Green Structural Engineering

Toddington Lane
Littlehampton, BN17 7PN

Drainage Strategy

for

Worthing Homes

20240453

October 2024

Toddington Lane

Drainage Strategy

for

Worthing Homes

Revision	Date of issue	Notes	Compiled By	Checked By
0	04/10/24	Preliminary Issue	TS	GG

Green Structural Engineering

Appendices

Green Structural Engineering

1.0 Introduction

1.1 This 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.

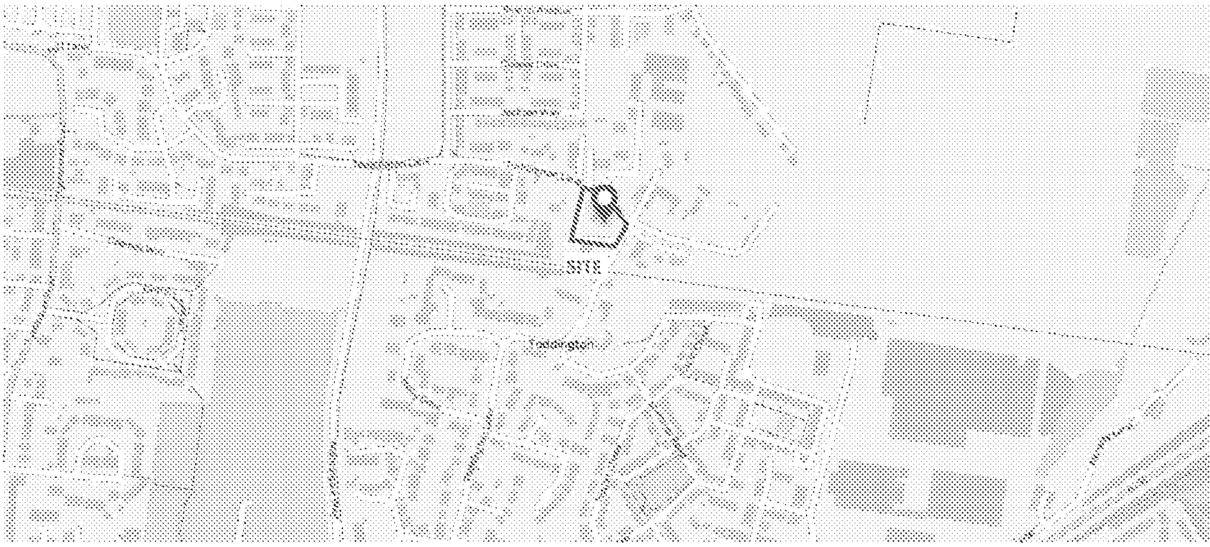

Figure 1 – Site Location Plan

1.2 This 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 should be read in conjunction with the site-specific Flood Risk Assessment produced by GSE, reference 20240453- R02- rev P0- FRA.

1.4 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 (mbgl)	Design Infiltration Rate		Notes
		mm/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 $1.45x10^{-7}$, 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 Existing Drainage

Public Sewers

3.1 Southern Water serves the surrounding area for the disposal of wastewater. Asset record 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.

3.2 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.

3.3 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

3.4 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.

3.5 The site is approximately 3,430m^2 in area, of which 1,640m^2 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 1,640m^2.

4.0 Planning Policy Context

National Planning Policy Framework and Planning Practice Guidance

4.1 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.

4.2 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.

4.3 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)

4.4 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)

4.5 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.

4.6 Section 18 of this document relates to water and provides policies on drainage and flood risk.

4.7 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

4.8 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.

4.9 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.

5.0 SuDS Hierarchy

Table 3 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	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. 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.
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 3 – SuDS Hierarchy

6.0 Proposed Drainage

Surface Water Drainage

6.1 As detailed in Section 3, the proposed 1,640m^2 of hardstanding area has an associated greenfield runoff rate of 0.7l/s.

6.2 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.

6.3 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.

6.4 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.

6.5 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.

6.6 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 105m^2 x 0.8m deep, with 95% porosity, with the final tank measuring 72m^2 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.

6.7 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, which is discussed further in the report 20240453- R02- rev P0-FRA.

6.8 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 J.

Foul Water Drainage

6.9 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.

6.10 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.

6.11 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

6.12 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	Hydro-carbons
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]	0.9[2]

6.13 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.

6.14 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

	Mitigation indices[1]		
Type of SuDS component	**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[4]	0.7[3]	0.7	0.5
Wetland	0.8[3]	0.8	0.8
Proprietary treatment systems[5,6]	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.		

6.15 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

6.16 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.

7.0 SuDS Maintenance, Management & Construction

Maintenance & Management

7.1 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.

7.2 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

7.3 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

7.4 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.

7.5 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.

8.0 Summary/Conclusion

8.1 This Drainage Strategy has been produced to review the proposed drainage strategy for the proposed development at Toddington Lane, Littlehampton, BN17 7PN. 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.

8.2 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.

8.3 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.

8.4 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.

8.5 This report clearly demonstrates that the proposed development can be served sustainably for drainage, in line with local and national policies and guidance.

APPENDIX A – Topographical Survey


FERNY BANKS
THE OLD FARMHOUSE
OLD BYRE HOUSE
HOLLYACRE
TODDINGTON LANE
Tarmac
Brick Paving
Grass
Overhead Cable
Limited Access Due To Dense Brambles
B A R N
Skalpings/Thistles/Tarmac/Concrete
Dense Brambles
Skalpings Track
Gate
Barrier
Bushes/Brambles

APPENDIX B – Soakage Report

Southern Testing
Environmental & Geotechnical

ST Consult
Environmental & Geotechnical

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

Southern Testing
Environmental & Geotechnical

ST Consult
Environmental & Geotechnical

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

For and on behalf of Southern Testing Laboratories Limited

DOCUMENT HISTORY AND STATUS

Issue No.	Date	Purpose or Status	Author	Check / Review
1	22-Dec-2023	Soakage Test Report	JAC	SFP

Southern Testing
Environmental & Geotechnical

ST Consult
Environmental & Geotechnical

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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 fluviatile 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 gravely 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 in 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.

Test ID	Test Depth (mbgl)	Design Infiltration Rate		Notes
		ℓ/m²/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

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.

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APPENDIX A

Site Plans and Exploratory Hole Logs

A

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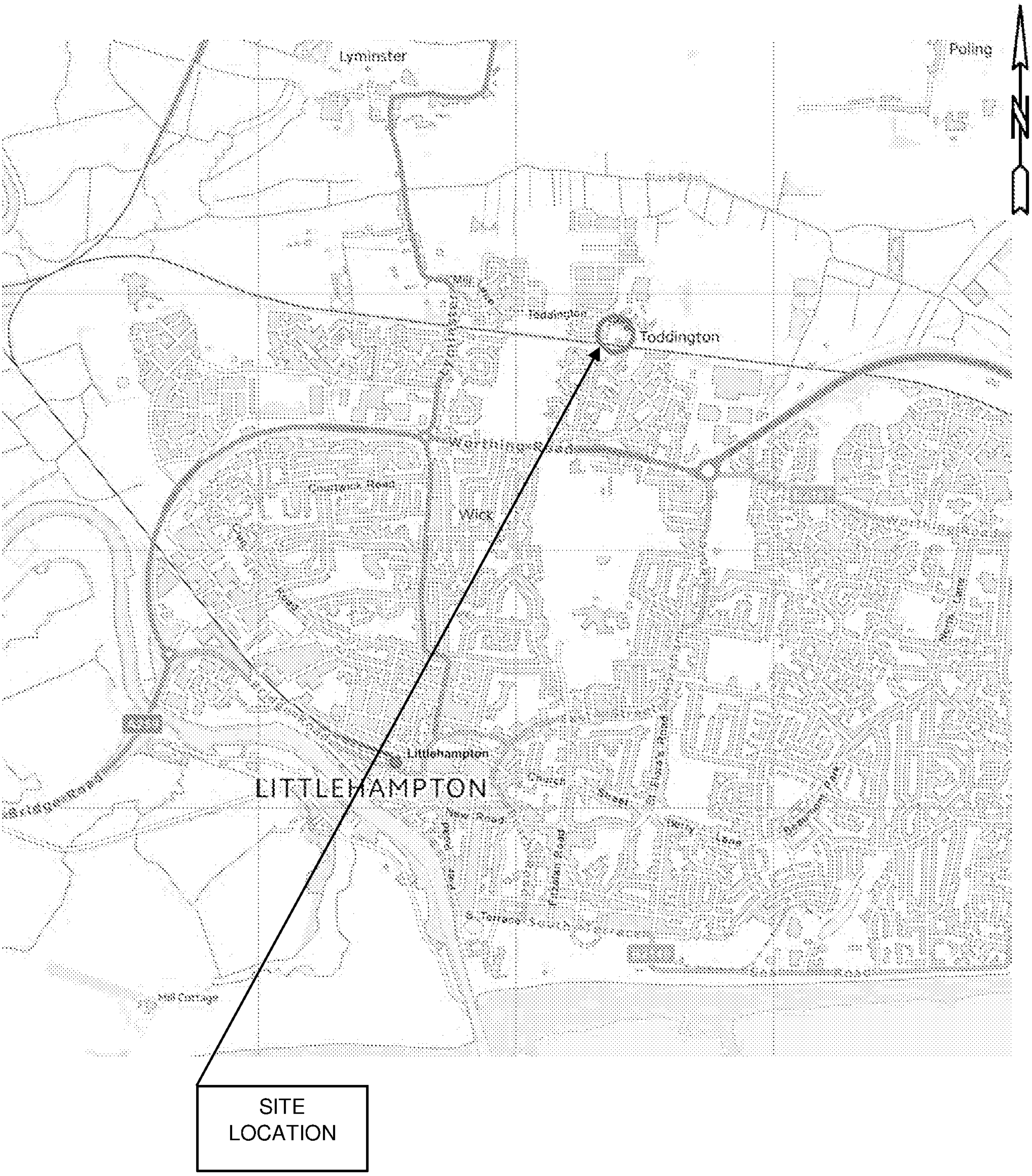

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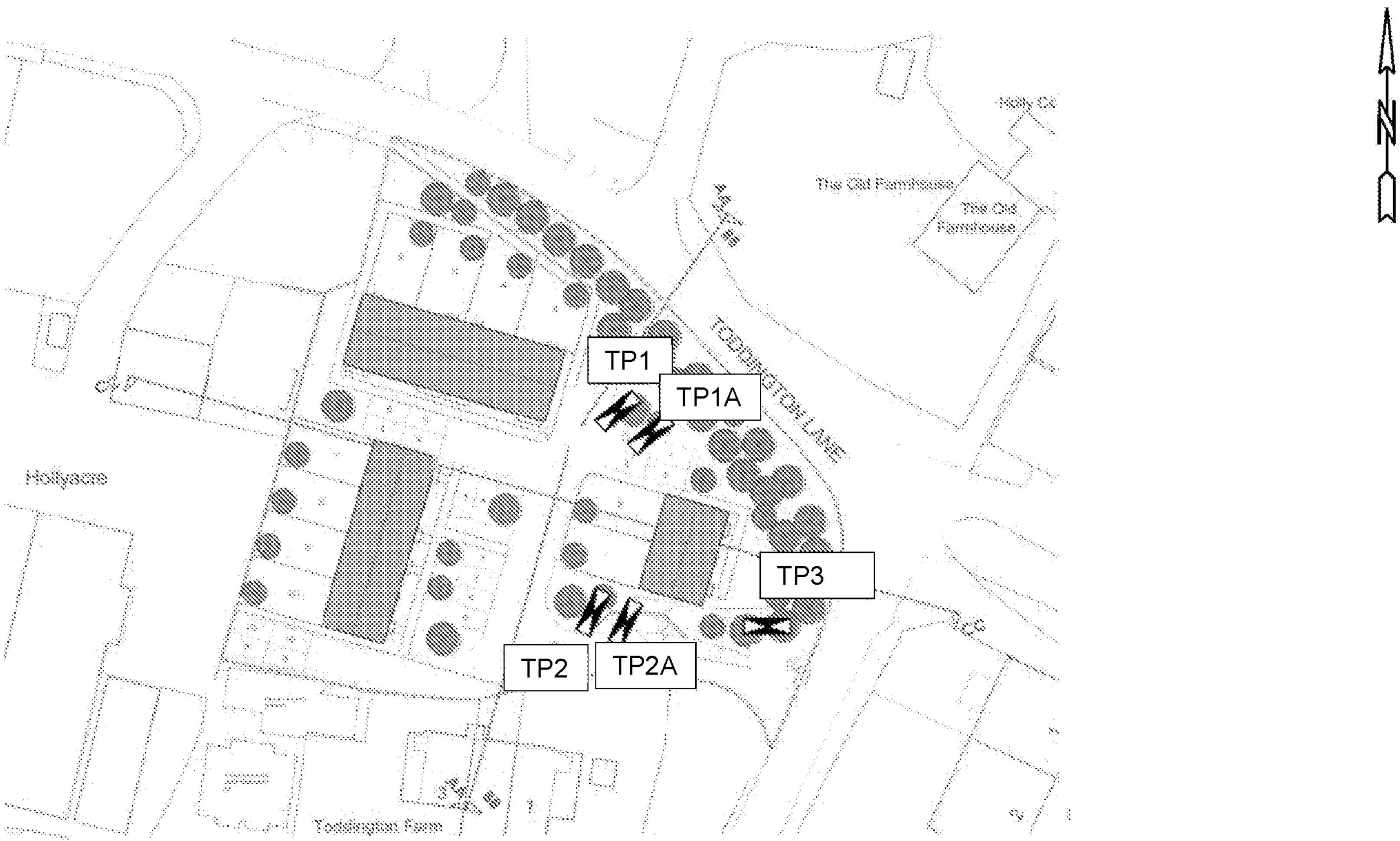
Site:	Land at Toddington Lane, Littlehampton, BN17 7PN	Project ID	J15618
Figure 1	Site Location Plan	Date:	21/12/2023



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 (%) RQD]	
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	
BH	Borehole (undefined)
CP	Cable Percussive
RC	Rotary Core
RO	Rotary Open Hole
ODC	Rotary Odex/Symmetrix drilling cased
CP+RC	Cable Percussive to Rotary Core
SNC	Sonic
CFA	Continuous Flight Auger
FA	Flight Auger
VC	Vibro Core
WLS+RC	Windowless (Dynamic) Sampler to Rotary Core
WLS	Windowless Sampler
WS	Window Sampler
HA	Hand Auger
C	Road / Pavement Core
IP	Inspection Pit (Hand Excavation)
TP	Trial Pit (Machine Excavated)
OP	Observation Pit (Supported Excavation Hand or Machine)

In-situ Test Location / Method	
DP	Dynamic Probe
CPT	Cone Penetration Test
CBR	In-situ CBR Test
DCP	CBR using Dynamic Cone Penetrometer
CBRT	CBR using TRL Probe
PB	Plate Bearing Test
SPT (S)	Standard Penetration Test (Split Barrel Sampler)
SPT (C)	Standard Penetration Test (Solid Cone)
N	SPT Result
-/-	Blows/Penetration (mm) after seating drive
-*/-	Total Blows / Penetration (mm)
( )	Extrapolated Value
PPT	Perth Penetration (In-House Method - Equivalent N Value)
HP / UCS	Strength from Hand Penetrometer (kN/m^2)
IVN	Strength from Hand Vane ((kN/m^2) P = peak, R = residual
PID	Photo Ionisation Detector (ppm)
MEXE	Mexi-Cone CBR (%)

Samples / Test Type	
B	Bulk Sample
BLK	Block Sample
C	Core Sample
CBRS	CBR Mould Sample
D	Small Disturbed Sample
ES	Environmental Sample (Soil)
EW	Environmental Sample (Water)
GS	Environmental Sample (Gas)

Samples / Test Type	
SPTLS	Standard Penetration Test Split Barrel Sample
TW	Thin Wall Push In Sample (e.g. Shelby Sampler)
U	Undisturbed Open Drive Sample (blows to take)
UT	Thin Wall Undisturbed Open Drive Sample (blows to take)
W	Water Sample (Geotechnical)
SP	Sample from Stockpile
P	Piston Sample
AMAL	Amalgamated Sample

Southern Testing ST Consult	Start - End Date:	Project ID:	Hole Type:	TP1
	06/12/2023	J15618	TP	Sheet 1 of 1

Client:	Worthing Homes	**Co-ordinates:**	**Level (m AOD)**	**Logger:** JAC
Project Name:	Land to the south of Toddington Road	**Location:**	Littlehamton	

Samples and Insitu Testing: Depth (m bgl)	Type	Results	Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description
				(1.00)		1.00	Brown silty sandy GRAVEL. Gravel is fine to coarse subangular brick, concrete, roots, tile fragments and cobbles of concrete. (MADE GROUND)
				(0.80)		1.80	Stiff light brown silty lightly fine sandy CLAY. *1.50m slightly gravelly. Gravel is fine to coarse subangular flint.*
				(1.20)		3.00	Orange brown and yellow brown very sandy slightly gravelly CLAY with occasional patches of clayey sand. Gravel is fine to coarse subrounded and subangular flint.
							Pit terminated at 3.00m

Pit Dimension (m)				Water Strikes		
		Pit Stability:	Stable	Depth (m)	Date/Time	Remarks
		Weather:				
Width:	0.45	**Remarks:**				
Length:	2.10					
Depth:	3.00					

Status:	DRAFT	**Log Print Date and Time:**	12/12/2023 09:48	**Log Approved By:**	

Southern Testing ST Consult	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: Depth (m bgl)	Type	Results	Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description
				(0.40)		0.40	Brown silty GRAVEL. Gravel is fine to coarse concrete, brick, flint, tile, chalk, rubber and plastic (MADE Ground)
				(0.60)		1.00	Firm brown and orange brown silty slightly sandy CLAY.
							Pit terminated at 1.00m

Depth scale: 1, 2, 3, 4

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:**	

Southern Testing ST Consult	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:**
				JAC
Project Name:	Land to the south of Toddington Road	**Location:**	Littlehamton	

Samples and Insitu Testing: Depth (m bgl)	Type	Results	Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description
				(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) *0.1m geotextile fabric*
				(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

Depth scale: 1, 2, 3, 4

Pit Dimension (m)		Pit Stability:	Minor collapse in top 1.0m	Water Strikes		
		Weather:		Depth (m)	Date/Time	Remarks
Width:		Remarks:				
Length:						
Depth:	3.80					

Status:	DRAFT	**Log Print Date and Time:**	12/12/2023 09:48	**Log Approved By:**	

Southern Testing ST Consult	Start - End Date:	Project ID:	Hole Type:	TP2A
	06/12/2023	J15618	TP	Sheet 1 of 1

Client:	Worthing Homes	**Co-ordinates:**	**Level (m AOD)**	**Logger:**
				JAC
Project Name:	Land to the south of Toddington Road	**Location:**	Littlehamton	

Samples and Insitu Testing: Depth (m bgl)	Type	Results	Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description
				(0.90)			Brown clayey GRAVEL. Gravel comprises fine to coarse subangular to subrounded concrete, brick, plastic, metal, wire, tile (MADE GROUND)
				(0.30)		0.90	Soft to firm orange brown silty slightly fine sandy CLAY with fragments of tile and fine brick (MADE GROUND)
						1.20	Pit terminated at 1.20m

Depth scale: 1, 2, 3, 4

Pit Dimension (m)		**Pit Stability:**	Stable	Water Strikes		
		Weather:		Depth (m)	Date/Time	Remarks
Width:	0.45	**Remarks:**				
Length:	1.20					
Depth:	1.20					
Status:	DRAFT	**Log Print Date and Time:**	12/12/2023 09:48	**Log Approved By:**		

Southern Testing ST Consult	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:**
					JAC
Project Name:	Land to the south of Toddington Road	**Location:**	Littlehamton		

Samples and Insitu Testing: Depth (m bgl)	Type	Results	Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description
				(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 gravely SILT. Gravel is fine to coarse medium density chalk and occasional flint.
							Pit terminated at 3.00m

Depth scale: 1, 2, 3, 4

Pit Dimension (m)		**Pit Stability:**	Generally stable with minor collapse in upper 0.8m	Water Strikes		
		Weather:		Depth (m)	Date/Time	Remarks
Width:		**Remarks:**				
Length:						
Depth:	3.00					

Status:	DRAFT	**Log Print Date and Time:**	12/12/2023 09:48	**Log Approved By:**	

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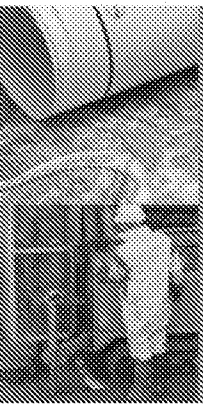
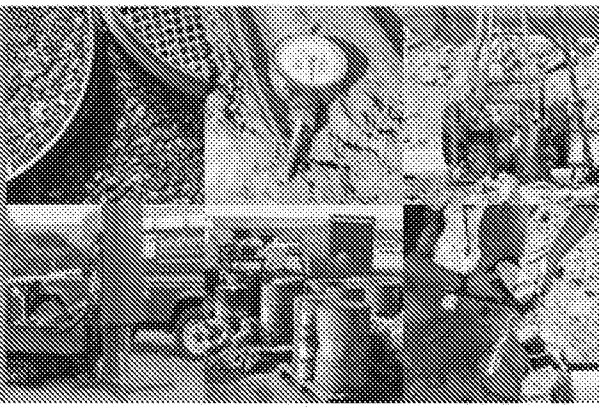


APPENDIX B

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/m^2/minute, which is a convenient rate to use. The BRE use a unit of m/sec, which is the value in l/m^2/minute divided by 60,000.

Summary Sheet

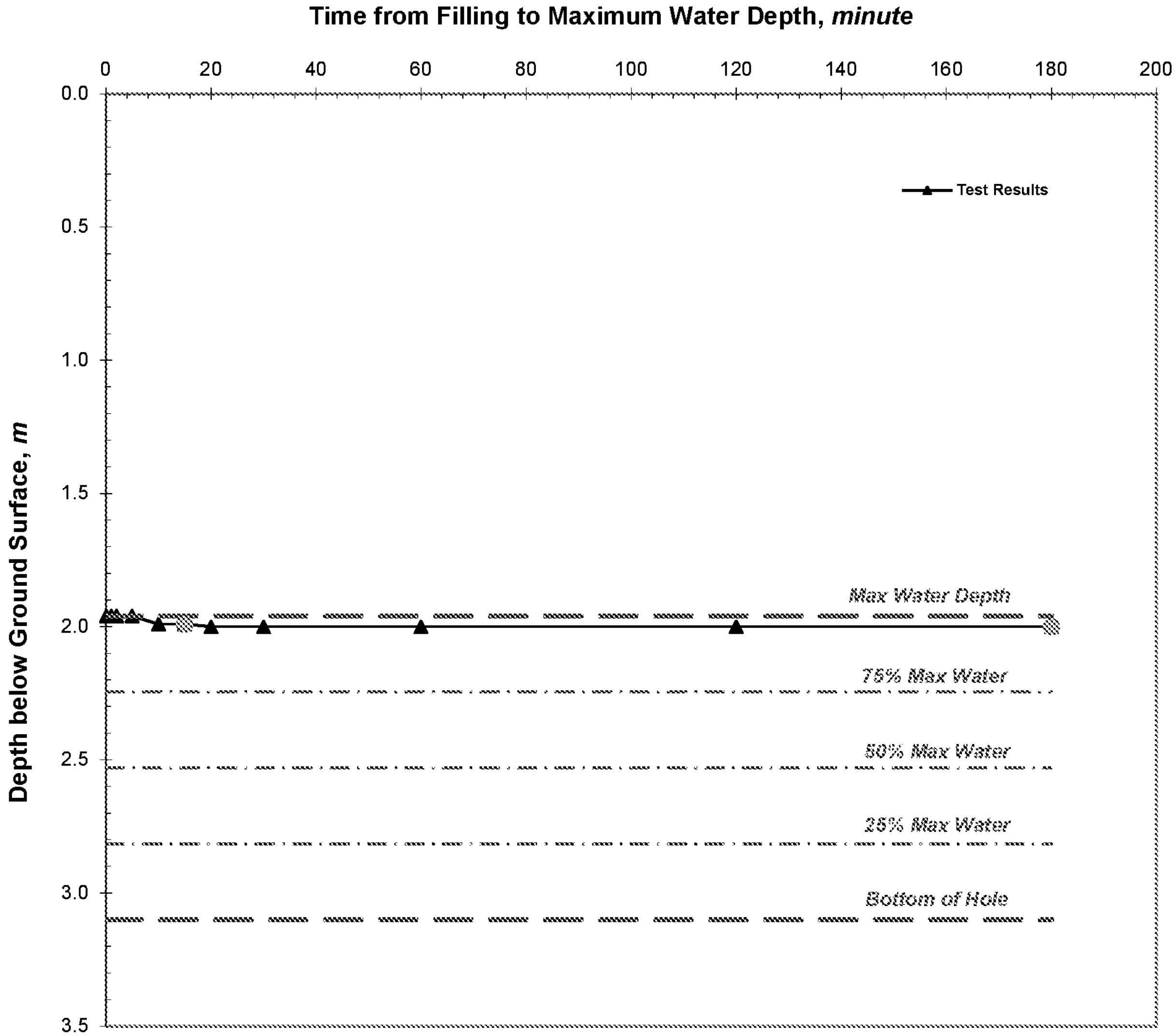
Results of BRE Digest DG365 Soakage Tests

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 (m)	Soakage Rate for Each Test (litre/m^2/min)	Soakage Rate for Each Hole (litre/m^2/min)	Soakage Rate for Each Hole (m/sec)	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** litre/m^2/min	**4.61E-6** m/sec		

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**

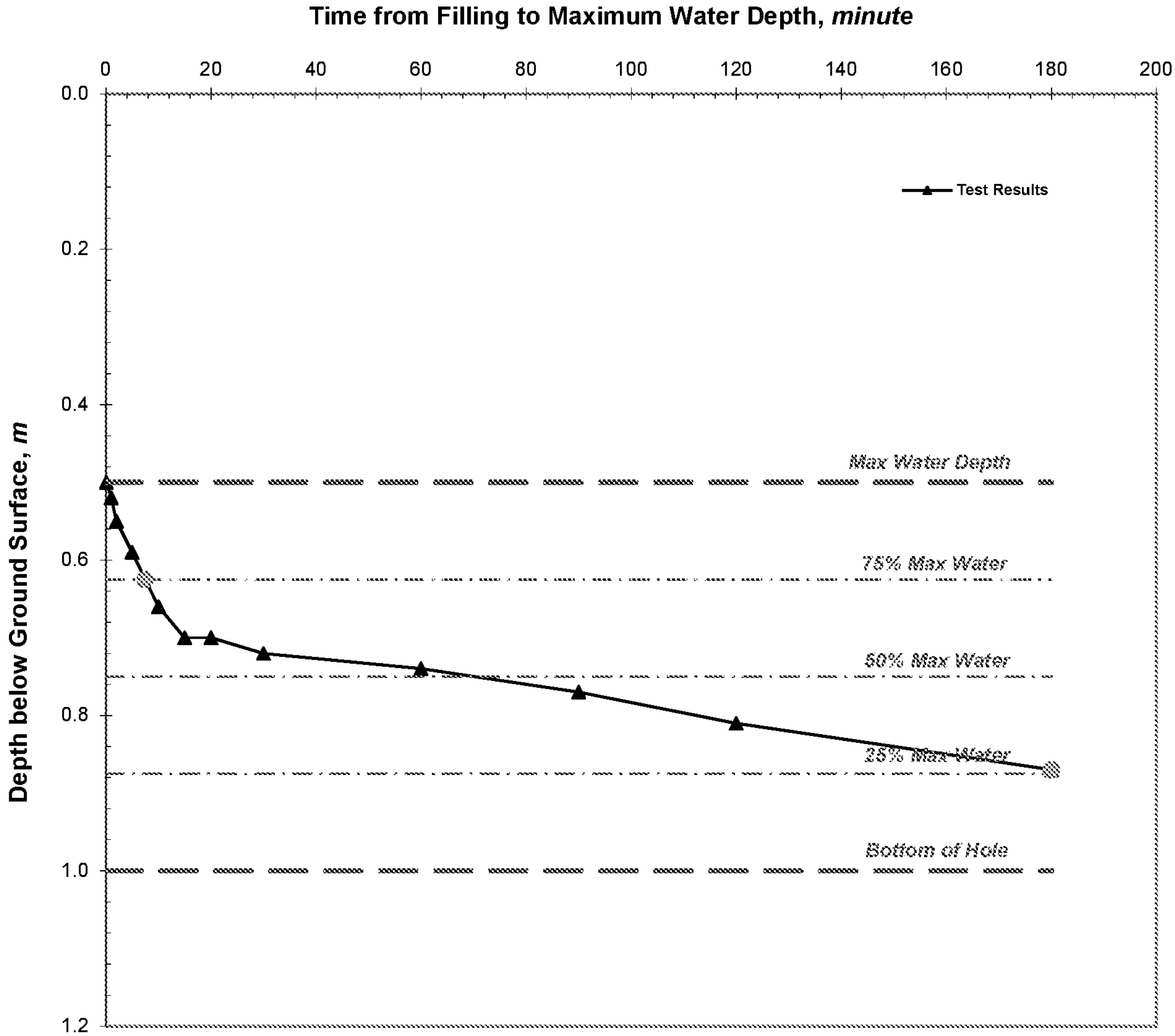
Comments:

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**

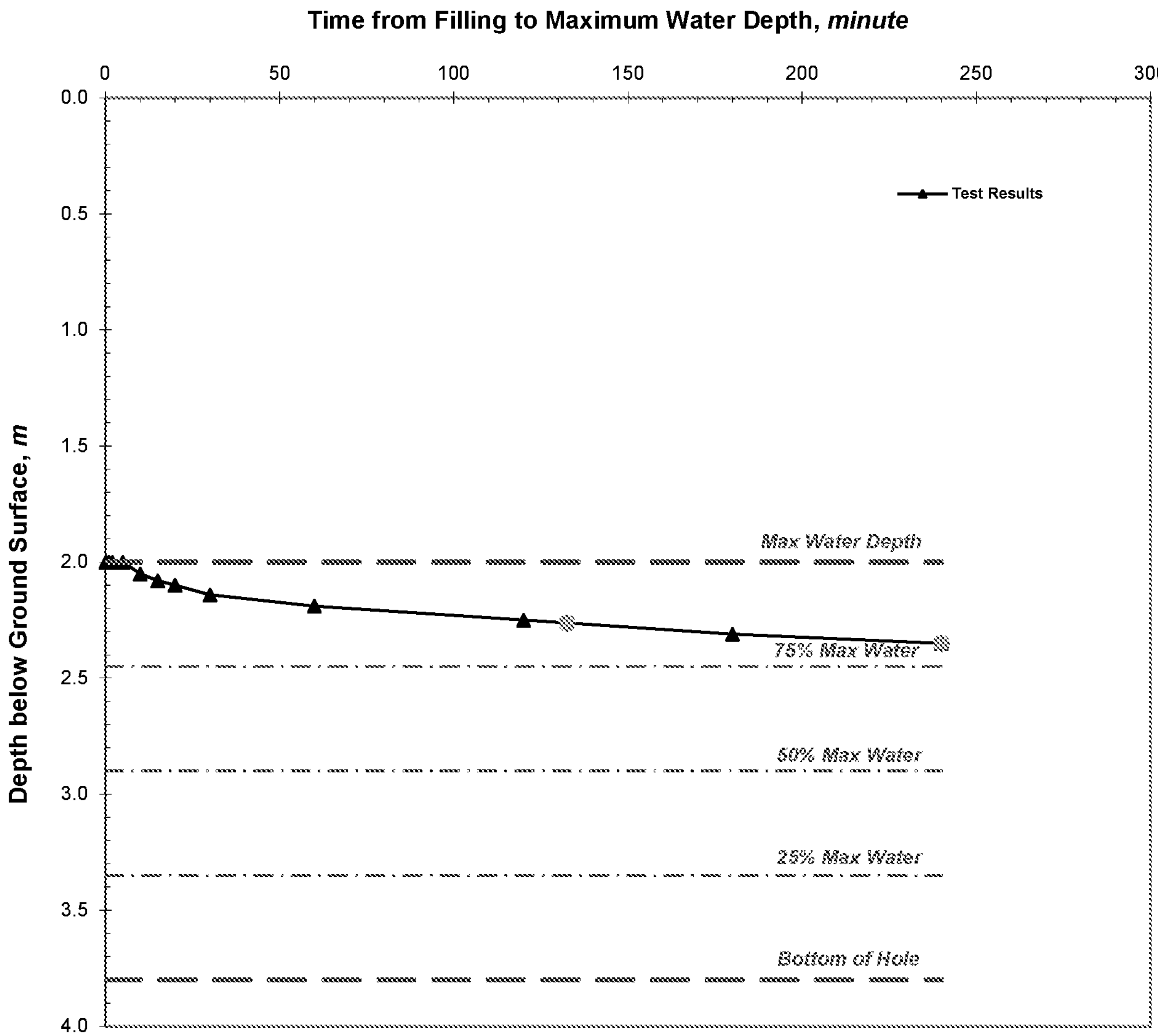
Comments:

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**

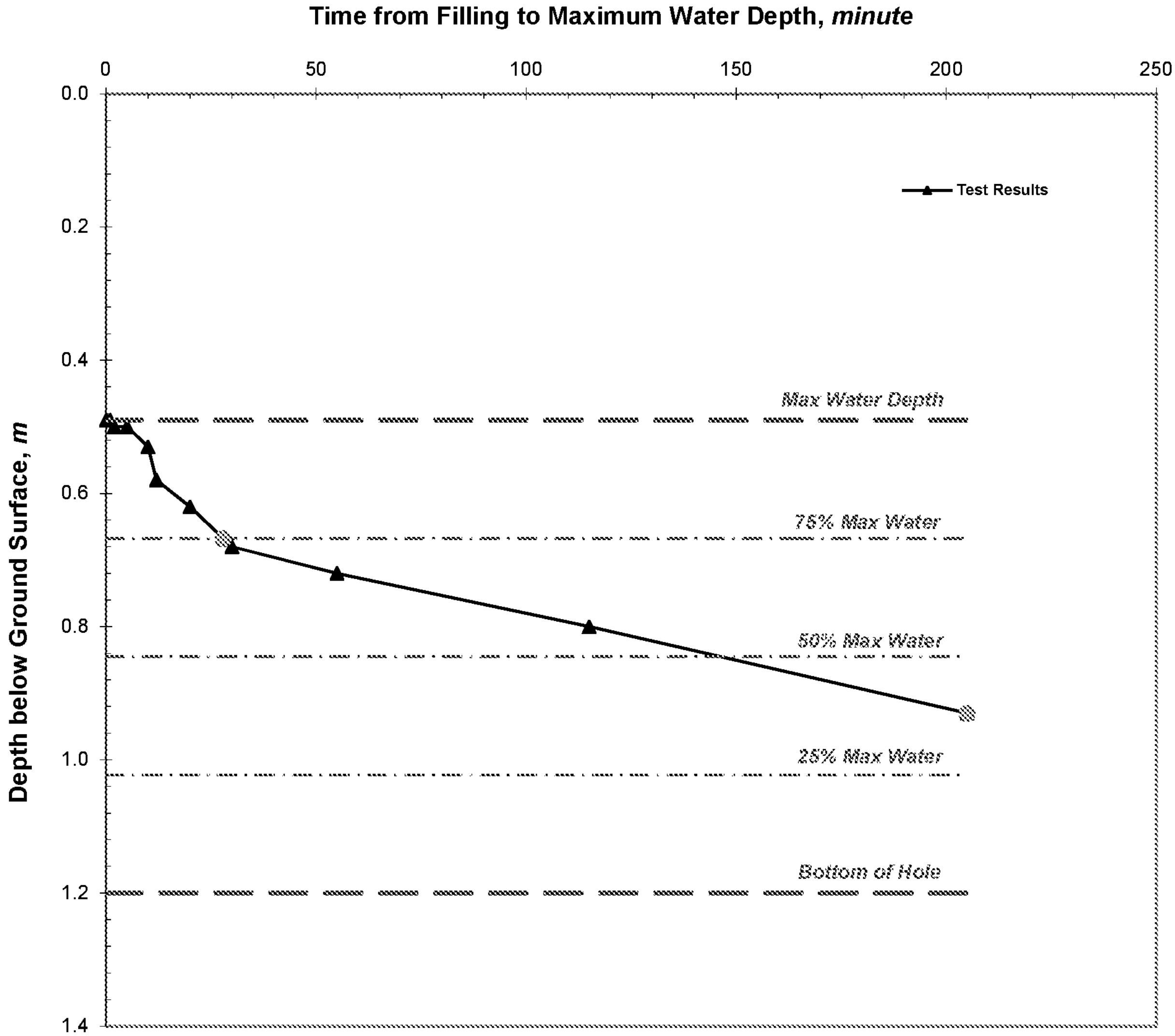
Comments:

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**

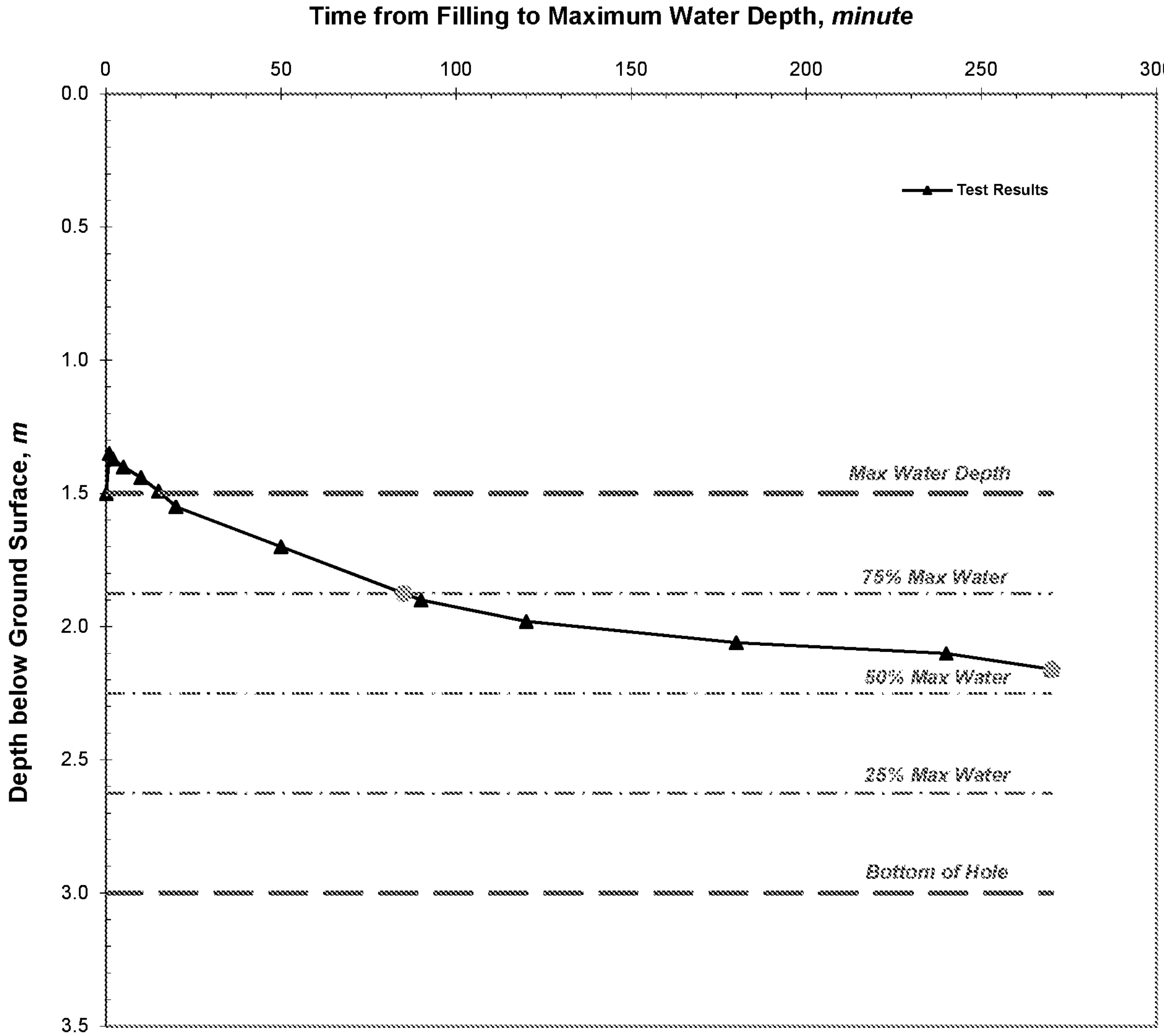
Comments:

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**
Voids Assumed for Granular Fill, %	100%	BRE Soil Infiltration Rate, *m/sec*	**4.21E-06**

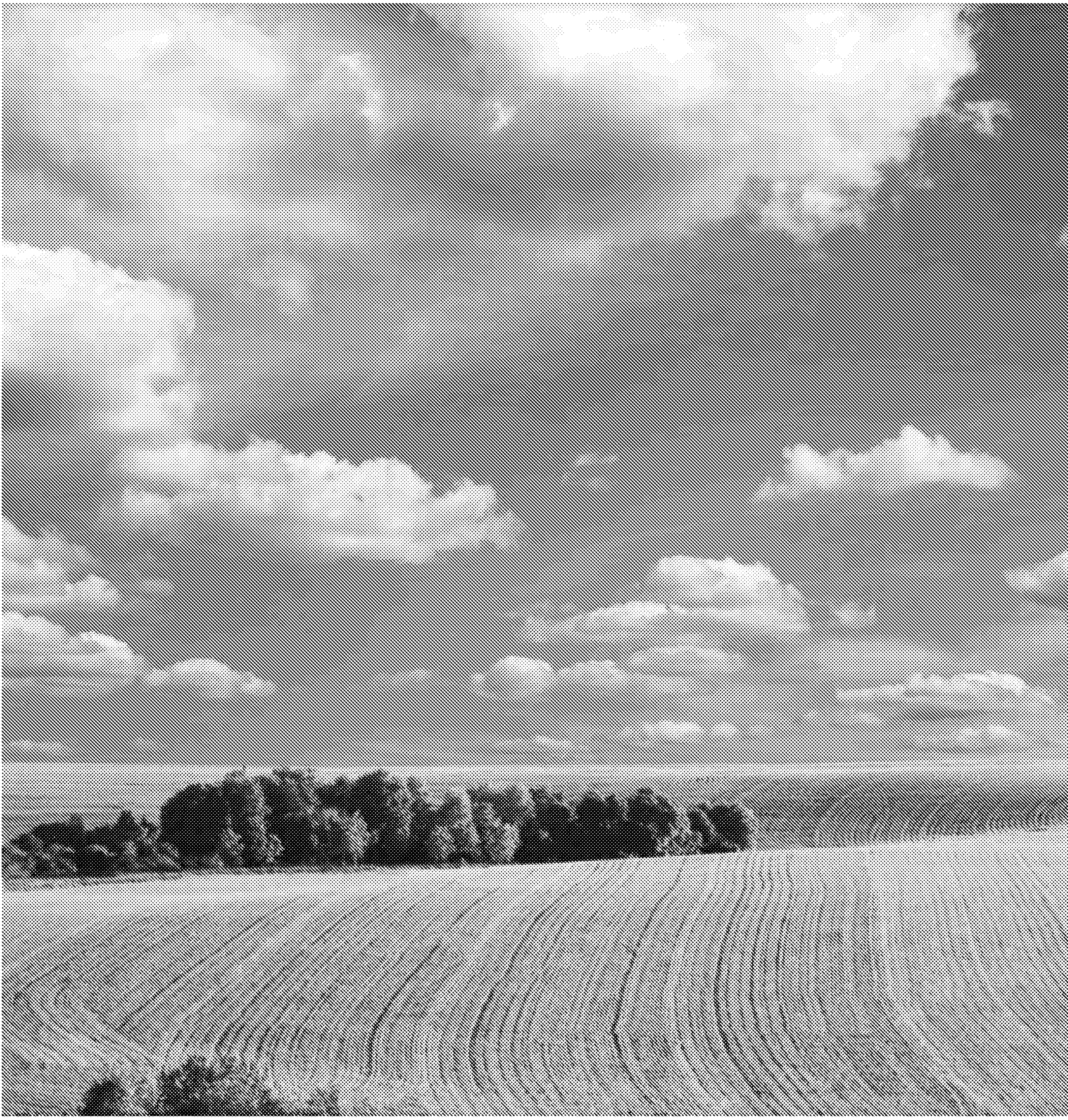
Comments:

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

[redacted]

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BRITISH DRILLING ASSOCIATION

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	Drw By	Date	Chk By	Date

WORK IN PROGRESS

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	79.0 sq. m	affordable rent
08	4 person 2 Bed house	79.0 sq. m	affordable rent
09	4 person 2 Bed house	79.0 sq. m	affordable rent
10	4 person 2 Bed house	79.0 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)

Plans 1:200 @ A1

N

2 0 2 4 6 8 10 12 14 16 18m

1:200

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	Type	Role	No.	Rev.
21-097	TDL	MHA	00	ZZ	DR	A	003	P07

Purpose of Issue

PRELIMINARY

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

t. 01243 774748
e. admin@mharchitects.co.uk
www.mharchitects.co.uk

Limited Company
Registered in England No.1994233

mh ARCHITECTS

APPENDIX D – Southern Water Sewer Records

(c) Crown copyright and database rights 2024 Ordnance Survey 100031673 | Date: 23/07/24 | Scale: 1:1000 | Map Centre: 503427,103844 | Data updated: 23/07/24 | Our Ref: 1527172 - 1

Wastewater Plan A1
Powered by digdat

The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. This plan is produced by Southern Water Services Ltd (c) Crown copyright and database rights 2024 Ordnance Survey 100031673 .This map is to be used for the purposes of viewing the location of Southern Water plant only. Any other uses of the map data or further copies is not permitted.

WARNING: BAC pipes are constructed of Bonded Asbestos Cement.

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

Foul Gravity Sewer; Combined Gravity Sewer; Culverted Water Course or Treated Effluent; Surface Water Gravity Sewer; Rising Main, Vacuum or Syphon

Combined Outfall; Foul Outfall; Surface Water Outfall; Surface Water Inlet

Combined Pumping Station; Surface Water Pumping Station; Foul Pumping Station; Water Treatment Works; Section 104 Area; Building Over Agreement Area

Foul Manhole; Combined Manhole; Surface Water Manhole; Side Entry Manhole Decantation Chamber, Dummy Manhole or Surface Water Soakaway

tim.seekings@gseltd.co.uk

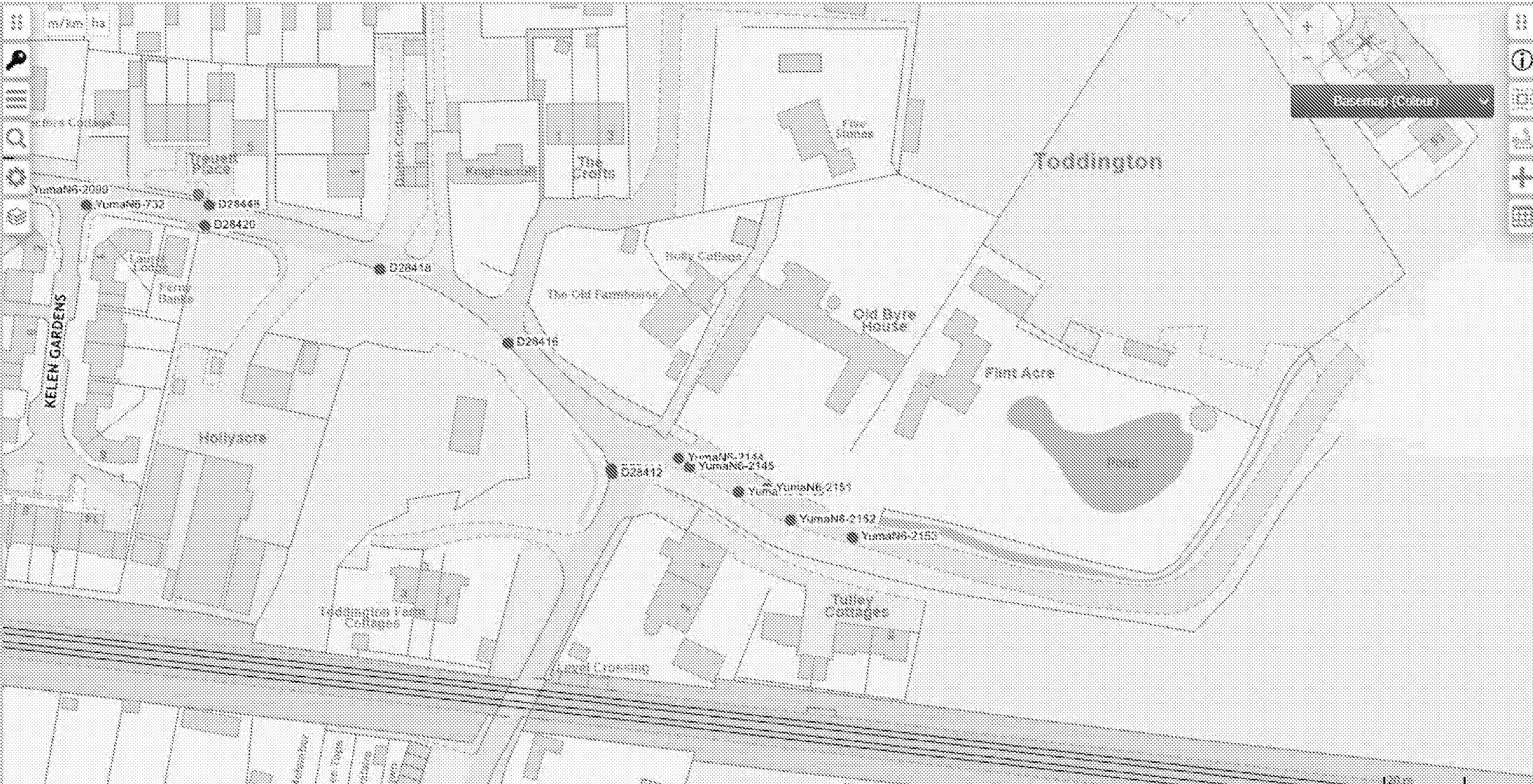
Toddington

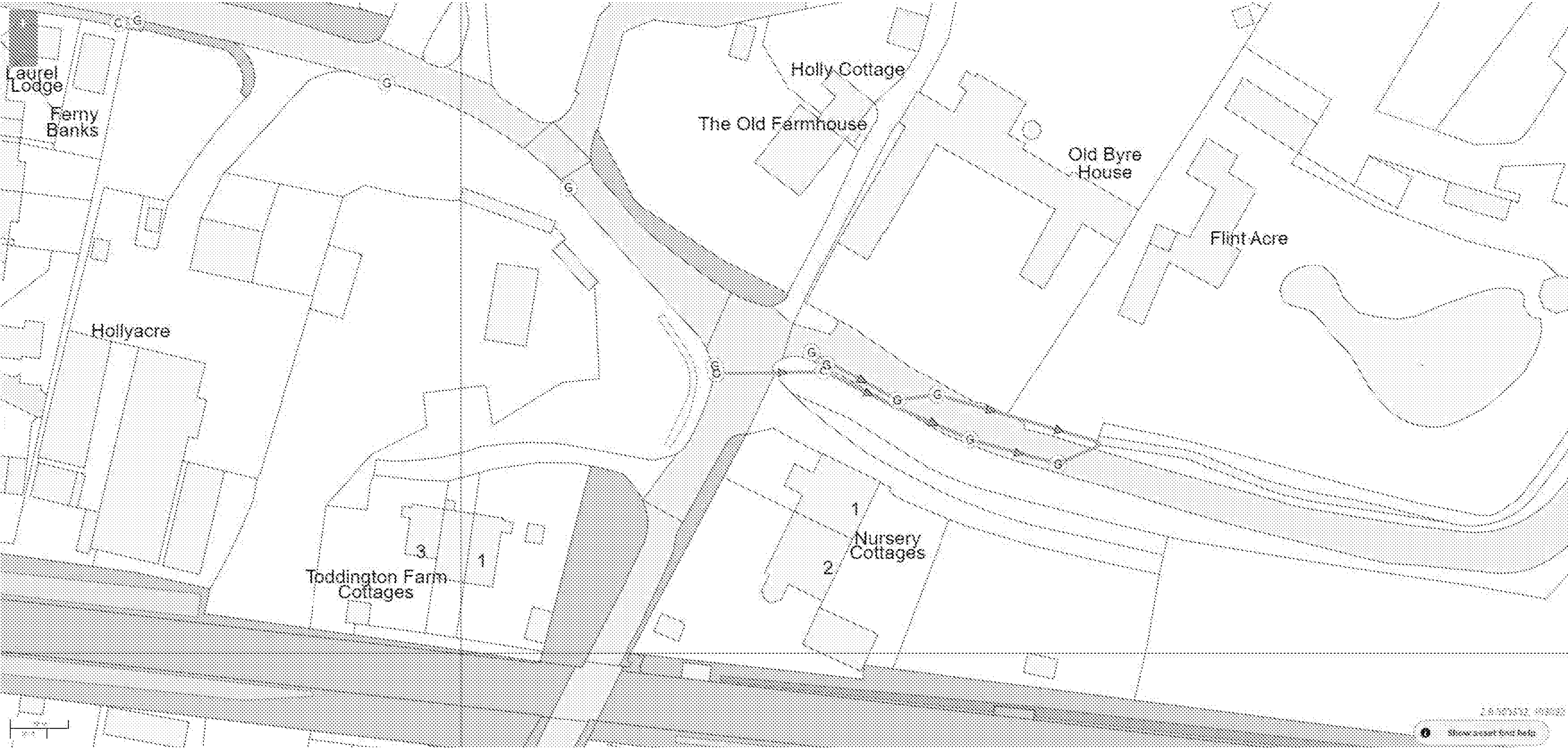
WATER for LIFE from Southern Water

ARUN DISTRICT COUNCIL LU/246/24/PL

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
1601	F	0.00	0.00	
1602	F	0.00	0.00	
1603	F	0.00	0.00	
1604	F	0.00	0.00	
1605	F	0.00	0.00	
1701	F	7.33	6.31	
2502	F	4.21	2.56	
2601	F	4.22	2.74	
2602	F	6.27	3.69	
2603	F	4.30	2.95	
2604	F	5.69	3.84	
2605	F	6.16	4.33	
2606	F	6.41	4.46	
2607	F	6.52	4.80	
2608	F	6.43	4.08	
2609	F	6.66	4.31	
2610	F	6.62	4.85	
2611	F	6.70	5.08	
2612	F	6.47	4.93	
2613	F	6.67	5.22	
2614	F	6.94	5.41	
2701	F	5.87	3.53	
2702	F	6.65	4.77	
2704	F	6.67	5.00	
2705	F	6.79	5.20	
2706	F	6.79	5.49	
2707	F	7.01	5.95	
2708	F	7.05	5.31	
2709	F	7.31	5.41	
2710	F	0.00	5.50	
2711	F	7.36	5.59	
2712	F	7.38	6.67	
2801	F	101.27	97.71	
3501	F	4.74	3.08	
3601	F	0.00	3.23	
3602	F	0.00	3.15	
3603	F	0.00	3.07	
3604	F	0.00	0.00	
3605	F	0.00	0.00	
3606	F	0.00	0.00	
3607	F	0.00	0.00	
3701	F	4.60	2.93	
3702	F	3.95	3.02	
3703	F	4.01	3.18	
3704	F	0.00	0.00	
3801	F	101.15	97.89	
4505	F	0.00	4.54	
4506	F	0.00	5.00	
4601	F	0.00	5.10	
4602	F	0.00	4.02	
4603	F	0.00	3.85	
4604	F	0.00	3.69	
4605	F	0.00	0.00	
4606	F	0.00	3.46	
4607	F	0.00	3.90	
4608	F	0.00	4.16	
4609	F	0.00	3.40	
4610	F	0.00	3.33	
4701	F	4.84	3.38	
4702	F	0.00	3.58	
4703	F	0.00	3.23	
4704	F	0.00	1.36	
4705	F	0.00	0.00	
5503	F	0.00	4.44	
5504	F	0.00	4.31	
5601	F	0.00	3.80	
5602	F	0.00	2.43	
5603	F	0.00	2.26	
5604	F	0.00	4.24	
5605	F	0.00	3.80	
5606	F	0.00	3.40	
5607	F	0.00	2.73	
5608	F	0.00	2.75	
5609	F	0.00	2.46	
5610	F	0.00	4.50	
5611	F	0.00	3.86	
5612	F	0.00	3.50	
5613	F	0.00	0.00	
5614	F	0.00	0.00	
5615	F	0.00	0.00	
5616	F	0.00	0.00	
5701	F	0.00	2.11	
5702	F	0.00	3.10	
5703	F	0.00	3.00	
5704	F	0.00	1.83	
5705	F	0.00	1.94	
5706	F	0.00	1.50	
6502	F	0.00	4.37	
6503	F	0.00	4.40	
6601	F	0.00	3.05	
6602	F	0.00	3.77	
6603	F	0.00	3.18	
4557	S	6.50	4.86	
4650	S	6.22	5.08	
4651	S	6.21	5.02	
4652	S	6.30	5.14	
4653	S	6.44	5.03	
4654	S	6.32	4.65	
4655	S	6.16	4.52	
4656	S	5.63	4.29	
4657	S	5.87	4.22	
4658	S	6.04	4.26	
4659	S	6.00	4.18	
4660	S	5.28	0.00	
4661	S	5.54	4.22	
4750	S	6.01	3.93	
4751	S	5.52	3.91	
4752	S	5.16	0.00	
4753	S	5.78	4.10	
4754	S	5.64	4.14	
5554	S	6.39	5.25	
5555	S	6.40	5.16	
5556	S	5.97	4.47	
5557	S	6.03	4.63	
5650	S	6.35	5.08	
5651	S	6.27	4.73	
5652	S	6.10	4.53	
5653	S	6.00	4.50	
5654	S	6.28	4.85	
5655	S	5.27	4.32	
5656	S	6.13	4.68	
5657	S	6.41	4.61	
5658	S	6.63	4.54	
5750	S	6.48	4.49	
5751	S	6.28	4.42	
5752	S	5.65	4.54	
5753	S	6.30	4.13	
6550	S	6.19	4.88	
6650	S	5.90	3.75	
6651	S	5.50	3.73	
6652	S	5.50	0.00	
6653	S	6.37	5.06	
6654	S	5.42	4.05	
7650	S	5.97	4.64	

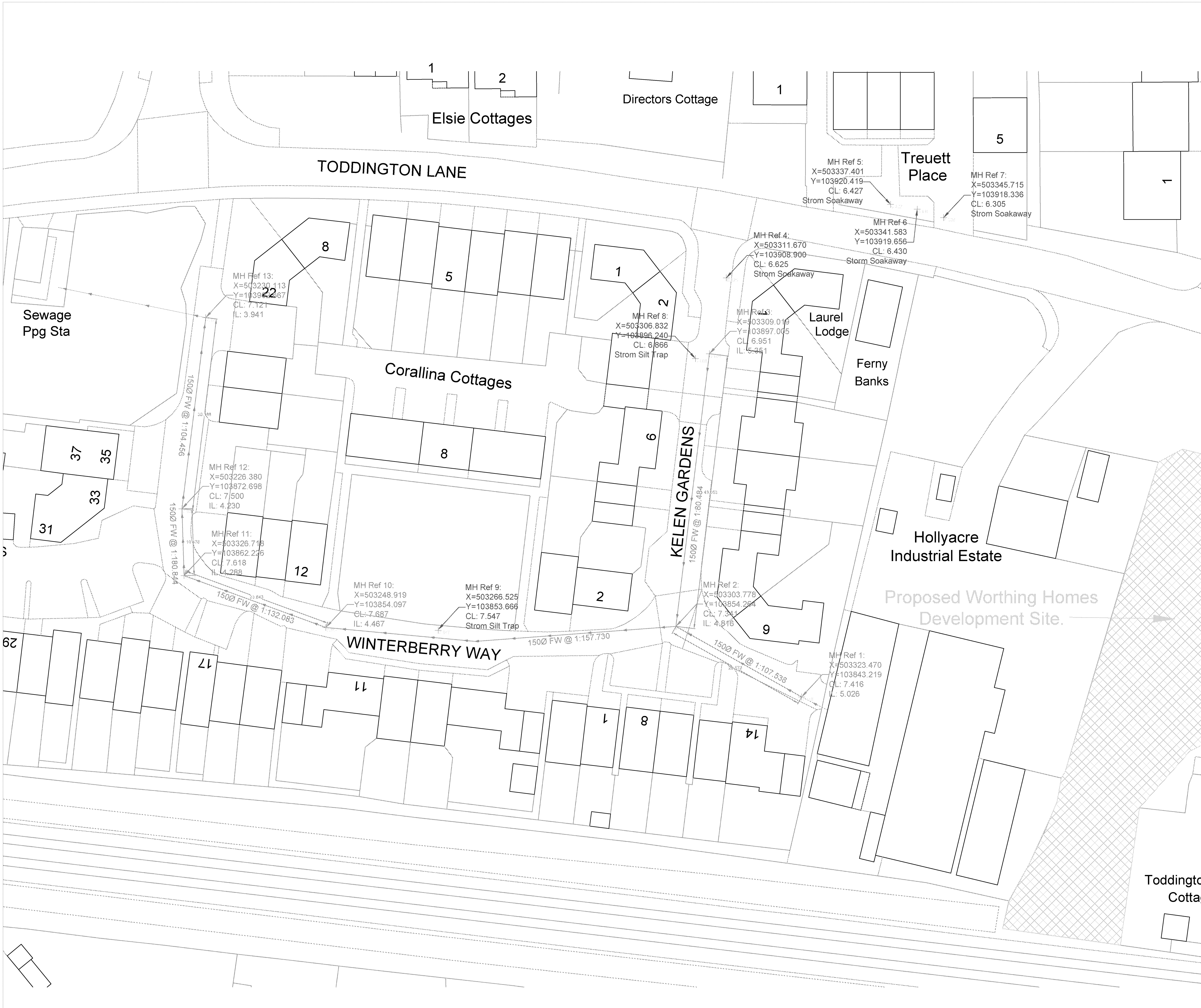
APPENDIX E – Highways Drainage Records


m/km
ha
Toddington
The Crofts
YumaN6-2090
YumaN6-732
D28448
D28420
D28418
D28416
D28412
KELEN GARDENS
The Old Farmhouse
Old Byre House
Flint Acre
Hollyacre
YumaN6-2144
YumaN6-2145
YumaN6-2151
YumaN6-2152
YumaN6-2153
Tulley Cottages
Toddington Farm Cottages
Level Crossing



Laurel Lodge
Ferny Banks
Hollyacre
Holly Cottage
The Old Farmhouse
Old Byre House
Flint Acre
Toddington Farm Cottages
3
1
Nursery Cottages
1
2

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.

smas worksafe contractor www.smasltd.com

SAFEMARK

CHAS Accredited Contractor www.chas.gov.uk

nrs surveying limited

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

Client: HAMPSHIRE HOMES

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

FEH Mean Annual Flood

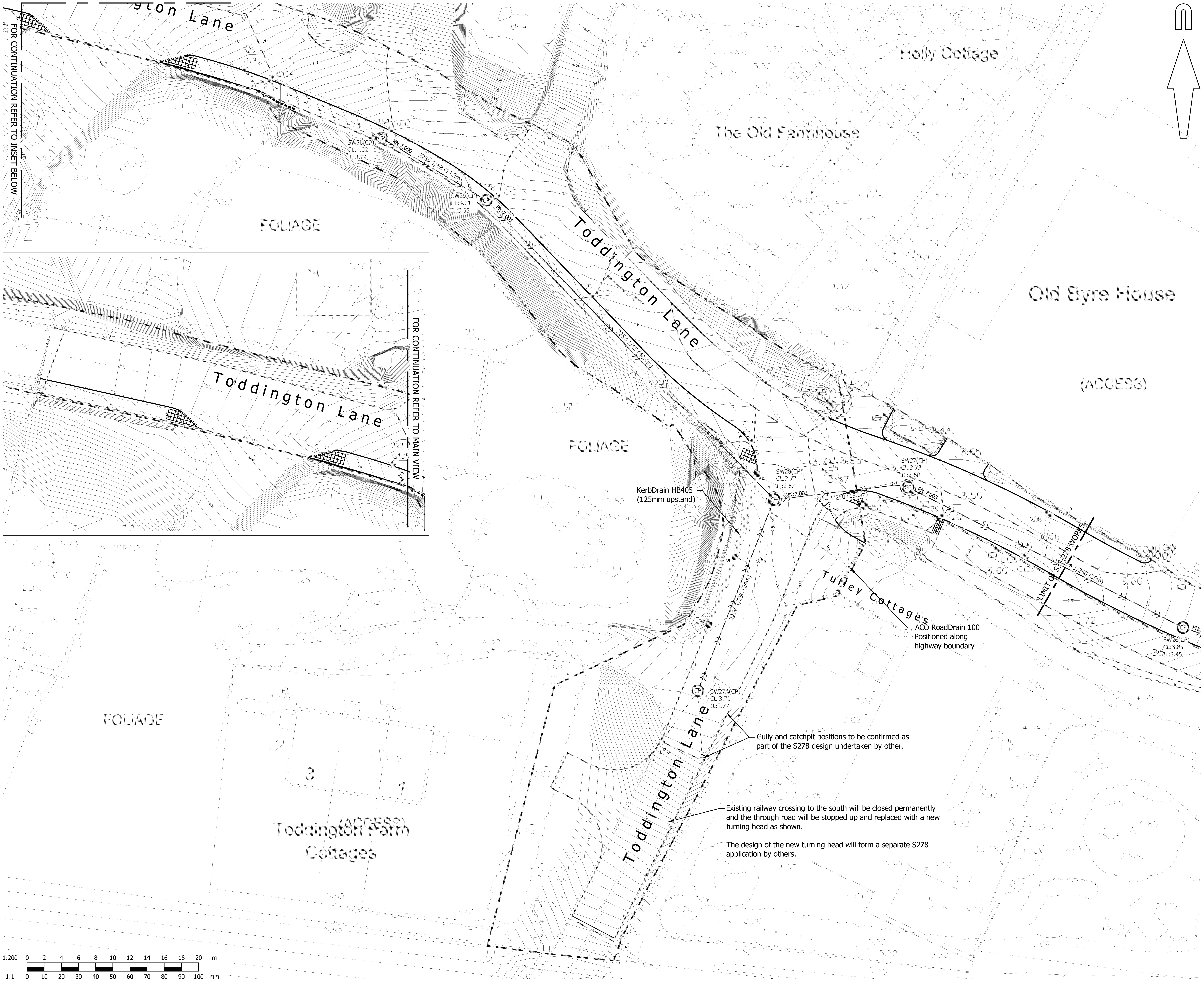
Input

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



A1 ORIGINAL

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:

1. This drawing is not to be scaled.
3. Based on topographic survey undertaken by Subvision Survey Ltd on March 2022, drawing reference SS-PH-013.
4. 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.
5. All on-site civils and drainage works constructed in accordance with the Mayer Brown Limited Specification, details and MH schedules.
8. Proprietary items are to be constructed in accordance with manufacturers recommendations / requirements.
9. 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.
10. 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.
11. 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.
12. All new manholes and catchpits are soffit to soffit unless noted otherwise. Invert level shown is outlet pipe.
13. All drainage shall comply with the typical details and the requirements of BS EN 752 and Part H of the Building Regulations.
14. All precast concrete units used in the drainage works shall be manufactured using sulphate resisting cement.
15. Cover levels are to be adjusted locally to suit finished ground levels.
16. 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
NOT FOR CONSTRUCTION

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

mayer brown

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Lion House Oriental Road Woking Surrey GU22 8AR
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

scale	drawn by	checked by
1:200	IC	SF

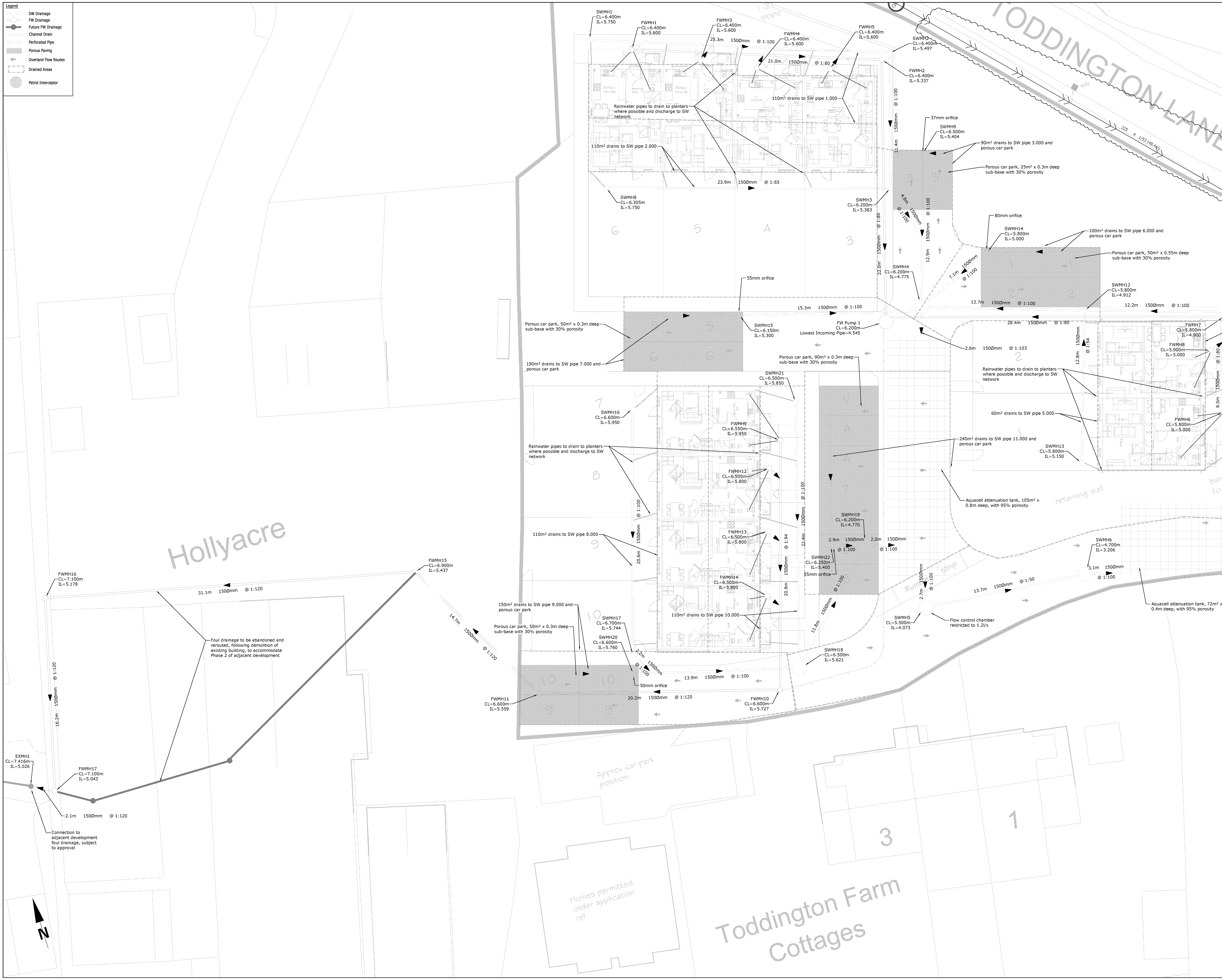
date	cad file
AUGUST 2021	PHMAIN-MB-278-XX-DR-D-10.DWG

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	TS
P1	20.08.24	Preliminary	TS	TS	TS

PRELIMINARY

Green Structural Engineering
www.gseltd.co.uk
Green Structural Engineering Ltd
Unit 21 Berghem Mews
Blythe Road
Hammersmith
W14 0HN
020 3405 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

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)	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)
1.000	50.00	5.42	5.750	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	5.750	0.011	0.0	0.0	0.0	1.25	22.1	1.5
1.002	50.00	5.69	5.383	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	5.150	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	5.150	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	5.300	0.019	0.0	0.0	0.0	1.01	17.8	2.6

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)	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)
1.003	50.00	5.73	4.775	0.072	0.0	0.0	0.0	0.99	17.5	9.7
8.000	50.00	5.34	5.950	0.011	0.0	0.0	0.0	1.00	17.7	1.5
8.001	50.00	5.38	5.744	0.011	0.0	0.0	0.0	0.99	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	5.760	0.015	0.0	0.0	0.0	1.00	17.7	2.0
10.000	50.00	5.37	5.850	0.011	0.0	0.0	0.0	1.01	17.8	1.5
8.002	50.00	5.57	5.621	0.037	0.0	0.0	0.0	1.01	17.8	5.0
11.000	50.00	5.20	5.520	0.024	0.0	0.0	0.0	1.00	17.7	3.2
11.001	50.00	5.25	5.400	0.024	0.0	0.0	0.0	1.00	17.7	3.2
8.003	50.00	5.61	4.770	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	4.073	0.133	0.0	0.0	0.0	1.42	25.2	18.0
1.006	50.00	5.98	3.206	0.133	0.0	0.0	0.0	1.01	17.9«	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	17.7«	22.2
1.008	50.00	6.13	2.880	0.164	0.0	0.0	0.0	1.00	17.8«	22.2

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	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	5.394	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	560
								3.001	5.275	150	500
								4.002	4.775	150	
								6.001	4.929	150	154
								7.001	5.147	150	372
SWMH16	6.600	0.650	Open Manhole	450	8.000	5.950	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	101
								9.001	5.621	150	
								10.000	5.626	150	5
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	733
								11.001	5.371	150	601
TANK 1	5.800	1.700	Junction		1.004	4.100	150	1.003	4.750	150	650
								8.003	4.750	150	650
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	3.206	150	1.005	3.800	150	594
Channel Drain	3.600	0.338	Junction		12.000	3.262	150				
SWMH23	3.900	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	246
								12.001	3.175	150	246
SWMH7	3.700	0.820	Open Manhole	1200	1.008	2.880	150	1.007	2.880	150	
	3.700	0.855	Open Manhole	0		OUTFALL		1.008	2.845	150	

Manhole Schedules for Storm

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

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	5.750	0.500	Open Manhole	450
1.001	o	150	SWMH2	6.400	5.497	0.753	Open Manhole	450
2.000	o	150	SWMH8	6.400	5.750	0.500	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	0.500	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	0.500	Open Manhole	450
4.002	o	150	SWMH12	5.800	4.912	0.738	Open Manhole	450
6.000	o	150	PP2	5.800	5.093	0.557	Junction	
6.001	o	150	SWMH14	5.800	5.000	0.650	Open Manhole	450
7.000	o	150	PP3	6.150	5.394	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	

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	0.580	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	0.188	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 Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.008	o	150	SWMH7	3.700	2.880	0.670	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)
1.008	3.510	100.0		3.700	2.845	0.705	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
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
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

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

Simulation Criteria

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

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	Data Type	Point
FEH Rainfall Version	2013	Cv (Summer)	1.000
Site Location	GB 503397 103865 TQ 03397 03865	Cv (Winter)	1.000

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 45

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (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 (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
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) Surcharge	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	