

Toddington Lane

Littlehampton, BN17 7PN

Flood Risk Assessment & Drainage Strategy

for

Worthing Homes

20240453

August 2024

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Worthing Homes

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1.0 Introduction

- 1.1 This Flood Risk Assessment (FRA) and Drainage Strategy (DS) report has been produced by Green Structural Engineering (GSE) on behalf of the Worthing Homes Ltd to support a planning application for the redevelopment of the existing land, for a new residential development at the site, Toddington Lane, Littlehampton, BN17 7PN. Figure 1 below shows the location of the site.

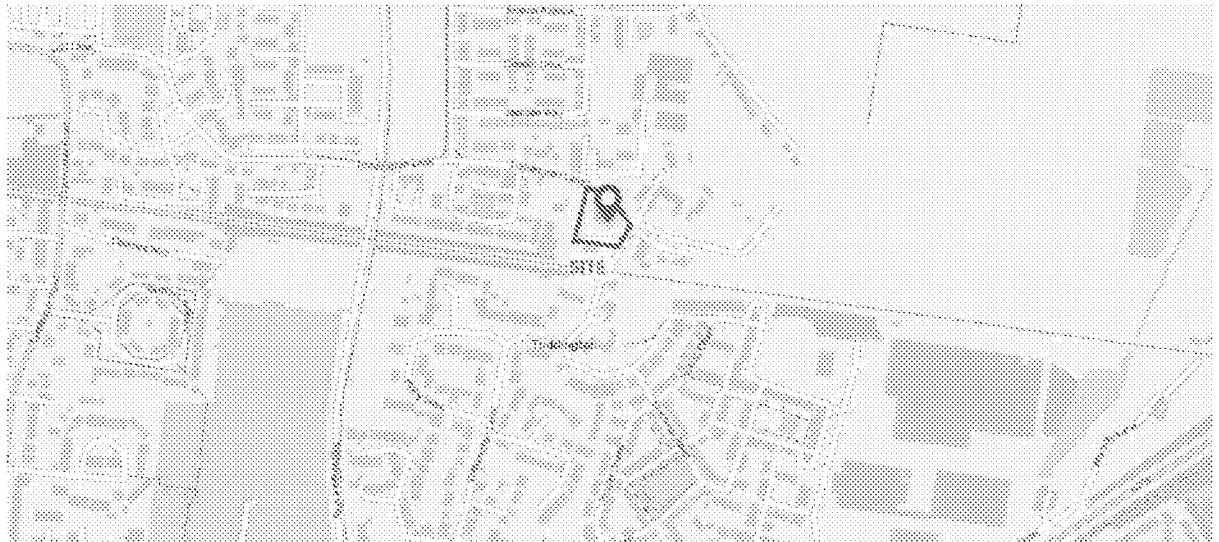


Figure 1 – Site Location Plan

- 1.2 This FRA & DS had been prepared in accordance with the requirements of the National Planning Policy Framework (NPPF) and its planning practice guidance, national design standards, local surface water policies and the nationally recognised SuDS Hierarchy, to demonstrate that the proposed development can be drained in an acceptable and sustainable manner and will not increase the risk of flooding to the site and surrounding area.
- 1.3 This report is not intended to provide the final details of the detailed drainage design for the proposed development. It rather provides the design concepts and systematic approach used for the drainage strategy to meet the requirements of the relevant guidelines. The scope of this Report is as follows:
- (i) To show that flood risk from the site associated with surface water (pluvial) can be satisfactorily managed so that the site and adjacent land will not be subject to unacceptable flood risk whilst considering allowances for climate change over the anticipated lifespan of the development.
 - (ii) To demonstrate that there will be no increased risk of flooding off site or on adjacent land and nearby property elsewhere; and
 - (iii) To demonstrate that wastewater and surface water runoff from the proposed development has satisfactory and achievable sustainable disposal strategies.

2.0 Site Parameters

Site Description

- 2.1 The site is located along Toddington Lane, Littlehampton, BN17 7PN, it lies approximately 560m to a watercourse noted as the Black Ditch, at its closest point. The existing site is currently occupied by a barn structure, with an access road leading on to Toddington Lane to the east, with a mixture of tarmac, concrete, skalpings, thistles and dense vegetation occupying the remainder of the site.

Site Topography

- 2.2 A topographical survey of the site and adjacent areas is included in Appendix A. The survey shows the site to be elevated above the surrounding highways, with high elevations of approximately 7m AOD, sloping down to 5m AOD towards the northern boundary and 3.6m AOD, where the access road meets Toddington Lane to the east.

Site Geology

- 2.3 Soakage testing was undertaken on site in December 2023 by Southern Testing, where the geologies encountered were noted. The various exploratory holes found that made ground, featuring Brown clayey silty sandy gravel, with patches of gravelly clay was present, with other foreign items identified.
- 2.4 Beneath the made ground, layers of sandy gravelly clay, gravelly sand and structureless chalk were found. A copy of the soakage report is included in Appendix B, with an extract summarising the soils encountered, shown on Table 1 below:

Depth (m)	Thickness (m)	Soil Type	Description
0.00-0.40/2.80	0.40-2.80	MADE GROUND	Brown clayey silty sandy GRAVEL with patches of gravelly CLAY. Gravel is fine to coarse subangular to subrounded flint and varying anthropogenic materials such as brick, concrete, plastic bottle, rubber tyre, metal bars and slate roof tile fragments.
0.40/1.00-2.60/3.00	1.20-1.30	Sandy gravelly CLAY	Brown silty sandy gravelly CLAY. Gravel is fine to coarse subangular to subrounded flint and occasional chalk.
2.80-3.80 (TP2 only)	Unproven	Gravelly SAND	Greenish yellow very clayey gravelly SAND. Gravel is fine to coarse subrounded flints.
2.60-3.00m (TP3 only)	Unproven	Structureless Chalk	Recovered as: Structureless chalk comprising off white and yellowish brown clayey gravelly SILT. Gravel is fine to coarse medium density chalk and occasional flint.

Table 1 – Summary of site Geology

- 2.5 The soakage report states that no groundwater was observed during the fieldwork.
- 2.6 A total of 5 infiltration tests were undertaken, with the findings summarised in Table 2 Below:

Test ID	Test Depth (mop)	Design Infiltration Rate		Notes
		l/m ² /minute	m/sec	
TP01	2.5	0.0087	1.45x10 ⁻⁷	Pit not emptied. negligible soakage
TP01A	1.0	0.601	1.00x10 ⁻⁵	Pit not emptied.
TP02	3.8	0.092	1.53x10 ⁻⁶	Pit not emptied. Poor soakage
TP02A	1.20	0.429	7.16x10 ⁻⁶	Pit not emptied.
TP03	3.0	0.253	4.21x10 ⁻⁶	Pit not emptied. Poor soakage

Table 2 – Infiltration test results

- 2.7 The report states that the lowest soakage result should be taken as the design rate, which in this instance was taken within TP01, with a rate of 1.45×10^{-7} , with 'negligible soakage'. The report goes on to state *'The soakage results indicated that the shallow soils on site have variable but generally poor soakage potential. Given that Made Ground was encountered in each of the trial holes to variable depths but generally greater than 1m we would not recommend that any permeable paving or soakaways be placed within any made ground soils due to their inherent variability and the risk of inundation settlement'*.

Development Proposals

- 2.8 The proposals will see the erection of a new 10-unit residential development, featuring a mixture of 2- and 3-bedroom units, some semi-detached and some terraced. Associated access roads and parking facilities are also proposed to serve the development. A copy of the proposed site plan is included in Appendix C.

3.0 Flood Risk

Fluvial/Tidal Flooding

3.1 The National Planning Policy Framework identify the Flood Zones as follows:

- Zone 1: 'Low Probability' This zone comprises land assessed as having a less than a 1 in 1000 annual probability of river or sea flooding (<0.1%) in any year.
- Zone 2: 'Medium Probability' – This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5%-0.1%) in any year.
- Zone 3a: 'High Probability' – This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.
- Zone 3b: 'The Functional Floodplain' – This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes).

3.2 Figure 2 below has been extracted from the Environment Agencies (EA's) flood map for planning and shows the various flood zone extents in the area around the site.

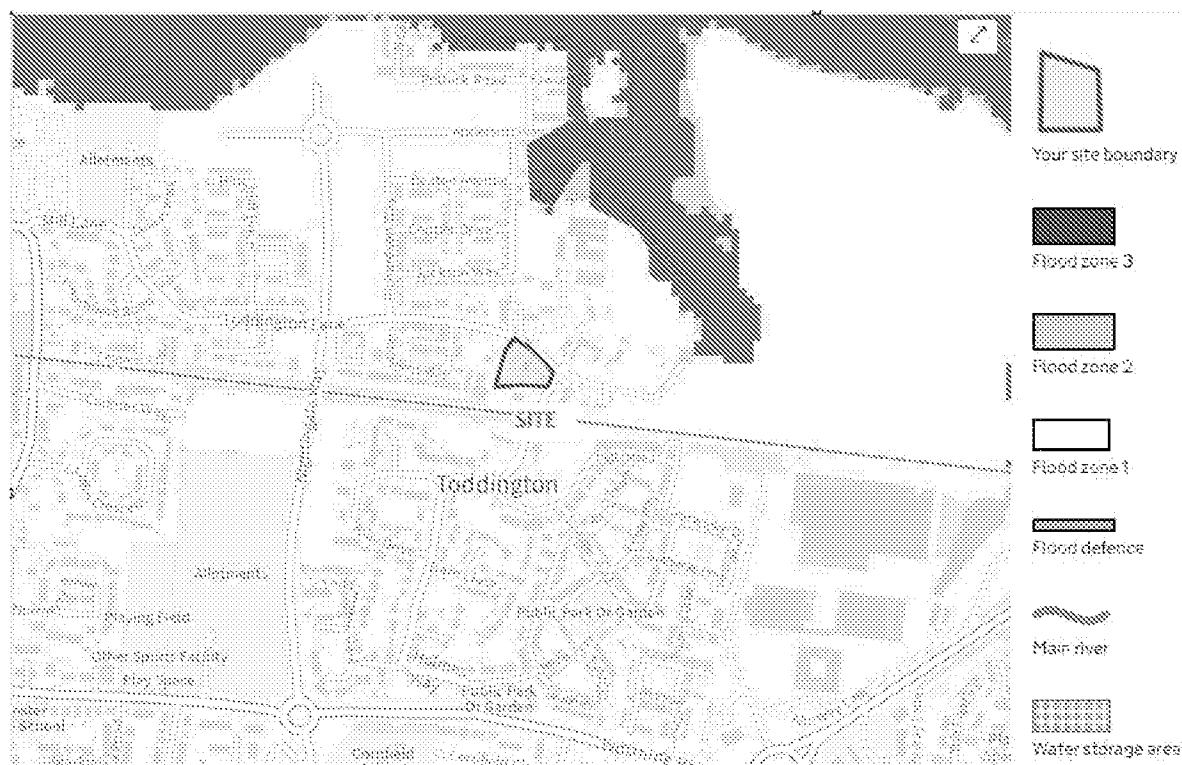


Figure 2 – EA Flood Map for Planning

- 3.3 As can be seen the site is located in Flood Zone 1, with the closest extents of Flood Zones 2 & 3 located approximately 250m to the northeast of the site, emanating from the Black Ditch.

Surface Water Flooding

- 3.4 At the time of writing, surface water flood mapping has been paused on the EAs website, as they await new data, however, a Level 1 Strategic Flood Risk Assessment, and associated mapping, was produced by JBA Consulting, for Arun District Council in August 2016.
- 3.5 Figure 3 below, has been extracted from mapping, and shows a small area, to the front of the site, where it meets Toddington Lane, is within the 1,000 year event extent. This information correlates with the topographical survey, included in Appendix A, where the bottom of access road is at a low level topographically.

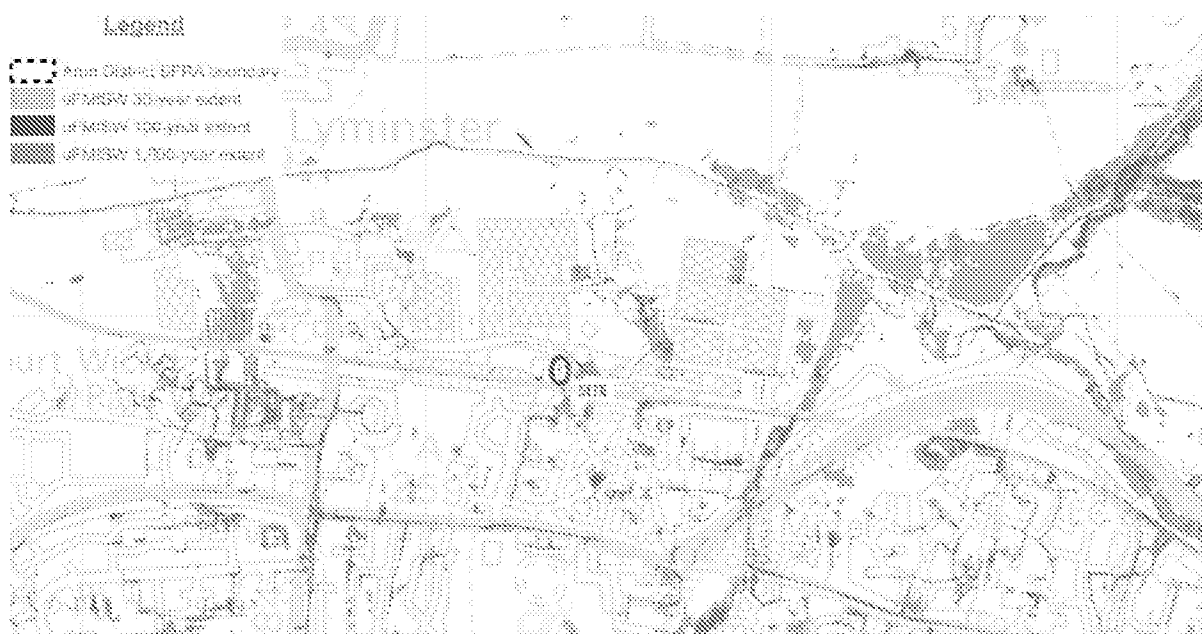


Figure 3 – Arun District Council Surface Water Flood Map

- 3.6 The surface water flood maps provided, take into account topography and do not consider positive drainage system. Any areas of higher surface water flood risk can therefore not be assessed without detailed interrogation of the local highway drainage networks. There are however proposals in place to provide upgrades to the surface water drainage, in this area of Toddington Lane, which is detailed further in Section 7, which will assist in alleviating this apparent surface water flood risk.

Groundwater Flooding

- 3.7 Figure 4 below has been extracted from the mapping within the Level 1 Strategic Flood Risk Assessment, produced by JBA Consulting, for Arun District Council in August 2016. As can be seen the site has been identified as having between a 25 and 50% of groundwater flooding, the 2nd lowest category. The site investigation works, where exploratory holes were excavated to depths of 3m, noted there was no presence of groundwater.

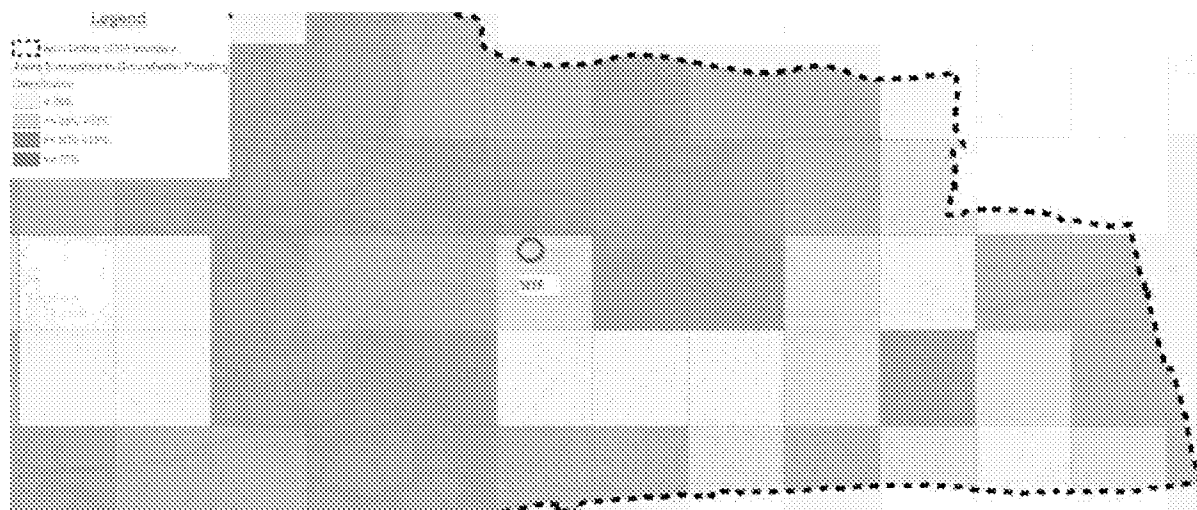


Figure 4 – Arun District Council Groundwater Flooding Classification

Historical Flooding

- 3.8 Historical flood mapping was also produced for the SFRA, which shows locations of recorded incidents from sources including fluvial, coastal, tidal, surface water, failure and unknown. Figure 5 has been extracted from this, which shows no recorded events to have affected the area around the site, with the closest being a surface water flood, approximately 500m to the west of the site.



Figure 5 – Arun District Historical Flood Events

Sequential Test

- 3.9 A document titled Chichester District Council Level 1 SFRA – Methodology in support of Performing the Sequential Test, was produced by JBA Consulting for Chichester District Council, who's policies align with Arun District Council, who are both governed under the West Sussex County Council Lead Local Flood Authority.

- 3.10 Page 7 of this document relates to surface water flood risk and states '*It is not anticipated that the Sequential Test for surface water would normally require the consideration of alternative sites at lower risk, as the widespread and dendritic nature of surface water flood risk is conceptually very different to river and sea flood risk, but in some circumstances for relatively small sites that are potentially substantially affected it is possible that alternatives should be considered (as these could potentially not satisfy the flood risk requirements when assessed under the Exception Test)*'.
- 3.11 As the area noted of potential surface water flood risk is confined to the sites entrance, at a low point topographically, and accounts for a very small percentage, in line with the guidance issued by JBA Consulting, it is not considered appropriate that alternative sites be reviewed in the application of the Sequential Test.
- 3.12 It should also be noted that the site has been included on the Arun District Council's Brownfield Land Register, identified as 'suitable for development', viewable here as site 1, identified as LU18A Toddington Farm (Land North & West of 1-3 Toddington Farm Cottages), shown in Figure 6 below:
<https://www.arun.gov.uk/helaa-brownfield-land-self-build-registers>

ARUN DISTRICT COUNCIL

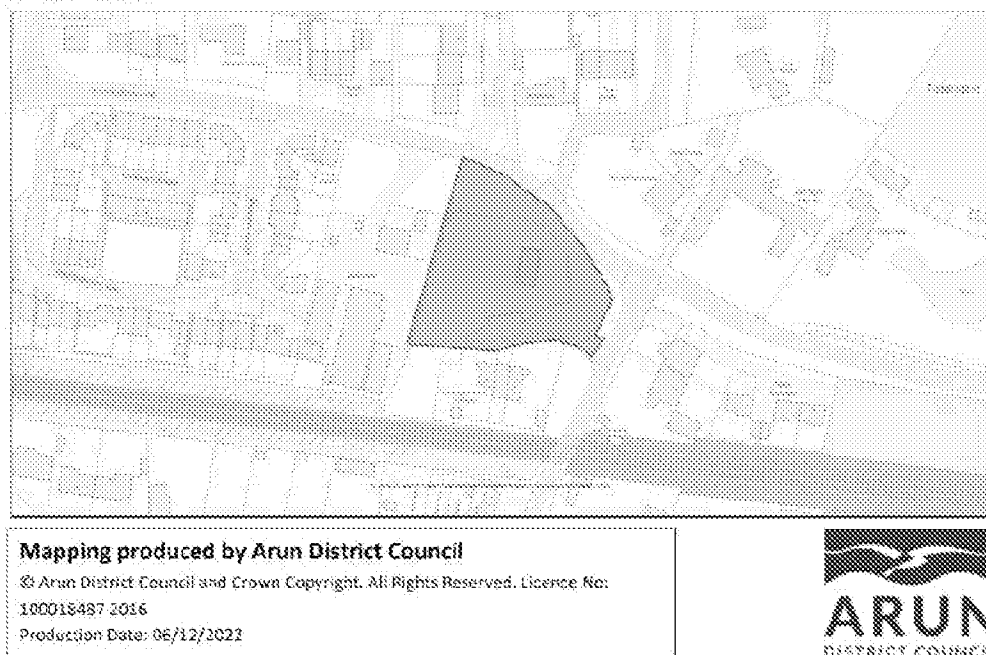


Figure 6 – Arun District Council Brownfield Land Register LU18A Toddington Farm (Land North & West of 1-3 Toddington Farm Cottages)

- 3.13 Paragraph: 027 Reference ID: 7-027-20220825 of the National Planning Practice Guidance states that:

*The Sequential Test should be applied to 'Major' and 'Non-major development' proposed in areas at risk of flooding, but it will **not be required where:** The site has been allocated for development and subject to the test at the plan making stage (provided the proposed development is consistent with the use for which the site was allocated and provided there have been no significant changes to the known level of flood risk to the site, now or in the future which would have affected the outcome of the test).*

- 3.14 For the reasons stated above, it is therefore considered that application of the Sequential Test to the development site is not appropriate.

Exception Test/Flood Mitigation

- 3.15 As detailed within this section, all risks of flooding associated with the site are low to negligible, with a small area along the eastern boundary shown to be within the surface water flooding extent. As detailed in Section 7 of this report, off-site works are proposed to alleviate this flood risk, in the form of upgrades to the local highways network drainage.

The following on-site principles will be adopted to provide additional mitigation:

1. Proposed house levels will be set several metres higher than the road level, which is currently shown to be within the surface water flood extent.
2. The surface water drainage for the development will be sized to cater for all storms up to and including the 100-year event, including 45% allowance for climate change (refer to Section 7 for further details).
3. Safe pedestrian access and egress can be sought to the north of the site, to an elevated position of Toddington Lane, away from the surface water flood risk extent.

4.0 Existing Drainage

Public Sewers

- 4.1 Southern Water serves the surrounding area for the disposal of wastewater. Asset records have been obtained from Southern Water showing the public sewer networks surrounding the site, a copy of which is included in [Appendix D](#). As can be seen, there are no public sewers within the immediate vicinity of the site, with a section of pumped foul public drainage to the west of the site, serving the adjacent development, with foul and surface water sewers present to the south, the other side of the railway line.
- 4.2 Drainage records have been obtained from the Highways Authority, which are included in [Appendix E](#). These show a series of gullies and pipes adjacent to the site, that are shown to discharge into a nearby ditch. It is believed these records are out of date, with the previous ditch now culverted.
- 4.3 The residential site, 50m to the west of the development site, is under the client, Worthing Homes ownership. A CCTV survey of this site was undertaken in August 2024 and is included in [Appendix F](#). The CCTV survey shows a network of foul pipes and manholes, flowing to the west and discharging to the Southern Water pumped system.

Site Drainage

- 4.4 As the existing site is undeveloped, there is no formal drainage serving it, with no manhole covers or other drainage features identified on the topographical survey included in [Appendix A](#).
- 4.5 The site is approximately 3,430m² in area, of which 1,640m² of this is proposed as hardstanding land, when a 10% allowance has been applied for urban creep. A greenfield runoff rate calculation has been undertaken and is included in [Appendix G](#), which shows a QMED rate of 0.7l/s, for the proposed hardstanding area of 1,640m².

5.0 Planning Policy Context

National Planning Policy Framework and Planning Practice Guidance

- 5.1 The National Planning Policy Framework (NPPF), originally published in 2012, was reissued in December 2023. The NPPF includes policies on flood risk and minimising the effect of flooding. The NPPF requires local authorities to adopt proactive strategies to mitigate and adapt to climate change, taking account of flood risk, coastal change and water supply and demand considerations.
- 5.2 Within the context of a drainage strategy the most applicable requirements of National and Local Planning Policy are that developments should not cause new, or exacerbate, existing flooding problems either on the proposal site, or elsewhere, and should incorporate Sustainable Drainage Systems (SuDS) in order to restrict or reduce surface water run-off.
- 5.3 Planning Practice Guidance has been issued to ensure the effective implementation of the planning policies set out in the NPPF on development in areas at risk of flooding. The guidance sets out an expectation that for major development SuDS will be provided unless demonstrated inappropriate but also that SuDS may not be practical for all development types and this will depend upon the nature of the proposed, development, its location and the existing flood risk. New developments will, however, only be considered appropriate if priority has been given to sustainable drainage. The Planning Practice Guidance to the NPPF outlines the following drainage hierarchy to be considered when disposing of surface water, with the aim of discharging as high up the hierarchy as possible:
- To the ground (infiltration)
 - To a surface water body
 - To a surface water sewer, highway drain or other drainage system
 - To a combined sewer

The Non-Statutory technical standards for sustainable drainage systems (2015)

- 5.4 In March, 2015, the Department for Environment, Food and Rural Affairs (DEFRA) published the Non-statutory technical standards for sustainable drainage systems; which are intended to be used in conjunction with the NPPF and the planning practice guidance. The Non-statutory technical standards for sustainable drainage systems provide guidance for developers to ensure that flood risk, from surface water, is managed appropriately so as not to lead to an increase in flood risk on and off site. This non-statutory guidance includes advisory standards on the peak flow rate, runoff volume and flood risk within the development. These standards also set out that that pumping would not normally be acceptable unless it is not reasonably practice to provide gravity drainage, that drainage systems should be structurally sound and that any damage from its construction must be minimised and rectified before the drainage system is considered completed.

Adoption Arun Local Plan 2011-2031 (July 2018)

- 5.5 The Arun Local Plan covers the period between 2011 and 2031 and was produced in July 2018. This document was produced to provide key policies in promoting sustainable development.
- 5.6 Section 18 of this document relates to water and provides policies on drainage and flood risk.
- 5.7 Policy W DM2 is specific to flood risk and states:

Development in areas at risk from flooding, identified on the latest Environment Agency flood risk maps and the Council's Strategic Flood Risk Assessment (SFRA) , will only be permitted where all of the following criteria have been satisfied:

- a) The sequential test in accordance with the National Planning Policy Guidance has been met.*
- b) A site specific Flood Risk Assessment demonstrates that the development will be safe, including access and egress, without increasing flood risk elsewhere and reduce flood risk overall.*
- c) The sustainability benefits to the wider community are clearly identified.*
- d) The scheme identifies adaptation and mitigation measures.*
- e) Appropriate flood warning and evacuation plans are in place; and*
- f) New site drainage systems are designed to take account of events which exceed the normal design standard i.e. consideration of flood flow routing and utilising temporary storage areas.*

The reports prepared as part of the criteria above must take into account contingency allowances, taking climate change into account as set out in Flood Risk Assessments: climate change allowances section of the NPPG.

In locations where strategic flood defence or resilient and resistant construction measures are necessary within the site itself, proposals will be required to demonstrate how measures have been incorporated as an intrinsic part of the scheme in a manner which is compatible with the latest Strategic Flood Risk Assessment.

All development proposals must take account of relevant Surface Water Management Plans, Catchment Flood Management Plans and related Flood Defence Plans and strategies such as the Lower Tidal River Arun Strategy. The council may require financial contributions from development on sites where measures to address flood risk or to improve the environmental quality of watercourses have been identified by these Plans and Strategies.

- 5.8 Policy W DM3 relates to Sustainable Urban Drainage Systems, and states:

To increase the levels of water capture and storage and improve water quality, all development must identify opportunities to incorporate a range of Sustainable Urban Drainage Systems (SUDS), appropriate to the size of development, at an early stage of the design process.

Proposals for both major and minor development proposals must incorporate SUDS within the private areas of the development in order to provide source control features to the overall SUDS design. These features include:

- *Green roofs*
- *Permeable driveways and parking*
- *Soakaways*
- *Water harvesting and storage features including water butts*

Proposals for major development must also integrate SUDS within public open spaces and roads, reflecting discussion with the appropriate bodies. SUDS must therefore be integrated into the overall design of a development and must:

- a) Contribute positively to the appearance of the area, integrating access to allow maintenance of existing watercourses and the system.*
- b) Effectively manage water (including its quality)*
- c) Accommodate and enhance biodiversity by making connections to existing Green Infrastructure assets and*
- d) Provide amenity for local residents (ensuring a safe environment)*
- e) Retain the existing drainage network of the site and the wider area,*
- f) Be maintained in perpetuity, supported through a Maintenance and Management Plan/Regime, including its financing, agreed with the Local Planning Authority*

In order to ensure that SUDS discharge water from the development at the same or lesser rate, as prior to construction, developers must:

- f) Follow the hierarchy of preference for different types of surface water drainage disposal systems as set out in Approved Document H of the Building Regulations and the SUDS manual produced by CIRIA.*
- g) Undertake up to six months groundwater monitoring within the winter period. h. Undertake winter percolation testing in accordance with BRE365.*
- h) The proposed drainage system must be designed to ensure that there is no flooding on a 1 in 30 year storm event.*
- i) The design must also take account of the 1 in 100 year storm event plus 30% allowance for climate change, on stored volumes, to ensure that there is no flooding of properties or the public highway or inundation of the foul sewerage system. Any excess flows must be contained within the site boundary, and within designated storage areas.*

Policy analysis

- 5.9 The drainage hierarchy presented by all levels of policy documents, despite differences in wording, largely follow the same concept. The drainage hierarchy should be considered as follows; infiltration to ground, rainwater discharge direct to a watercourse, controlled discharge to surface water sewer.
- 5.10 Both local and national planning policy and guidance indicate that, wherever possible, developments should aim for discharge of surface water at greenfield rates regardless of development type, if infiltration cannot be used. The different levels of policy and guidance vary as to what should be achieved in the case of brownfield sites, or where discharge at greenfield rates is not practical. It is, however, clear that the development should not result in additional flood risk with discharge rates above that of the existing brownfield runoff rates and that betterment would be expected.

6.0 SuDS Hierarchy

Table 4 has been produced and shows the SuDS Hierarchy in order along with comments specific to the development site and their suitability:

Discharge hierarchy	Viable	Comments
Rainwater use as a resource (for example rainwater harvesting)	Partially	Water Butts can be utilised at property level for partial rainwater reuse.
Rainwater infiltration to ground at or close to source	No	As detailed in Section 2.3 to 2.7 of this report, the soil conditions on site are unsuitable for infiltration.
Rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens)	Partially	<p>The only green spaces that could accommodate open water features such as swales and basins, along the eastern boundary of the site, slope steeply towards Toddington Lane, to account for the level difference between the raised site and public highway. Incorporating swales/basins has therefore been discounted.</p> <p>Rainwater pipes can discharge directly to above ground planters, before discharging to the underground network. This may form a hybrid solution with the Water Butts.</p>
Attenuate rainwater by storing in tanks or sealed water features for gradual release	Yes	Underground attenuation tanks proposed.
Rainwater discharge direct to a watercourse	No	No watercourses located within the immediate vicinity of the site to discharge to.
Controlled rainwater discharge to a surface water sewer or drain.	Yes	New proposed off-site surface water sewer, that can form the discharge point, refer to Section 7 for further details.
Controlled rainwater discharge to a combined sewer	N/A	N/A, option higher up the hierarchy available.

Table 4 – SuDS Hierarchy

7.0 Proposed Drainage

Surface Water Drainage

- 7.1 As detailed in Section 4, the proposed 1,640m² of hardstanding area has an associated greenfield runoff rate of 0.7l/s.
- 7.2 Given the low greenfield runoff rate, it is not considered that utilising this low rate will be practical, as such a rate will be prone to blockages causing greater risks of flooding, contrary to the intent of the initiative. It is considered that a proposed surface water discharge rate of 2l/s would be suitable without reducing rates to a value that may cause maintenance issues on site due to blockages.
- 7.3 It is proposed that a new network of surface water pipes and manholes will be installed to convey surface water runoff generated from the proposed houses to a new underground attenuation facility. Runoff generated along the proposed access roads and external hardstanding areas is to be sloped towards porous paving parking bays, wherever possible, which will be lined and served by perforated pipes and restricted by orifice plate chambers, that will act as a collection point and also a water quality treatment facility. Footpaths adjacent to soft landscaping, will be graded to these areas.
- 7.4 Porous finishes will be incorporated wherever possible, however, within the parking areas, not along the access roads, which will be required to support HGVs, such as moving vehicles. Utilising porous pavement along the access road is not considered suitable, due to potential damage that may be sustained by the HGV movements, a more robust surface would be needed to accommodate such vehicles. External areas that cannot be routed to porous car park sections will however receive water quality treatment in the form of petrol interceptors with the necessary indices required to mitigate pollution based on the proposed land use.
- 7.5 Additional source control features are proposed in the form of above ground planters, that will accommodate rainwater pipes from roofs, which may also perform a hybrid role of storing water for reuse. The rainwater from the planters will then drain to the below ground network, before draining to the main attenuation tank in the centre of the site.
- 7.6 This tank will then be restricted via a flow control chamber, at a rate of 1.2l/s and cascade to a final section of below ground attenuation, another tank, located at the sites entrance, the low point topographically, that will also accommodate runoff from the front section of access road, that is to pass through a petrol interceptor. The central attenuation tank will have approximate dimensions of 105m² x 0.8m deep, with 95% porosity, with the final tank measuring 72m² x 0.4m deep, also with 95% porosity. The final outlet from site will then discharge at a restricted rate of 2l/s, via a flow control chamber.

- 7.7 The proposed point of connection will not be an existing feature, rather a new proposed network of surface water drainage that is to be installed along Toddington Lane. The proposed surface water network will form part of a set of highways improvement works, that are proposed by a neighbouring development. A copy of the off-site surface water drainage works is included in [Appendix H](#). The proposed surface water sewer along Toddington Lane, will not only form the discharge position for surface water from site, it will also serve the dual purpose of alleviating the apparent surface water flood risk, identified in Section 3 of this report.
- 7.8 The full surface water network has been sized to accommodate all storms, up to and including the 100-year event, including a 45% allowance for climate change. CVs (Runoff coefficients) of 1 have been used, with a 10% increased allowance applied to all drained hardstanding areas, to allow for urban creep. A drainage strategy plan of the proposed arrangements is included in [Appendix I](#), with a Microdrainage network model, that correlates with the strategy plan included in [Appendix I](#).

Foul Water Drainage

- 7.9 A new network of foul manholes and pipes is to be installed to serve the proposed houses. Due to restrictions in levels, the northern and eastern set of houses will drain via gravity to a new pump chamber that will then discharge, via a rising main, to the network serving the set of houses along the western boundary.
- 7.10 As there are no formal public sewers to discharge to within the vicinity of the site, it is proposed the full site foul drainage will discharge to the adjacent sites foul water network, which is shown in [Appendix F](#). There is an area in between the adjacent site and this site to be developed, which is currently occupied by an industrial estate, which is planned to be demolished, and replaced by Phase 2 of the adjacent residential site, under Worthing Homes ownership.
- 7.11 To accommodate this arrangement, it is proposed that a temporary network will be installed around the industrial unit, to serve the development, which will then be rerouted via a new section of pipework, once the industrial building has been demolished, such that it aligns with the proposed access road of Phase 2 of the neighbouring site, and not through the extents of any individual properties. The details and legal agreements of this arrangement will be finalised at the detailed design stage, prior to commencement of works. The indicative layout of this arrangement is shown on the drainage strategy plan, included in [Appendix I](#).

Water Quality

- 7.12 The CIRIA SuDS Manual has been reviewed for guidance on pollution mitigation indices. Table 26.2 of this document has been extracted below, indicating expected pollution hazards for different land uses, with the items applicable to the site highlighted.

TABLE 26.2 Pollution hazard indices for different land use classifications				
Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydrocarbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways ¹	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured, industrial sites, trunk roads and motorways ¹	High	0.8 ²	0.8 ²	0.8 ²

7.13 As can be seen the proposed residential roof use is considered to have a very low pollution hazard level, with the parking areas/low traffic roads noted as low.

7.14 Table 26.3 below has also been extracted the CIRIA SuDS Manual and shows how certain pollution indices can be mitigated.

TABLE 26.3 Indicative SuDS mitigation indices for discharges to surface waters			
Type of SuDS component	Mitigation indices ¹		
	TSS	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter drain	0.4 ²	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond ³	0.7 ²	0.7	0.5
Wetland	0.6 ²	0.8	0.8
Proprietary treatment systems ^{3,4}	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

- 7.15 As can be seen the proposed permeable paving, will prove suitable for mitigating any contaminants generated from the access roads which drain to these sections. External areas that cannot be routed to the permeable parking bays will pass through a petrol interceptor, with mitigation indices consistent with parking areas/low traffic roads
- 7.16 It is proposed that catchpit chambers will be installed upstream of tanks that will help filter out potential contaminants generated from the very low pollution hazard associated with residential roofs.

8.0 SuDS Maintenance, Management & Construction

Maintenance & Management

- 8.1 It is recommended that catchpit sumps be monitored 3 monthly, and after periods of intense rainfall and cleared where required. Jetting of the pipework may be required on occasion, if and when a decrease in the performance of the drainage network has been identified. For the correct methods of maintenance on the various drainage features, refer to S.H.W., Volume 1, Series 500, Clauses 520, 521 and 526.
- 8.2 The following maintenance regime for tanks should be adopted to ensure efficient performance.

Maintenance Schedule	Required Actions	Typical Frequency
Regular Maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter- remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from pre-treatment structures and/ or internal forebays	Annually, or as required
	System inspection after heavy storms	After every extreme storm event
Remedial actions	Repair/rehabilitate inlets, outlet, overflows and vents.	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

8.3 The following maintenance regime for permeable paving should be adopted to ensure efficient performance.

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Remove debris and leaves etc.	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surfaces from adjacent impermeable areas as this area is most likely to collect the most sediment.
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds	As required- once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
	Remedial work to any depressions, rutting etc	As required
	Rehabilitation of surface and upper substructure	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Inspect for evidence of poor operation and/or weed growth - if required, take remedial action.	Three-monthly, 48 hours after large storms in the first six months
	Inspect silt accumulation rates and establish appropriate frequencies for rehabilitation	Annually
	Monitor inspection chambers	Annually

Construction Works

- 8.4 It will be the duty of the site owner/management team to ensure that the proposed surface water drainage system is maintained correctly during the lifetime of the site, as per the regime listed above, to mitigate the risk of drainage failure that may lead to flooding.
- 8.5 Listed below are some potential risks that may be encountered during the construction of the new drainage network, and how these risks can be mitigated.

Item	Potential Effects	Recommended Actions
Deep excavations required for installation of drainage	Excavations required for drainage installation may be subject to collapse, and/or workers/plant/material falling in.	Temporary support to be provided along excavations. Edge support required along excavations.
Protection of installed infrastructure during work suspensions	During work suspensions, excavations and installed drainage that are exposed may be subject to ingress of debris and other material, also presenting risk to site operators.	Contractor to utilise appropriate protection measures including but not limited to temporary pipe stoppers and trench covers.
Storage of construction materials and surplus materials.	Construction materials and surplus materials to be exported from site may be obstructive to working areas and access routes.	Designated areas to store materials away from working areas and pedestrian/vehicle access routes to be provided.
Perched groundwater	Perched groundwater encountered during the construction phase may impact on work proposals	Appropriate dewatering techniques to be utilised to mitigate the risk of groundwater effects.

9.0 Summary/Conclusion

- 9.1 This report has been produced to assess the risk of flooding and review the proposed drainage strategy for the proposed development at Toddington Lane, Littlehampton, BN17 7PN. 2.8 The development proposals will see the erection of a new 10-unit residential development, featuring a mixture of 2- and 3-bedroom units, some semi-detached and some terraced. Associated access roads and parking facilities are also proposed to serve the development.
- 9.2 The site is located within Flood Zone 1, land assessed as having less than a 1 in 1000 annual probability of river or sea flooding ($<0.1\%$) in any year. The risk of flooding affecting the site from, ground water and other sources is considered low to negligible, with the exception of surface water, where a small section of the site is shown within the surface water flood extents, where the access road meets Toddington Lane, at a low point topographically.
- 9.3 The perceived area of surface water flood risk is soon to be alleviated, in the form of upgrades to the surrounding highways drainage networks, which will form part of the works of a future neighbouring development. Mitigation against flood risk will be provided on site by having buildings raised several metres above the existing area of surface water flood risk, safe pedestrian access and egress to the northern elevated part of Toddington Lane, and the proposed surface water drainage network.
- 9.4 National and local policies have been reviewed regarding preferred methods of surface water disposal. The use of infiltration as a means of surface water disposal will not be possible due to the poor soakage potential of the soil on site, along with mass buildups of made ground, a medium unsuitable for infiltration. The option of discharging to a watercourse is not possible, as there are none within the vicinity of the site to discharge to.
- 9.5 It is proposed that surface water generated on site will be stored in a combination of porous paving and below ground attenuation tanks, with above ground planters/water butts used as additional source control provisions, to collect rainwater pipe outlets. Porous paving will be utilised in parking bays, with, that will accommodate runoff from the adjacent access roads and hardstanding, restricted by orifice plates which will then drain to the central below ground attenuation tank. restricted via orifice plates. The central attenuation tank will then cascade into a smaller one, which will also accommodate runoff generated on the front section of access road, that will pass through a petrol interceptor, where the total discharge from site will be restricted to 2l/s, via a flow control chamber. Surface water will discharge to the soon to be developed off-site surface water drainage network to serve Toddington Lane. The surface water drainage system has been designed to cater for all flood events up to and including the 100-year storm, including a 45% allowance for climate change.
- 9.6 It is proposed that foul water will discharge to the neighbouring residential site, in a 2 staged approach, with consideration given to the soon to be developed Phase 2 of this site, that is currently occupied by an industrial building, with the legal arrangements of this proposal to be finalised at detailed design stage.
- 9.7 This report clearly demonstrates that the proposed development has low to negligible risk of flooding from all sources, and can be served sustainably for drainage, in line with local and national policies and guidance.

APPENDIX A – Topographical Survey

Diagram of a parallelogram with vertices K, S, and two unlabeled vertices. The side KS is labeled 15.45, and the adjacent side is labeled 11.80.

Ridge 10.40
Eave 7.19

Ridge 11.09

Save 9.64

Ridge 10.04
Eave 9.55

Diagram of a barn with a gabled roof. The roof is divided into two sections by a vertical ridge line. The left section is labeled "Eave 11.39" and the right section is labeled "Ridge 12.94". The word "BARN" is written in the center of the diagram.

Figure 1 is a schematic diagram of a two-layer system. The top layer is labeled "Zone 1/0" and the bottom layer is labeled "Zone 1/0/95". The layers are separated by a horizontal line. The top layer is labeled "1" and the bottom layer is labeled "2".

CL 5.41

APPENDIX B – Soakage Report



Soakage Test Report

Project Name: Land to the south of Toddington Lane

Location: Lyminster, Littlehampton, BN17 7FU

Client: Worthing Homes

Project ID: J15618

Report Date: 22 December 2023

Report Issue: 1

Author	J A Clifford BSc FGS		
Check / Review	S F Pratt BSc MSc CGeol FGS DIC		

For and on behalf of Southern Testing Laboratories Limited

DOCUMENT HISTORY AND STATUS

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Site Plans and Exploratory Hole Logs

APPENDIX B

In-Situ Test Methods and Results

A INTRODUCTION

1 Authority

Our authority for carrying out this work is contained in a Project Order from Approved by S Gearing of Worthing Homes on the 27th November 2023.

2 Location

The site is located 1.8km north East of Littlehampton Railway station, and just to the south of Toddington Lane. The approximate National Grid Reference of the site is TQ 03400 03859. The site location is indicated on Figure 1 within Appendix A.

3 Investigation Brief

In accordance with the Client's instructions, and our quotation, the following was included in our brief for this soakage investigation:

Soakage tests to be carried out on site using the BRE 365 method at locations specified by the client's engineer.

4 Scope

This factual report presents our exploratory hole logs and test results only.

A UXO risk assessment was not included within our brief for the investigation, however a preliminary UXO risk assessment has been carried out prior to our initial site investigation dated November 2021.

As with any site there may be differences in soil conditions between exploratory hole positions.

This report is not an engineering design and the figures and calculations contained in the report should be used by the Engineer, taking note that variations will apply, according to variations in design loading, in techniques used, and in site conditions. Our figures therefore should not supersede the Engineer's design.

The findings and opinions conveyed via this investigation report are based on information obtained from a variety of sources as detailed within this report, and which Southern Testing Laboratories Ltd. believes are reliable. Nevertheless, Southern Testing Laboratories Ltd. cannot and does not guarantee the authenticity or reliability of the information it has obtained from others.

The investigation was conducted and this report has been prepared for the sole internal use and reliance of Worthing Homes and their appointed Engineers. This report shall not be relied upon or transferred to any other parties without the express written authorisation of Southern Testing Laboratories Ltd. If an unauthorised third party comes into possession of this report they rely on it at their peril and the authors owe them no duty of care and skill.

The recommendations contained in this report are made in respect of the particular context of the investigation as described in the report and may not be appropriate to alternative development schemes. This report should be considered in its entirety and Southern Testing Laboratories Ltd accepts no responsibility for and excludes liability in respect of any omission or alteration made by others, and any use of the report for any purpose other than that for which it was produced.

B SITE SETTING

5 Geological Records

No formal desk study has been carried out, but reference has been made to both online and published geological maps to put the site into context. A geotechnical investigation report has been previously carried out by ourselves (Ref: J14912 November 2021) and the reader is referred to this report for additional information.

5.1 Geology

The British Geological Survey Map No317/332 indicates that the site geology consists of River Terrace Deposits over Raised Beach Deposits over the New Pit Chalk Formation

5.1.1 River Terrace Deposits

The River Terrace Deposits are of fluvial origin and were laid down by the Thames when the climate was much wetter and cooler than at present. The terraces consist of sheets of gravel and sand with an overlying deposit of Brickearth (really an ancient alluvium). Some variability in soils is to be expected at junctions with the various terraces, as riverbanks existed there. The remains of these former riverbanks can be soft and silty or contain clay.

5.1.2 Brickearth

Brickearth (loess deposit) is a recent deposit which is so called as it is suited to brick manufacture. It is predominantly an aeolian deposit; formed during cold, dry climatic conditions. There is evidence that brickearth has been reworked as part of 'sheet flooding' which helped incorporate flint gravels into the deposit. Brickearth consists mainly of ferruginous silty clay, which is often sandy and may contain some finely divided chalk, scattered flints and gravelly seams, or other locally derived material. It is usually poorly consolidated and may contain numerous hollow root tubes and worm burrows.

5.1.3 Raised Beach Deposits (South Coast)

There are four raised beaches on the south coast. These are:

1. The Higher Raised Beach (30m Beach, Goodwood Slindon Raised Beach).
2. The 15 to 20 m Beach.
3. The Sussex Low Raised Beach (The 7.5 m Raised Beach).
4. The 4 m Beach.

The principal beaches in Southeast England are the Higher and Low beaches, as described below:

The Higher Raised Beach (Goodwood-Slindon Raised Beach)

The higher beach is variously referred to as the 100 foot beach, the 30 m beach, the Goodwood Beach and the upper beach.

The beach deposits consist of uniformly graded, often buff, silty sand, which lie beneath a superficial cover of (usually) clayey gravel. They are above 4 m thick and are dated to the second warm interglacial period (the Hoxnian). They rest on a wave-cut platform which falls gently from its maximum elevation of just over 30 m AOD to about 25 m AOD over a distance of 1 to 2 km. Where the base platform is in chalk there is often a thin gravelly layer and the upper 150 mm or so of the chalk is hard and calcreted. At the interface between the chalk and the overlying beach large solution features may be found.

The northern margin of the beach is marked by a slight break in slope at about +45 m AOD - the beach deposits and overlying cover are about 15 m thick there. A "buried cliff" line may be found and intense reworking and variability of soils must be anticipated.

It is noted that coarse beach deposits are usually absent and it is not entirely clear whether the northern margin is a cliff line or a fault scarp.

Low Sand Beach (7.5 m Beach) (Sussex/Hampshire Low Raised Beach)

The Low Beach deposits comprise fine uniform silty sands with some gravel, which rest on a platform that falls from about +15 m AOD, to present sea level, over a distance of up to 15 km. They lie beneath a superficial cover of brickearth or Coombe deposits.

As the deposits are up to about 5 m thick, the ground level at the inland margin is about +20 m AOD, and a slight change in slope can sometimes be detected at this point. There is a former cliff at the margin, usually in soft Tertiary clays which have been highly degraded but which may have been up to 10 to 12 m high. Highly variable soil conditions must be anticipated in the region of the ancient cliffs.

The beaches were formed in a complex marine transgression which is traditionally considered to belong to the Ipswichian Interglacial (about 80,000 years ago) and there are also deep local cryoturbation and solution features.

5.1.4 New Pit Chalk Formation

The New Pit Chalk Formation typically comprises a blocky creamy white, smooth textured chalk with well-developed marl seams. Small finger shaped flint occurs sporadically in the lower part of the sequence. Conjugate fractures are usually clay-coated and slickensided, reflecting the presence of many clay-rich marl seams.

The White Chalk outcrop in particular is frequently highly fractured and highly permeable, and usually has good infiltration characteristics. On the other hand, Chalk Head, highly weathered Chalk and Chalk under a low permeability superficial cover may have very poor infiltration characteristics.

Chalk is slightly soluble in water and, while it has excellent bearing properties when unweathered, this solubility can lead to deep weathering and softening, and the upper layers of chalk often have an irregular boundary with overlying strata

The Chalk may be softened by solution to a depth of 5 to 15 metres and bearing capacities and engineering properties improve with depth. Where there is an outcrop of impermeable soil overlying the chalk there may be a dramatically increased solution effect due to concentrated surface water flow to the Chalk close to the outcrop boundary.

Solution features are common in the Chalk, and these can present significant difficulties to development on affected sites.

Man has also worked the chalk for flints, and for other purposes, for thousands of years and any signs of old workings should be carefully investigated.

C FIELDWORK

6 Strategy and Method

The strategy adopted for the soakage testing comprised the following:

Activity / Method	Purpose	Max Depth Range (mbgl)	Installations / Notes
TP01,TP01A,TP02,TP02A and TP03 JCB 3CX	Trial pit to investigate the shallow ground conditions and allow for assessment of soakage potential using the BRE365 method.	1.00-3.80	BRE365 Soakage tests

Exploratory hole locations were specified by the Client's Engineer and are shown in Figure 2 in Appendix A.

In-situ test method descriptions employed are given in Appendix B together with the test results.

7 General Site Description

The site was roughly rectangular in shape measuring approximately 100m across in the east to west direction and 70m in a north to south direction. The site comprised mostly vacant land overgrown with vegetation, with a part brick and part concrete agricultural barn measuring approximately 15m x 30m. This had a suspected asbestos cement pitched roof and sides. The site was bound by Toddington Lane to the north east, residential housing to the south and commercial buildings and workshops to the west.

7.1 Topography and Drainage

The topography of the site was elevated in comparison to Toddington Lane to the north, south and east and overlooked the flat lying land to the north. The topography of the surrounding area is predominantly flat towards the coastline but rises steeply to the north towards Arundel.

7.2 Vegetation

The site was heavily vegetated with weeds and brambles with the northern and eastern boundaries being the most heavily vegetated. An ecological boundary fence was also in place along the southern boundary.

7.3 Buildings and Land Use on Site and Nearby

A single building was present on site and this comprised a part brick part concrete barn with concrete floor slab and suspected asbestos cement roof and sides that had partially collapsed in several places.

8 Weather Conditions

The fieldwork was carried out on the 6th December 2023 at which time the weather was generally cold following a period of higher than average rainfall.

9 Soils as Found

The soils encountered are described in detail in the attached exploratory hole logs (Appendix A), but in general comprised a covering of Made Ground over variable natural superficial deposits over Chalk. A summary is given below.

Depth (m)	Thickness (m)	Soil Type	Description
0.00-0.40/2.80	0.40-2.80	MADE GROUND	Brown clayey silty sandy GRAVEL with patches of gravelly CLAY. Gravel is fine to coarse subangular to subrounded flint and varying anthropogenic materials such as brick, concrete, plastic bottle, rubber tyre, metal bars and slate roof tile fragments.
0.40/1.00-2.60/3.00	1.20-1.30	Sandy gravelly CLAY	Brown silty sandy gravelly CLAY. Gravel is fine to coarse subangular to subrounded flint and occasional chalk.
2.80-3.80 (TP2 only)	Unproven	Gravelly SAND	Greenish yellow very clayey gravelly SAND. Gravel is fine to coarse subrounded flints.
2.60-3.00m (TP3 only)	Unproven	Structureless Chalk	Recovered as: Structureless chalk comprising off white and yellowish brown clayey gravelly SILT. Gravel is fine to coarse medium density chalk and occasional flint.

10 Groundwater Observations

Groundwater was not observed in any of the exploratory holes during the fieldwork.

D TEST RESULTS

11 Soakage Test Results

The BRE paper DG365, Ref [22] describes a method for site testing to determine soil infiltration rates at the proposed site of a soakaway. The in-situ test method is described in Appendix B.

A total of 5 soakage tests were carried out across the site, at the locations shown on the attached site plan Figure 2, Appendix A. The full results of the soakage tests are presented within Appendix B.

The DG365 Ref [22], states that each pit should be allowed to drain three times to near empty, with filling on the same or consecutive days. This was not possible given the slow soakage rates on site and the one day of testing allowed for.

The infiltration rate from each trial hole is summarised in the table below. The soakage rate in this report is expressed as $\text{l/m}^2/\text{minute}$, which is a convenient rate to use. The BRE use a unit of m/sec , which is the value in $\text{l/m}^2/\text{minute}$ divided by 60,000.

Test ID	Test Depth (mbgl)	Design Infiltration Rate		Notes
		$\text{l/m}^2/\text{minute}$	m/sec	
TP01	2.5	0.0087	1.45×10^{-7}	Pit not emptied. negligible soakage
TP01A	1.0	0.601	1.00×10^{-5}	Pit not emptied.
TP02	3.8	0.092	1.53×10^{-6}	Pit not emptied. Poor soakage
TP02A	1.20	0.429	7.16×10^{-6}	Pit not emptied.
TP03	3.0	0.253	4.21×10^{-6}	Pit not emptied. Poor soakage

Note: The Design Infiltration Rate is the lowest of the three tests

Where three fillings have not been carried out, a reduction factor should be applied to the result to provide a design infiltration rate.

The soakage results indicated that the shallow soils on site have variable but generally poor soakage potential. Given that Made Ground was encountered in each of the trial holes to variable depths but generally greater than 1m we would not recommend that any permeable paving or soakaways be placed within any made ground soils due to their inherent variability and the risk of inundation settlement.

12 General Guidance on Design of Soakaways

Any soakaway scheme may require the approval of the Environment Agency, Building Control and, where applicable, the adopting Highways Authority.

Soakaways are used to store the immediate surface water run-off from hard surfaced areas, such as roof or carparks, and allow for efficient infiltration into the adjacent soil. They should be designed to discharge their stored water sufficiently quickly to provide the necessary capacity to receive run-off from a subsequent storm. The time taken for discharge depends upon the soakaway shape and size, and the surrounding soil's infiltration characteristics.

Groundwater levels can vary considerably from season to season and year to year, often rising in wet or winter weather, and falling in periods of drought. As such, a high groundwater table may affect the storage capacity of soakaways. In addition, it should be noted that an unsaturated zone may be required between the base of soakaways and the groundwater table, by the Environment Agency. Longer term monitoring may be required to establish actual groundwater levels as part of the planning approval process.

The design of soakaways can be square, circular (conventional) or trench excavations, and may be rubble filled, perforated precast concrete ring units, plastic cells or any similar structure that collects rainwater and run-off and allow discharge directly into the ground. Depending on the geological conditions, and depth at which suitable infiltration is achieved, soakaways can also be deep bored.

Long-term maintenance and inspection must be considered during the design and construction process. Maintenance of silt traps, gully pots and interceptors will improve the long-term performance of soakaways. The use of wet well chambers within the soakaway system can further assist in pollutant trapping and extending the operating life of soakaways.

Risk of pollution to the quality of groundwater must be considered as part of the design.

Generally, roof and surface run-off should not significantly impact on groundwater quality and subject to appropriate approvals from the Environment Agency could be discharged directly to soakaways. However, although again subject to approvals from the Environment Agency, paved surface run-off for larger trafficked areas should generally be passed through a suitable form of oil interception device prior to discharge to the soakaway.

Care must be taken to ensure that the discharge of large volumes of surface run-off into the soil does not disrupt the existing sub-surface drainage patterns. Similarly in areas of sloping topography, consideration should be given to the siting of soakaways to avoid potential discharge and or flooding of down slope areas.

Soakaways should not normally be constructed closer than 10m to buildings.

REFERENCES

- [1] Building Research Establishment (BRE), "DG365 Soakaway Design," 2016.
- [2] BSI Standards, "BS 5930 Code of practice for ground investigations," 2015.
- [3] BSI Standards, "BS 3882:2015 Specification for Topsoil," 2015.
- [4] CIRIA, "C574 Engineering in Chalk," 2002.
- [5] R. N. Mortimore, Logging the Chalk, 2014.



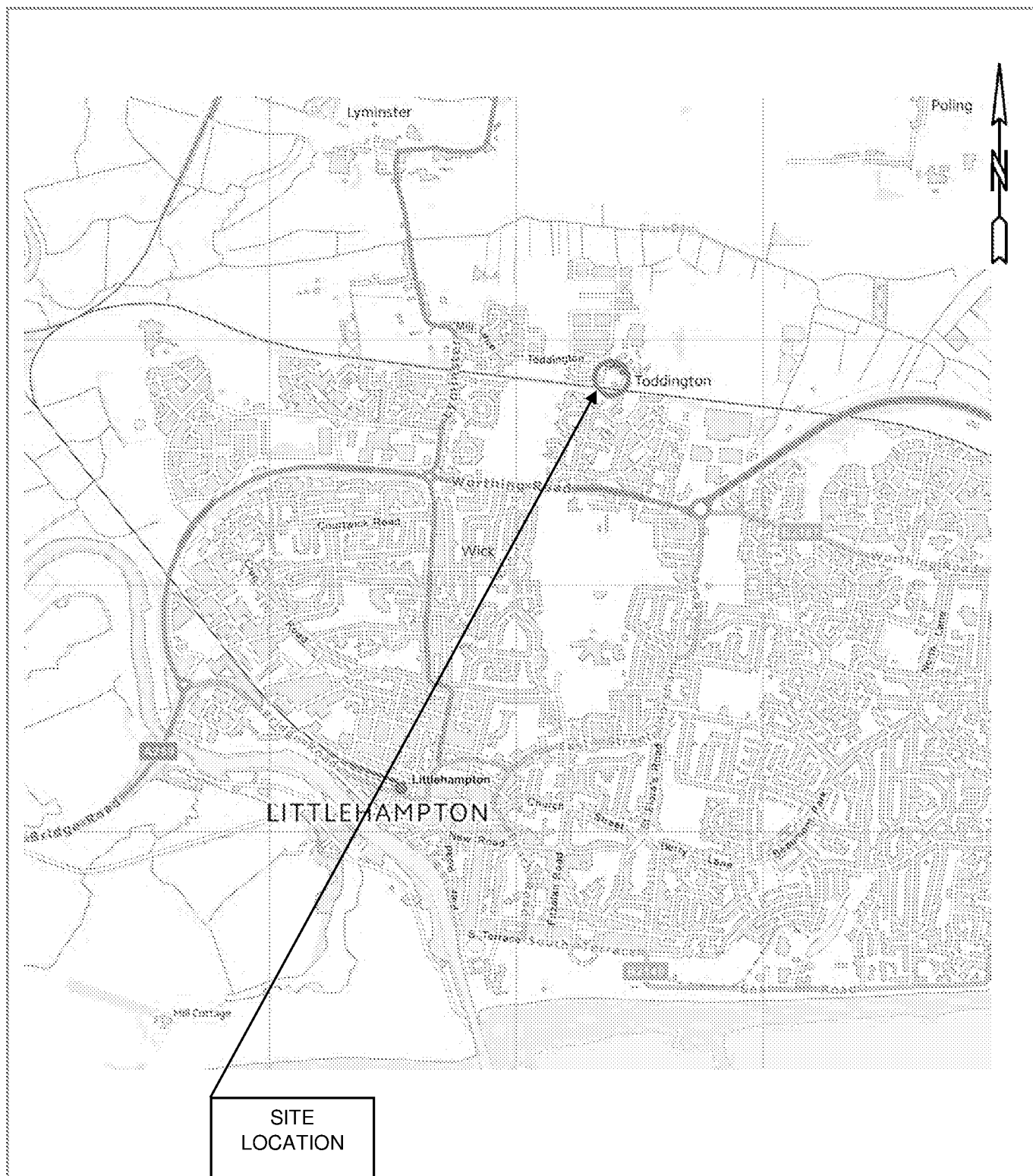
Southern Testing
Environmental & Geotechnical

ST Consult 
Environmental & Geotechnical

APPENDIX A

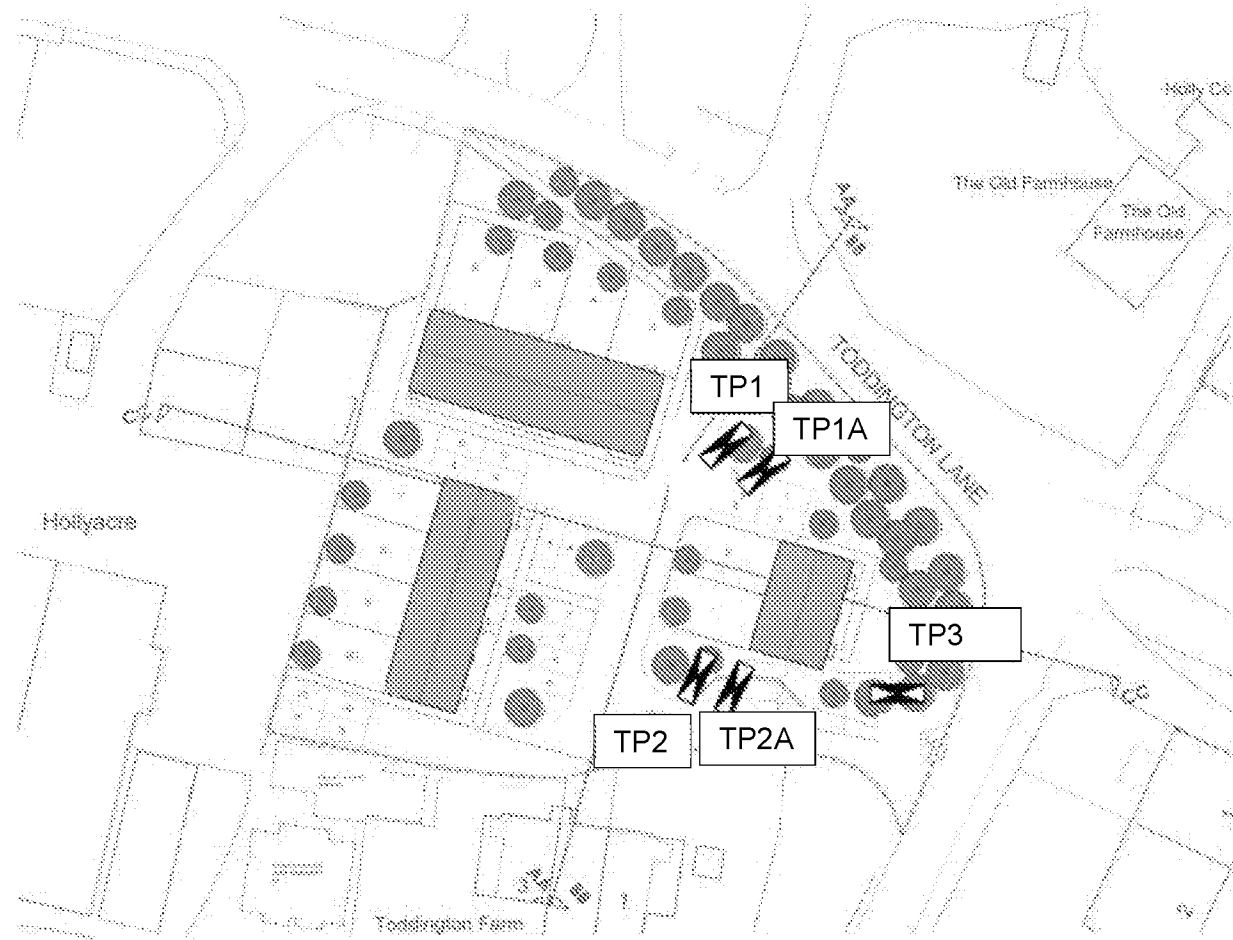
Site Plans and Exploratory Hole Logs





Contains Ordnance Survey Data © Crown Copyright and Database Right 2019

Site:	Land at Toddington Lane, Littlehampton, BN17 7PN	Project ID	J15618
Figure 1	Site Location Plan	Date:	21/12/2023



NB: Positions of exploratory holes / test positions are only indicative unless dimensioned.

Site:	Land to the south of Toddington Lane, Littlehampton	Project Id:	J15618
Figure 2	Site Location Plan	Date:	12/12/2023

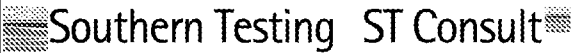
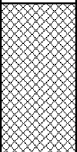
Key to Exploratory Hole Logs, Plans and Sections

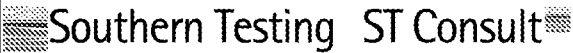
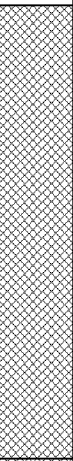
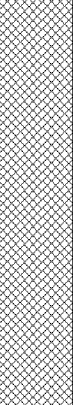
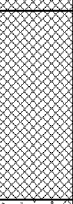
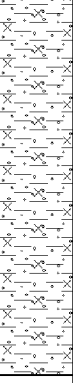
Backfill Symbols	Pipe Symbols	Principal Soil Types	Principal Rock Types	Drilling Records
Arisings	Plain Pipe	Topsoil	Mudstone	Water Strike
Concrete	Slotted Pipe	Made Ground	Claystone	Depth Water Rose
Blacktop	Piezometer	Clay	Siltstone	Total Core Recovery (%) [TCR]
Bentonite	Piezometer Tip	Silt	Sandstone	Solid Core Recovery (%) [SCR]
Gravel Filter	Filter Tip	Sand	Limestone	Rock Quality Index (%) [RQI]
Sand Filter	Extensometer	Gravel	Chalk	Fracture Index (fractures / m) [FI]
	Inclinometers	Peat		

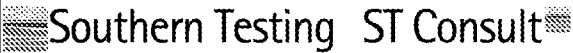
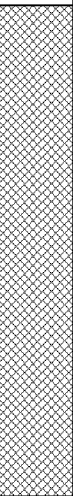
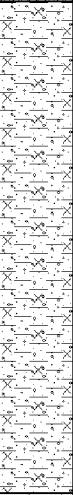

All soil and rock descriptions are in general accordance with BS5930 2015, BS EN ISO 14688-1:2002+A1:2013 and BS EN ISO 14689-1:2003. Chalk descriptions are also based on CIRIA C574 and "Logging the Chalk – R.N. Mortimer 2015". The Geology Code is only provided where a positive identification of the sample strata has been made.

Location / Method Identifiers		In-situ Test Location / Method	
BH	Borehole (undefined)	DP	Dynamic Probe
CP	Cable Percussive	CPT	Cone Penetration Test
RC	Rotary Core	CBR	In-situ CBR Test
RO	Rotary Open Hole	DCP	CBR using Dynamic Cone Penetrometer
ODC	Rotary Odex/Symmetrix drilling cased	CBRT	CBR using TRL Probe
CP+RC	Cable Percussive to Rotary Core	PB	Plate Bearing Test
SNC	Sonic	SPT (S)	Standard Penetration Test (Split Barrel Sampler)
CFA	Continuous Flight Auger	SPT (C)	Standard Penetration Test (Solid Cone)
FA	Flight Auger	N	SPT Result
VC	Vibro Core	-/-	Blows/Penetration (mm) after seating drive
WLS+RC	Windowless (Dynamic) Sampler to Rotary Core	-*/-	Total Blows / Penetration (mm)
WLS	Windowless Sampler	()	Extrapolated Value
WS	Window Sampler	PPT	Perth Penetration (In-House Method - Equivalent N Value)
HA	Hand Auger	HP / UCS	Strength from Hand Penetrometer (kN/m ²)
C	Road / Pavement Core	IVN	Strength from Hand Vane ((kN/m ²) P = peak, R = residual)
IP	Inspection Pit (Hand Excavation)	PID	Photo Ionisation Detector (ppm)
TP	Trial Pit (Machine Excavated)	MEXE	Mexi-Cone CBR (%)
OP	Observation Pit (Supported Excavation Hand or Machine)		

Samples / Test Type		Samples / Test Type	
B	Bulk Sample	SPTLS	Standard Penetration Test Split Barrel Sample
BLK	Block Sample	TW	Thin Wall Push In Sample (e.g. Shelby Sampler)
C	Core Sample	U	Undisturbed Open Drive Sample (blows to take)
CBRS	CBR Mould Sample	UT	Thin Wall Undisturbed Open Drive Sample (blows to take)
D	Small Disturbed Sample	W	Water Sample (Geotechnical)
ES	Environmental Sample (Soil)	SP	Sample from Stockpile
EW	Environmental Sample (Water)	P	Piston Sample
GS	Environmental Sample (Gas)	AMAL	Amalgamated Sample

<div>Southern Testing ST Consult</div>				Start - End Date:		Project ID:		Hole Type:		TP1A	
				06/12/2023		J15618		TP		Sheet 1 of 1	
Client:		Worthing Homes				Co-ordinates:		Level (m AOD)		Logger:	
Project Name:		Land to the south of Toddington Road				Location:		Littlehamton			
Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description				
Depth (m bgl)	Type	Results									
				(0.40)		0.40	Brown silty GRAVEL. Gravel is fine to coarse concrete, brick, flint, tile, chalk, rubber and plastic (MADE Ground)				
							Firm brown and orange brown silty slightly sandy CLAY.				
							Pit terminated at 1.00m				
Pit Dimension (m)		Pit Stability:		Stable.		Water Strikes					
		Weather:				Depth (m)		Date/Time		Remarks	
Width:	0.45	Remarks:									
Length:	2.10										
Depth:	1.00										
Status:		DRAFT		Log Print Date and Time:		12/12/2023 09:48		Log Approved By:			

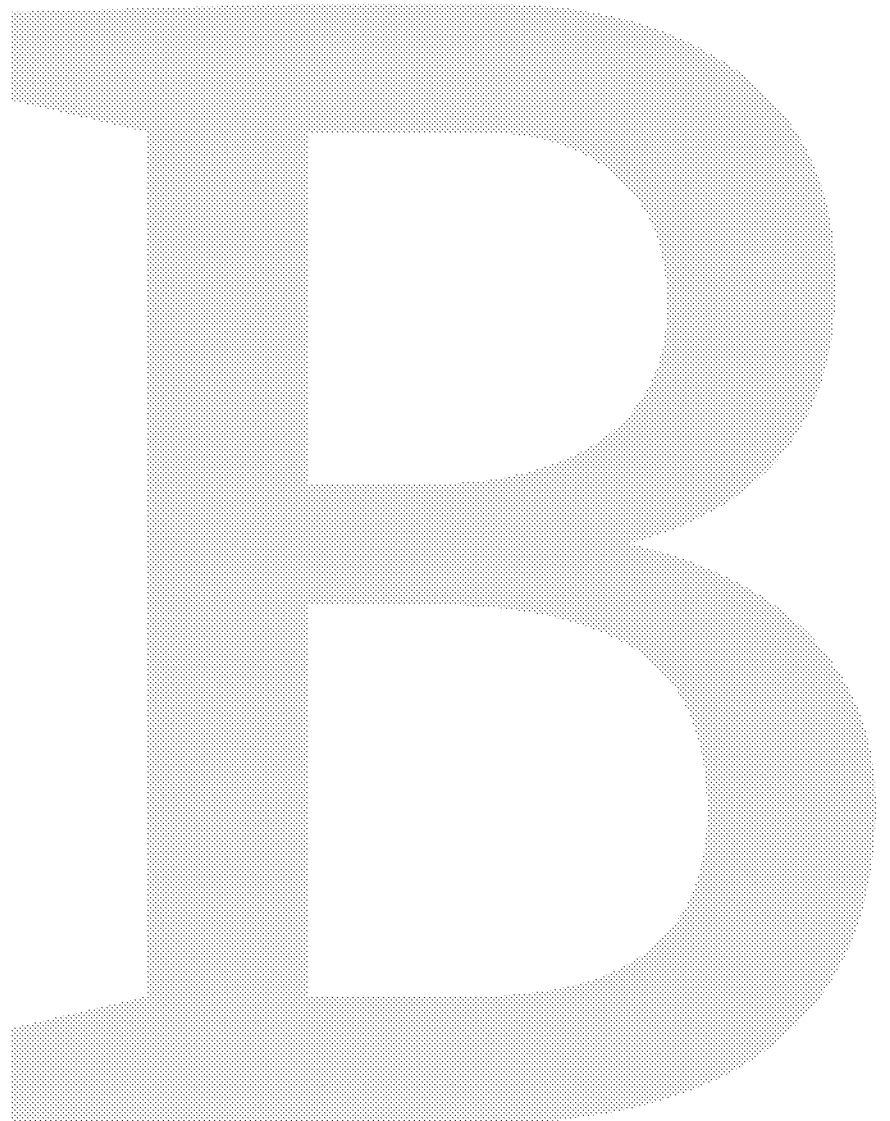
<div>Southern Testing ST Consult</div>				Start - End Date:		Project ID:		Hole Type:		TP2	
				06/12/2023		J15618		TP		Sheet 1 of 1	
Client:		Worthing Homes				Co-ordinates:		Level (m AOD)		Logger:	
Project Name:		Land to the south of Toddington Road				Location:		Littlehamton			
		Samples and Insitu Testing		Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description			
		Depth (m bgl)	Type								
					(1.20)		1.20	Probably loose brown clayey silty sandy GRAVEL with patches of gravelly CLAY. Gravel is fine to coarse subangular to subrounded flint, brick, concrete, plastic bottle, rubber tyre, metal bars. (MADE GROUND) <i>0.1m geotextile fabric</i>			
					(1.10)		2.30	Orange brown silty slightly gravelly very sandy CLAY. Gravel comprises fine brick and tile fragments (MADE GROUND)			
					(0.50)		2.80	Orange brown silty gravelly clayey SAND/slightly very sandy CLAY. Gravel comprises fine brick and tile fragments (MADE GROUND)			
					(1.00)		3.80	Greenish yellow very clayey gravelly SAND. Gravel is fine to coarse subrounded flints.			
								Pit terminated at 3.80m			
Pit Dimension (m)		Pit Stability:		Minor collapse in top 1.0m				Water Strikes			
		Weather:						Depth (m)		Date/Time	
Width:				Remarks:							
Length:											
Depth:		3.80									
Status:		DRAFT		Log Print Date and Time:		12/12/2023 09:48		Log Approved By:			

<div>Southern Testing ST Consult</div>				Start - End Date:		Project ID:		Hole Type:		TP3	
				06/12/2023		J15618		TP		Sheet 1 of 1	
Client:		Worthing Homes				Co-ordinates:		Level (m AOD)		Logger:	
Project Name:		Land to the south of Toddington Road				Location:		Littlehamton			
JAC											
Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description				
Depth (m bgl)	Type	Results									
				(1.30)		1.30	Dark brown silty sandy gravelly CLAY. Gravel is fine to coarse subangular to subrounded brick, plastic, roots, flint, slate, aluminium can, paving slab. (MADE GROUND)				
				(1.30)		2.60	Firm brown and light brown silty gravelly CLAY. Gravel is fine to coarse subrounded flint and occasional chalk.				
				(0.40)		3.00	Recovered as: Structureless chalk comprising off white and yellowish brown clayey gravelly SILT. Gravel is fine to coarse medium density chalk and occasional flint.				
							Pit terminated at 3.00m				
Pit Dimension (m)		Pit Stability:		Generally stable with minor collapse in upper 0.8m			Water Strikes				
		Weather:					Depth (m)		Date/Time		Remarks
Width:											
Length:											
Depth:											
Status:		DRAFT		Log Print Date and Time:		12/12/2023 09:48		Log Approved By:			



APPENDIX B

In-Situ Test Methods and Results





Soil and Rock Descriptions

All soil and rock descriptions are in general accordance with BS5930 Ref [4].

Anthropogenic soils ('made ground' or 'fill') describe materials which have been placed by man and can be divided into those composed of reworked natural soils and those composed of or containing man-made materials. 'Fill' is used to describe material placed in a controlled manner and 'made ground' is used to describe materials placed without strict engineering control.

The classification of materials such as topsoil is based on visual description only and should not be interpreted to mean that the material complies with criteria used in BS 3882 Ref [33].

Chalk descriptions are based on CIRIA C574 Ref [34] and Mortimore Ref [35].

The geology code is only provided on logs where a positive identification of the sample strata has been made.

Soakage Tests (after BRE DG365 2016)

The BRE DG365 Ref [22] paper on soakaway design allows for the design of trench soakaways as well as traditional square and circular soakaways.

The test to measure the soil infiltration rate is carried out in pits which are excavated to the full depth of the proposed soakaway. The trial pits are filled and allowed to drain to empty or near empty, three times, on the same day or on consecutive days. Water levels are recorded against time. Where the sides are unstable the pit should be filled with granular material to provide stability during the test.

Calculated soakage rates are expressed as l/m²/minute, which is a convenient rate to use. The BRE use a unit of m/sec, which is the value in l/m²/minute divided by 60,000.

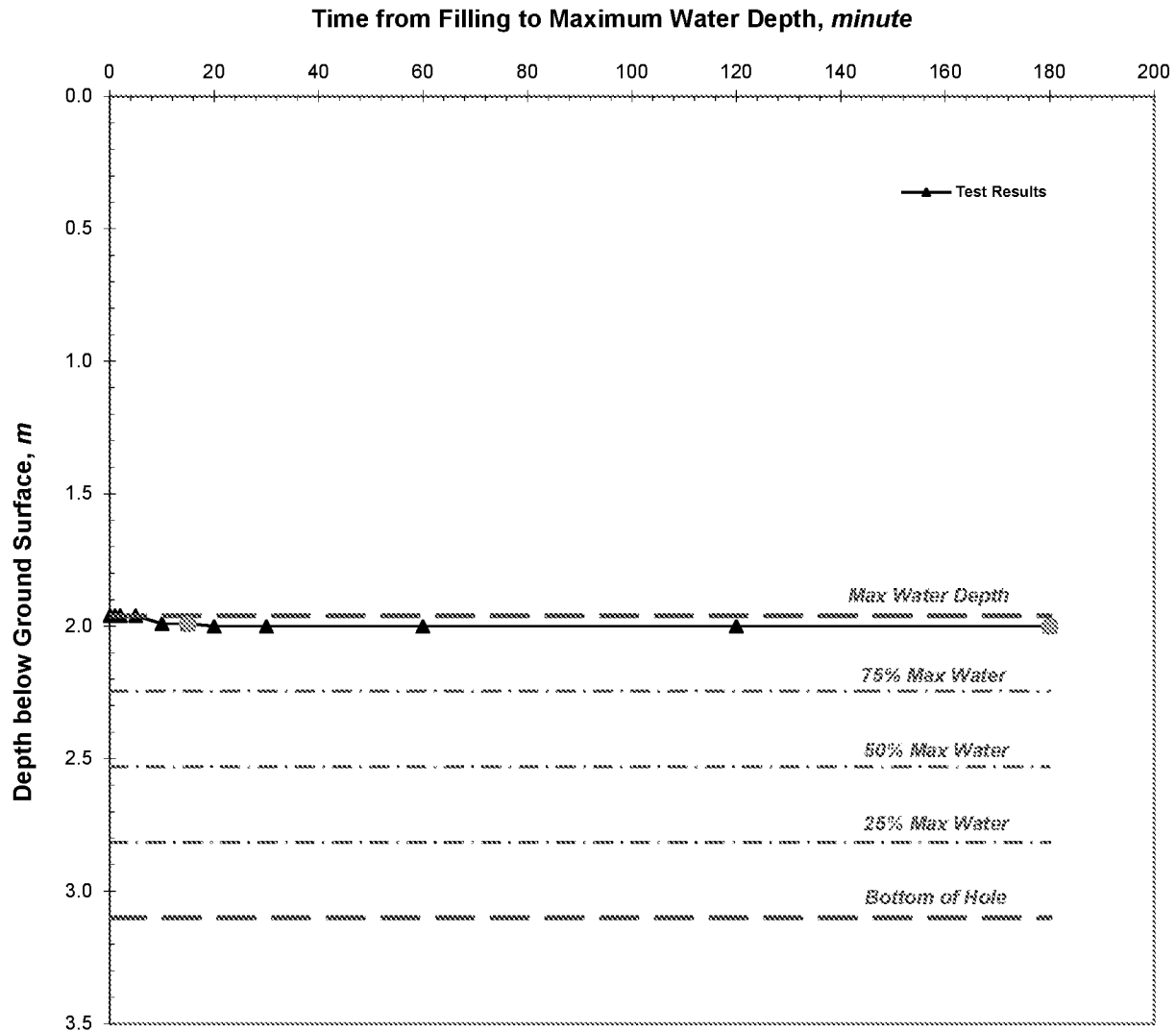
Summary Sheet

Results of BRE Digest DG365 Soakage Tests

Site : Land to the South of Toddington Lane					Job No : J15618		
Client : Worthing Homes					O S Reference :		
Tested By : JB				Engineer: JC		Test Date : 06/Nov/2023	
Hole No	Test No	Hole Depth <i>m</i>	Soakage Rate for Each Test <i>litre/m²/min</i>	Soakage Rate for Each Hole <i>litre/m²/min m/sec</i>		Water Level at Finish of Test	Remarks
TP03	No 1	3.00	0.253	0.253	4.21E-6	Pit was not emptied; Non compliant value was calculated.	
TP02	No 1	3.80	0.092	0.092	1.53E-6	Pit was not emptied; Non compliant value was calculated.	
TP02A	No 1	1.20	0.429	0.429	7.16E-6	Pit was not emptied; Non compliant value was calculated.	
TP01	No 1	3.10	0.0087	0.0087	1.45E-7	Pit was not emptied; Non compliant value was calculated.	
TP01A	No 1	1.00	0.601	0.601	1.00E-5	Pit was not emptied; Non compliant value was calculated.	
Mean Value of All Calculated Soakage Rates :				0.277 <i>litre/m²/min</i>	4.61E-6 <i>m/sec</i>		

BRE Digest DG365 Soakage Test

Test Hole No: TP01
Test No: Test No 1 (Initial)



Pit Length, m	2.100	Depth to Water at Start of Test, m	1.960
Pit Width, m	0.450	Max Water Dropdown during Test, m	0.040
Depth to Pit Base, m	3.100	Total Soakage Test Time, min	180.0
Depth to Top of Permeable Soils, m		Mean Internal Discharge Area, m ²	6.581
Depth to Groundwater Surface, m		Discharge Rate, litre/min	0.057
Depth to Top of Granular Fill, m		Soakage Rate, litre/m ² /min	0.0087
Voids Assumed for Granular Fill, %	100%	BRE Soil Infiltration Rate, m/sec	1.45E-07

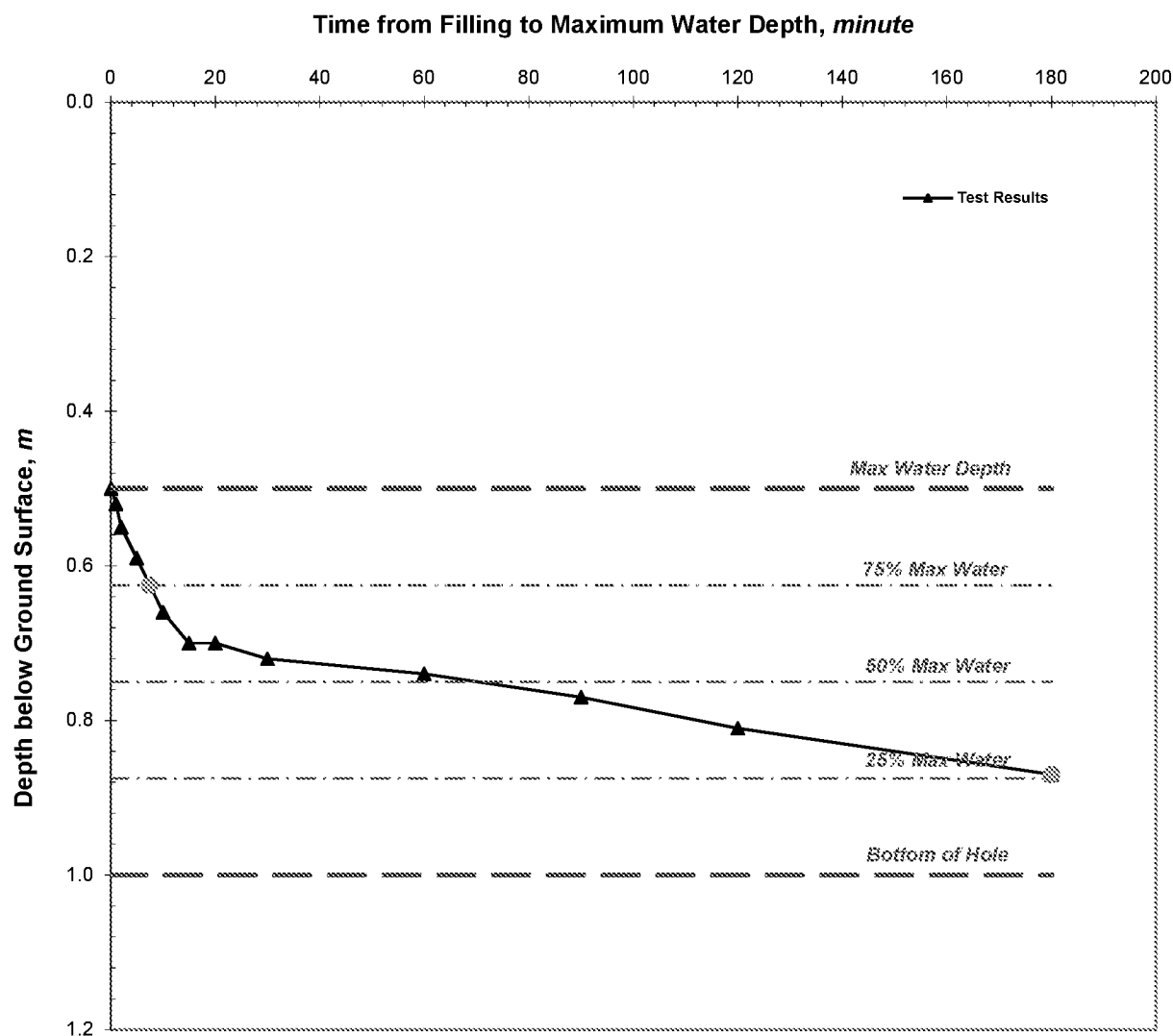
Comments:

Water level did not fall to 75% max water depth, calculations were based on actual fall of water level achieved.
Result not compliant with BRE365 requirement since water did not fall to 25% max water depth.

Client: Worthing Homes	Job No: J15618	Test Date: 06/Nov/2023
Site: Land to the South of Toddington Lane	Tested By: JB	Engineer: JC Fig. S4

BRE Digest DG365 Soakage Test

Test Hole No: TP01A
 Test No: Test No 1 (Initial)



Pit Length, m	2.100	Depth to Water at Start of Test, m	0.500
Pit Width, m	0.450	Max Water Dropdown during Test, m	0.370
Depth to Pit Base, m	1.000	Total Soakage Test Time, min	180.0
Depth to Top of Permeable Soils, m		Mean Internal Discharge Area, m ²	2.233
Depth to Groundwater Surface, m		Discharge Rate, litre/min	1.342
Depth to Top of Granular Fill, m		Soakage Rate, litre/m ² /min	0.601
Voids Assumed for Granular Fill, %	100%	BRE Soil Infiltration Rate, m/sec	1.00E-05

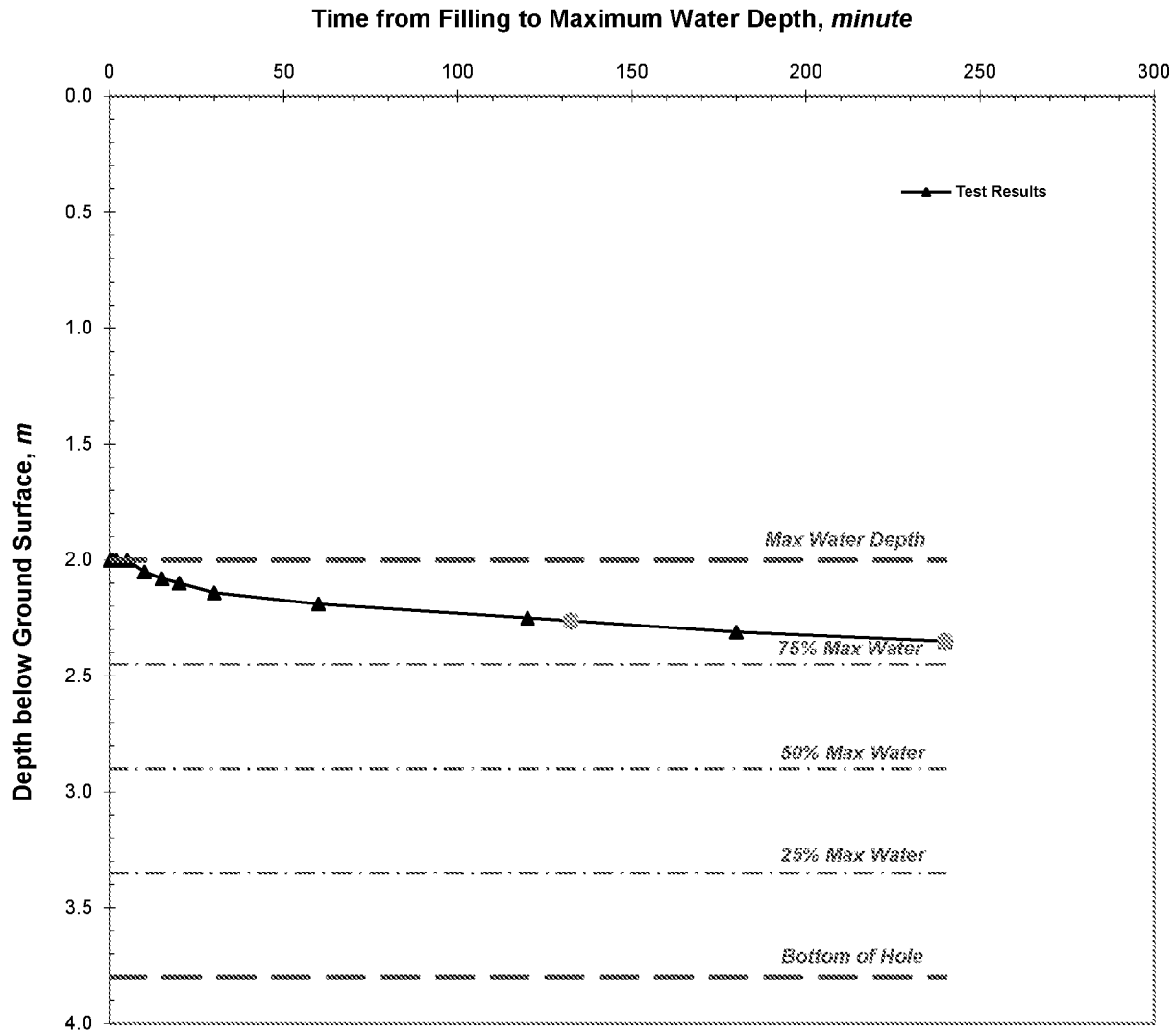
Comments:

Water level fell to 50% -- 25% max water depth, calculations were based on actual fall of water level achieved.
 Result not compliant with BRE365 requirement since water did not fall to 25% max water depth.

Client: Worthing Homes	Job No: J15618	Test Date: 06/Nov/2023
Site: Land to the South of Toddington Lane	Tested By: JB	Engineer: JC Fig. S5

BRE Digest DG365 Soakage Test

Test Hole No: TP02
Test No: Test No 1 (Initial)



Pit Length, m	2.400	Depth to Water at Start of Test, m	2.000
Pit Width, m	0.450	Max Water Dropdown during Test, m	0.350
Depth to Pit Base, m	3.800	Total Soakage Test Time, min	240.0
Depth to Top of Permeable Soils, m		Mean Internal Discharge Area, m ²	9.594
Depth to Groundwater Surface, m		Discharge Rate, litre/min	0.879
Depth to Top of Granular Fill, m		Soakage Rate, litre/m ² /min	0.092
Voids Assumed for Granular Fill, %	100%	BRE Soil Infiltration Rate, m/sec	1.53E-06

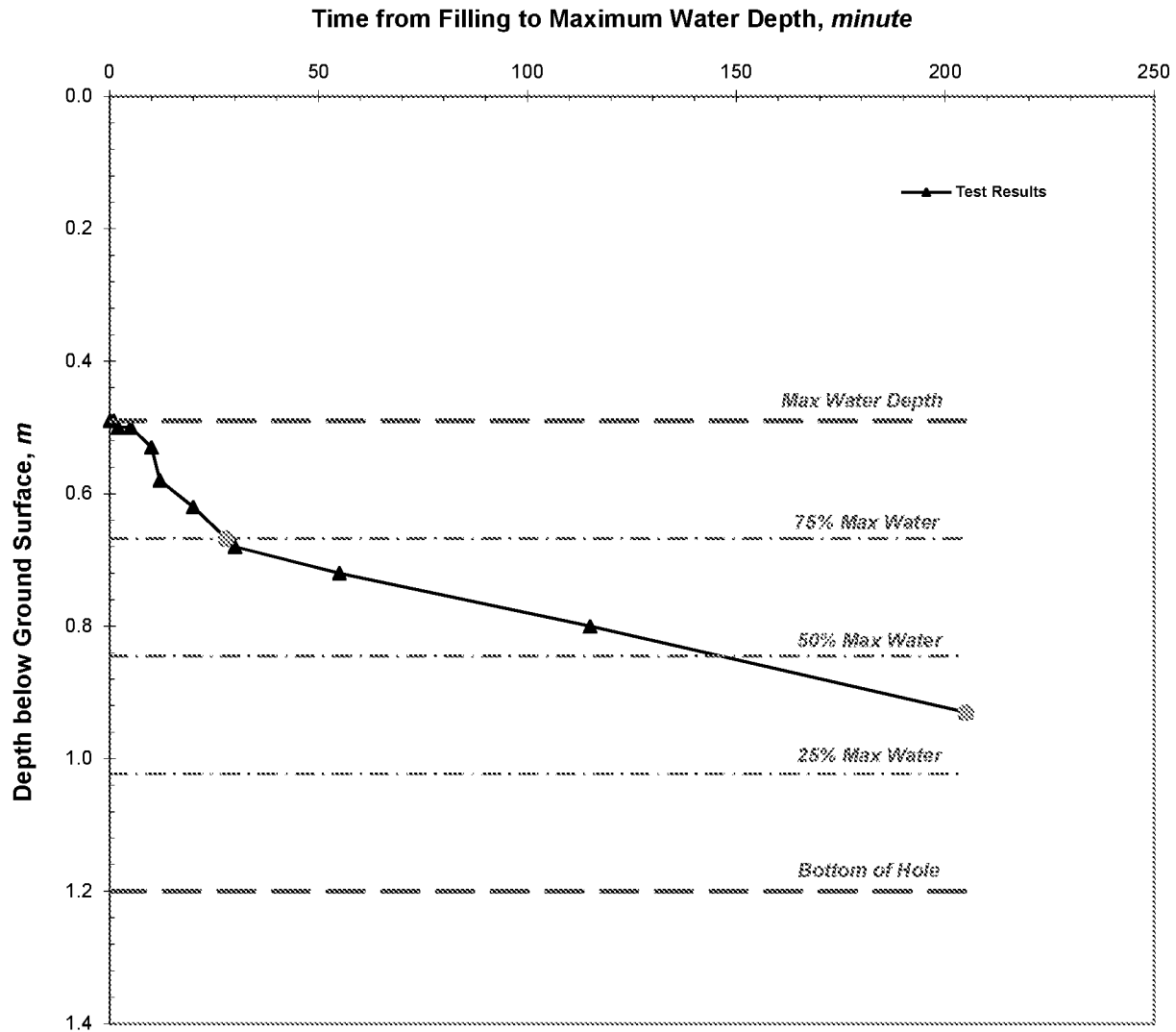
Comments:

Water level did not fall to 75% max water depth, calculations were based on actual fall of water level achieved.
Result not compliant with BRE365 requirement since water did not fall to 25% max water depth.

Client: Worthing Homes	Job No: J15618	Test Date: 06/Nov/2023
Site: Land to the South of Toddington Lane	Tested By: JB	Engineer: JC Fig. S2

BRE Digest DG365 Soakage Test

Test Hole No: TP02A
Test No: Test No 1 (Initial)



Pit Length, m	1.200	Depth to Water at Start of Test, m	0.490
Pit Width, m	0.450	Max Water Dropdown during Test, m	0.440
Depth to Pit Base, m	1.200	Total Soakage Test Time, min	205.0
Depth to Top of Permeable Soils, m		Mean Internal Discharge Area, m ²	1.864
Depth to Groundwater Surface, m		Discharge Rate, litre/min	0.800
Depth to Top of Granular Fill, m		Soakage Rate, litre/m ² /min	0.429
Voids Assumed for Granular Fill, %	100%	BRE Soil Infiltration Rate, m/sec	7.16E-06

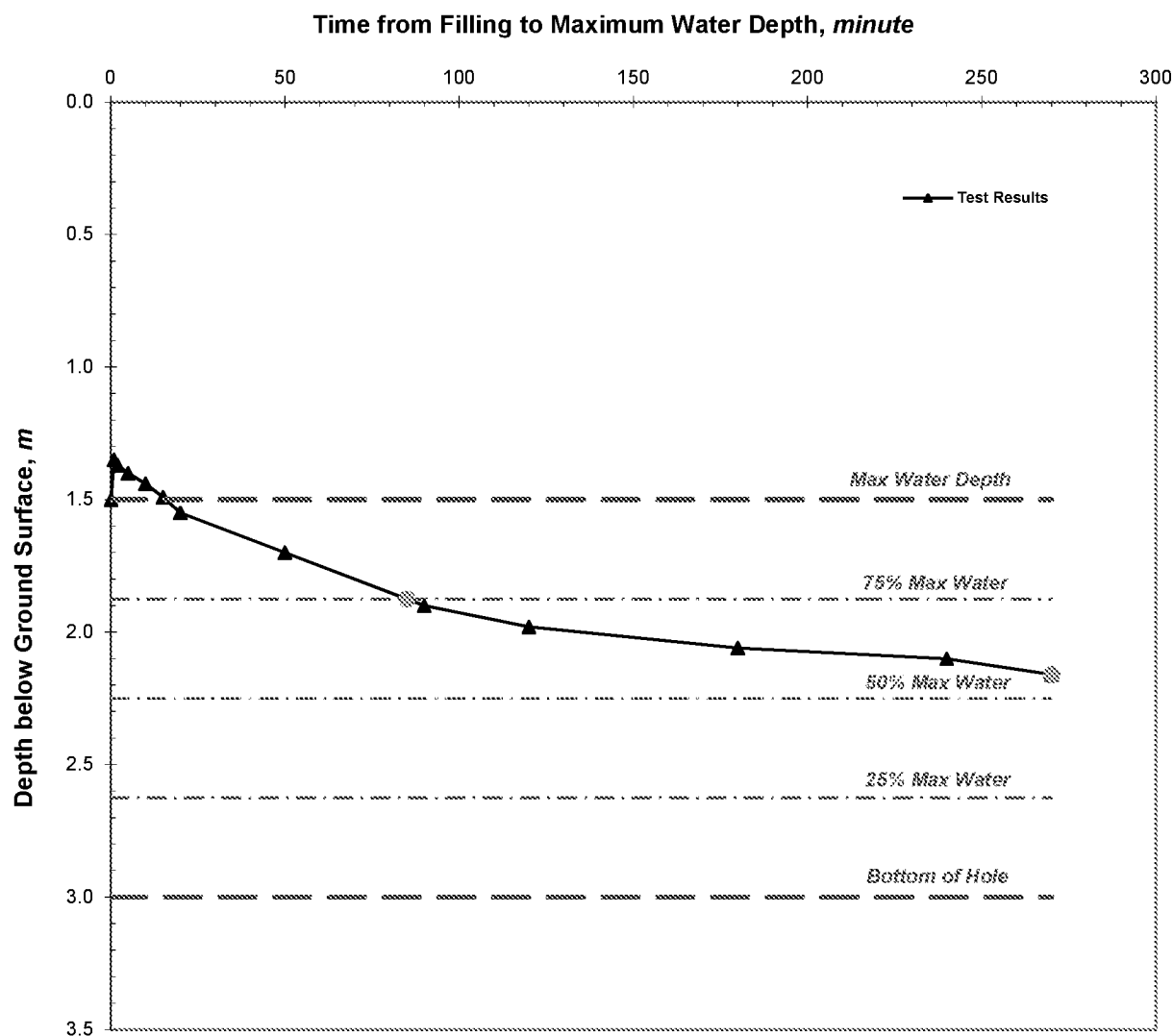
Comments:

Water level fell to 50% -- 25% max water depth, calculations were based on actual fall of water level achieved.
Result not compliant with BRE365 requirement since water did not fall to 25% max water depth.

Client: Worthing Homes	Job No: J15618	Test Date: 06/Nov/2023
Site: Land to the South of Toddington Lane	Tested By: JB	Engineer: JC Fig. S3

BRE Digest DG365 Soakage Test

Test Hole No: TP03
Test No: Test No 1 (Initial)



Pit Length, m	2.700	Depth to Water at Start of Test, m	1.500
Pit Width, m	0.450	Max Water Dropdown during Test, m	0.660
Depth to Pit Base, m	3.000	Total Soakage Test Time, min	270.0
Depth to Top of Permeable Soils, m		Mean Internal Discharge Area, m ²	7.405
Depth to Groundwater Surface, m		Discharge Rate, litre/min	1.872
Depth to Top of Granular Fill, m		Soakage Rate, litre/m ² /min	0.253
Void Assumed for Granular Fill, %	100%	BRE Soil Infiltration Rate, m/sec	4.21E-06

Comments:

Water level fell to 75% -- 50% max water depth, calculations were based on actual fall of water level achieved.
Result not compliant with BRE365 requirement since water did not fall to 25% max water depth.

Client: Worthing Homes	Job No: J15618	Test Date: 06/Nov/2023
Site: Land to the South of Toddington Lane	Tested By: JB	Engineer: JC Fig. S1



Southern Testing
Environmental & Geotechnical

ST Consult
Environmental & Geotechnical

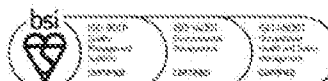


Head Office
East Grinstead

ST Consult Midlands
Northampton

ST Consult Thames Valley
Hannington

ST Consult North West
Warrington



APPENDIX C – Proposed Site Plan



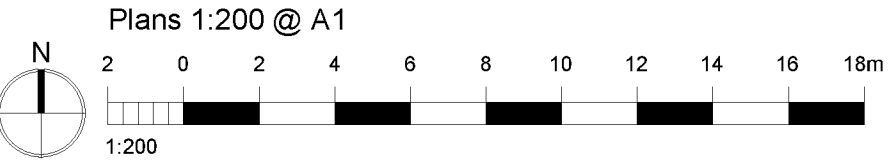
Notes

1. This drawing is the copyright of MH Architects Ltd
2. Do not scale this drawing except for Local Authority planning purposes
3. All dimensions must be checked on site by the contractor prior to commencement of the works.

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

SCHEDULE OF ACCOMMODATION		
UNIT	ACCOMMODATION	Internal Area
01	5 person 3 Bed house	93.2 sq. m affordable rent
02	5 person 3 Bed house	93.2 sq. m affordable rent
03	4 person 3 Bed house	80.0 sq. m affordable rent
04	4 person 2 Bed house	80.0 sq. m affordable rent
05	5 person 3 Bed house	93.2 sq. m affordable rent
06	5 person 3 Bed house	93.2 sq. m affordable rent
07	4 person 2 Bed house	78.0 sq. m affordable rent
08	4 person 2 Bed house	78.0 sq. m affordable rent
09	4 person 2 Bed house	78.0 sq. m affordable rent
10	4 person 2 Bed house	78.0 sq. m affordable rent
TOTALS:-		
4 person 2 Bed house		= 6 units
5 person 3 Bed house		= 4 units
Development Site		0.35 Ha
Site Density		28.5 Units/Ha
Car Parking		TOTAL = 21 spaces on site
		2 spaces for each 2 bed house
		2 spaces for each 3 bed house
		1 visitors space
Cycle Parking:		2 secure cycle space per house in private gardens (see plans)
Refuse & recycling:		House bins integrated into rear garden (access is near to roadside)

WORK IN
PROGRESS



Client
Worthing Homes

Job title
**Land at Toddington Lane
Toddington
West Sussex**

Drawing title
Site Plan

Drawn	Date	Checked	Date	Scale at A1
MD	07/01/22			1:200
Job No.	Pro.	Org.	Zone	Level
21-097	TDL	MHA	00	ZZ
Purpose of issue				
PRELIMINARY				

Ground Floor | Bicentennial Building
Southern Gate | Chichester
West Sussex | PO19 8EZ

L: 01243 774748
e: admin@mharchitects.co.uk
www.mharchitects.co.uk

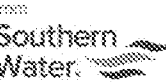
limited company
Registered in England No 1094313

APPENDIX D – Southern Water Sewer Records

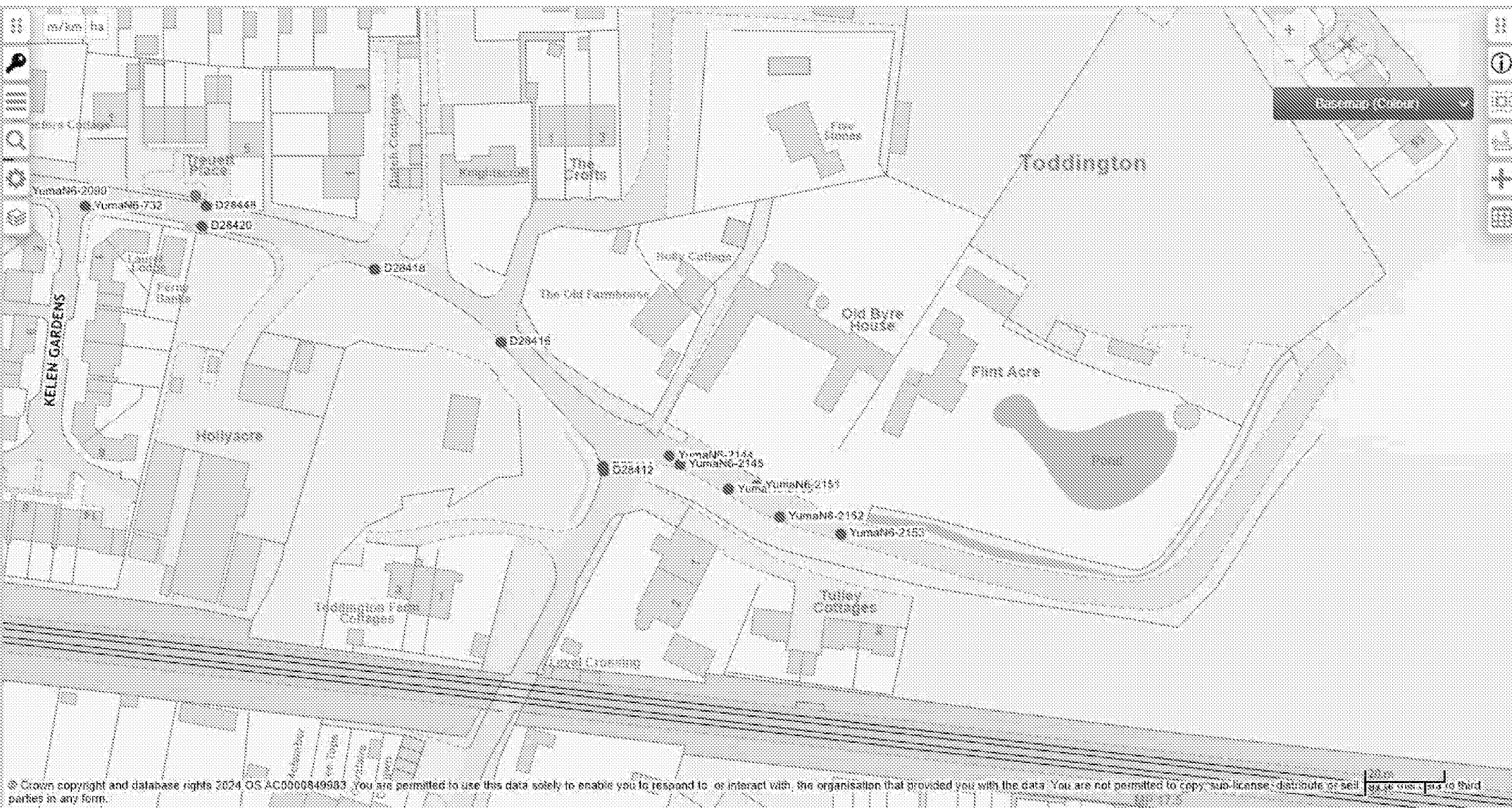


Our Ref: 1527172 - 1

Toddington	
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APPENDIX E – Highways Drainage Records



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2.6/10/19/12 - 19/10/20

Show asset find help

APPENDIX F – Neighbouring Site Drainage CCTV Survey



NOTES:

This Drawing is for As Built / Technical Query reasons only and not to be used for setting out unless drawing is approved and signed off and copies emailed to Nick Rogers - NRS Surveying Ltd.

Ordnance Survey (OS) national grid coordinates have been established for survey control points using GPS and related to OSTN15(GB). The survey grid is orientated Grid North. All levels relate to Ordnance Survey (OS) level datum at survey control points.

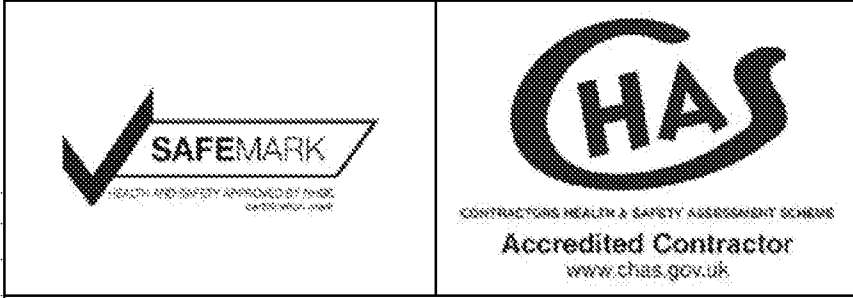
The grid is related to OS using Industry Standard Network RTK GPS.

All levels are related to OS Grid using Industry Standard Network RTK GPS.

Survey completed Using GPS Only: 06/08/2024
N Rogers - NRS Surveying Ltd.

Drawing Issued: 06/08/2024 - N Rogers - NRS Surveying Ltd.

ALL DIMENSION & SETTING OUT TO BE CHECKED & VERIFIED BY CLIENT PRIOR TO CONTINUING TO ENSURE THEY ARE HAPPY & TIES INTO CONSTRUCTION DRAWINGS ISSUED.



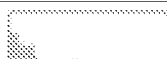
NRS Surveying Limited,
6 Purbrook Way,
Havant,
Hampshire
PO9 3RY
Mobile:
07564 602518.
Email:
nrsurveying@gmail.com
Client:



Project: Toddington Lane & Kelen Gardens, Littlehampton.
Drawing Title: GPS As Built Location & Level Survey
Existing Foul Manholes;
Kelen Gardens & Winterberry Way, Littlehampton.

Scale @ A1: xxxxx	Drawn Date: 06/08/2024.	Project Number: HHOMES - TODDINGTON- NRS001 - Rev -.
Drawn By: Nick Rogers.		Checked By: Nick Rogers.

APPENDIX G – Greenfield Runoff Rate

Green Structural Engineers		Page 1
Unit , Quayside Lodge William Morris Way, Fulham London, SW6 2UZ	Toddington Lane Littlehampton Greenfield Runoff Rate	
Date 01/08/2024 File	Designed by TS Checked by TS	
Innovyze	Source Control 2020.1.3	

FEH Mean Annual Flood

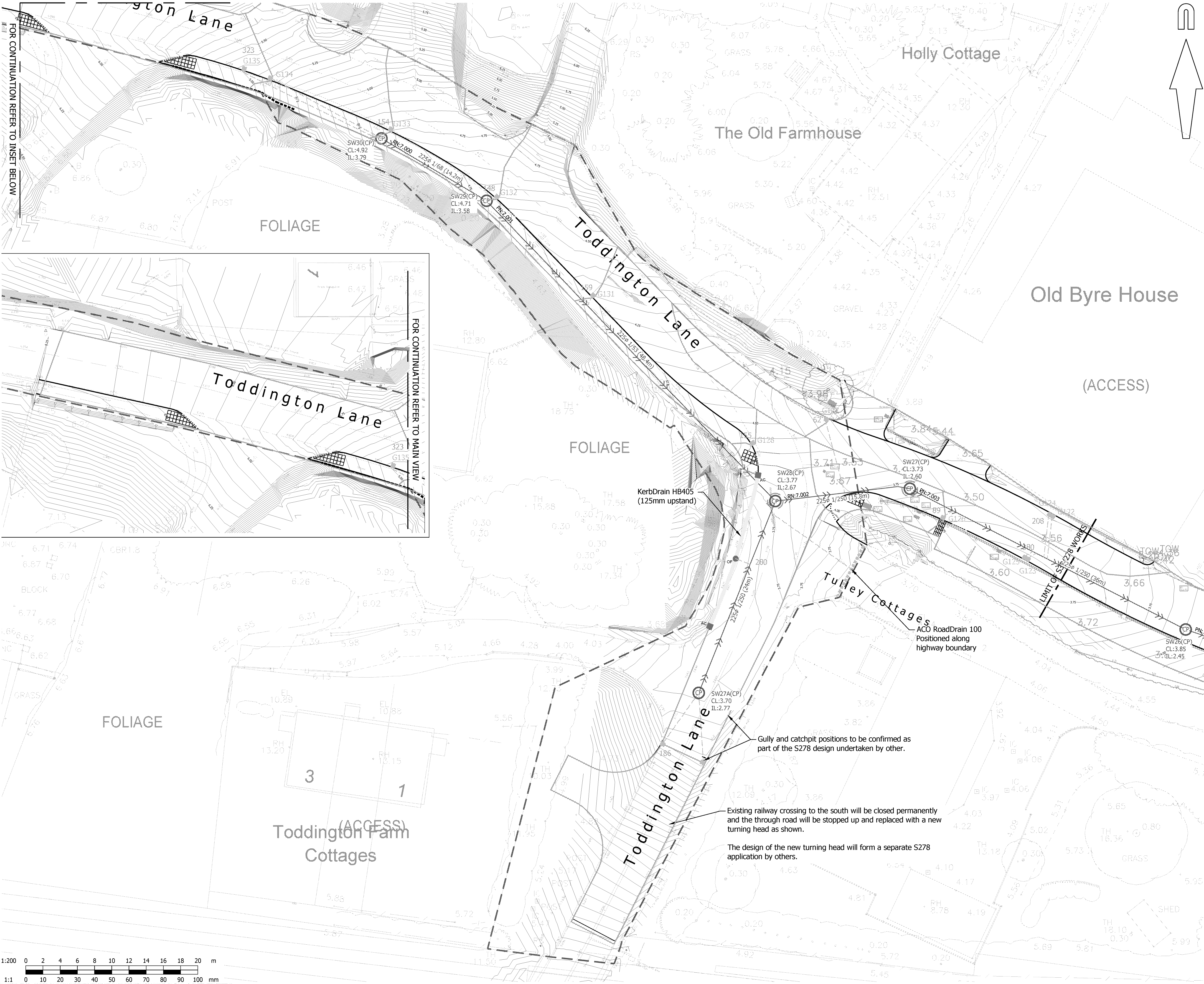
Input

QMED Method	2008 URBEXT (2000)	0.0000
Site Location GB 503397 103865 TQ 03397 03865	SPRHOST	0.000
Area (ha)	0.164	BFIHOST 0.650
SAAR (mm)	733	FARL 1.000

Results

QMED Rural (l/s) 0.7 QMED Urban (l/s) n/a

APPENDIX H – Proposed Toddington Lane Surface Water Drainage



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A1 ORIGINAL

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KEY

- PROPOSED HIGHWAY DRAINAGE AND CATCHPIT
- PROPOSED ROAD GULLY AND GULLY LEAD
- PROPOSED ACO ROADDRAIN 100
- PROPOSED ACO KERBDRAIN HB405
- PROPOSED CONTOURS
- EXISTING CONTOURS
- PROPOSED GULLY DRAINAGE AREA (SQ.M)
- PROPOSED EMBANKMENT
- PROPOSED RETAINING WALL
- EXISTING HIGHWAY BOUNDARY

NOTES:

- This drawing is not to be scaled.
- Based on topographic survey undertaken by Subvision Survey Ltd on March 2022, drawing reference SS-PH-013.
- This drawing is to be read in conjunction with all other relevant engineering and landscaping drawings. Any discrepancies are to be reported to the Engineer immediately for clarification.
- All on-site civils and drainage works constructed in accordance with the Mayer Brown Limited Specification, details and MH schedules.
- Proprietary items are to be constructed in accordance with manufacturers recommendations / requirements.
- All drainage works shall be carried out in accordance with the requirements of the Local Authority, the Environment Agency and in conjunction with all relevant British Standards, Codes of Practice, the Design and Construction Guidance for foul and surface water sewers and any addendums as appropriate.
- Invert levels and positions of existing drains / chambers / sewers where new connections are to be made must be checked and confirmed to the engineer prior to the commencement of any works.
- Any part of the existing drainage system to be retained as part of the new scheme shall be cleaned and inspected. Any structural defects shall be repaired using appropriate and approved means.
- All new manholes and catchpits are soffit to soffit unless noted otherwise. Invert level shown is outlet pipe.
- All drainage shall comply with the typical details and the requirements of BS EN 752 and Part H of the Building Regulations.
- All precast concrete units used in the drainage works shall be manufactured using sulphate resisting cement.
- Cover levels are to be adjusted locally to suit finished ground levels.
- HEALTH AND SAFETY:** The works shall be carried out by specialist competent and experienced contractors who are members of a recognised national organisation. Operatives shall have received full and appropriate training for the operations they are to undertake. All work shall be carried out in accordance with all pertinent Health and Safety Regulations.

FOR APPROVAL

rev.	amendment	checked	date
A2	Extent of S278 works amended. S38 area added to submission. Viewports amended and drawing title/number revised accordingly. Design revised to suit latest WSCC technical review. (IC)	SF	20/10/2023
A1	Issued to WSCC for approval. (TC)	SF	29/06/2023
P1	Initial issue. (IC)	SF	15/12/2022

rev.	amendment	checked	date
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mayer brown

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Telephone 01483 750 508 Fax 01483 750 437
wokingoffice@mayerbrown.co.uk www.mayerbrown.co.uk

client
PERSIMMON HOMES THAMES VALLEY

project
**NORTH LITTLEHAMPTON
TODDINGTON LANE / S38 SPINE ROAD**

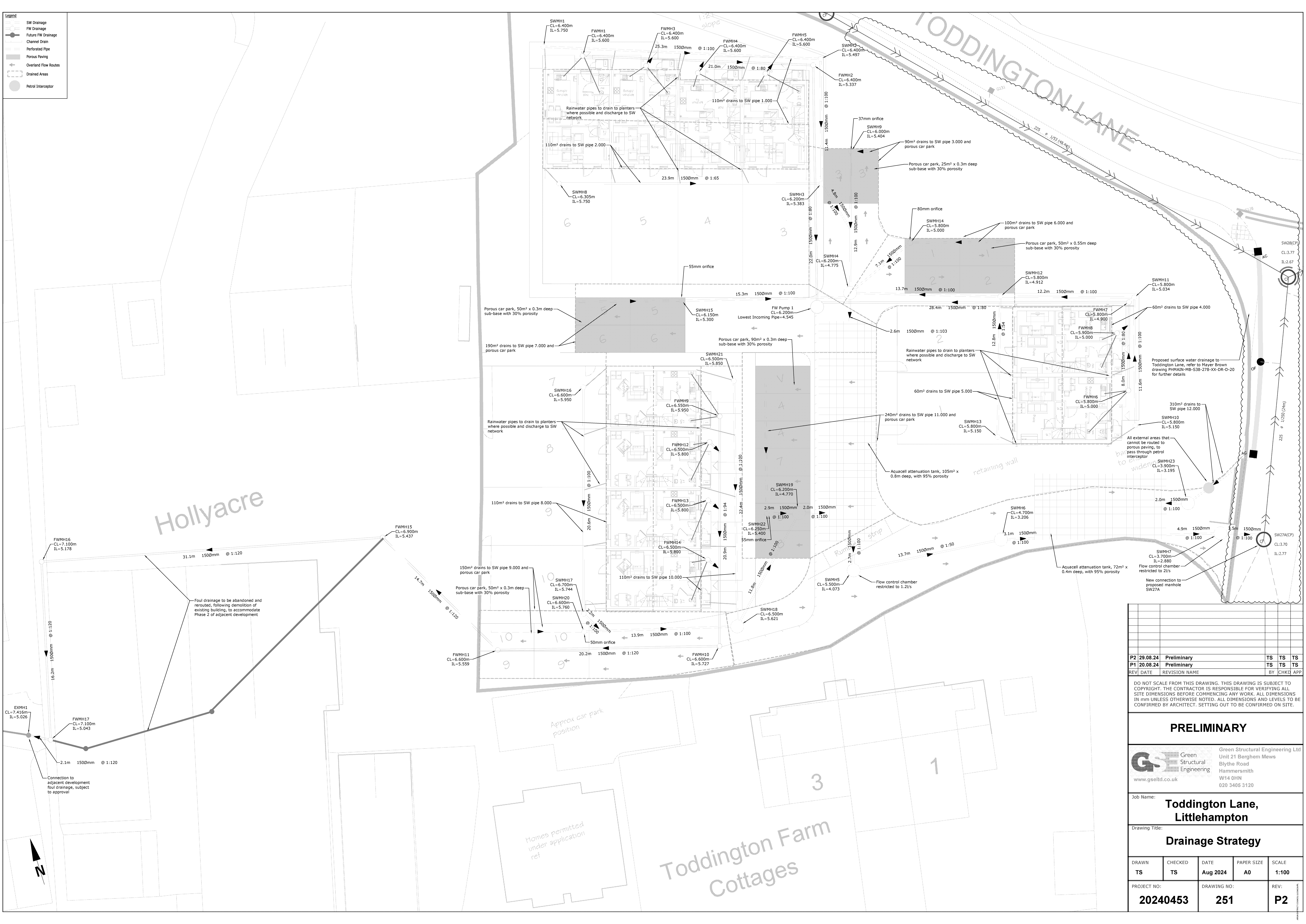
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date AUGUST 2021	cad file PHMAIN-MB-278-XX-DR-D-10.DWG	
title		

**SECTION 38/278 HIGHWAY WORKS -
DRAINAGE GENERAL ARRANGEMENT**

Mayer Brown Limited jobcode	suitability	revision
	-	A2

drawing number
PHMAIN-MB-S38-278-XX-DR-D-20

APPENDIX I – Drainage Strategy Plan



REV	DATE	REVISION NAME	BY	CHKD	APP
P2	29.08.24	Preliminary		TS	TS
P1	20.08.24	Preliminary		TS	TS

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PRELIMINARY



Green Structural Engineering Ltd

Unit 21 Berghem Mews

Blythe Road

Hammersmith

W14 0HN

020 3465 3120


Job Name: **Toddington Lane, Littlehampton**

Drawing Title: **Drainage Strategy**

DRAWN	CHECKED	DATE	PAPER SIZE	SCALE
TS	TS	Aug 2024	A0	1:100

PROJECT NO:	DRAWING NO:	REV:
20240453	251	P2















APPENDIX J – Microdrainage Calculations

Green Structural Engineers		Page 1
Unit , Quayside Lodge	Toddington Lane	
William Morris Way, Fulham	Littlehampton	
London, SW6 2UZ	SW Drainage Calculations	
Date 29/08/2024	Designed by TS	
File SW NETWORK.MDX	Checked by TS	
Innovyze	Network 2020.1.3	

STORM SEWER DESIGN by the Modified Rational Method


Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	25.225	0.253	99.7	0.011	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	11.360	0.114	99.6	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	23.909	0.367	65.1	0.011	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	4.830	0.048	100.6	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
3.000	2.198	0.022	99.9	0.009	5.00	0.0	0.600	o	150	Pipe/Conduit	
3.001	12.882	0.129	99.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
4.000	11.637	0.116	100.3	0.006	5.00	0.0	0.600	o	150	Pipe/Conduit	
4.001	12.191	0.122	99.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
5.000	12.777	0.238	53.7	0.006	5.00	0.0	0.600	o	150	Pipe/Conduit	
4.002	13.675	0.137	99.8	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
6.000	9.345	0.093	100.5	0.010	5.00	0.0	0.600	o	150	Pipe/Conduit	
6.001	7.114	0.071	100.2	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
7.000	9.368	0.094	99.7	0.019	5.00	0.0	0.600	o	150	Pipe/Conduit	
7.001	15.262	0.153	99.8	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
















Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.42	5.759	0.011	0.0	0.0	0.0	1.01	17.8	1.5
1.001	50.00	5.61	5.497	0.011	0.0	0.0	0.0	1.01	17.8	1.5
2.000	50.00	5.32	5.759	0.011	0.0	0.0	0.0	1.25	22.1	1.5
1.002	50.00	5.69	5.989	0.022	0.0	0.0	0.0	1.00	17.7	3.0
3.000	50.00	5.04	5.426	0.009	0.0	0.0	0.0	1.01	17.8	1.2
3.001	50.00	5.25	5.404	0.009	0.0	0.0	0.0	1.01	17.8	1.2
4.000	50.00	5.19	5.159	0.006	0.0	0.0	0.0	1.00	17.7	0.8
4.001	50.00	5.40	5.034	0.006	0.0	0.0	0.0	1.01	17.8	0.8
5.000	50.00	5.15	5.159	0.006	0.0	0.0	0.0	1.38	24.3	0.8
4.002	50.00	5.62	4.912	0.012	0.0	0.0	0.0	1.01	17.8	1.6
6.000	50.00	5.16	5.093	0.010	0.0	0.0	0.0	1.00	17.7	1.4
6.001	50.00	5.27	5.000	0.010	0.0	0.0	0.0	1.00	17.7	1.4
7.000	50.00	5.16	5.394	0.019	0.0	0.0	0.0	1.01	17.8	2.6
7.001	50.00	5.41	5.990	0.019	0.0	0.0	0.0	1.01	17.8	2.6

Green Structural Engineers		Page 2
Unit , Quayside Lodge	Toddington Lane	
William Morris Way, Fulham	Littlehampton	
London, SW6 2UZ	SW Drainage Calculations	
Date 29/08/2024	Designed by TS	
File SW NETWORK.MDX	Checked by TS	
Innovyze	Network 2020.1.3	

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Storm

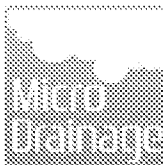
PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.003	2.577	0.025	103.1	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
8.000	20.640	0.206	100.2	0.011	5.00	0.0	0.600	o	150	Pipe/Conduit	
8.001	2.249	0.022	102.2	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
9.000	8.470	0.085	99.6	0.015	5.00	0.0	0.600	o	150	Pipe/Conduit	
9.001	13.936	0.139	100.3	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
10.000	22.356	0.224	99.8	0.011	5.00	0.0	0.600	o	150	Pipe/Conduit	
8.002	11.750	0.118	99.6	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
11.000	12.020	0.120	100.2	0.024	5.00	0.0	0.600	o	150	Pipe/Conduit	
11.001	2.932	0.029	101.1	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
8.003	2.031	0.020	101.6	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.004	2.676	0.027	99.1	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.005	13.697	0.273	50.2	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.006	3.072	0.031	99.1	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
12.000	6.704	0.067	100.1	0.031	5.00	0.0	0.600	o	150	Pipe/Conduit	
12.001	1.966	0.020	98.3	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	I.Area (ha)	Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.003	50.00	5.73	4.775	0.072	0.0	0.0	0.0	0.93	17.5	9.7
8.000	50.00	5.34	5.886	0.011	0.0	0.0	0.0	1.00	17.7	1.5
8.001	50.00	5.38	5.784	0.011	0.0	0.0	0.0	0.93	17.6	1.5
9.000	50.00	5.14	5.845	0.015	0.0	0.0	0.0	1.01	17.8	2.0
9.001	50.00	5.37	5.786	0.015	0.0	0.0	0.0	1.00	17.7	2.0
10.000	50.00	5.37	5.836	0.011	0.0	0.0	0.0	1.01	17.8	1.5
8.002	50.00	5.57	5.821	0.037	0.0	0.0	0.0	1.01	17.8	5.0
11.000	50.00	5.20	5.826	0.024	0.0	0.0	0.0	1.00	17.7	3.2
11.001	50.00	5.25	5.460	0.024	0.0	0.0	0.0	1.00	17.7	3.2
8.003	50.00	5.61	4.776	0.061	0.0	0.0	0.0	1.00	17.6	8.3
1.004	50.00	5.77	4.100	0.133	0.0	0.0	0.0	1.01	17.8	18.0
1.005	50.00	5.93	4.678	0.133	0.0	0.0	0.0	1.42	25.2	18.0
1.006	50.00	5.98	3.266	0.133	0.0	0.0	0.0	1.01	17.8	18.0
12.000	50.00	5.11	3.262	0.031	0.0	0.0	0.0	1.00	17.8	4.2
12.001	50.00	5.14	3.195	0.031	0.0	0.0	0.0	1.01	17.9	4.2


STORM SEWER DESIGN by the Modified Rational Method												
Network Design Table for Storm												
PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section	Type	Auto Design
1.007	4.926	0.049	100.5	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit		
1.008	3.510	0.035	100.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit		
Network Results Table												
PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)		
1.007	50.00	6.07	2.929	0.164	0.0	0.0	0.0	1.00	17.74	22.2		
1.008	50.00	6.13	2.989	0.164	0.0	0.0	0.0	1.00	17.84	22.2		

Manhole Schedules for Storm										
MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Invert Level (m)	Pipes In Diameter (mm)	Pipes In PN	Invert Level (m)	Backdrop (mm)
SWMH1	6.400	0.650	Open Manhole	450	1.000	5.750	150			
SWMH2	6.400	0.903	Open Manhole	450	1.001	5.497	150	1.000	5.497	150
SWMH8	6.400	0.650	Open Manhole	450	2.000	5.750	150			
SWMH3	6.200	0.817	Open Manhole	450	1.002	5.383	150	1.001	5.383	150
								2.000	5.383	150
PP1	6.000	0.574	Junction		3.000	5.426	150			
SWMH9	6.000	0.596	Open Manhole	450	3.001	5.404	150	3.000	5.404	150
SWMH10	5.800	0.650	Open Manhole	450	4.000	5.150	150			
SWMH11	5.800	0.766	Open Manhole	450	4.001	5.034	150	4.000	5.034	150
SWMH13	5.800	0.650	Open Manhole	450	5.000	5.150	150			
SWMH12	5.800	0.888	Open Manhole	450	4.002	4.912	150	4.001	4.912	150
								5.000	4.912	150
PP2	5.800	0.707	Junction		6.000	5.093	150			
SWMH14	5.800	0.800	Open Manhole	450	6.001	5.000	150	6.000	5.000	150
PP3	6.150	0.756	Junction		7.000	5.304	150			
SWMH15	6.150	0.850	Open Manhole	450	7.001	5.300	150	7.000	5.300	150
SWMH4	6.200	1.425	Open Manhole	1200	1.003	4.775	150	1.002	5.335	150
								3.001	5.275	150
								4.002	4.775	150
								6.001	4.929	150
								7.001	5.147	150
SWMH16	6.600	0.650	Open Manhole	450	8.000	5.850	150			
SWMH17	6.700	0.956	Open Manhole	450	8.001	5.744	150	8.000	5.744	150
PP4	6.600	0.755	Junction		9.000	5.845	150			
SWMH20	6.600	0.840	Open Manhole	450	9.001	5.760	150	9.000	5.760	150
SWMH21	6.500	0.650	Open Manhole	450	10.000	5.850	150			
SWMH18	6.500	0.879	Open Manhole	1200	8.002	5.621	150	8.001	5.722	150
								9.001	5.621	150
								10.000	5.626	150
PP5	6.250	0.730	Junction		11.000	5.520	150			
SWMH22	6.250	0.850	Open Manhole	450	11.001	5.400	150	11.000	5.400	150
SWMH19	6.200	1.430	Open Manhole	1200	8.003	4.770	150	8.002	5.503	150
								11.001	5.371	150
TANK 1	5.800	1.700	Junction		1.004	4.100	150	1.003	4.750	150
								8.003	4.750	150
SWMH5	5.500	1.427	Open Manhole	1200	1.005	4.073	150	1.004	4.073	150
SWMH6	4.700	1.494	Open Manhole	1200	1.006	3.200	150	1.005	3.800	150
Channel Drain	3.600	0.338	Junction		12.000	3.262	150			
SWMH23	3.800	0.705	Open Manhole	1200	12.001	3.195	150	12.000	3.195	150
TANK 2	4.000	1.071	Junction		1.007	2.929	150	1.006	3.175	150
								12.001	3.175	150
SWMH7	3.700	0.820	Open Manhole	1200	1.008	2.800	150	1.007	2.880	150
	3.700	0.855	Open Manhole	0		OUTFALL		1.008	2.845	150

Green Structural Engineers		Page 5
Unit , Quayside Lodge	Toddington Lane	
William Morris Way, Fulham	Littlehampton	
London, SW6 2UZ	SW Drainage Calculations	
Date 29/08/2024	Designed by TS	
File SW NETWORK.MDX	Checked by TS	
Innovyze	Network 2020.1.3	

Manhole Schedules for Storm

No coordinates have been specified, layout information cannot be produced.

Green Structural Engineers		Page 6
Unit , Quayside Lodge William Morris Way, Fulham London, SW6 2UZ	Toddington Lane Littlehampton SW Drainage Calculations	
Date 29/08/2024	Designed by TS	
File SW NETWORK.MDX	Checked by TS	
Innovyze	Network 2020.1.3	

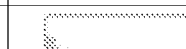
PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	150	SWMH1	6.400	5.758	0.600	Open Manhole	450
1.001	o	150	SWMH2	6.400	5.497	0.753	Open Manhole	450
2.000	o	150	SWMH8	6.400	5.758	0.600	Open Manhole	450
1.002	o	150	SWMH3	6.200	5.383	0.667	Open Manhole	450
3.000	o	150	PP1	6.000	5.426	0.424	Junction	
3.001	o	150	SWMH9	6.000	5.404	0.446	Open Manhole	450
4.000	o	150	SWMH10	5.800	5.150	0.600	Open Manhole	450
4.001	o	150	SWMH11	5.800	5.034	0.616	Open Manhole	450
5.000	o	150	SWMH13	5.800	5.150	0.600	Open Manhole	450
4.002	o	150	SWMH12	5.800	4.912	0.738	Open Manhole	450
6.000	o	150	PP2	5.800	5.003	0.557	Junction	
6.001	o	150	SWMH14	5.800	5.000	0.650	Open Manhole	450
7.000	o	150	PP3	6.150	5.304	0.606	Junction	
7.001	o	150	SWMH15	6.150	5.300	0.700	Open Manhole	450
1.003	o	150	SWMH4	6.200	4.775	1.275	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	25.225	99.7	SWMH2	6.400	5.497	0.753	Open Manhole	450
1.001	11.360	99.6	SWMH3	6.200	5.383	0.667	Open Manhole	450
2.000	23.909	65.1	SWMH3	6.200	5.383	0.667	Open Manhole	450
1.002	4.830	100.6	SWMH4	6.200	5.335	0.715	Open Manhole	1200
3.000	2.198	99.9	SWMH9	6.000	5.404	0.446	Open Manhole	450
3.001	12.882	99.9	SWMH4	6.200	5.275	0.775	Open Manhole	1200
4.000	11.637	100.3	SWMH11	5.800	5.034	0.616	Open Manhole	450
4.001	12.191	99.9	SWMH12	5.800	4.912	0.738	Open Manhole	450
5.000	12.777	53.7	SWMH12	5.800	4.912	0.738	Open Manhole	450
4.002	13.675	99.8	SWMH4	6.200	4.775	1.275	Open Manhole	1200
6.000	9.345	100.5	SWMH14	5.800	5.000	0.650	Open Manhole	450
6.001	7.114	100.2	SWMH4	6.200	4.929	1.121	Open Manhole	1200
7.000	9.368	99.7	SWMH15	6.150	5.300	0.700	Open Manhole	450
7.001	15.262	99.8	SWMH4	6.200	5.147	0.903	Open Manhole	1200
1.003	2.577	103.1	TANK 1	5.800	4.750	0.900	Junction	

Green Structural Engineers		Page 7
Unit , Quayside Lodge William Morris Way, Fulham London, SW6 2UZ	Toddington Lane Littlehampton SW Drainage Calculations	
Date 29/08/2024 File SW NETWORK.MDX	Designed by TS Checked by TS	
Innovyze	Network 2020.1.3	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
8.000	o	150	SWMH16	6.600	5.950	0.500	Open Manhole	450
8.001	o	150	SWMH17	6.700	5.744	0.806	Open Manhole	450
9.000	o	150	PP4	6.600	5.845	0.605	Junction	
9.001	o	150	SWMH20	6.600	5.760	0.690	Open Manhole	450
10.000	o	150	SWMH21	6.500	5.850	0.500	Open Manhole	450
8.002	o	150	SWMH18	6.500	5.621	0.729	Open Manhole	1200
11.000	o	150	PP5	6.250	5.520	0.560	Junction	
11.001	o	150	SWMH22	6.250	5.400	0.700	Open Manhole	450
8.003	o	150	SWMH19	6.200	4.770	1.280	Open Manhole	1200
1.004	o	150	TANK 1	5.800	4.100	1.550	Junction	
1.005	o	150	SWMH5	5.500	4.073	1.277	Open Manhole	1200
1.006	o	150	SWMH6	4.700	3.206	1.344	Open Manhole	1200
12.000	o	150	Channel Drain	3.600	3.262	0.168	Junction	
12.001	o	150	SWMH23	3.900	3.195	0.555	Open Manhole	1200
1.007	o	150	TANK 2	4.000	2.929	0.921	Junction	

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
8.000	20.640	100.2	SWMH17	6.700	5.744	0.806	Open Manhole	450
8.001	2.249	102.2	SWMH18	6.500	5.722	0.628	Open Manhole	1200
9.000	8.470	99.6	SWMH20	6.600	5.760	0.690	Open Manhole	450
9.001	13.936	100.3	SWMH18	6.500	5.621	0.729	Open Manhole	1200
10.000	22.356	99.8	SWMH18	6.500	5.626	0.724	Open Manhole	1200
8.002	11.750	99.6	SWMH19	6.200	5.503	0.547	Open Manhole	1200
11.000	12.020	100.2	SWMH22	6.250	5.400	0.700	Open Manhole	450
11.001	2.932	101.1	SWMH19	6.200	5.371	0.679	Open Manhole	1200
8.003	2.031	101.6	TANK 1	5.800	4.750	0.900	Junction	
1.004	2.676	99.1	SWMH5	5.500	4.073	1.277	Open Manhole	1200
1.005	13.697	50.2	SWMH6	4.700	3.800	0.750	Open Manhole	1200
1.006	3.072	99.1	TANK 2	4.000	3.175	0.675	Junction	
12.000	6.704	100.1	SWMH23	3.900	3.195	0.555	Open Manhole	1200
12.001	1.966	98.3	TANK 2	4.000	3.175	0.675	Junction	
1.007	4.926	100.5	SWMH7	3.700	2.880	0.670	Open Manhole	1200

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd	Diam	MH	C.Level	I.Level	D.Depth	MH	MH DIAM., L*W
	Sect	(mm)	Name	(m)	(m)	(m)	Connection	(mm)
1.008	o	150	SWMH7	3.700	2.880	0.670	Open Manhole	1200

Downstream Manhole

PN	Length	Slope	MH	C.Level	I.Level	D.Depth	MH	MH DIAM., L*W
	(m)	(1:X)	Name	(m)	(m)	(m)	Connection	(mm)
1.008	3.510	100.0		3.700	2.845	0.795	Open Manhole	0

Simulation Criteria for Storm

Volumetric Runoff Coeff 0.750 Additional Flow - % of Total Flow 0.000
 Areal Reduction Factor 1.000 MADD Factor * 10m³/ha Storage 2.000
 Hot Start (mins) 0 Inlet Coeffiecient 0.800
 Hot Start Level (mm) 0 Flow per Person per Day (l/per/day) 0.000
 Manhole Headloss Coeff (Global) 0.500 Run Time (mins) 60
 Foul Sewage per hectare (l/s) 0.000 Output Interval (mins) 1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
 Number of Online Controls 7 Number of Storage Structures 7 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	Summer Storms	Yes
Return Period (years)	2	Winter Storms	Yes
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location	GB 503397 103865 TQ 03397 03865	Cv (Winter)	0.840
Data Type		Point Storm Duration (mins)	30

Online Controls for Storm

Orifice Manhole: SWMH9, DS/PN: 3.001, Volume (m³): 0.1

Diameter (m) 0.037 Discharge Coefficient 0.600 Invert Level (m) 5.404

Orifice Manhole: SWMH14, DS/PN: 6.001, Volume (m³): 0.3

Diameter (m) 0.080 Discharge Coefficient 0.600 Invert Level (m) 5.000

Orifice Manhole: SWMH15, DS/PN: 7.001, Volume (m³): 0.3

Diameter (m) 0.055 Discharge Coefficient 0.600 Invert Level (m) 5.300

Orifice Manhole: SWMH20, DS/PN: 9.001, Volume (m³): 0.3

Diameter (m) 0.050 Discharge Coefficient 0.600 Invert Level (m) 5.760

Orifice Manhole: SWMH22, DS/PN: 11.001, Volume (m³): 0.3

Diameter (m) 0.055 Discharge Coefficient 0.600 Invert Level (m) 5.400

Hydro-Brake® Optimum Manhole: TANK 1, DS/PN: 1.004, Volume (m³): 0.1

Unit Reference MD-SHE-0047-1200-1400-1200	
Design Head (m)	1.400
Design Flow (l/s)	1.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	47
Invert Level (m)	4.100
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.400	1.2	Kick-Flo®	0.423	0.7
Flush-Flo™	0.211	0.9	Mean Flow over Head Range	-	0.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.8	0.800	0.9	2.000	1.4	4.000	1.9	7.000	2.5
0.200	0.9	1.000	1.0	2.200	1.5	4.500	2.0	7.500	2.6
0.300	0.8	1.200	1.1	2.400	1.5	5.000	2.1	8.000	2.7
0.400	0.7	1.400	1.2	2.600	1.6	5.500	2.2	8.500	2.7
0.500	0.8	1.600	1.3	3.000	1.7	6.000	2.3	9.000	2.8
0.600	0.8	1.800	1.3	3.500	1.8	6.500	2.4	9.500	2.9

Hydro-Brake® Optimum Manhole: TANK 2, DS/PN: 1.007, Volume (m³): 0.1

Unit Reference MD-SHE-0068-2000-0950-2000

Design Head (m)0.950

Design Flow (l/s)2.0

Flush-Flo™Calculated

ObjectiveMinimise upstream storage

ApplicationSurface

Sump AvailableYes

Diameter (mm)68

Invert Level (m)2.929

Minimum Outlet Pipe Diameter (mm)100

Suggested Manhole Diameter (mm)1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.950	2.0	Kick-Flo®	0.596	1.6
Flush-Flo™	0.292	2.0	Mean Flow over Head Range	-	1.8

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.7	0.800	1.8	2.000	2.8	4.000	3.9	7.000	5.0
0.200	2.0	1.000	2.0	2.200	2.9	4.500	4.1	7.500	5.2
0.300	2.0	1.200	2.2	2.400	3.1	5.000	4.3	8.000	5.4
0.400	2.0	1.400	2.4	2.600	3.2	5.500	4.5	8.500	5.5
0.500	1.9	1.600	2.5	3.000	3.4	6.000	4.7	9.000	5.7
0.600	1.6	1.800	2.7	3.500	3.6	6.500	4.9	9.500	5.8

Storage Structures for Storm

Porous Car Park Manhole: SWMH9, DS/PN: 3.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	5.0
Max Percolation (l/s)	6.9	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.404	Cap Volume Depth (m)	0.300

Porous Car Park Manhole: SWMH14, DS/PN: 6.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	5.0
Max Percolation (l/s)	13.9	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.000	Cap Volume Depth (m)	0.550

Porous Car Park Manhole: SWMH15, DS/PN: 7.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	13.9	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.300	Cap Volume Depth (m)	0.300

Porous Car Park Manhole: SWMH20, DS/PN: 9.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	13.9	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.760	Cap Volume Depth (m)	0.300

Porous Car Park Manhole: SWMH22, DS/PN: 11.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	9.0
Max Percolation (l/s)	25.0	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.400	Cap Volume Depth (m)	0.300

Cellular Storage Manhole: TANK 1, DS/PN: 1.004

Invert Level (m)	4.100	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	105.0	0.0	0.800	105.0	0.0	0.801	0.0	0.0

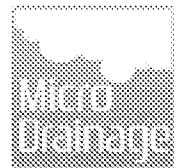
Cellular Storage Manhole: TANK 2, DS/PN: 1.007

Invert Level (m) 2.400 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	72.0	0.0	0.400	72.0	0.0	0.401	0.0	0.0

Toddington Lane
Littlehampton
SW Drainage Calculations

Designed by TS
Checked by TS



Network 2020.1.3

									Water	Surcharged	Flooded	
	US/MH			Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level	Depth	Volume
PN	Name	Storm	Period	Change		Surcharge	Flood	Overflow	Act.	(m)	(m)	(m³)
1.000	SWMH1	15 Summer	100	+45%						5.832	-0.068	0.000
1.001	SWMH2	480 Winter	100	+45%	100/240	Summer				5.796	0.149	0.000
2.000	SWMH8	15 Summer	100	+45%						5.822	-0.078	0.000
1.002	SWMH3	480 Winter	100	+45%	100/15	Summer				5.795	0.262	0.000
3.000	PP1	60 Summer	30	+0%						5.576	0.000	0.000
3.001	SWMH9	60 Summer	100	+45%	30/15	Summer				5.914	0.360	0.000
4.000	SWMH10	480 Winter	100	+45%	100/120	Summer				5.794	0.494	0.000
4.001	SWMH11	480 Winter	100	+45%	100/15	Summer				5.794	0.610	0.000
5.000	SWMH13	480 Winter	100	+45%	100/120	Summer				5.794	0.494	0.000
4.002	SWMH12	480 Winter	100	+45%	100/15	Summer				5.794	0.732	0.000
6.000	PP2	1440 Summer	100	+45%						5.243	0.000	0.000
6.001	SWMH14	480 Winter	100	+45%	100/15	Summer				5.798	0.648	0.000
7.000	PP3	1440 Summer	100	+45%						5.544	0.000	0.000
7.001	SWMH15	60 Summer	100	+45%	30/15	Summer				6.124	0.674	0.000
1.003	SWMH4	480 Winter	100	+45%	30/15	Summer				5.795	0.870	0.000
8.000	SWMH16	15 Summer	100	+45%						6.032	-0.068	0.000
8.001	SWMH17	15 Summer	100	+45%						5.854	-0.040	0.000
9.000	PP4	15 Summer	100	+45%						5.995	0.000	0.000
9.001	SWMH20	60 Summer	100	+45%	30/30	Summer				6.204	0.294	0.000
10.000	SWMH21	15 Summer	100	+45%						5.932	-0.068	0.000
8.002	SWMH18	15 Summer	100	+45%	100/15	Summer				5.831	0.060	0.000
11.000	PP5	15 Winter	100	+45%						5.670	0.000	0.000
11.001	SWMH22	60 Summer	100	+45%	30/30	Summer				6.035	0.485	0.000
8.003	SWMH19	480 Winter	100	+45%	30/15	Summer				5.795	0.875	0.000
1.004	TANK 1	1440 Summer	100	+45%	2/60	Summer				4.901	0.651	0.000

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flow / Cap.	Overflow (1/s)	Half Drain Pipe		Status	Level Exceeded
				Time (mins)	Flow (1/s)		
1.000	SWMH1	0.56			9.5	OK	
1.001	SWMH2	0.06			1.0	SURCHARGED	
2.000	SWMH8	0.46			9.5	OK	
1.002	SWMH3	0.15			2.0	SURCHARGED	
3.000	PP1	0.25			2.7	SURCHARGED*	
3.001	SWMH9	0.12		34	2.0	FLOOD RISK	
4.000	SWMH10	0.03			0.6	FLOOD RISK	
4.001	SWMH11	0.03			0.6	FLOOD RISK	
5.000	SWMH13	0.03			0.6	FLOOD RISK	
4.002	SWMH12	0.07			1.1	FLOOD RISK	
6.000	PP2	0.03			0.6	SURCHARGED*	
6.001	SWMH14	0.06		403	1.0	FLOOD RISK	
7.000	PP3	0.06			1.1	SURCHARGED*	
7.001	SWMH15	0.34		32	5.6	FLOOD RISK	
1.003	SWMH4	0.59			6.4	SURCHARGED	
8.000	SWMH16	0.57			9.5	OK	
8.001	SWMH17	0.88			9.6	OK	
9.000	PP4	0.71			12.6	SURCHARGED*	
9.001	SWMH20	0.20		33	3.3	SURCHARGED	
10.000	SWMH21	0.57			9.5	OK	
8.002	SWMH18	1.24			20.0	SURCHARGED	
11.000	PP5	1.06			18.9	SURCHARGED*	
11.001	SWMH22	0.45		44	4.9	FLOOD RISK	
8.003	SWMH19	0.48			5.2	SURCHARGED	
1.004	TANK 1	0.11		1474	1.2	SURCHARGED*	

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.005	SWMH5	480 Winter	100	+45%					4.096	-0.127
1.006	SWMH6	960 Summer	100	+45%	100/240 Summer				3.900	0.544
12.000	Channel Drain	1440 Summer	100	+45%					3.412	0.000
12.001	SWMH23	960 Summer	100	+45%	30/15 Summer				3.899	0.554
1.007	TANK 2	1440 Summer	100	+45%	100/120 Summer				3.325	0.246
1.008	SWMH7	960 Summer	100	+45%					2.922	-0.108

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.005	SWMH5	0.000	0.06			1.3	OK	
1.006	SWMH6	0.000	0.12			1.4	SURCHARGED	
12.000	Channel Drain	0.000	0.09			1.5	FLOOD RISK*	
12.001	SWMH23	0.000	0.18			1.9	FLOOD RISK	
1.007	TANK 2	0.000	0.14			2.0	SURCHARGED*	
1.008	SWMH7	0.000	0.17			2.0	OK	