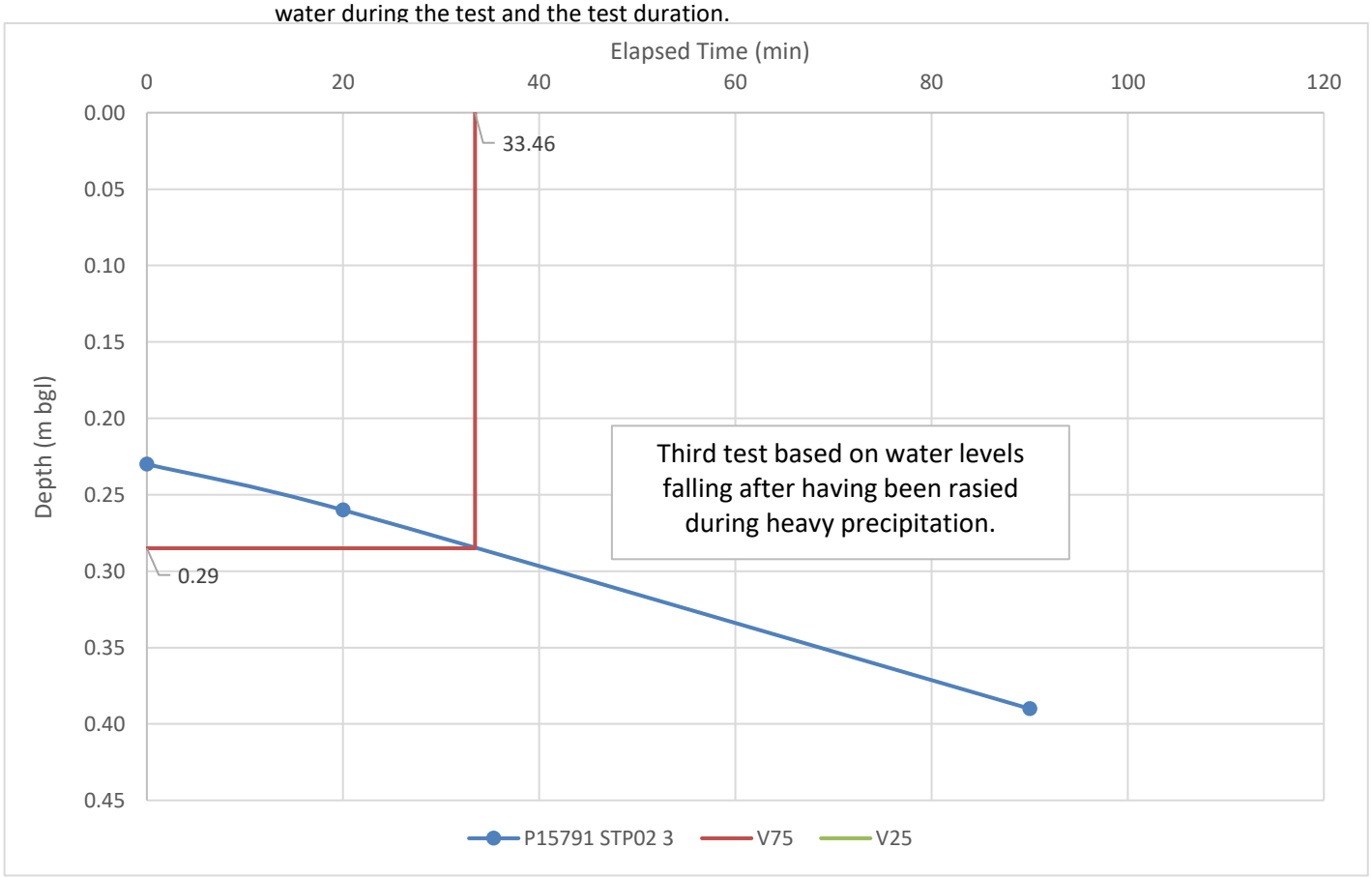
STP02	STP02
Test No.	3
Project No.	P15791
Project Name	South Street, Lancing, West Sussex

Width of Pit	0.30	m	W
Length of Pit	0.30	m	L
Depth of Pit	0.45	m	D
Pit type	Open		

Volume of water introduced into pit	0.020	m^3	
Initial head of water	0.22	m	h_o
Water level at start of test	0.23	m	
Water level at end of test	0.39	m	
Volume of water discharged from pit	0.014	m^3	
Duration of test	90	min	
Average soaked surface area	0.26	m^2	
Time for water level to fall to 75% of initial head	33.46	min	t_{p75}
Time for water level to fall to 25% of initial head	Not reached	min	t_{p25}
Depth to water at 75% of initial head	0.29	m	d_{75}
Depth to water at 25% of initial head	Not reached	m	d_{25}
Time for the water level to fall from 75% to 25% of initial head	Not reached	min	t_{p75-25}
Effective storage volume of water in the soakage trial pit between 75% and 25% of initial head	Not reached	m^3	V_{p75-25}
Internal surface area of the soakage trial pit up to 50% of initial head and including the base area	0.22	m^2	a_{s50}

Infiltration rate **1.03E-05 m/sec f**

Calculation method: The water level did not fall below 25% of the effective storage depth. 'f' has been calculated by dividing the volume of water lost during the test by the product of the average surface area in contact with water during the test and the test duration.



Gas Concentrations and Groundwater Monitoring Results

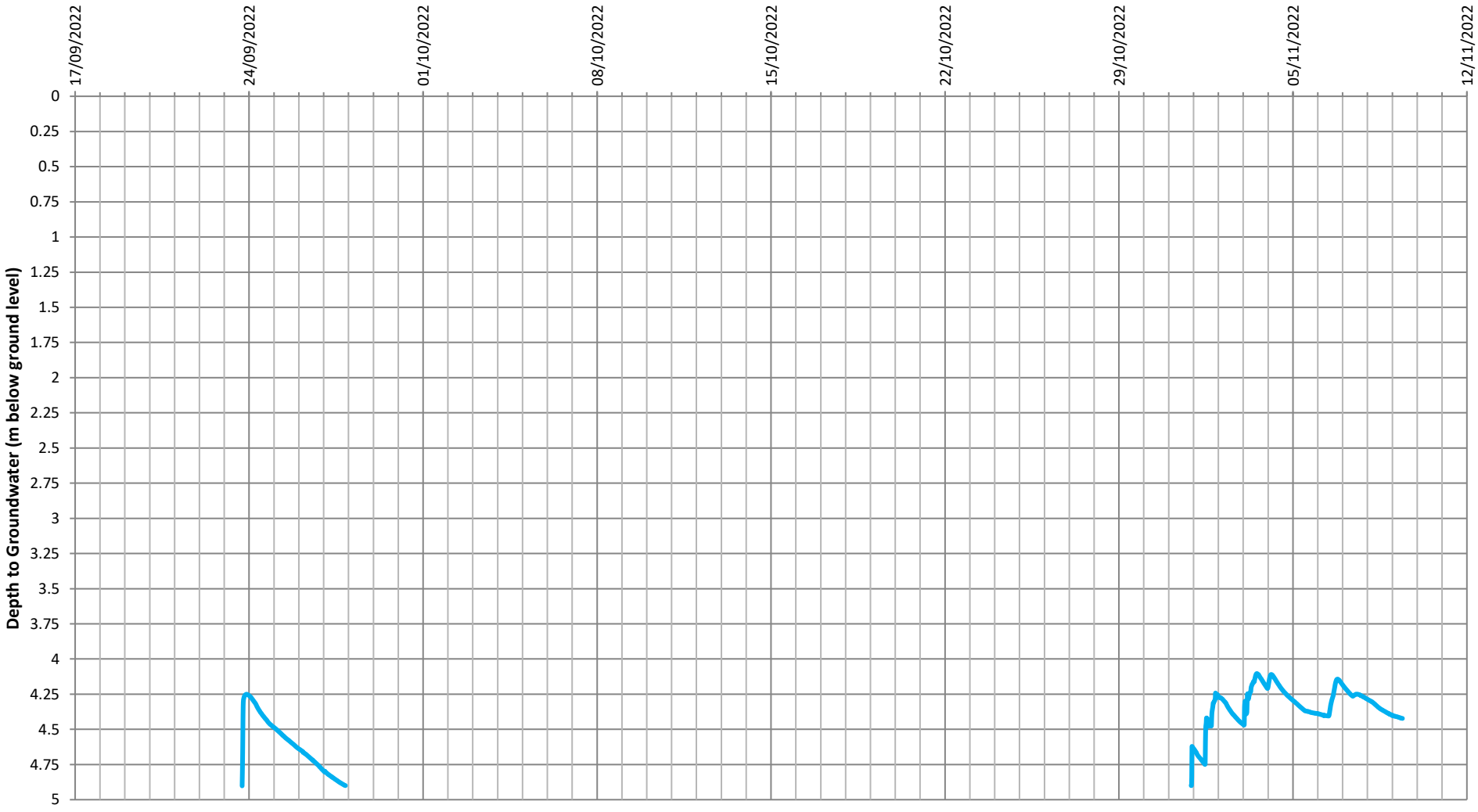
Site Name:	South Street, Lancing, West Sussex
Project Ref:	P15791

Position	Date	Time	Dynamic Pressure (pa)	Atmospheric Pressure (mbar)	Atmospheric Trend	Standing Water Depth (m bgl)	Flow Rate (l/hr)				Methane (%)				Carbon Dioxide (%)				Oxygen (%)				CO (ppm)	H_2S (ppm)
							Seconds				Seconds				Seconds				Seconds					
							15	30	45	60	15	30	45	60	15	30	45	60	15	30	45	60		
BH02	26/10/2022	14:10	0	1015	Falling	Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	2.7	2.8	2.8	15.9	15.7	15.6	15.6	0	0
BH03	26/10/2022	14:00	0	1015	Falling	Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	20.7	20.7	20.7	20.7	0	0
BH06	26/10/2022	14:15	0	1014	Falling	Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	3.8	3.9	3.9	14.9	13.5	13.5	13.5	0	0
STB01	26/10/2022	14:05	0	1015	Falling	Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.5	0.5	19.7	19.6	19.5	19.5	0	0
BH02	01/11/2022	10:11	0	1011	Rising	Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.2	2.3	2.3	18.1	17.3	16.9	16.9	0	0
BH03	01/11/2022	09:52	0	1011	Rising	Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1	0.0	0.0	20.6	20.5	20.5	20.5	0	0
BH06	01/11/2022	10:15		1011	Rising	*	* Unable to monitor as position flooded.																	
STB01	01/11/2022	09:56	0	1011	Rising	1.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.6	0.6	0.6	20.3	19.6	19.4	19.3	0	0
BH02	08/11/2022	14:05	0	1000	Falling	2.82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	3.8	3.9	3.9	15.0	13.9	13.6	13.5	0	0
BH03	08/11/2022	13:56	0	1000	Falling	Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.2	0.1	0.1	20.2	20.3	20.3	20.3	0	0
BH06	08/11/2022	14:10		1000	Falling	0.35	Unable to monitor as position flooded.																	
STB01	08/11/2022	14:00	0	1000	Falling	Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	20.3	19.8	19.7	19.7	0	0

Ashdown Site Investigation Limited

Site: South Street, Lancing, West Sussex	Project No. P15791

Groundwater Monitoring Results - BH01



Appendix D BGS Borehole Records

318/177

318/177

TQ10/156

South LANCING.

For Mr LE GRAND. By Duke & Ockenden 1899
Shaft 3 ft., rest bore. Lined with 51 ft. of 4½ inch tubes, standing up, borehole being open from 54 ft. down.

Drift	[Sand & gravel	20
	Shell & flints	80
		100

The well was for the supply of Mr Le Grand's Nurseries between Roberts Road and Brighton Road. The well is immediately N of a cottage which serves as the garage to Seabrook (Mr Le Grand's house) The nurseries have been pulled down — only the house & cottage remaining & the well has been filled in.

OD 20

Visited S. Buchan
1.5.40.

DATA Bank

W. S. Sx. 11 p. 188

1.

RECORD OF WELL (SHAFT OR BORE)

(attach copy of analysis if available)

318/416 For Survey use only

318

N.

TQ10/253

416

EXACT SITE OF WELL

At Site of flats; West side of South sheet

Town or Village South Lancing

County Six-inch quarter sheet 64SE/E

For Mr. State whether owner, tenant, builder, contractor, consultant, etc. :—

Address (if different from above)

Level of ground surface above sea-level (O.D.) + 26·45 ft. If well-top is not at ground level, state how far ... above; below; ft.

SHAFT W. on ~~6 in. map~~ 25·88 ft.; diameter ft.; Details of headings

BORE ft.; diameter of bore: at top ins.; at bottom ins.

Details of permanent lining tubes

Water struck at depths of ft. below well-top.

TEST CONDITIONS

Rest-level of water ft. above/below well-top. Suction at ft. Yield on hours'/days' test pumping at galls. per with depression to ft. below well-top.

Recovery to rest-level in mins./hours Capacity of pump g.p.h. Date of measurements

NORMAL CONDITIONS

Description of permanent pumping equipment:

Make and/or type Motive power

Capacity gallons per hour. Suction at ft.

Amount pumped galls. per day. Estimated consumption galls. per week.

Well made by Date of well

Information from

ADDITIONAL NOTES

R.W.L. + 3.15. 29/9/1893. Clement Reid (cf. 318/215. no. 145)
Bottom of well +0.57
Building site; new flats. No knowledge of well; presumed filled in. 25.5.59. AEJ.

LOG OF STRATA OVERLEAF.

GEOLOGICAL SURVEY AND MUSEUM, SOUTH KENSINGTON, LONDON, S.W.7.		Date Received	1" O.S. Map No.	Site marked on 1" Map	(use symbol) on 6" Map

(*35243) Wt.44731/0424 12,000 3/48 A.& E.W.Ltd. Gp.685

Appendix E Southern Water Public Sewer Records

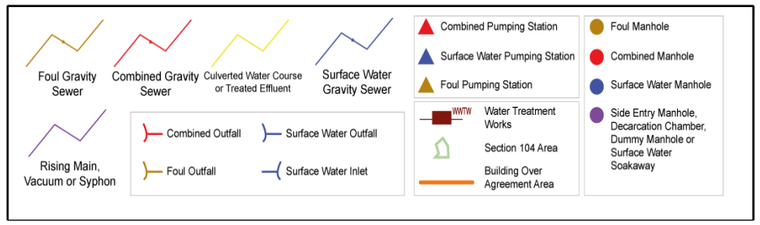


(c) Crown copyright and database rights 2022 Ordnance Survey 100031673	Date: 04/07/22	Scale: 1:1250	Map Centre: 518218,104008	Data updated: 16/06/22	Our Ref: 892418 - 1	Wastewater Plan A3

The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. This plan is produced by Southern Water Services Ltd (c) Crown copyright and database rights 2022 Ordnance Survey 100031673 .This map is to be used for the purposes of viewing the location of Southern Water plant only. Any other uses of the map data or further copies is not permitted.

WARNING: BAC pipes are constructed of Bonded Asbestos Cement.

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



searches@bpcivils.co.uk

D2112

from Southern Water

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
0001	F	8.31	6.40	
0002	F	8.04	6.88	
0802	F	0.00	0.00	
0803	F	0.00	0.00	
0805	F	0.00	0.00	
0901	F	9.04	5.23	
0902	F	8.93	7.45	
0903	F	8.61	0.00	
0904	F	0.00	0.00	
1001	F	7.83	7.83	
1004	F	8.70	7.76	
1901	F	8.17	4.71	
1902	F	7.96	4.63	
1905	F	0.00	0.00	
1906	F	0.00	0.00	
1907	F	0.00	0.00	
1908	F	0.00	0.00	
2001	F	7.86	0.00	
2002	F	7.44	4.20	
2004	F	0.00	0.00	
2103	F	0.00	0.00	
2104	F	0.00	0.00	
2105	F	0.00	0.00	
2805	F	6.79	0.00	
2806	F	6.45	4.15	
2901	F	6.06	5.15	
2902	F	6.56	4.91	
3001	F	5.60	4.81	
3002	F	5.70	4.27	
3003	F	5.83	4.67	
3006	F	0.00	0.00	
3007	F	0.00	0.00	
3008	F	0.00	0.00	
3009	F	0.00	0.00	
3010	F	0.00	0.00	
3011	F	0.00	0.00	
3012	F	0.00	0.00	
3013	F	0.00	0.00	
3103	F	4.83	2.33	
3801	F	5.70	4.43	
3802	F	5.44	0.00	
3803	F	5.41	4.75	
3805	F	0.00	0.00	
3901	F	5.60	4.65	
3915	F	0.00	0.00	
4001	F	5.56	5.20	
4002	F	5.57	5.07	
4003	F	5.58	5.07	
4004	F	5.58	4.11	
4013	F	0.00	0.00	

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
4016	F	0.00	0.00	
4018	F	0.00	0.00	
4103	F	5.52	2.45	
4901	F	5.39	4.87	
4902	F	5.46	0.00	
4903	F	0.00	0.00	
4915	F	0.00	0.00	
4916	F	0.00	0.00	
4917	F	0.00	0.00	
4918	F	0.00	0.00	
4919	F	0.00	0.00	
4920	F	0.00	0.00	
4921	F	0.00	0.00	
4924	F	0.00	0.00	
4925	F	0.00	0.00	
9011	F	0.00	0.00	
9802	F	8.95	0.00	

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Appendix E Wallingford Greenfield Calculations

Print | Close Report

HR Wallingford
Working with water

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Stuart Burnett
Site name:	South Street
Site location:	Lancing

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	50.82353° N
Longitude:	0.32247° W
Reference:	1642251512
Date:	Oct 18 2022 12:25

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 0.1342

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics	Default	Edited
SOIL type:	1	1
HOST class:	N/A	N/A
SPR/SPRHOST:	0.1	0.1

Hydrological characteristics	Default	Edited
SAAR (mm):	718	718
Hydrological region:	7	7
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates	Default	Edited
Q_{BAR} (l/s):	0.02	0.02
1 in 1 year (l/s):	0.02	0.02
1 in 30 years (l/s):	0.05	0.05
1 in 100 year (l/s):	0.07	0.07
1 in 200 years (l/s):	0.09	0.09

Appendix F Causeway Flow Hydraulic Calculations

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	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)
4		5.00	7.500		518260.452	104022.103	0.600
3	0.011	5.00	7.350	450	518255.477	103993.427	0.750
5		5.00	7.500		518251.545	104023.675	0.600
2	0.011	5.00	7.500	450	518246.538	103995.005	1.100
1	0.041	5.00	7.450		518242.490	103996.162	1.260
9		5.00	7.650		518213.332	104004.746	0.600
8	0.004	5.00	7.550	450	518222.876	104003.062	0.600
11		5.00	7.650		518211.498	103994.343	0.600
10	0.004	5.00	7.550	450	518221.042	103992.662	0.600
7	0.000	5.00	7.575		518230.633	103995.043	0.737
6			7.575		518231.618	103994.869	0.747
dummy			7.575				1.475

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	4	3	29.104	0.600	6.900	6.600	0.300	97.0	100	5.62	50.0
1.001	3	2	9.077	0.600	6.600	6.400	0.200	45.4	100	5.75	50.0
2.000	5	2	29.104	0.600	6.900	6.400	0.500	58.2	100	5.48	50.0
1.002	2	1	4.210	0.600	6.400	6.190	0.210	20.0	100	5.79	50.0
3.000	9	8	9.691	0.600	7.050	6.950	0.100	96.9	100	5.21	50.0
3.001	8	7	11.157	0.600	6.950	6.838	0.112	100.0	100	5.45	50.0
4.000	11	10	9.691	0.600	7.050	6.950	0.100	96.9	100	5.21	50.0
4.001	10	7	9.882	0.600	6.950	6.838	0.112	88.2	100	5.41	50.0
3.002	7	6	1.000	0.600	6.838	6.828	0.010	100.0	100	5.47	50.0
1.003	6	1	10.949	0.600	6.828	6.720	0.108	101.4	150	5.65	50.0
1.004	1	dummy	5.000	0.600	6.190	6.100	0.090	55.6	100	5.87	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)
1.000	0.781	6.1	0.0	0.500	0.650	0.000	0.0
1.001	1.147	9.0	2.0	0.650	1.000	0.011	0.0
2.000	1.011	7.9	0.0	0.500	1.000	0.000	0.0
1.002	1.732	13.6	4.0	1.000	1.160	0.022	0.0
3.000	0.781	6.1	0.0	0.500	0.500	0.000	0.0
3.001	0.769	6.0	0.7	0.500	0.637	0.004	0.0
4.000	0.781	6.1	0.0	0.500	0.500	0.000	0.0
4.001	0.819	6.4	0.7	0.500	0.637	0.004	0.0
3.002	0.769	6.0	1.5	0.637	0.647	0.008	0.0
1.003	0.998	17.6	1.5	0.597	0.580	0.008	0.0
1.004	1.035	8.1	12.9	1.160	1.375	0.071	0.0

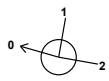
Flow+ v10.7 Copyright © 1988-2024 Causeway Technologies Ltd

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	29.104	97.0	100	Circular	7.500	6.900	0.500	7.350	6.600	0.650
1.001	9.077	45.4	100	Circular	7.350	6.600	0.650	7.500	6.400	1.000
2.000	29.104	58.2	100	Circular	7.500	6.900	0.500	7.500	6.400	1.000
1.002	4.210	20.0	100	Circular	7.500	6.400	1.000	7.450	6.190	1.160
3.000	9.691	96.9	100	Circular	7.650	7.050	0.500	7.550	6.950	0.500
3.001	11.157	100.0	100	Circular	7.550	6.950	0.500	7.575	6.838	0.637
4.000	9.691	96.9	100	Circular	7.650	7.050	0.500	7.550	6.950	0.500
4.001	9.882	88.2	100	Circular	7.550	6.950	0.500	7.575	6.838	0.637
3.002	1.000	100.0	100	Circular	7.575	6.838	0.637	7.575	6.828	0.647
1.003	10.949	101.4	150	Circular	7.575	6.828	0.597	7.450	6.720	0.580
1.004	5.000	55.6	100	Circular	7.450	6.190	1.160	7.575	6.100	1.375

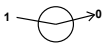
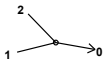
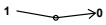
Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	4		Junction		3	450	Manhole	Adoptable
1.001	3	450	Manhole	Adoptable	2	450	Manhole	Adoptable
2.000	5		Junction		2	450	Manhole	Adoptable
1.002	2	450	Manhole	Adoptable	1		Junction	
3.000	9		Junction		8	450	Manhole	Adoptable
3.001	8	450	Manhole	Adoptable	7		Junction	
4.000	11		Junction		10	450	Manhole	Adoptable
4.001	10	450	Manhole	Adoptable	7		Junction	
3.002	7		Junction		6		Junction	
1.003	6		Junction		1		Junction	
1.004	1		Junction		dummy		Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
4	518260.452	104022.103	7.500	0.600		 0	1.000	6.900	100
3	518255.477	103993.427	7.350	0.750	450	 1	1.000	6.600	100
						0	1.001	6.600	100
5	518251.545	104023.675	7.500	0.600		 0	2.000	6.900	100
2	518246.538	103995.005	7.500	1.100	450	 1	2.000	6.400	100
						2	1.001	6.400	100
						0	1.002	6.400	100
1	518242.490	103996.162	7.450	1.260		1	1.003	6.720	150
						 2	1.002	6.190	100
						0	1.004	6.190	100
9	518213.332	104004.746	7.650	0.600		 0	3.000	7.050	100
8	518222.876	104003.062	7.550	0.600	450	 1	3.000	6.950	100
						0	3.001	6.950	100

Flow+ v10.7 Copyright © 1988-2024 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
11	518211.498	103994.343	7.650	0.600					
						0	4.000	7.050	100
10	518221.042	103992.662	7.550	0.600	450		1	4.000	6.950	100
							0	4.001	6.950	100
7	518230.633	103995.043	7.575	0.737			1	4.001	6.838	100
							2	3.001	6.838	100
							0	3.002	6.838	100
6	518231.618	103994.869	7.575	0.747			1	3.002	6.828	100
							0	1.003	6.828	150
dummy			7.575	1.475			1	1.004	6.100	100

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Detailed	Additional Storage (m³/ha)	20.0
Summer CV	1.000	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	1.000	Drain Down Time (mins)	1440	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	45	10	0	100	45	10	0
30	45	10	0				

Node 1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	6.890	Slope (1:X)	100.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	5	Depth (m)	0.450
Safety Factor	1.0	Width (m)	5.500	Inf Depth (m)	
Porosity	0.32	Length (m)	74.283		

Node 1 Lined Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.05796	Invert Level (m)	3.950	Pit Length (m)	3.000
Side Inf Coefficient (m/hr)	0.05796	Time to half empty (mins)	272	Depth (m)	3.500
Safety Factor	2.0	Ring Diameter (m)	2.100	Inf Depth (m)	
Porosity	0.32	Pit Width (m)	3.000	Number Required	1

Node 6 Lined Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.05796	Invert Level (m)	6.075	Pit Length (m)	3.000
Side Inf Coefficient (m/hr)	0.05796	Time to half empty (mins)	214	Depth (m)	1.500
Safety Factor	2.0	Ring Diameter (m)	2.100	Inf Depth (m)	
Porosity	0.32	Pit Width (m)	3.000	Number Required	1

Flow+ v10.7 Copyright © 1988-2024 Causeway Technologies Ltd

Results for 2 year +45% CC +10% A Critical Storm Duration. Lowest mass balance: 99.62%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	4	1	6.900	0.000	0.0	0.0000	0.0000	OK
15 minute summer	3	10	6.642	0.042	3.3	0.0203	0.0000	OK
15 minute summer	5	1	6.900	0.000	0.0	0.0000	0.0000	OK
15 minute summer	2	10	6.451	0.051	6.5	0.0194	0.0000	OK
180 minute summer	1	100	6.258	0.068	7.5	12.1304	0.0000	OK
15 minute summer	9	1	7.050	0.000	0.0	0.0000	0.0000	OK
15 minute summer	8	10	6.980	0.030	1.2	0.0090	0.0000	OK
15 minute summer	11	1	7.050	0.000	0.0	0.0000	0.0000	OK
15 minute summer	10	10	6.979	0.029	1.2	0.0088	0.0000	OK
15 minute summer	7	11	6.882	0.044	2.4	0.0005	0.0000	OK
180 minute winter	6	176	6.497	-0.331	0.6	2.2069	0.0000	OK
180 minute summer	dummy	100	6.164	0.064	6.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	4	1.000	3	0.0	0.000	0.000	0.0454	
15 minute summer	3	1.001	2	3.2	0.902	0.358	0.0325	
15 minute summer	5	2.000	2	0.0	0.000	0.000	0.0588	
15 minute summer	2	1.002	1	6.4	1.645	0.471	0.0164	
180 minute summer	1	1.004	dummy	6.0	1.096	0.737	0.0273	8.3
180 minute summer	1	Infiltration		0.3				
15 minute summer	9	3.000	8	0.0	0.000	0.000	0.0094	
15 minute summer	8	3.001	7	1.2	0.450	0.191	0.0290	
15 minute summer	11	4.000	10	0.0	0.000	0.000	0.0090	
15 minute summer	10	4.001	7	1.2	0.459	0.180	0.0253	
15 minute summer	7	3.002	6	2.4	0.729	0.398	0.0033	
180 minute winter	6	1.003	1	0.0	0.000	0.000	0.0000	
180 minute winter	6	Infiltration		0.1				

Flow+ v10.7 Copyright © 1988-2024 Causeway Technologies Ltd

Results for 30 year +45% CC +10% A Critical Storm Duration. Lowest mass balance: 99.62%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	4	37	6.972	0.072	1.3	0.0000	0.0000	OK
60 minute summer	3	38	6.968	0.368	6.0	0.1775	0.0000	SURCHARGED
60 minute summer	5	37	6.938	0.038	0.9	0.0000	0.0000	OK
60 minute summer	2	36	6.932	0.532	11.1	0.2018	0.0000	SURCHARGED
60 minute summer	1	36	6.871	0.681	28.4	15.7784	0.0000	SURCHARGED
15 minute summer	9	1	7.050	0.000	0.0	0.0000	0.0000	OK
15 minute summer	8	10	7.000	0.050	3.1	0.0154	0.0000	OK
15 minute summer	11	1	7.050	0.000	0.0	0.0000	0.0000	OK
15 minute summer	10	10	6.999	0.049	3.1	0.0149	0.0000	OK
15 minute summer	7	11	6.921	0.083	6.4	0.0010	0.0000	OK
120 minute winter	6	80	6.853	0.025	2.1	4.0752	0.0000	OK
15 minute summer	dummy	12	6.195	0.095	17.7	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	4	1.000	3	-1.3	-0.233	-0.215	0.2019	
60 minute summer	3	1.001	2	5.5	0.979	0.615	0.0710	
60 minute summer	5	2.000	2	-0.9	-0.155	-0.109	0.1541	
60 minute summer	2	1.002	1	9.3	1.731	0.683	0.0329	
60 minute summer	1	1.004	dummy	20.3	2.598	2.499	0.0387	23.8
60 minute summer	1	Infiltration		0.4				
15 minute summer	9	3.000	8	0.0	0.000	0.000	0.0191	
15 minute summer	8	3.001	7	3.1	0.562	0.507	0.0604	
15 minute summer	11	4.000	10	0.0	0.000	0.000	0.0183	
15 minute summer	10	4.001	7	3.1	0.574	0.476	0.0527	
15 minute summer	7	3.002	6	6.4	0.930	1.059	0.0069	
120 minute winter	6	1.003	1	1.1	0.559	0.063	0.0216	
120 minute winter	6	Infiltration		0.1				

Flow+ v10.7 Copyright © 1988-2024 Causeway Technologies Ltd

Results for 100 year +45% CC +10% A Critical Storm Duration. Lowest mass balance: 99.62%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	4	37	7.228	0.328	3.2	0.0000	0.0000	FLOOD RISK
60 minute summer	3	37	7.225	0.625	7.6	0.3011	0.0000	FLOOD RISK
60 minute summer	5	37	7.157	0.257	2.5	0.0000	0.0000	SURCHARGED
60 minute summer	2	37	7.154	0.754	11.3	0.2857	0.0000	SURCHARGED
60 minute summer	1	39	7.040	0.850	35.7	18.0042	0.0000	SURCHARGED
15 minute summer	9	1	7.050	0.000	0.0	0.0000	0.0000	OK
60 minute summer	8	39	7.049	0.099	2.8	0.0302	0.0000	OK
15 minute summer	11	1	7.050	0.000	0.0	0.0000	0.0000	OK
60 minute summer	10	39	7.048	0.098	2.8	0.0301	0.0000	OK
60 minute summer	7	39	7.044	0.206	5.9	0.0025	0.0000	SURCHARGED
60 minute summer	6	39	7.042	0.214	15.2	5.0641	0.0000	SURCHARGED
15 minute summer	dummy	11	6.195	0.095	21.2	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	4	1.000	3	-3.2	-0.437	-0.519	0.2277	
60 minute summer	3	1.001	2	5.5	0.969	0.607	0.0710	
60 minute summer	5	2.000	2	-2.5	-0.381	-0.310	0.2277	
60 minute summer	2	1.002	1	9.8	1.702	0.722	0.0329	
60 minute summer	1	1.004	dummy	22.7	2.905	2.795	0.0387	35.1
60 minute summer	1	Infiltration		0.4				
15 minute summer	9	3.000	8	0.0	0.000	0.000	0.0228	
60 minute summer	8	3.001	7	2.8	0.541	0.463	0.0872	
15 minute summer	11	4.000	10	0.0	0.000	0.000	0.0218	
60 minute summer	10	4.001	7	2.8	0.550	0.435	0.0772	
60 minute summer	7	3.002	6	5.9	0.890	0.974	0.0078	
60 minute summer	6	1.003	1	-9.5	-0.621	-0.538	0.1928	
60 minute summer	6	Infiltration		0.2				

Flow+ v10.7 Copyright © 1988-2024 Causeway Technologies Ltd

Appendix G Ultiporous maintenance recommendations

TARMAC

ULTIPOROUS

The ultimate porous asphalt for driveways and car parks



ULTIPOROUS

The ultimate porous asphalt for driveways and car parks

Combining excellent drainage with long term durability, ULTIPOROUS is designed for use on driveways and car parks. It helps to eliminate the problem of surface water and can also help meet local planning requirements.

PROVEN PERFORMANCE

Using the latest porous asphalt technology and a modified binder, the open aggregate structure allows effective drainage and avoids surface water.

ENHANCED COMPLIANCE

Reduces direct surface water run-off to meet the requirements of planning regulations and the Code for Sustainable Homes.

IMPROVED SAFETY

Eliminates the problem of both standing water and ice patches that can occur in cold weather conditions.

FASTER COMPLETION

Avoids expensive additional drainage, allowing quicker project delivery and reduced disruption to clients and end users.

POROUS FOOTPATHS

Where a fast draining, all weather footpath surface is required, ULTIPOROUS is available as a 6mm porous surface course and specialist binder course.

ULTIMATE SOLUTIONS

Available in 6mm for residential driveways and 10mm for small parking areas. When combined with the Tarmac ULTIFLOW range of permeable sub-base aggregates, we can offer a complete permeable solution. Ulticolour Porous asphalt is also available with a clear binder, pigment and colour matched aggregate for bright, long lasting coloured porous surfaces.

ULTIMATE SUPPORT

At Tarmac, technical excellence comes as standard. Laying contractors are supported with our ULTIPOROUS laying guide.

To find your local Tarmac office visit: ***tarmac.com/contact***

TYPICAL APPLICATIONS

Where site conditions or planning requirements make drainage a priority, ULTIPOROUS offers the solution. It requires less groundwork and excavation than alternative rainwater management systems, helping to save time on site and reduce disruption for clients.

FOR DRIVEWAYS

- 6mm porous surface course (recommended at 30mm thickness) suitable for hand lay.
- 20mm porous binder course.

FOR FOOTPATHS

- 6mm porous surface course (recommended at 30mm thickness) suitable for hand lay.
- 20mm porous binder course.

FOR CAR PARKS

- 10mm porous surface course.
- 20mm porous binder course.
- 32mm porous binder course.

SPECIALIST BASE AGGREGATE

Tarmac's ULTIFLOW sub-base aggregate is recommended, for a complete permeable pavement solution.

TECHNICAL DATA

	Typical Air Voids	Typical Stiffness (ITSM)	Typical Water Sensitivity (ITSR)	Typical Hydraulic Conductivity
Product	BS EN 12697-8	BS EN 12697-26	BS EN 12697-12	DD229
ULTIPOROUS 6mm	16.0%	3,300MPa	85%	>5000 mm/hr
ULTIPOROUS 10mm	16.5%	1,100MPa	89%	>5000 mm/hr
ULTIPOROUS 20mm	23.0%	1,200MPa	N/R	>5000 mm/hr
ULTIPOROUS 32mm	23.0%	1,200MPa	N/R	>5000 mm/hr

COMPARATIVE RAINFALL

- Worst recorded UK rainfall: 341mm in one day (averaging 15mm/hr for 22 hrs) in Cumbria in December 2015.
- A hydraulic conductivity of 5,300mm/hr (above the 5,000mm/hr min. requirement for 6mm) would take ≈94 seconds to drain 15mm of water.
- All Tarmac porous asphalts are designed to provide a minimum hydraulic conductivity of 5,000mm/hr/m^2 using the BS DD 229 testing method and meet the requirements laid out in CIRIA 753 and SAPCA.

FCC/0323

Ground Floor, T3 Trinity Park
Bickenhill Lane, Birmingham, B37 7ES

TARMAC.COM

©2023 Tarmac Trading Limited. 'ULTIPOROUS', 'ULTIFLOW', 'ULTICOLOUR', 'Tarmac' and the 'circle logo' are registered trademarks.

TARMAC
A CRH COMPANY

ULTIPOROUS

System aftercare and maintenance

(including UltiColour Porous)





The long term performance of an ULTIPOROUS pavement relies on client awareness and good site practice. By preventing misuse and implementing some key house keeping measures, the system will perform effectively for many years.

Clients who have installed ULTIPOROUS systems are encouraged to return to Tarmac Contracting at any point to ask for support and guidance should they have concerns over any aspect of the system.

We advise the surface is not used or trafficked until it has cooled to ambient temperature. We recommend to achieve this that the area should be left for a minimum of 24 hours.

AFTER INSTALLATION

- Protect the system from construction and maintenance trades involving heavy plant and equipment.
- Prevent loose building and landscaping materials being dropped on the surface as these will clog the pores of the asphalt.
- Traditional pressure washing equipment should not be used as this forces dirt deeper into the asphalt.

NEW BUILDING WORK

- Any new building or landscaping works on site may place the system at risk, hence an effective protection method should be agreed with all trades using the system area, in particular those requiring heavy plant, equipment and materials which may damage or clog the surface.

EMERGENCY INTERVENTION

- Oil and fuel spillages can be cleaned up using absorbent cloths with any residues left for treatment within the pavement itself.
- High levels of spillage or long term deposits of oil and fuel may force minor repairs to the system layers. An experienced contractor should be employed.

ROUTINE MAINTENANCE

- Litter, leaves and spillages should be brushed or if possible vacuumed off the surface.
- Periodic use of a standard road sweeper is permitted.

WINTER MAINTENANCE

- Winter maintenance can be undertaken using BS 3247 Fine Grade 6.3mm rock salt however, effective dispersal across the surface is highly recommended and reduces clogging of the asphalt pores. As such, applicators or spreaders should be employed.
- Snow clearance by unmodified or general plant must be prohibited. All clearance equipment such as JCB type loading shovels or tractors should use either plastic/rubber ploughs or buckets protected with rubber sheaths to prevent damage to the surface.





ANNUAL ASSESSMENT OF SURFACE PERMEABILITY

- During a period of heavy rain, an annual assessment of the surface should be undertaken to identify any areas which over time begin to hold water. Should any areas of ponding begin to show over 50% of the total surface area, we would recommend Hydraulic Conductivity testing is undertaken and an appropriate course of cleaning agreed.
- Trials show that silts and detritus materials build up just 30–40mm from the surface, travelling no deeper. As such they can be easily removed by hydro cleaning, a specialist process detailed below.
- Any systems which comprise flow control devices and other related SUDS components should also be inspected to ensure they continue to operate free from litter or debris.

RESTORING PERMEABILITY THROUGH 'HYDRO' CLEANING

Under controlled pressure these machines jet water into the surface to agitate the solids back in to suspension and then under intense vacuum draws them out of the surface, restoring hydraulic conductivity levels some thirty times more than that required for a very heavy UK storm event.

Although the speed of silting is largely linked to the number of vehicle movements across the surface and end use, on most 'trafficked' sites cleaning is not anticipated until years eight, nine or ten. Experience thus far shows that even systems subject to constant aggregate spills and high vehicle movements, did not show signs of pooling until year six.

Although more specialist than a traditional road sweeper, this jetting plant is readily available for hire across the UK.

CLIENT FRIENDLY

The process is performed at walking pace with large areas cleaned in hours and with minimal impact on the client or users.



FCC/0323

TARMAC
A CRH COMPANY

Ground Floor, T3 Trinity Park
Bickenhill Lane, Birmingham, B37 7ES
0800 1 218 218 enquiries@tarmac.com

TARMAC.COM

©2023 Tarmac Trading Limited.
'ULTIPOROUS', 'ULTICOLOUR POROUS', 'Tarmac' and
the 'circle logo' are registered trademarks.