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FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY

Hopkins Estates

Land at Harvest Lane, Charlton Horethorne

July 2023

Report control

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Primary Author:	Helena Preston	Initialled:	HP
Contributor:		Initialled:	
Review by:	Nick Bosanko	Initialled:	NB

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Appendices

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1 Introduction

Background

1.1 Vectos | SLR has been commissioned by Hopkins Estates to provide a Flood Risk Assessment (FRA) and Drainage Strategy to support a full planning application for the development of land off Harvest Lane, Charlton Horethorne, Somerset.

Background

1.2 According to the Environment Agency (EA) Flood Map for Planning, the site is located in Flood Zone 1 (i.e. low risk and is defined as land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding). Given the size of the site (i.e. greater than 1 hectare), an FRA is required to support the planning application in accordance with the National Planning Policy Framework (NPPF).

1.3 This FRA has been undertaken in accordance with the guidelines set out in the NPPF and wider national and local guidance documents.

Aims and Objectives

1.4 The aim of this FRA is to demonstrate that the site can be developed safely, without exposing it to an unacceptable degree of flood risk or increasing the flood risk to third parties. The objectives of this FRA are to:

- Undertake a desk-based review of the available flood risk data for the site to assess flood risk.
- Review the relevant planning policy and guidance documents to ensure that the development proposals are in accordance with these requirements.
- Identify the key sources of flood risk to the site and surrounding area.
- Identify flood mitigation requirements, if any, to demonstrate how the development can be made safe from flooding without a detrimental impact to third parties.
- Assess whether the development will result in an increase of surface water runoff and how this can be mitigated through the application of Sustainable Drainage Systems (SuDS).
- Identify a foul water drainage strategy.

Development Proposals

1.5 It is proposed to develop the site to provide a mixed-use development comprising 31 new residential dwelling and new commercial space, with associated access roadways, parking areas, public open space, allotments and gardens. The proposed site plan is included in Appendix A.

Limitations

1.6 The general limitations of this assessment are that:

- A number of sources have been used to compile this document, whilst Vectos believe them to be trustworthy; Vectos is unable to guarantee the accuracy of the information that has been provided by others.

- This report is based on information available at the time of preparation. Consequently, there is potential for further information to become available. These changes may lead to future alteration to the conclusions drawn in this report for which Vectos cannot be held responsible.

2 Site Description

2.1 The site is located at the north-western end of the village of Charlton Horethorne, and comprises two fields. Harvest Lane is located along the southwest boundary of the site, whilst some low-density residential dwellings North Road are located immediately east of the site. The site is approximately 3.2 hectares (ha) in area and is has an approximate grid reference of ST 66220 23525. The site location is shown in Figure 1.

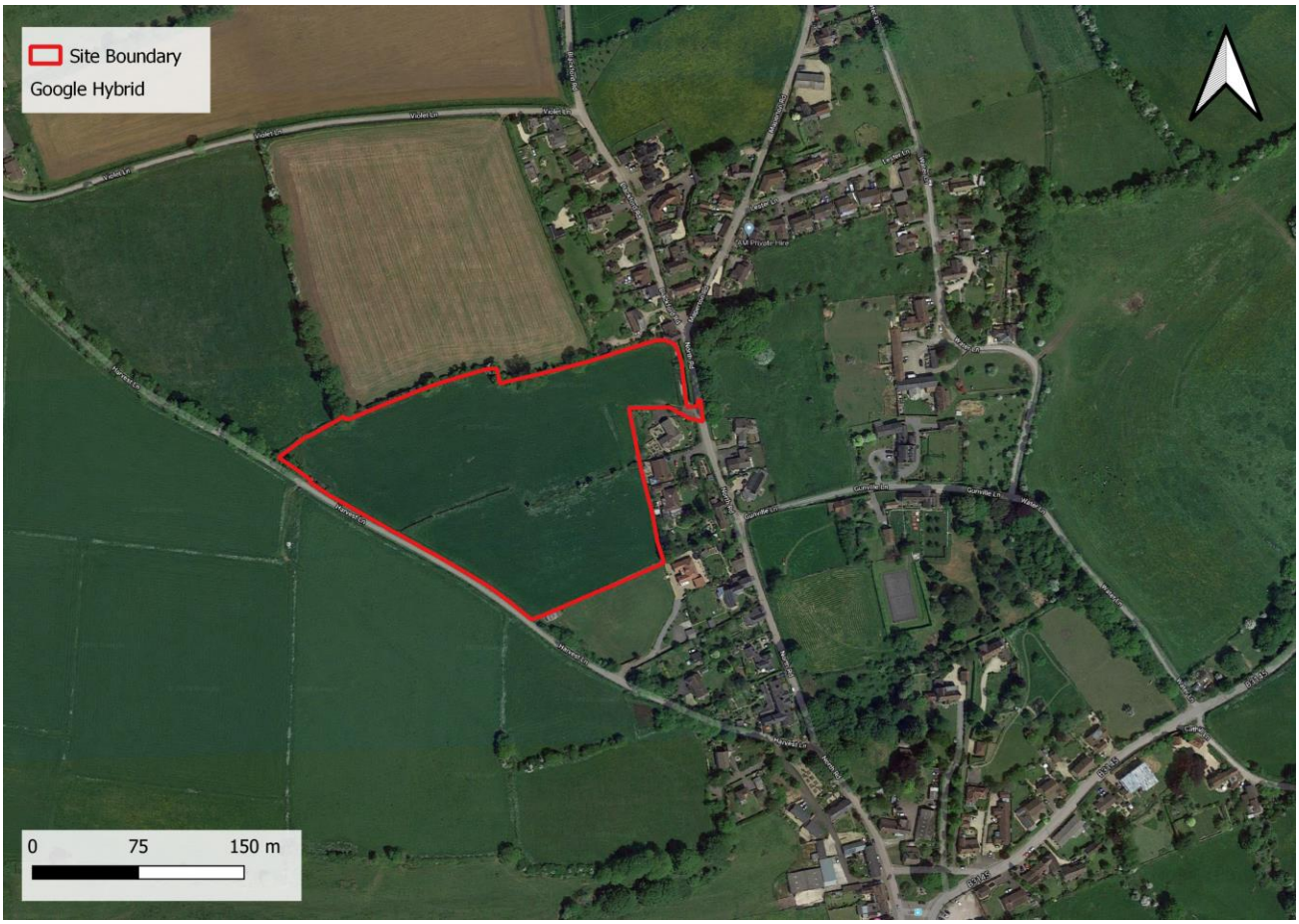

Figure 1: Site Location Plan

Topography

2.2 The topographical survey is enclosed in Appendix B, which shows that the site slopes from west to east, from a maximum level of approximately 144 m Above Ordnance Datum (AOD) to 128 m AOD (along the east site boundary).

Geology and Hydrogeology

2.3 The 1:50,000 scale British Geological Survey (BGS) mapping indicates that the site is underlain by Limestone of the Inferior Oolite Group. No superficial deposits are indicated to be present beneath the site.

2.4 A ground investigation was undertaken at the site in March 2020, by TerraFirma (South), which comprised five trial pits. The ground investigation recorded Topsoil underlain by Limestone strata comprising gravel and cobbles, to a maximum recorded depth of 1.7 m.

2.5 As part of the investigation, infiltration testing was undertaken in all 5 trial pits. These recorded infiltration rates of between 1.07 x 10^{-4} m/s and 5.63 x 10^{-5} m/s in Sand and Gravel strata. This suggests that the site is suitable for infiltration drainage. Extracts of the report from this investigation are enclosed in Appendix C.

2.6 No groundwater was encountered during the ground investigation.

2.7 The bedrock geology (Limestone) is classified as a Principal aquifer. Principal aquifers provide a high level of water storage and may support water supply and/or river base flow on a strategic scale.

2.8 The site is not located within a groundwater Source Protection Zone (SPZ); however, the site is located within a Drinking Water Safeguard Zone (Groundwater).

Hydrology and Existing Drainage

2.9 Asset records have been obtained from Wessex Water. These indicate that no public surface or foul sewers are present within the site. A 150 mm diameter public foul sewer is indicated beneath North Road to the east of the site. Sewer asset plans are enclosed in Appendix D.

2.10 According to the topographical survey no ditches or streams are present within the site boundary. An unnamed stream flows from north to south, approximately 250 m east of the site at its closest point. This stream is a tributary of the River Yeo.

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3 Planning Policy and Guidance

National Planning Policy Framework

3.1 The NPPF sets out the Government's national policies for flood risk management in a land use planning context within England and how these are expected to be applied. It states the requirement for a sequential, risk-based approach to the location of development – taking into account all sources of flood risk and the current and future impacts of climate change – so as to avoid, where possible, flood risk to people and property.

3.2 The aim of the sequential test is to steer new development to areas with the lowest risk of flooding from any source. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower risk of flooding.

3.3 If it is not possible for development to be located in areas with a lower risk of flooding (taking into account wider sustainable development objectives), the exception test may have to be applied. The need for the exception test will depend on the potential vulnerability of the site and of the development proposed.

3.4 In accordance with Annex 3: Flood risk vulnerability classification of the Planning Practice Guidance (PPG), the proposed development (i.e. residential) is classified as More Vulnerable.

3.5 Table 2 of PPG sets out the 'incompatibility' of the vulnerability classification with the identified flood zones. The site has been designated by the Environment Agency as Flood Zone 1 and therefore locating More Vulnerable development does not need to be subject to the Sequential Test.

South Somerset Local Plan

3.6 The local plan is a collection of planning documents, including the South Somerset Local Plan (2006 – 2028). This sets out the key elements of the vision for the development of South Somerset until 2028. It includes Policy EQ1 (Addressing Climate Change in South Somerset), which identifies the need to direct development away from flood risk areas and mitigate the impact of flooding and climate change by the use of sustainable drainage systems.

Joint Level 1 Strategic Flood Risk Assessment (SFRA)

3.7 The SFRA was updated in July 2019 and identifies the flood risk within the South Somerset Council and Somerset West & Taunton Council from rivers, surface water, groundwater, sewers and other artificial sources. Guidance for planners and developers is also included. The SFRA refers to the inclusion of SuDS within developments (with infiltration SuDS used where practicable).

LLFA SuDS Guidance

3.8 The LLFA (Somerset County Council) are a statutory consultee to the planning process to assess major planning applications for their surface water drainage implications. The LLFA use the '*West of England Sustainable Drainage Developer Guide*' (March 2015), which is available online.

3.9 The guide is intended to assist developers in the design of surface water drainage systems, providing specific information on the planning, design and delivery of surface water drainage, designed to reduce the risk of flooding and maximise environmental gain, including water quality, water resources, biodiversity, landscape and amenity. The guide also aims to ensure that all new developments are designed to mitigate the effects of climate change.

3.10 The guide has informed the surface water drainage strategy discussed in Section 5.

The SuDS Manual (CIRIA C753) 2015

3.11 The CIRIA SuDS Manual provides comprehensive guidance for the design and incorporation of SuDS. The manual sets out the process by which appropriate SuDS options may be selected for a site.

3.12 The guidance within the CIRIA SuDS Manual (2015) will be used for the planning, design, operation and maintenance of the proposed SuDS.

Policy Conclusions

3.13 The development proposals are consistent with the policies within the NPPF, Local Plan and supporting national, regional and local guidance documents. This is because all built development has been located within Flood Zone 1 and because surface water will be managed using SuDS. This is discussed in the following sections.

4 Assessment of Flood Risk

River and the Sea Flood Risk

4.1 The EA Flood Map for Planning (see Figure 2) shows the risk of flooding from rivers and the sea. It locates the entire site in Flood Zone 1. This means it has a low probability of flooding from these sources.

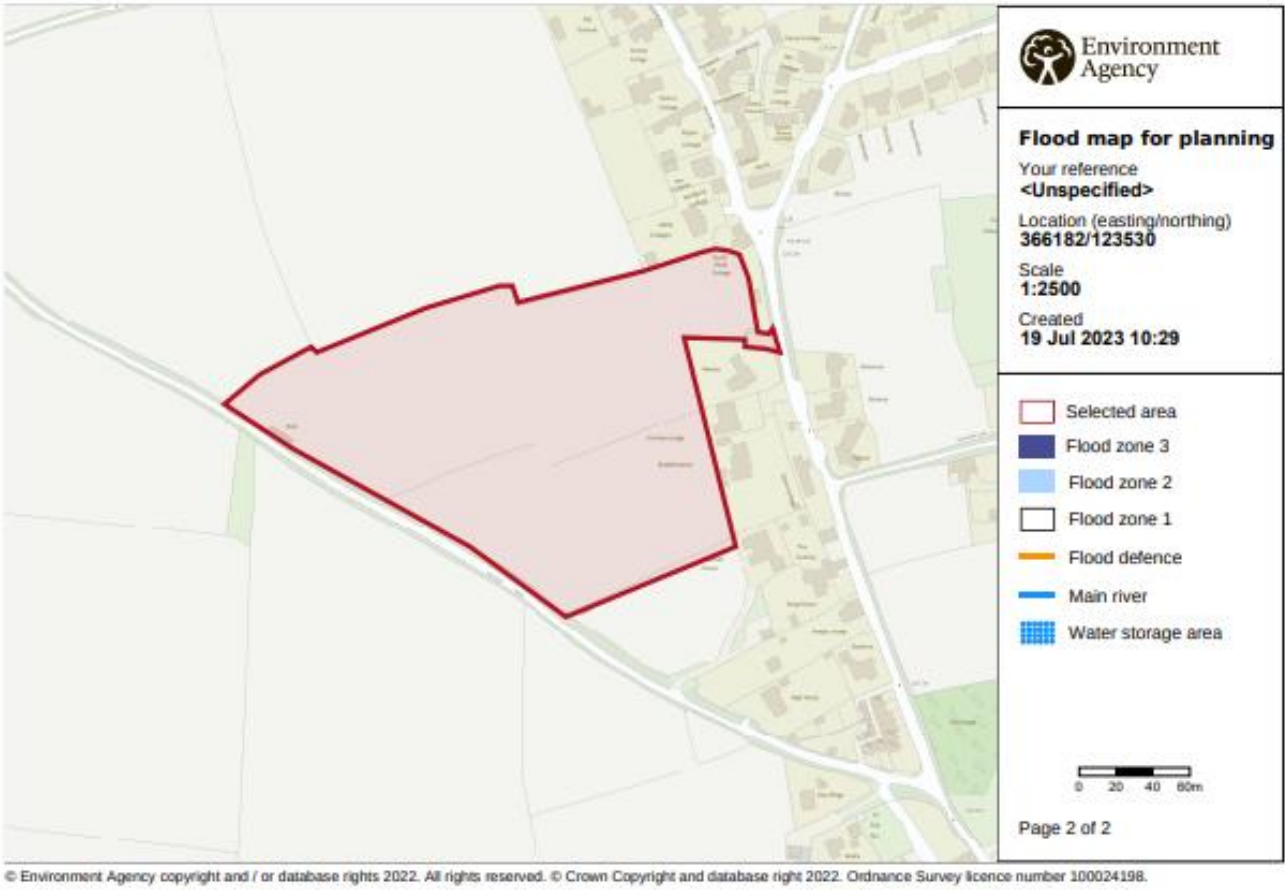

Figure 2: Flood Map for Planning

Surface Water Flood Risk

4.2 Surface water flooding is a result of overland flow that can follow a rainfall event, before the runoff enters a watercourse or sewer. This form of flooding is usually associated with high intensity rainfall events but can also occur with lower intensity rainfall or melting snow where the ground is saturated, frozen, developed or otherwise has a low permeability.

4.3 The flood risk relates to both the conveyance of waters to the site by overland flow from areas outside the site and also areas within the site itself, and the ponding of these waters in depressions in the topography.

4.4 The Risk of Flooding from Surface Water map is available online. An extract from this map is provided in Figure 3.

4.5 It shows that the site is within an area at a very low risk of surface water flooding, defined as an area that has less than a 1 in 1000 chance of flooding each year.

4.6 The Joint Level 1 SFRA for Somerset West & Taunton and South Somerset (July 2019) indicates that the site is not within a surface water priority catchment at higher risk of surface water flooding. Therefore, it is considered that the site is unlikely to be affected by surface water flooding. Flood risk from surface water is therefore considered to be low.

Figure 3: Extent of Flooding from Surface Water Map

Sewer Flood Risk

4.7 This source of flooding occurs when sewerage systems are overwhelmed and result in flooding, which may occur alone or be combined with other flood sources (e.g. fluvial or surface water).

4.8 As noted in Section 2, no public surface or foul water networks are present within the existing site. Asset records obtained from Wessex Water indicate the presence of a public foul sewer beneath North Road, to the east of the site. North Road is at a lower elevation than that of the site and therefore, if the sewer were to surcharge and flood, the resulting floodwater would not affect the site. Flood risk from existing sewers is therefore considered to be low.

Groundwater Flood Risk

4.9 Groundwater flooding usually occurs in low lying areas during periods of sustained heavy rainfall. During these periods rain infiltrates into the underlying rocks and strata raising the water table above the level of the surrounding ground.

4.10 The Joint Level 1 SFRA for Somerset West & Taunton and South Somerset (July 2019) does not record any groundwater flooding in the vicinity of the site. The BGS Geoindex identifies the nearest historic borehole approximately 900 m west of the site, which was drilled in March 1965 and recorded a groundwater level of approximately 30 m below ground level.

4.11 The ground investigation by TerraFirma (South) included five trial pits to a maximum depth of 1.70 m. The intrusive works were undertaken in Spring, which is when groundwater tends to be highest. No groundwater was encountered within these trial pits. The risk of groundwater flooding is therefore considered to be low.

Other Sources

4.12 The site is not located within an area at risk of reservoir flooding and there are no canals within the vicinity of the site that could pose a potential flood risk. The flood risk at the site from other sources is therefore negligible.

5 Flood Mitigation

5.1 Flood risk is not considered to represent a development constraint and no flood mitigation is required. However, in accordance with building regulations, finished floor levels should be set 150 mm above surrounding ground levels. This will help to protect against shallow ponding or saturated ground, which is inevitable following very prolonged or heavy rainfall.

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6 Surface Water Drainage Strategy

Overview

6.1 It is well understood that one of the effects of development is typically to reduce the permeability of the site and consequently to change its response to rainfall. Therefore, a suitable surface water drainage strategy is required to ensure that the surface water runoff regime is managed appropriately so that there will be no increase in flood risk to third parties.

6.2 The NPPF states that flood risk to land and property must not be increased as a result of development. The associated PPG states that flood risk should not increase for events up to and including a 1 in 100 year return period, with appropriate allowance for climate change.

6.3 A fundamental principle of sustainable development in terms of flood defence is the reduction of surface water runoff from new developments. Surface water drainage arrangements for any development site must ensure that volumes and peak discharge rates leaving the site are no greater than those for the site prior to development. Any increase in surface water run-off above the pre-development volumes must also be controlled on site.

Proposed Receptor of Site Runoff

6.4 The drainage hierarchy presented in the PPG states that the aim should be to discharge surface run off as high up the following hierarchy of drainage options as reasonably practicable:

- Store water for re-use;
- Discharge into the ground (infiltration);
- Discharge to a surface water body;
- Discharge to a surface water sewer, highway drain, or another drainage system;
- Discharge to a combined sewer.

6.5 Discharge options were investigated in the order of preference specified in the drainage hierarchy. Infiltration testing was undertaken by TerraFirma (South), as described in Section 2. The ground conditions recorded were found to be suitable for the use of infiltration as a means of surface water disposal.

Existing Greenfield Runoff Rates

6.6 Given that surface water runoff is likely to be managed using infiltration, it is not necessary to establish a greenfield runoff rate.

Proposed Surface Water Drainage Strategy

6.7 The surface water management strategy proposed for the site has been derived based upon the principles of sustainable drainage as detailed in the CIRIA SuDS Manual (2015) and the LLFA SuDS guide.

6.8 SuDS will be utilised to manage surface water runoff from the entire site. This will include a series of soakaways, swales and a storage basin, as shown on the Drainage Strategy, enclosed in Appendix E.

6.9 The concept of sustainable drainage is that environmental and social factors such as the quantity and quality of runoff and amenity value of surface water in the urban or developed environment are considered when making decisions about drainage. SuDS can be used to compliment or replace conventional piped urban drainage to recreate the natural water cycle.

6.10 This process can be used in certain locations to reduce the existing problems associated with such conventional piped systems, which can include the risk of flooding, the potential of pollution or poor water quality and damage to the natural environment.

Plot Drainage

6.11 The surface water drainage strategy for individual plots have been based on providing storage for up to and including the 1 in 100 year plus a 45% allowance climate change event, which is in accordance with national planning policy.

6.12 All roof surfaces and driveways will be discharged to a private soakaway in rear gardens. The largest plot size was measured, and a soakaway was sized accordingly. The key parameters are identified in Table 1. The Drainage Strategy, enclosed in Appendix E, illustrates how these have been positioned across the site. A 10% urban creep factor was adopted to estimate the future impermeable area. The infiltration rate used was the lowest rate recorded. As a second precautionary measure, infiltration was applied from the sides only.

Table 1: Soakaway Parameters

Impermeable Area (m^2)	Future Impermeable Area (m^2)	Infiltration Rate (m/hr)
245	270	0.03924

6.13 This identified that a soakaway 2.00 m x 5.00 m x 2.25 m is required for this purpose. The calculations are enclosed in Appendix F. The soakaways have been set at least 5 m away from roads and buildings.

Highway Drainage

6.14 The surface water drainage strategy for the highway has also been based on providing storage for up to and including the 1 in 100 year plus a 45% allowance climate change event.

6.15 The highway will be drained via a separate system, which uses swales, a storage basin, and a soakaway. The key parameters are identified in Table 2. No allowance was needed for the highway to account for urban creep. The infiltration rate used was the closest trial pit. As a precautionary measure, infiltration was applied from the sides only.

Table 2: Highway Drainage Parameters

Impermeable Area (ha)	Infiltration Rate (m/hr)
0.337	0.0774

6.16 A MicroDrainage network model (see Appendix F) has been constructed for the highway drainage using the values presented in Table 2. To provide some above ground SuDS and incorporate the wider benefits that they offer, swales and a storage basin have been used to supplement the soakaway. They will also provide some attenuation storage, while water seeps into the ground via the soakaway. The soakaway has been set at least 5 m away from roads and buildings. Further details are shown on the Drainage Strategy, enclosed in Appendix E

Swales

6.17 Swales are shallow vegetated open channels designed to convey, treat and in certain circumstances attenuate surface water runoff. They enhance the natural landscape and provide aesthetic and biodiversity benefits. The swales will be unlined to allow runoff from smaller storms to infiltrate and provide some localised interception of rainfall.

Conveyance of Exceedance Surface Water Flooding

6.18 The surface water drainage strategy must consider an exceedance scenario, i.e. for flows in excess of the 1 in 100 year plus climate change rainfall event. Exceedance flows must be managed in conveyance routes across a site that minimise the risk to people and property.

6.19 The design for exceedance will be addressed at a more detailed stage. However, in an exceedance scenario, roads would be designed to convey any exceedance flows away from people and property using appropriate kerbing for channelling. Exceedance flow routes will ultimately be directed into the swales or basins located across the site. Exceedance routes are displayed on the Drainage Strategy in Appendix E.

Water Quality

6.20 In accordance with the CIRIA SuDS Manual (2015), SuDS components must have a total pollution index that equals or exceeds the pollution hazard index for different land use classifications. It is considered that the SuDS provided as part of the surface water drainage strategy would offer sufficient mitigation for the land use classification as demonstrated in Table 3 and Table 4 (as informed by Table 26.2 and 26.3 of the CIRIA SuDS Manual (2015), respectively).

Table 3: Pollution Hazard Indices

Land Use	Pollution Hazard Indices for Different Land Use Classifications			
	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydro-carbons
Individual property driveways, residential car parks, low traffic roads and non-residential car parking with infrequent change	Low	0.5	0.4	0.4

Table 4: SuDS Mitigation Indices (for discharges to the ground)

Type of SuDS	Mitigation Indices		
	TSS	Metals	Hydro-carbons
Swales	0.50	0.60	0.60
Detention basin[1]	0.25	0.25	0.30
Total	0.75	0.85	0.90

Operation and Maintenance

SuDS

6.21 It is likely that SuDS will be privately maintained. Where privately maintained, the general maintenance requirements should be undertaken in accordance with the recommendations outlined in the CIRIA SuDS Manual (2015), as replicated in Figure 4 and 5.

Other Assets

6.22 Various other smaller assets of the surface water drainage strategy consist of gutters, down water pipes, manholes, pipes and drainage channels. These assets should be checked annually and after large storm events, in order to remove debris and inspect the condition.

- Jet washing may be required on occasion to remove any blockages within the pipe network. If the condition is found to be poor, replacement or repairs may be required.

1 As per the CIRIA SuDS Manual (2015), where the mitigation index of an individual component is insufficient, two components (or more) will be required. However, a factor of 0.5 is used to account for the secondary or tertiary components associated with the already reduced inflow concentrations. The infiltration basins will require a layer of dense vegetation underlain by a soil with good contamination attenuation potential of at least 300 mm depth to achieve the mitigation indices.

TABLE 17.1 Operation and maintenance requirements for swales		
Maintenance schedule	**Required action**	**Typical frequency**
Regular maintenance	Remove litter and debris	Monthly, or as required
	Cut grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for > 48 hours	Monthly, or when required
	Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly
Occasional maintenance	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required	As required or if bare soil is exposed over 10% or more of the swale treatment area
Remedial actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

Figure 4: Operation and Maintenance Requirements for Swales

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TABLE 22.1 Operation and maintenance requirements for detention basins

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly
	Cut grass – for spillways and access routes	Monthly (during growing season), or as required
	Cut grass – meadow grass in and around basin	Half yearly (spring – before nesting season, and autumn)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Monthly (for first year), then annually or as required
	Check any penstocks and other mechanical devices	Annually
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets, outlet and forebay	Annually (or as required)
	Manage wetland plants in outlet pool – where provided	Annually (as set out in Chapter 23)
Occasional maintenance	Reseed areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years, or as required
	Remove sediment from inlets, outlets, forebay and main basin when required	Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is provided)
Remedial actions	Repair erosion or other damage by reseeding or re-turfing	As required
	Realignment of rip-rap	As required
	Repair/rehabilitation of inlets, outlets and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required

Figure 5: Operation and Maintenance Requirements for Detention Basins

Summary

6.23 The surface water drainage strategy has been prepared to demonstrate that the proposed development of the site can meet national and local requirements for the management of surface water runoff. This will be achieved through the principles of SuDS but is subject to detailed design prior to construction.

6.24 The SuDS will offer wider benefits including biodiversity and recreational opportunities, as well as aesthetic improvements.

7 Foul Water Drainage Strategy

7.1 Foul water is to be treated on site using a package treatment plant. Treated foul effluent will subsequently drain into the ground using a soakaway. This has been led by others and further consideration is excluded from this report.

8 Conclusions

8.1 This Flood Risk Assessment (FRA) and Drainage Strategy has been prepared to support a full planning application for the development at land off Harvest Lane, Charlton Horethorne, Somerset.

8.2 This report has been prepared in accordance with the guidelines set out in the National Planning Policy Framework (Department for Communities and Local Government).

8.3 Flood risk is not considered to represent a significant development constraint and no flood mitigation is required.

8.4 The surface water drainage strategy has been designed to accommodate the 1 in 100 year rainfall event including a 45% climate change allowance. This will be achieved using Sustainable Drainage Systems (SuDS).

8.5 Foul water is to be treated on site using a package treatment plant and disposed into the ground using a soakaway.

8.6 The drainage strategy is subject to detailed design, which will be undertaken once planning permission has been granted.

Appendix A

Site Plans

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Harvest Lane

revision	drawn/check	date

title	Site Layout Plan
date	26.07.22
scale	1:500 @ A1
	JS/MG
drg	1742/005 rev *

Preliminary

Mill Farm Barns, Tuckers Lane, Baltonsborough, Glastonbury, BA6 8RH :: t 01458 445100 :: info@orme-architecture.com

Appendix B

Topographic Survey

Appendix C

Ground Investigation

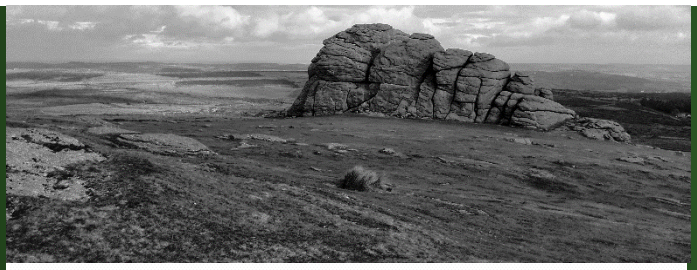
GROUND INVESTIGATION REPORT

Proposed Mixed Use Development
Land off Harvest Lane, Charlton Horethorne

Prepared for: Hopkins Estates Ltd

Date: August 2022

Report No: 6616/GIR



terrafirma(south)

Consulting Geo-Technical &
Geo-Environmental Engineers
Site Investigation Contractors

The Slate Barn, Lower Lowley, Dunsford, Devon, EX6 7BP
Tel: 01647 252414
Email: info@terrafirmasouth.co.uk
Web: www.terrafirmasouth.co.uk

REPORT TITLE : **Ground Investigation Report:**

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REPORT STATUS : **Final**

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DATE : **August 2022**

PREPARED BY :

Kevin Scanlon B.Eng.(Hons), M.Sc.

REVIEWED BY :

Paul Standish B.Sc.(Hons), FGS

APPROVED BY :

Steven Hill B.Sc.(Hons), M.Sc., CGeol, EurGeol, FGS

EXECUTIVE SUMMARY

Proposals	Hopkins Estates Ltd is proposing the construction of a mixed use development within Land off Harvest Lane, Charlton Horethorne. The proposed development will consist of mixed style residential dwellings, commercial buildings, soft landscaped areas and associated infrastructure.
Geology	The Geological Map of the area shows the site to be underlain by the Inferior Oolite Group, which typically comprise of varied succession of limestones, sandstone, limestone conglomerate, lime-mudstone and mudstone beds. No Superficial Deposits are shown to overlie the solid geology of the area.
Field Investigation	In order to confirm the underlying ground conditions at the site, field investigations comprising 5No. trial pits and in-situ infiltration tests were undertaken on the 10th of March 2020. The soil sequence beneath the proposed development typically comprised topsoil to a depth of between 0.20m and 0.30m underlain by Residual Soils comprising typically brownish orange sandy very clayey gravels and cobble to a depth of between 0.80m and 1.50m. Underlying the Residual Soils was the weathered bedrock of the Inferior Oolite Group typically comprising limestone recovered as cobbles and boulders to the maximum investigated depth of 1.70m.
Storm Drainage Recommendations	In three of the five localities (TP1, TP3 and TP4) three complete soakage tests were completed in accordance with BRE 365 revealing infiltration rates of between 1.28 x 10^{-04} m/s and 4.20 x 10^{-05} m/s. TP4 and TP5 completed two and one tests respectively revealing infiltration rates of between 2.15 x 10^{-05} m/s and 1.09 x 10^{-05} m/s. With additional time it is likely these localities could complete three complete fills in accordance with BRE365. Therefore, based on the above it is considered soakaways will be viable at the site for discharging surface waters. It should be noted proposed soakaways would only be effective above the level of groundwater. No groundwater was encountered during this investigation but higher groundwater may be encountered during winter months. Evidence from this investigation shows the underlying Inferior Oolite Formation is typically broken and fractured. The site topography is also shallow and so discharging of surface waters into the Inferior Oolite Formation is very unlikely to cause appearance of spring lines of discharged waters further down slopes. It is recommended to position any soakaways at least 5m from neighbouring property boundaries to further mitigate against this risk. The limestone beneath the site will be water soluble to some degree and as such there is potential for solution features to be present in this stratum. However, the natural and mining cavity assessment undertaken for the site determined that the risk of solution features being present at the site was Low. The proposed development is therefore unlikely to be impacted by solution features. However, it is recommended that a watching brief for cavity features is maintained during construction.

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Drawings

SECTION 1 Introduction and Proposed Development

Hopkins Estates Ltd is proposing the construction of a mixed-use development within Land off Harvest Lane, Charlton Horethorne. The proposed development will consist of mixed style residential dwellings, commercial buildings, soft landscaped areas and associated infrastructure.

Grass Roots Planning Ltd are the Planning Consultants for the proposed development.

Terra Firma (South) have been commissioned as Geo-technical and Geo-Environmental Engineers to carry out a Ground Investigation of the site.

The main objectives of the Ground Investigation were to:

- Establish the ground conditions of the site, including logging of the holes and undertaking of in-situ infiltration testing.

The Ground Investigation has been undertaken in accordance with the following advisory guidance:

- Code of Practice for Site Investigations - (BS 5930): 2015

In order to achieve the above objectives, Terra Firma (South) carried out an assessment programme including a review of existing data, followed by a field investigation to determine the prevailing ground conditions and undertake in-situ infiltration testing at selected locations around the site.

The scope of the works including the schedule for in-situ testing was determined by Vectos (South West).

1.1 Limitations and Exceptions of Investigation

Hopkins Estates Ltd has requested that a Ground Investigation Report (GIR) be performed in order to establish the ground conditions and undertake in-situ infiltration testing at the site.

The Ground Investigation was conducted and this report has been prepared for the sole internal reliance of Hopkins Estates Ltd and their design and construction team. This report shall not be relied upon or transferred to any other parties without the express written authorisation of Terra Firma (South). 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 report represents the findings and opinions of experienced geo-environmental and geo-technical consultants. Terra Firma (South) does not provide legal advice and the advice of lawyers may also be required.

The subsurface geological profiles and other plots are generalised by necessity and have been based on the information found at the locations of the exploratory holes and depths sampled and tested.

The ground investigation was limited by the following site constraints:

- The presence of overhead services and utilities, and
- The presence of time restraints outside of our reasonable control.

SECTION 2 Review of Existing Data

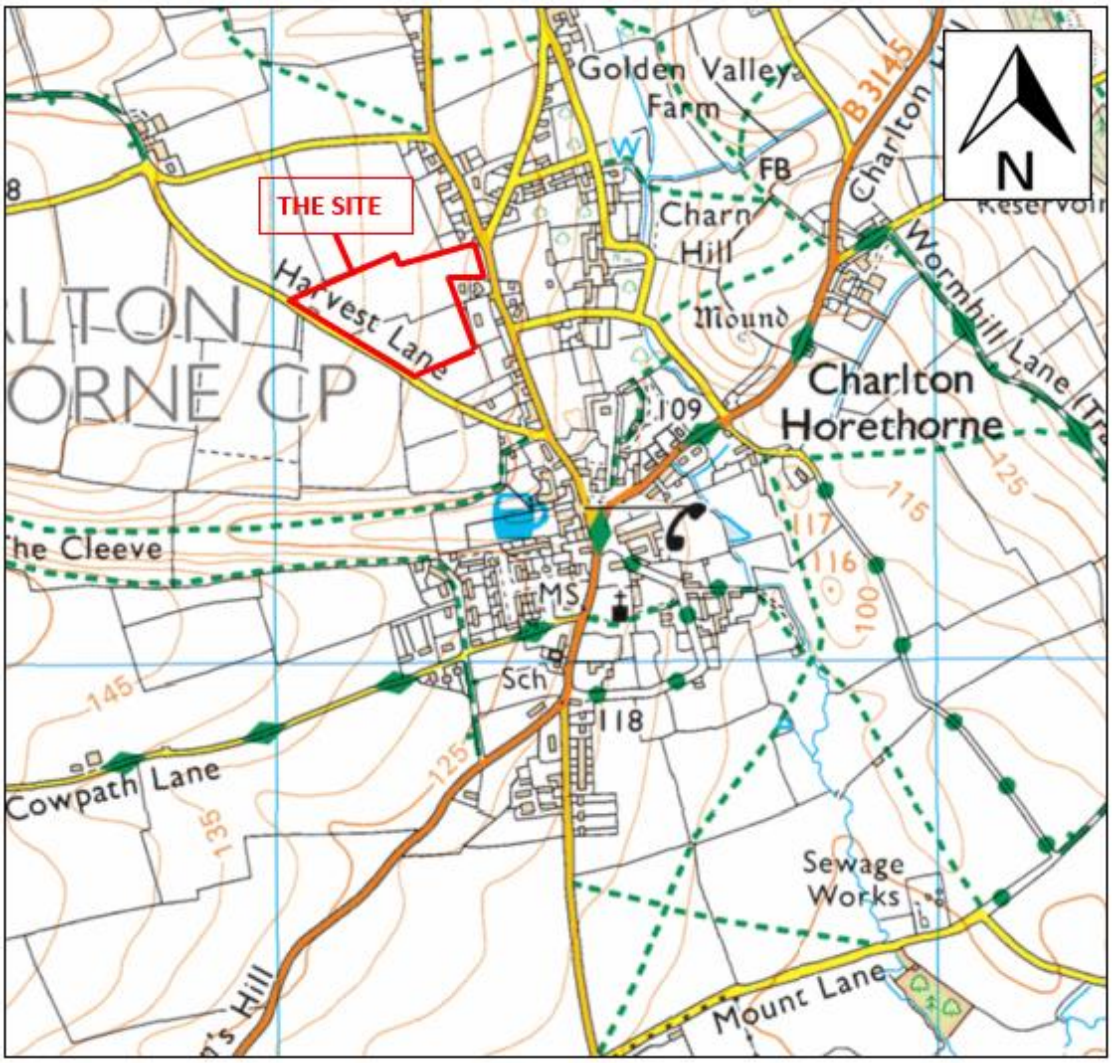
The following review has been undertaken using existing database information obtained from the following sources:

1. BGS OpenGeoscience
2. Groundsure Enviro Data Viewer
3. GroundSure GeoInsight Report, presented in **Annex A**

2.1 Physical Setting

The proposed development is to be located on Land off Harvest Lane, Charlton Horethorne, Dorset, DT9 4PQ.

The site is centred approximately on National Grid Reference (NGR) 366252, 123472. The site location is presented in **Drawing 2.1** below.



Drawing 2.1: Site Location Plan

The site is irregular in shape with a plan area of approximately 3.162 hectares and sits between approximately 128 and 142m above ordnance datum (aod).

The site and the surrounding area slopes gently to the east.

The site boundaries comprise the following:

- North – Mature hedgerows with agricultural land beyond
- East – Residential gardens of properties along North Road.
- South – Open field.
- West – Harvest Lane with agricultural fields beyond.

2.1.1 Current Use and Site Conditions

A walk-over survey was undertaken on the 10th of March 2020 by a Terra Firma (South) Engineer.

The site was accessed via a gate off North Road on the eastern boundary. The site comprised two open fields separated by a hedgerow. The only surface development present within the site comprised a dilapidated barn structure on the western boundary and overhead electricity cables that pass through the eastern section of the site. The site boundary was formed by hedgerows with occasional trees. The trees were up to 20 m in height.

2.2 Geological Setting

2.2.1 Geology

The 1:50, 000-scale Geological Map of the area shows the site to be underlain by the Inferior Oolite Group of Jurassic Age. The Inferior Oolite Group typically comprise of varied succession of bioclastic, peloidal, sandy, ferruginous, argillaceous, bioturbated limestones, with subordinate ooidal limestone, sandstone, limestone conglomerate, lime-mudstone and mudstone beds.

No Superficial Deposits are shown to overlie the solid geology of the area.

No Artificial and Made Ground Deposits are shown to overlie the Superficial / Bedrock geology of the area.

2.2.2 Near-by Boreholes

No boreholes are located close enough to the site to give pertinent information.

2.2.3 Natural Cavities

The Groundsure report states that there are no recorded natural cavities noted within 500m of the site:

2.2.4 Mining (Artificial) Cavities

The Groundsure Report states that the following recorded Mining Cavities (Artificial) area noted within the surrounding area:

Table 2.1: Mining Cavities (Artificial)

Cavity Type	Details	Location
Britpits	Gunvill Farm (Limestone Quarry)	41m NE
Surface Ground Workings	Unspecified Quarry	15-18m NE-E
	Unspecified Ground Workings	81m SE
	Water Body	228m E
	Pond	241m E

2.2.5 Ground Stability

Based upon BGS GeoSure data the risk from various ground stability hazards has been assessed below:

Table 2.2: Ground Stability Hazards

Potential Hazard	Maximum Hazard Rating
Landslides	**Very low Risk** – Slope instability problems are not likely to occur but consideration to potential problems of adjacent areas impacting on the site should always be considered.
Soluble Rocks	**Very low Risk** – Soluble rocks are present within the ground. Few dissolution features are likely to be present. Potential for difficult ground conditions or localised subsidence are at a level where they need not be considered.
Collapsible Rocks	**Very low Risk** – Deposits with potential to collapse when loaded and saturated are unlikely to be present.
Running Sand	**Negligible Risk** – Running sand conditions are not thought to occur whatever the position of the water table. No identified constraints on lands use due to running conditions.

2.3 Environmental Setting

2.3.1 Hydrology and Flooding

As mentioned in Section 2.1, the topography of the site and surrounding area slopes gently down to the east.

These waters will probably be collected by the nearest surface water feature, indicated as an inland river, located approximately 230 m to the east of the site.

Environment Agency records show the site to lie within a Flood Zone 1 for nearby surface water bodies.

Environment Agency records show that the site lies in a Zone 1 Floodplain. A Zone 1 Floodplain is land assessed as having less than a 0.1 per cent (1 in 1000) chance of flooding occurring each year.

The Environmental Agency (EA) Risk of Flooding from Rivers and the Sea (RoFRas) data indicates the site is in an area with a very low chance of flooding in any given year.

There are no flood defences, areas benefiting from flood defences or flood storage areas within 250m of the site.

2.3.2 Source Protection Zones

Source Protection Zones (SPZs) have been defined for a number of groundwater sources such as wells, boreholes and springs which are used for public drinking water supply. These zones show the risk of contamination from any activities that might cause pollution in the area, the closer the activity, the greater the risk. SPZs are typically defined as three main zones (inner, outer and total catchment).

The site does not lie within 1km of a Source Protection Zone (SPZ) or a zone of special interest resulting in no restrictions by the EA on activities that may pollute water supplies.

2.3.3 Anticipated Soil Chemistry

A Phase 1 Contaminated Land & Geo-technical Risk Assessment was undertaken by Terra Firma (South) in March 2020 (Report number 6616/DS) and should be read in conjunction with this report.

The preliminary human health and environmental risk assessment has revealed that due to the sites and surrounding areas current and past land uses that a **Low** risk is present from contamination present beneath the site.

SECTION 3 Preliminary Ground Instability Risk Assessment

3.1 Natural Cavity Occurrence Assessment

Karstic or solution features are typically associated with soluble rocks such as chalk and limestone.

The formation of natural cavities within the Inferior Oolite Group will be dictated by geological, hydrogeological and geomorphological factors. A paper produced by C. Edmonds et al titled "Subsidence Hazard Prediction for Limestone Terrains as applied to the English Cretaceous chalk" presents a methodology on how to assess the potential for cavities to be present based upon these factors.

Geological Factors

The geological factors considered by the methodology are the relative proportions of metastable solution features within the soluble stratum and whether the stratum is overlain by post Cretaceous deposits.

The Inferior Oolite Group will be water soluble to some degree, but the absence of any known solution features in this stratum indicates that the proportions of metastable solution features are low. Geological mapping together with ground conditions encountered by the ground investigation show that the Inferior Oolite Group is not overlain by post Cretaceous deposits.

The relative level of limestone is of significant as it will determine the hazard for natural and mining cavities to have formed.

Hydrogeological Factors

As cavities are formed by water dissolution, hydrogeological conditions will have a significant influence on the likelihood of cavities being formed. The methodology provides various groundwater and topographic scenarios to model this, with conditions allowing concentrated discharges of water into unsaturated ground having the greatest impact.

Groundwater is unlikely to be encountered in the upper Inferior Oolite Group and as such is likely to be largely unsaturated.

The topography of the site is typically sloping gently down to the east. Therefore, the inferred direction of surface and groundwater flow is likely to be in this direction, following the natural topography of the area.

These waters will probably be collected by the nearest surface water feature, indicated as an inland river, located approximately 230 m to the east of the site.

As mentioned in Section 2.2.1, no Quaternary Deposits are present across the site.

Geomorphological Factors

Limestone regions with geomorphologies formed during glacial and periglacial periods are more likely to contain solution features. This is because groundwater was lower during these periods so when water was released during cyclic thawing of the ice, it could percolate freely through the ground creating cavities. Where the limestone was capped by impermeable glacial deposits there would also be potential for zones of intense dissolution due to concentrated discharge of waters where the impermeable cover tapers.

The regional geology has not been directly subjected to glacial conditions and the absence of Quaternary Deposits indicate that periglacial activities are unlikely to have occurred.

The above site specific geological, hydrogeological and geomorphological factors have been incorporated into the model proposed by C Edmonds to assess the potential for cavities to be present. This basic assessment has determined that the potential for the site to be impacted by natural cavity related subsidence is **Very Low**.

3.2 Mining (Artificial) Cavity Occurrence Assessment

Historic mining has taken place across many localities for many different purposes.

Based on historical data and taking into account the geological, hydrogeological and geomorphological conditions it is considered that mining related risk is **Low**.

3.3 Ground Stability Hazard Assessment

The ground stability hazard assessment has revealed that a **Very Low** Risk is present.

SECTION 4 Field Investigation

4.1 General

The site works were scoped by Vectos (South West) and comprised the following:

- 5No. machine excavated trial pits (TP1-TP5), and
- 5No. in-situ soakaway tests (SA1-SA5).

The site works were carried out at the site on the 10th of March 2020.

Prior to the site works, the following Health and Safety measures were undertaken:

- Risk Assessment & Method Statement (RAMS) was issued and approved beforehand,
- Underground Utility Plans were obtained from the relevant Statutory Undertakers, and
- Before any excavation, all exploratory hole locations were scanned using a Cable Avoidance Tool (CAT).

The exploratory holes were set out at locations provided by Vectos (South West) and adjusted where necessary to take account of the site constraints detailed in Section 1.1.

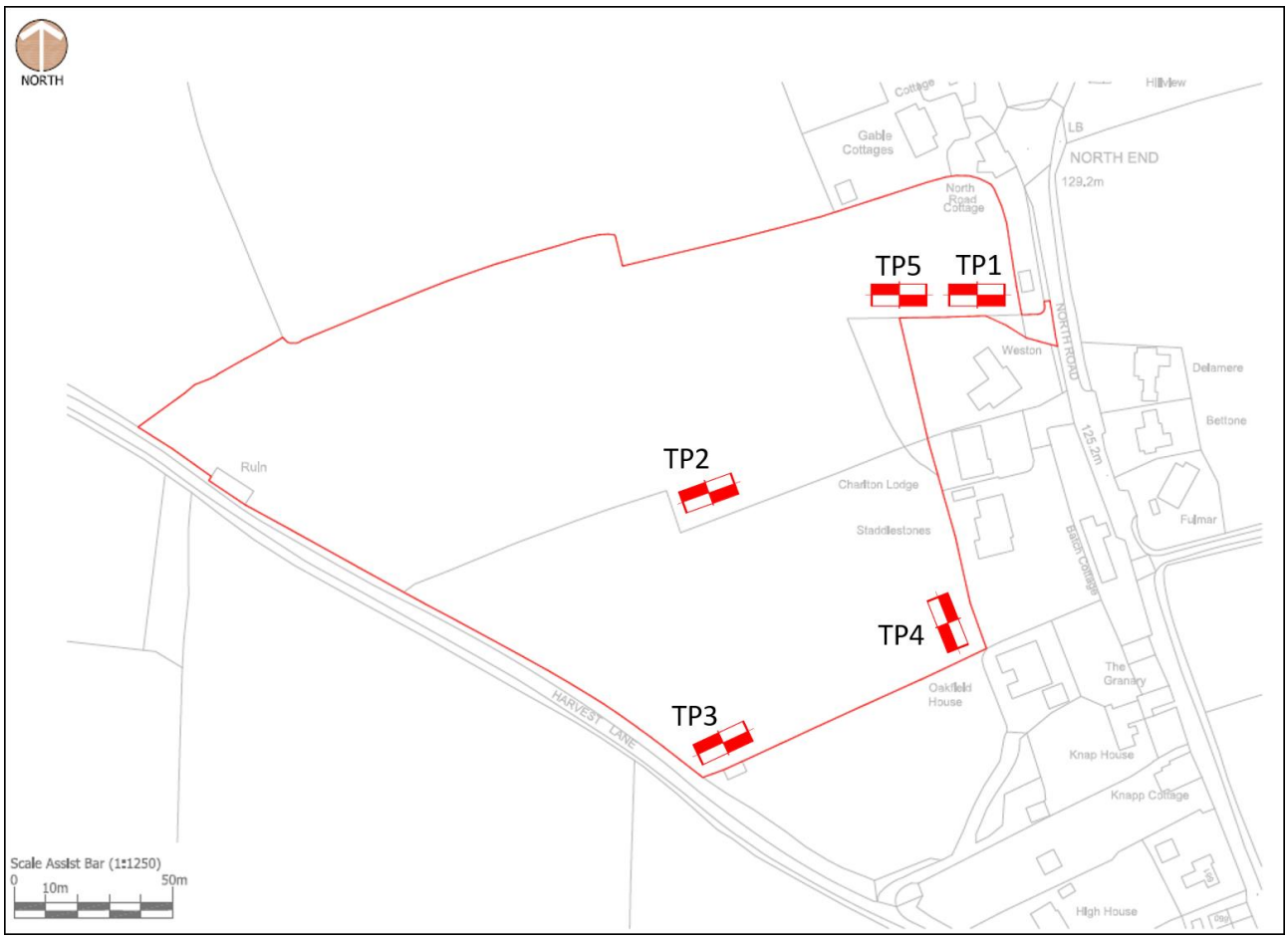
Approximate exploratory hole co-ordinates and levels were picked up post-investigation using a hand held Global Positioning System (GPS) receiver and presented in the table below:

Table 4.1: Exploratory Hole Co-ordinates

Exploratory Hole	Easting	Northing
TP1	366312	123600
TP2	366216	123536
TP3	366214	123447
TP4	366298	123478
TP5	366290	123598

The site works were supervised by Terra Firma (South), who also logged the exploratory holes to the requirements of BS5930:2015.

The exploratory hole logs and in-situ test results are presented in **Annex B** and **Annex C** respectively, and their locations shown on **Drawing 3.1** below.



Drawing 4.1: Exploratory Hole Location Plan

4.2 Exploratory Holes

4.2.1 Machine Excavated Trial Pits

The trial pits were excavated using a JCB 3CX wheeled excavator.

Following completion of soil logging, in-situ testing and sampling, the trial pits were backfilled using arisings and re-compacted as best as practicably possible using the excavator backhoe. If necessary, the trial pit was left slightly proud in order to allow for short-term settlement.

4.3 In-situ Testing

4.3.1 Permeability Testing

The in-situ permeability tests were undertaken within the excavated trial pits in order to provide a soil infiltration rate to be used in soakaway design. A 2000-gallon tractor-towed bowser was used to rapidly fill the pit with water.

During the site investigation, in-situ permeability tests were undertaken within all exploratory locations and where possible were carried out to the requirements of BRE Digest 365.

The appropriate calculation sheets are presented in **Annex C** and the results given in the table below.

Table 4.2: Infiltration Test Results				
Soak away Test	**Depth (m)**	**Type**	**Soil Type**	**Infiltration Rate (m/s)**
TP1 – First Fill	1.60	Storm Drainage	Residual Soils / Bedrock	1.07×10^{-04}
TP1 – Second Fill	1.60		Residual Soils / Bedrock	1.18×10^{-04}
TP1 – Third Fill	**1.60**		Residual Soils / Bedrock	**1.28×10^{-04}**
TP2 – First Fill	1.10		Residual Soils / Bedrock	1.09×10^{-05}
TP3 – First Fill	1.10		Residual Soils / Bedrock	4.62×10^{-05}
TP3 – Second Fill	1.10		Residual Soils / Bedrock	4.39×10^{-05}
TP3 – Third Fill	**1.10**		Residual Soils / Bedrock	**4.20×10^{-05}**
TP4 – First Fill	0.95		Residual Soils / Bedrock	5.63×10^{-05}
TP4 – Second Fill	0.95		Residual Soils / Bedrock	5.58×10^{-05}
TP4 – Third Fill	**0.95**		Residual Soils / Bedrock	**5.49×10^{-05}**
TP5 – First Fill	1.45		Residual Soils / Bedrock	2.15×10^{-05}

SECTION 5 Ground Conditions

5.1 Summary

The ground conditions encountered by the exploratory holes were variable across the site and but can in general be summarised as shown in the following table:

Table 5.1: Summary of Ground Conditions

Depth (mbgl)		Thickness (m)		Stratum	
From	To	Min	Max		
0.00	0.20 / 0.30	0.20	0.30	Grass over soft brown becoming orangish brown slightly gravelly sandy SILT with rootlets	*Topsoil*
0.20 / 0.30	0.80 / 1.50	0.50	1.30	Typically, brownish orange sandy very clayey GRAVEL with high cobble content. Locally overlain by firm slightly gravelly slightly sandy silty CLAY	*Residual Soils*
0.80 / 1.50	>1.70	Unproven		LIMESTONE recovered as grey slightly gravelly slightly sandy slightly clayey COBBLES and BOULDERS	*Solid Bedrock (Inferior Oolite Group)*

Within trial pits, the estimated strength of granular deposits was determined from visual assessment only (ease/difficulty of excavation and pit stability).

5.2 Stability

The sides of the excavations were typically found to be stable.

5.3 Strata Details

5.3.1 Topsoil

The Topsoil layer was encountered within all exploratory holes and comprised grass over brown slightly gravelly sandy SILT with numerous rootlets. The Topsoil was of limited thickness extending to depths of between 0.20 and 0.30m bgl.

No evidence of surface contamination was noted within the Topsoil material

5.3.2 Residual Soils

The Residual Soils were encountered within all exploratory holes and comprised an orange brown sandy very clayey GRAVEL of limestone. This gravel stratum became more cobbly with depth.

A layer of firm slightly gravelly slightly sandy silty CLAY was locally encountered above the gravel is TP1 and TP2 only.

5.3.3 Bedrock Geology

The Bedrock Geology was encountered within all exploratory holes and comprised limestone of the Inferior Oolite Formation. This formation was recovered as grey COBBLES and BOULDERS with variable concentrations of clay sand and gravel.

5.4 Water Strikes

During site works, no groundwater was encountered within any of the exploratory holes.

SECTION 6 Engineering Recommendations

6.1 Storm Drainage Potential

Five in-situ soakaway tests were undertaken at TP1 – TP5 broadly in accordance with the requirements of BRE 365.

In three of the five localities (TP1, TP3 and TP4) three complete soakage tests were completed in accordance with BRE 365.

TP4 and TP5 completed two and one tests respectively and with additional time it is likely these localities could complete three complete fills in accordance with BRE365.

Therefore, based on the above it is considered soakaways will be viable at the site for discharging surface waters.

During drainage design, consideration should be given to the variability encountered across the site.

6.2 Drainage Hazards

6.2.1 Groundwater

It should be noted proposed soakaways would only be effective above the level of groundwater. No groundwater was encountered during this investigation but higher groundwater may be encountered during winter months.

6.2.2 Flooding

Soakaways should normally not be constructed in areas at risk of any type of flooding – river, surface water, groundwater, sewer, reservoirs or canals. If this is not possible, the storage calculations should account for the additional storage required to contain existing flooding.

6.2.3 Cavities

The limestone beneath the site will be water soluble to some degree and as such there is potential for solution features to be present in this stratum. However, the natural and mining cavity assessment undertaken for the site determined that the risk of solution features being present at the site was Low.

The proposed development is therefore unlikely to be impacted by solution features. However, it is recommended that a watching brief for cavity features is maintained during construction.

6.2.4 Easements

Due to the likely absence of cavity features, any planned soakaways should be at least 5m away from building foundations or roads in accordance with recommendations within CIRIA C574.

6.2.5 Re-emergence

Evidence from this investigation shows the underlying Inferior Oolite Formation is typically broken and fractured.

The site topography is also shallow and so discharging of surface waters into the Inferior Oolite Formation is very unlikely to cause appearance of spring lines of discharged waters further down slopes. It is recommended to position any soakaways at least 5m from neighbouring property boundaries to further mitigate against this risk.

6.2.6 Contamination

Drainage through Made Ground deposits risks mobilising potential contaminants further downstream. Although no obvious signs of contamination were noted it would be prudent if soakaways are proposed within these deposits to undertake chemical testing to confirm the absence.

Annex A: GIS Data

Annex B: Exploratory Hole Logs

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Site Investigation Contractors

The Slate Barn, Lower Lowley,
Dunsford, Exeter, EX6 7BP
01647 252414
www.terrafirmasouth.co.uk

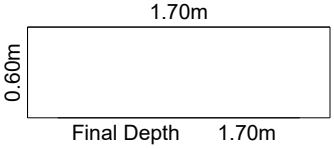
Borehole No.
TP1
Sheet 1 of 1

Project Name	**Project No.**	**Date**	**Hole Type**
Harvest Lane, Charlton Horethorne	6616	10/03/2020 to 10/03/2020	TP
Client	**Co-ords**	**Water Strike Details**	**Logged By**
Hopkins Estates Ltd	E: 366312.00	Depth Strike / Remarks	KS
Contractor / **Plant Used**	N: 123600.00		**Approved By**
Hopkins Estate Limited / JCB 3CX	L:		KS
			Scale 1:50

Samples and Results			Depth, (Thickness)	Level	Stratum Description	Legend
Results	Type	Depth				
			(0.20) 0.20		TOPSOIL: Grass over firm orangish brown slightly gravelly sandy SILT. Sand is fine and medium. Gravel is subrounded fine to coarse limestone.	
			(0.30) 0.50		Firm orange slightly sandy slightly gravelly silty CLAY. Gravel is subrounded fine to coarse limestone.	
			(0.50) 1.00		(Medium dense?) orange slightly sandy clayey subangular and subrounded medium and coarse limestone GRAVEL with medium cobble content.	
			(0.50) 1.50		Orange slightly clayey slightly sandy gravelly COBBLES and BOULDERS of limestone.	
			(0.20) 1.70		Grey LIMESTONE. Recovered as slightly clayey slightly sandy gravelly COBBLES and BOULDERS.	
					End of Trial Pit at 1.70m	

Trial Pit Photographs

Remarks
Pit terminated due to refusal on possible bedrock. Large scale soakaway carried out within excavation and pit backfilled once completed.



Pit Stability: Stable

Notes: For all symbols and abbreviations please see key sheet. All depths and measurements in metres. Stratum thicknesses given in brackets.

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Borehole No.
TP2
Sheet 1 of 1

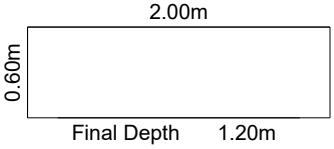
Project Name	Project No.	Date	Hole Type
Harvest Lane, Charlton Horethorne	6616	10/03/2020 to 10/03/2020	TP

Client	Co-ords	Water Strike Details		Logged By
Hopkins Estates Ltd	E: 366216.00	Depth Strike	Remarks	KS
Contractor / Hopkins Estate Limited	**Plant Used** / JCB 3CX	N: 123536.00 L:		**Approved By** KS
				Scale 1:50

Samples and Results			Depth, (Thickness)	Level	Stratum Description	Legend
Results	Type	Depth				
			(0.20) 0.20		TOPSOIL: Grass over firm orangish brown slightly gravelly sandy SILT. Sand is fine and medium. Gravel is subrounded fine to coarse limestone.	
			(0.20) 0.40		Firm brownish orange slightly sandy slightly gravelly to gravelly silty CLAY. Gravel is subrounded fine to coarse limestone.	
			(0.40) 0.80		(Medium dense?) orange sandy clayey subangular and subrounded fine to coarse limestone GRAVEL with high cobble and low boulder (<0.35 x 0.35 x 0.04m) content.	
			(0.30) 1.10		Orange slightly clayey slightly sandy gravelly COBBLES and BOULDERS (<0.35 x 0.5 x 0.04m) of limestone.	
			(0.10) 1.20		Grey LIMESTONE. Recovered as slightly clayey slightly sandy gravelly COBBLES and BOULDERS (<0.30 x 0.15 x 0.05m).	
					End of Trial Pit at 1.20m	

Trial Pit Photographs

Remarks
Pit terminated due to refusal on possible bedrock. Large scale soakaway carried out within excavation and pit backfilled once completed.



Pit Stability: Stable

Notes: For all symbols and abbreviations please see key sheet. All depths and measurements in metres. Stratum thicknesses given in brackets.

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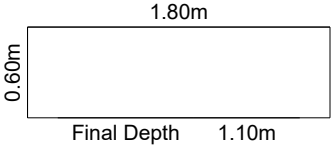
Borehole No.
TP3
Sheet 1 of 1

Project Name	**Project No.**	**Date**	**Hole Type**
Harvest Lane, Charlton Horethorne	6616	10/03/2020 to 10/03/2020	TP
Client	**Co-ords**	**Water Strike Details**	**Logged By**
Hopkins Estates Ltd	E: 366214.00	Depth Strike / Remarks	KS
Contractor / **Plant Used**	N: 123447.00		**Approved By**
Hopkins Estate Limited / JCB 3CX	L:		KS
			Scale 1:50

Samples and Results			Depth, (Thickness)	Level	Stratum Description	Legend
Results	Type	Depth				
			(0.25)		TOPSOIL: Grass over soft brown slightly gravelly sandy SILT with rootlets. Grass is subangular and subrounded fine to coarse limestone.	
			0.25			
			(0.15)		Orange sandy very clayey subangular and subrounded fine to coarse limestone GRAVEL with high cobble content.	
			0.40		Orange slightly clayey slightly sandy gravelly COBBLES and BOULDERS (<0.35 x 0.25 x 0.05) of limestone.	
			(0.50)		*0.70 to 0.90m - reducing clay content*	
			0.90			
			1 (0.20)		Grey LIMESTONE. Recovered as slightly clayey slightly sandy gravelly COBBLES and BOULDERS (<0.30 x 0.15 x 0.05m).	
			1.10		End of Trial Pit at 1.10m	
			2			
			3			
			4			

Trial Pit Photographs

Remarks
Pit terminated due to refusal on possible bedrock. Large scale soakaway carried out within excavation and pit backfilled once completed.



Pit Stability: Stable

Notes: For all symbols and abbreviations please see key sheet. All depths and measurements in metres. Stratum thicknesses given in brackets.

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Borehole No.
TP4
Sheet 1 of 1

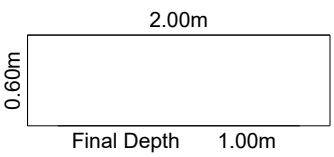
Project Name	**Project No.**	**Date**	**Hole Type**
Harvest Lane, Charlton Horethorne	6616	10/03/2020 to 10/03/2020	TP
Client	**Co-ords**	**Water Strike Details**	**Logged By**
Hopkins Estates Ltd	E: 366298.00	Depth Strike / Remarks	KS
Contractor / **Plant Used**	N: 123478.00		**Approved By**
Hopkins Estate Limited / JCB 3CX	L:		KS
			Scale 1:50

Samples and Results			Depth, (Thickness)	Level	Stratum Description	Legend
Results	Type	Depth				
			(0.30)		TOPSOIL: Grass over soft brown becoming orangish brown slightly gravelly sandy SILT with rootlets and roots (<0.5cm). Gravel is subangular and subrounded fine to coarse limestone.	
			0.30			
			(0.20)		Orange sandy very clayey subangular and subrounded fine to coarse limestone GRAVEL with high cobble content.	
			0.50			
			(0.30)		Orange slightly clayey slightly sandy very gravelly limestone COBBLES.	
			0.80			
			(0.20)		Grey LIMESTONE. Recovered as slightly clayey slightly sandy gravelly COBBLES and BOULDERS (<0.30 x 0.20 x 0.05m).	
			1.00		End of Trial Pit at 1.00m	

Trial Pit Photographs

Remarks
Pit terminated due to refusal on possible bedrock. Large scale soakaway carried out within excavation and pit backfilled once completed.

Pit Stability: Stable



Notes: For all symbols and abbreviations please see key sheet. All depths and measurements in metres. Stratum thicknesses given in brackets.

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Borehole No.

TP5

Sheet 1 of 1

Project Name	Project No.	Date	Hole Type
Harvest Lane, Charlton Horethorne	6616	10/03/2020 to 10/03/2020	TP

Client	Co-ords	Water Strike Details		Logged By
Hopkins Estates Ltd	E: 366290.00	Depth Strike	Remarks	KS

Contractor	Plant Used			Approved By
Hopkins Estate Limited	JCB 3CX	N: 123598.00 L:		KS

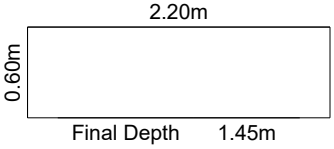
Scale 1:50

Samples and Results			Depth, (Thickness)	Level	Stratum Description	Legend
Results	Type	Depth				
			(0.25)		TOPSOIL: Grass over soft brown becoming orangish brown slightly gravelly sandy SILT with rootlets. Gravel is subangular and subrounded fine to coarse limestone.	
			0.25			
			(0.25)		Brownish orange sandy very clayey subangular and subrounded fine to coarse limestone GRAVEL with medium cobble content.	
			0.50			
			(0.40)		Orange slightly sandy clayey very gravelly limestone COBBLES.	
			0.90			
			1 (0.30)		Orange slightly sandy very gravelly COBBLES and BOULDERS of limestone.	
			1.20			
			(0.25)		Grey LIMESTONE. Recovered as slightly clayey slightly sandy gravelly COBBLES and BOULDERS (<0.30 x 0.25 x 0.03m) of limestone.	
			1.45		End of Trial Pit at 1.45m	
			2			
			3			
			4			

Trial Pit Photographs

Remarks

Pit terminated due to refusal on possible bedrock. Large scale soakaway carried out within excavation and pit backfilled once completed.



Pit Stability: Stable

Notes: For all symbols and abbreviations please see key sheet. All depths and measurements in metres. Stratum thicknesses given in brackets.

Annex C: In-situ Test Results

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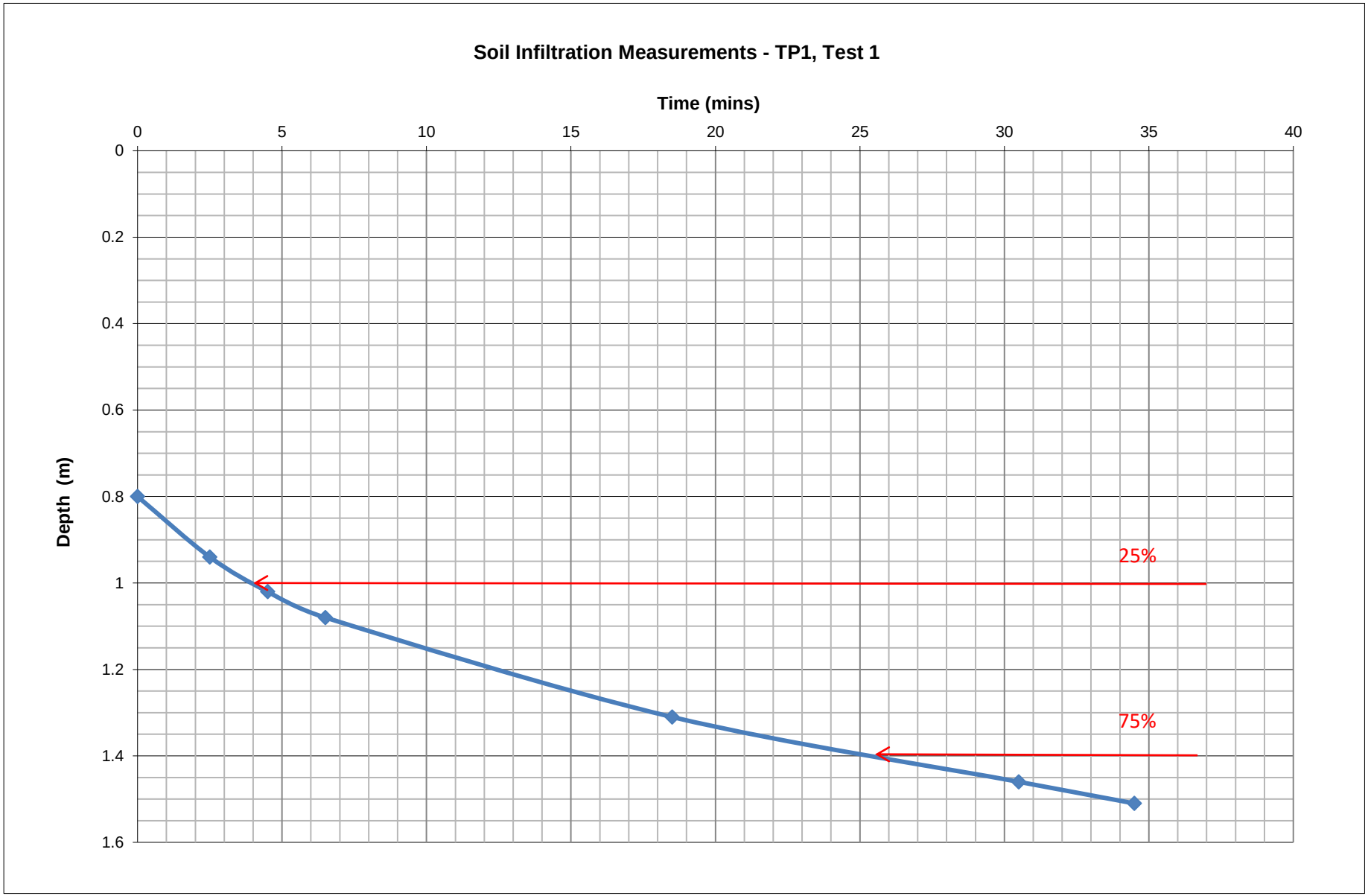
Site Name:	Harvest Lane, Charlton	**Job No.:** 6616	**Date Undertaken**: 10/03/2020
Trial Pit No.:	TP1	**Test No.**: 1	

	Depth to Water (m)	Time (Mins)
(Top of test / effective depth - 100%)	0.8	0
	0.94	2.5
	1.02	4.5
	1.08	6.5
	1.31	18.5
	1.46	30.5
	1.51	34.5
(Base of pit / effective depth - 0%)	1.600	

Length of Trial Pit (m)	1.4
Width of Trial Pit (m)	0.6
Depth of Trial Pit (m)	1.6
Effective Storage Depth (m)	0.800
Vp25	1.0000
Vp75	1.4000
Vp75-25	0.336
50% effective depth (m)	0.400
Mean Surface area ap50 (m2)	2.440
Time for 25% **Outflow** (t_{p25})	4
Time for 75% **Outflow** (t_{p75})	25.5
tp75 - 25	21.5
Soil Infiltration Rate (m/s)	**1.07E-04**

Soil Infiltration Worksheet: This worksheet has been produced in combination with the document 'BRE Digest 365- September 1991'. This worksheet can be used to determine soil infiltration rates from trial pit field measurements. Worksheet options are identified by a green background


Soil Infiltration Measurements - TP1, Test 1
Time (mins)
0
5
10
15
20
25
30
35
40
Depth (m)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
25%
75%

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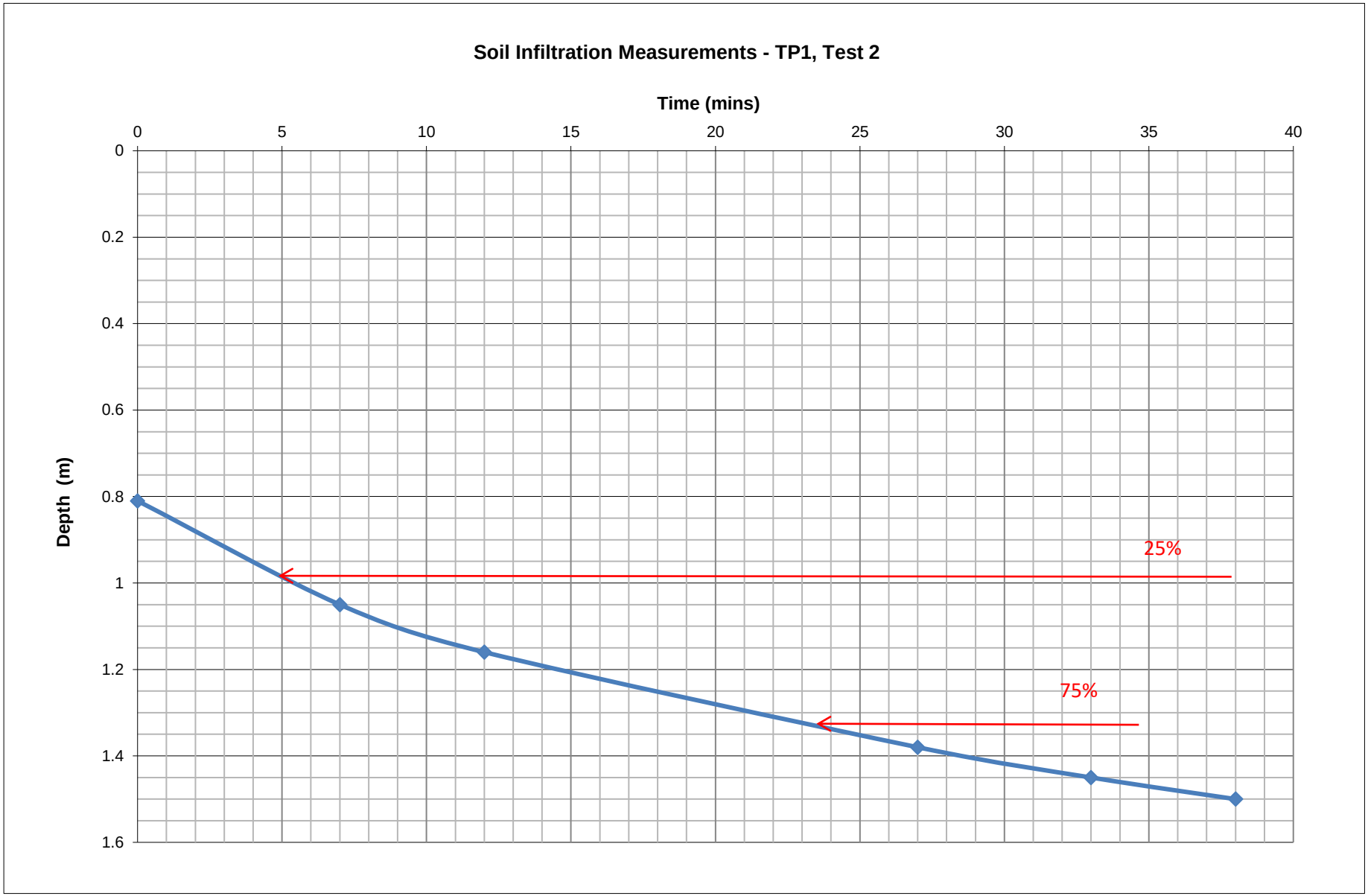
Site Name:	Harvest Lane, Charlton	**Job No.:** 6616	**Date Undertaken**: 10/03/2020
Trial Pit No.:	TP1	**Test No.**: 2	

	Depth to Water (m)	Time (Mins)
(Top of test / effective depth - 100%)	0.81	0
	1.05	7
	1.16	12
	1.38	27
	1.45	33
	1.5	38
(Base of pit / effective depth - 0%)	1.500	

Length of Trial Pit (m)	1.4
Width of Trial Pit (m)	0.6
Depth of Trial Pit (m)	1.5
Effective Storage Depth (m)	0.690
Vp25	0.9825
Vp75	1.3275
Vp75-25	0.290
50% effective depth (m)	0.345
Mean Surface area ap50 (m2)	2.220
Time for 25% **Outflow** (t_{p25})	5
Time for 75% **Outflow** (t_{p75})	23.5
tp75 - 25	18.5
Soil Infiltration Rate (m/s)	**1.18E-04**

Soil Infiltration Worksheet: This worksheet has been produced in combination with the document 'BRE Digest 365- September 1991'. This worksheet can be used to determine soil infiltration rates from trial pit field measurements. Worksheet options are identified by a green background


Soil Infiltration Measurements - TP1, Test 2
Time (mins)
0
5
10
15
20
25
30
35
40
Depth (m)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
25%
75%

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Site Name:	Harvest Lane, Charlton	**Job No.:** 6616	**Date Undertaken**: 10/03/2020
Trial Pit No.:	TP1	**Test No.**: 3	

	Depth to Water (m)	Time (Mins)
(Top of test / effective depth - 100%)	0.81	0
	1.25	19
	1.35	26
	1.42	32
	1.48	37
(Base of pit / effective depth - 0%)	1.500	

Length of Trial Pit (m)	1.4
Width of Trial Pit (m)	0.6
Depth of Trial Pit (m)	1.5
Effective Storage Depth (m)	0.690
Vp25	0.9825
Vp75	1.3275
Vp75-25	0.290
50% effective depth (m)	0.345
Mean Surface area ap50 (m2)	2.220
Time for 25% **Outflow** (t_{p25})	7.5
Time for 75% **Outflow** (t_{p75})	24.5
tp75 - 25	17
Soil Infiltration Rate (m/s)	**1.28E-04**

Soil Infiltration Worksheet: This worksheet has been produced in combination with the document 'BRE Digest 365- September 1991'. This worksheet can be used to determine soil infiltration rates from trial pit field measurements. Worksheet options are identified by a green background


Soil Infiltration Measurements - TP1, Test 3
Time (mins)
0
5
10
15
20
25
30
35
40
Depth (m)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
25%
75%

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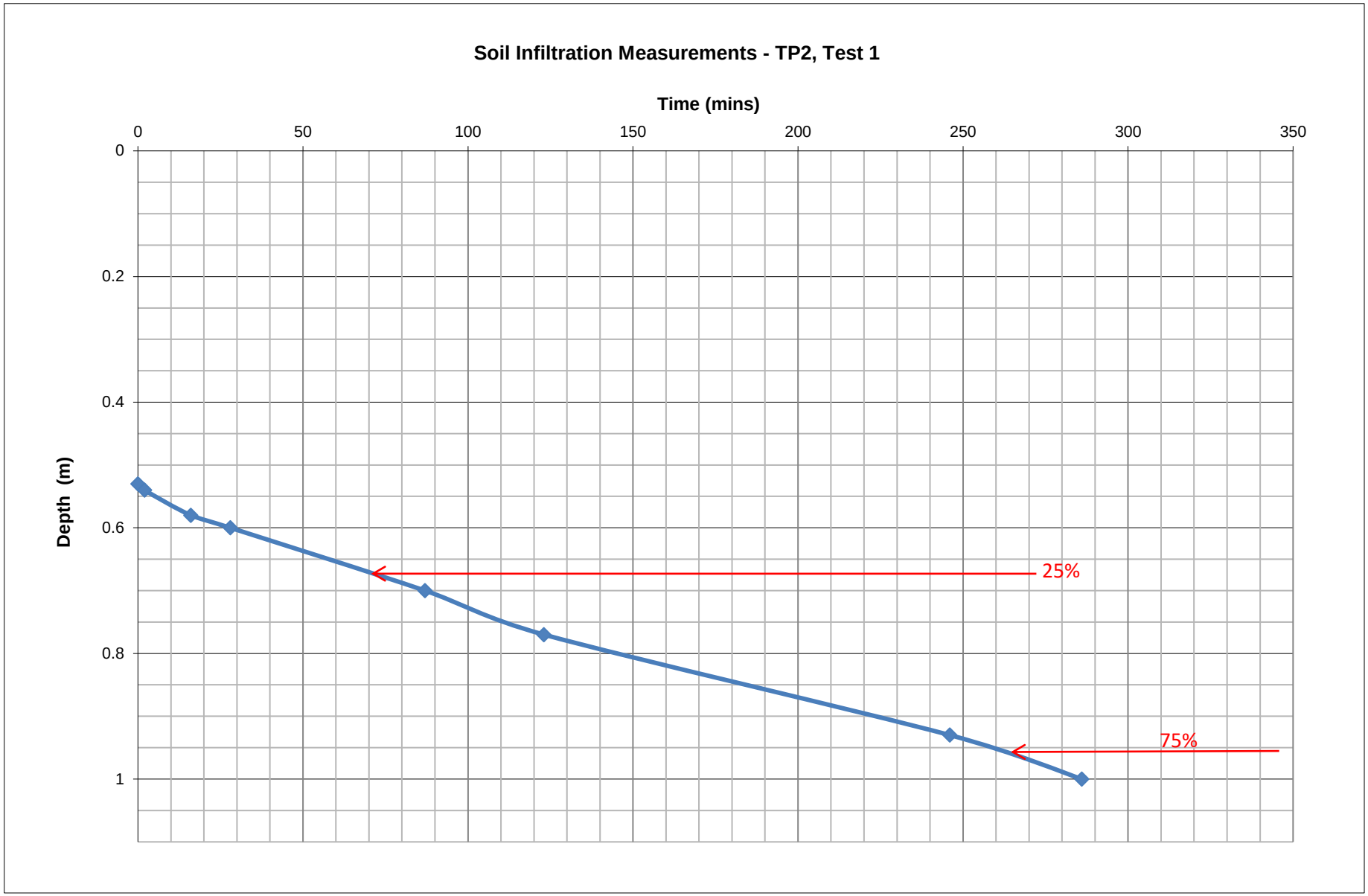
Site Name:	Harvest Lane, Charlton	**Job No.:** 6616	**Date Undertaken**: 10/03/2020
Trial Pit No.:	TP2	**Test No.**: 1	

	Depth to Water (m)	Time (Mins)
(Top of test / effective depth - 100%)	0.53	0
	0.54	2
	0.58	16
	0.6	28
	0.7	87
	0.77	123
	0.93	246
	1	286
(Base of pit / effective depth - 0%)	1.100	

Length of Trial Pit (m)	2
Width of Trial Pit (m)	0.6
Depth of Trial Pit (m)	1.1
Effective Storage Depth (m)	0.570
Vp25	0.6725
Vp75	0.9575
Vp75-25	0.342
50% effective depth (m)	0.285
Mean Surface area ap50 (m2)	2.682
Time for 25% **Outflow** (t_{p25})	70
Time for 75% **Outflow** (t_{p75})	265
tp75 - 25	195
Soil Infiltration Rate (m/s)	**1.09E-05**

Soil Infiltration Worksheet: This worksheet has been produced in combination with the document 'BRE Digest 365- September 1991'. This worksheet can be used to determine soil infiltration rates from trial pit field measurements. Worksheet options are identified by a green background


Soil Infiltration Measurements - TP2, Test 1
Time (mins)
0
50
100
150
200
250
300
350
Depth (m)
0
0.2
0.4
0.6
0.8
1
25%
75%

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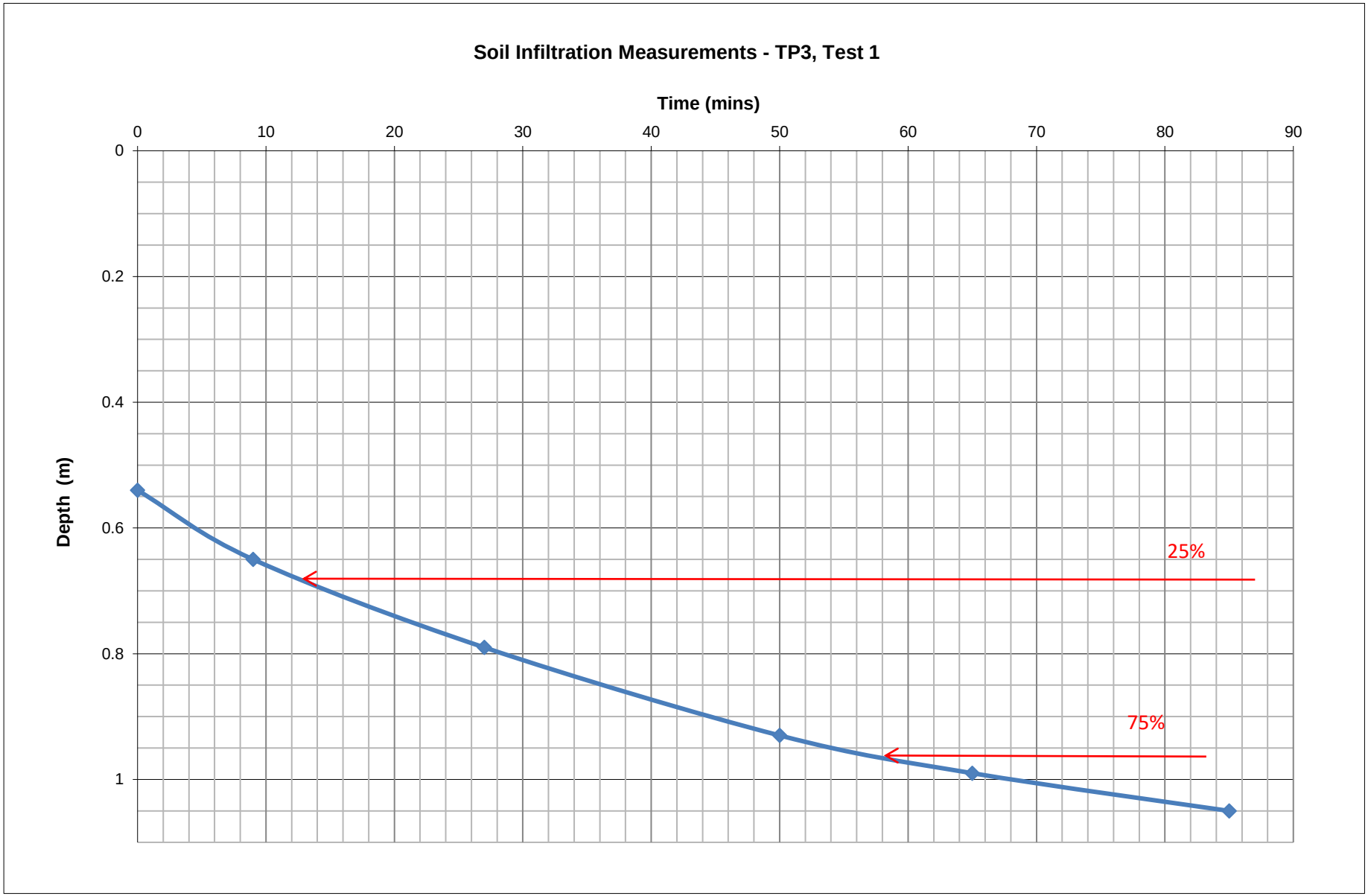
Site Name:	Harvest Lane, Charlton	**Job No.:** 6616	**Date Undertaken**: 10/03/2020
Trial Pit No.:	TP3	**Test No.**: 1	

	Depth to Water (m)	Time (Mins)
(Top of test / effective depth - 100%)	0.54	0
	0.65	9
	0.79	27
	0.93	50
	0.99	65
	1.05	85
(Base of pit / effective depth - 0%)	1.100	

Length of Trial Pit (m)	1.8
Width of Trial Pit (m)	0.6
Depth of Trial Pit (m)	1.1
Effective Storage Depth (m)	0.560
Vp25	0.6800
Vp75	0.9600
Vp75-25	0.302
50% effective depth (m)	0.280
Mean Surface area ap50 (m2)	2.424
Time for 25% **Outflow** (t_{p25})	13
Time for 75% **Outflow** (t_{p75})	58
tp75 - 25	45
Soil Infiltration Rate (m/s)	**4.62E-05**

Soil Infiltration Worksheet: This worksheet has been produced in combination with the document 'BRE Digest 365- September 1991'. This worksheet can be used to determine soil infiltration rates from trial pit field measurements. Worksheet options are identified by a green background


Soil Infiltration Measurements - TP3, Test 1
Time (mins)
0
10
20
30
40
50
60
70
80
90
Depth (m)
0
0.2
0.4
0.6
0.8
1
25%
75%

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Site Name:	Harvest Lane, Charlton	**Job No.:** 6616	**Date Undertaken**: 10/03/2020
Trial Pit No.:	TP3	**Test No.**: 2	

	Depth to Water (m)	Time (Mins)
(Top of test / effective depth - 100%)	0.51	0
	0.78	30
	0.89	50
	1	77
	1.03	85
(Base of pit / effective depth - 0%)	1.100	

Length of Trial Pit (m)	1.8
Width of Trial Pit (m)	0.6
Depth of Trial Pit (m)	1.1
Effective Storage Depth (m)	0.590
Vp25	0.6575
Vp75	0.9525
Vp75-25	0.319
50% effective depth (m)	0.295
Mean Surface area ap50 (m2)	2.496
Time for 25% **Outflow** (t_{p25})	16.5
Time for 75% **Outflow** (t_{p75})	65
tp75 - 25	48.5
Soil Infiltration Rate (m/s)	**4.39E-05**

Soil Infiltration Worksheet: This worksheet has been produced in combination with the document 'BRE Digest 365- September 1991'. This worksheet can be used to determine soil infiltration rates from trial pit field measurements. Worksheet options are identified by a green background


Soil Infiltration Measurements - TP3, Test 2
Time (mins)
0
10
20
30
40
50
60
70
80
90
Depth (m)
0
0.2
0.4
0.6
0.8
1
25%
75%

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Site Name:	Harvest Lane, Charlton	**Job No.:** 6616	**Date Undertaken**: 10/03/2020
Trial Pit No.:	TP3	**Test No.**: 3	

	Depth to Water (m)	Time (Mins)
(Top of test / effective depth - 100%)	0.5	0
	0.54	4
	0.66	16
	0.86	48
	0.94	63
	1	77
(Base of pit / effective depth - 0%)	1.100	

Length of Trial Pit (m)	1.8
Width of Trial Pit (m)	0.6
Depth of Trial Pit (m)	1.1
Effective Storage Depth (m)	0.600
Vp25	0.6500
Vp75	0.9500
Vp75-25	0.324
50% effective depth (m)	0.300
Mean Surface area ap50 (m2)	2.520
Time for 25% **Outflow** (t_{p25})	15
Time for 75% **Outflow** (t_{p75})	66
tp75 - 25	51
Soil Infiltration Rate (m/s)	**4.20E-05**

Soil Infiltration Worksheet: This worksheet has been produced in combination with the document 'BRE Digest 365- September 1991'. This worksheet can be used to determine soil infiltration rates from trial pit field measurements. Worksheet options are identified by a green background


Soil Infiltration Measurements - TP3, Test 3
Time (mins)
0
10
20
30
40
50
60
70
80
90
Depth (m)
0
0.2
0.4
0.6
0.8
1
25%
75%

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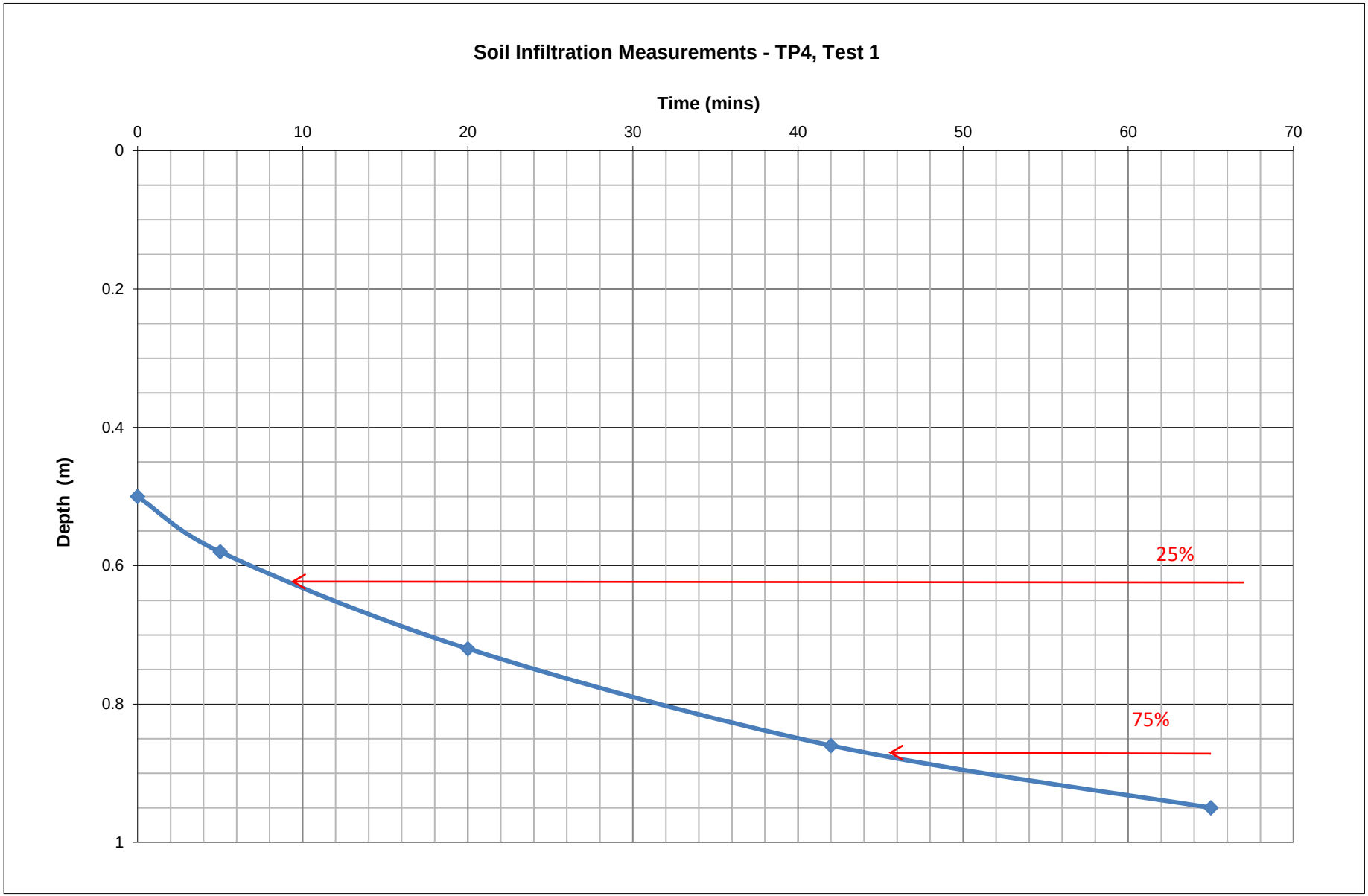
Site Name:	Harvest Lane, Charlton	**Job No.:** 6616	**Date Undertaken**: 10/03/2020
Trial Pit No.:	TP4	**Test No.**: 1	

	Depth to Water (m)	Time (Mins)
(Top of test / effective depth - 100%)	0.5	0
	0.58	5
	0.72	20
	0.86	42
	0.95	65
(Base of pit / effective depth - 0%)	1.000	

Length of Trial Pit (m)	2
Width of Trial Pit (m)	0.6
Depth of Trial Pit (m)	1
Effective Storage Depth (m)	0.500
Vp25	0.6250
Vp75	0.8750
Vp75-25	0.300
50% effective depth (m)	0.250
Mean Surface area ap50 (m2)	2.500
Time for 25% **Outflow** (t_{p25})	9.5
Time for 75% **Outflow** (t_{p75})	45
tp75 - 25	35.5
Soil Infiltration Rate (m/s)	**5.63E-05**

Soil Infiltration Worksheet: This worksheet has been produced in combination with the document 'BRE Digest 365- September 1991'. This worksheet can be used to determine soil infiltration rates from trial pit field measurements. Worksheet options are identified by a green background


Soil Infiltration Measurements - TP4, Test 1
Time (mins)
0
10
20
30
40
50
60
70
Depth (m)
0
0.2
0.4
0.6
0.8
1
25%
75%

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Site Name:	Harvest Lane, Charlton	**Job No.:** 6616	**Date Undertaken**: 10/03/2020
Trial Pit No.:	TP4	**Test No.**: 2	

	Depth to Water (m)	Time (Mins)
(Top of test / effective depth - 100%)	0.5	0
	0.67	19
	0.86	50
	0.92	64
(Base of pit / effective depth - 0%)	0.950	

Length of Trial Pit (m)	2	
Width of Trial Pit (m)	0.6	
Depth of Trial Pit (m)	0.95	Silted up to 0.95m bgl
Effective Storage Depth (m)	0.450	
Vp25	0.6125	
Vp75	0.8375	
Vp75-25	0.270	
50% effective depth (m)	0.225	
Mean Surface area ap50 (m2)	2.370	
Time for 25% **Outflow** (t_{p25})	12	
Time for 75% **Outflow** (t_{p75})	46	
tp75 - 25	34	
Soil Infiltration Rate (m/s)	**5.58E-05**	

Soil Infiltration Worksheet: This worksheet has been produced in combination with the document 'BRE Digest 365- September 1991'. This worksheet can be used to determine soil infiltration rates from trial pit field measurements. Worksheet options are identified by a green background


Soil Infiltration Measurements - TP4, Test 2
Time (mins)
0
10
20
30
40
50
60
70
Depth (m)
0
0.2
0.4
0.6
0.8
1
25%
75%

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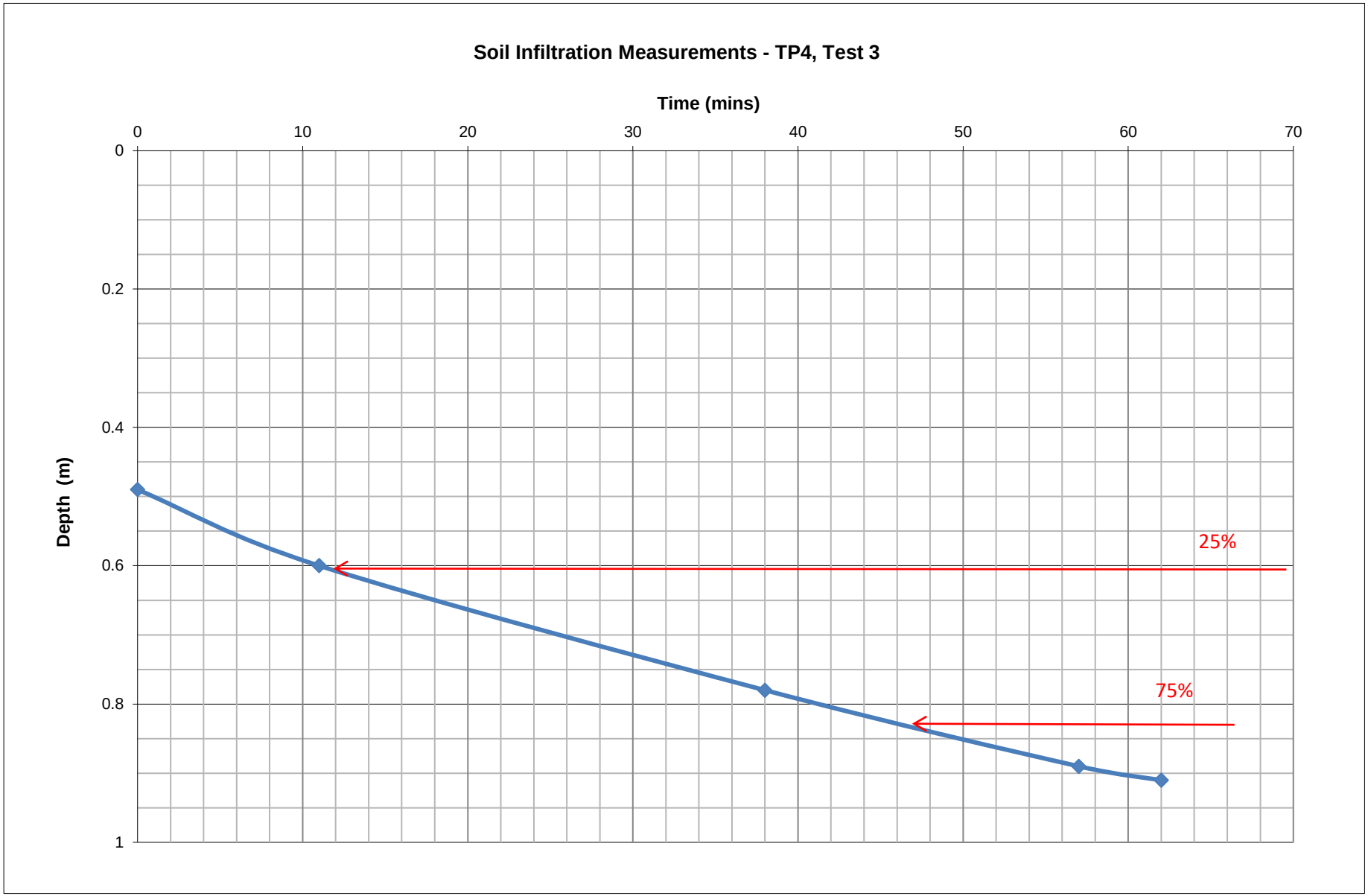
Site Name:	Harvest Lane, Charlton	**Job No.:** 6616	**Date Undertaken**: 10/03/2020
Trial Pit No.:	TP4	**Test No.**: 3	

	Depth to Water (m)	Time (Mins)
(Top of test / effective depth - 100%)	0.49	0
	0.6	11
	0.78	38
	0.89	57
	0.91	62
(Base of pit / effective depth - 0%)	0.950	

Length of Trial Pit (m)	2	
Width of Trial Pit (m)	0.6	
Depth of Trial Pit (m)	0.95	Silted up to 0.95m bgl
Effective Storage Depth (m)	0.460	
Vp25	0.6050	
Vp75	0.8350	
Vp75-25	0.276	
50% effective depth (m)	0.230	
Mean Surface area ap50 (m2)	2.396	
Time for 25% **Outflow** (t_{p25})	12	
Time for 75% **Outflow** (t_{p75})	47	
tp75 - 25	35	
Soil Infiltration Rate (m/s)	**5.49E-05**	

Soil Infiltration Worksheet: This worksheet has been produced in combination with the document 'BRE Digest 365- September 1991'. This worksheet can be used to determine soil infiltration rates from trial pit field measurements. Worksheet options are identified by a green background


Soil Infiltration Measurements - TP4, Test 3
Time (mins)
0
10
20
30
40
50
60
70
Depth (m)
0
0.2
0.4
0.6
0.8
1
25%
75%

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Site Name:	Harvest Lane, Charlton	**Job No.:** 6616	**Date Undertaken**: 10/03/2020
Trial Pit No.:	TP5	**Test No.**: 1	

	Depth to Water (m)	Time (Mins)
(Top of test / effective depth - 100%)	0.5	0
	0.52	1
	0.59	11
	0.72	31
	0.87	61
	0.94	78
	1.05	109
	1.22	158
(Base of pit / effective depth - 0%)	1.450	

Length of Trial Pit (m)	2.2	
Width of Trial Pit (m)	0.6	
Depth of Trial Pit (m)	1.45	Silted up to 1.45m bgl during test
Effective Storage Depth (m)	0.950	
Vp25	0.7375	
Vp75	1.2125	
Vp75-25	0.627	
50% effective depth (m)	0.475	
Mean Surface area ap50 (m2)	3.980	
Time for 25% **Outflow** (t_{p25})	34	
Time for 75% **Outflow** (t_{p75})	156	
tp75 - 25	122	
Soil Infiltration Rate (m/s)	**2.15E-05**	

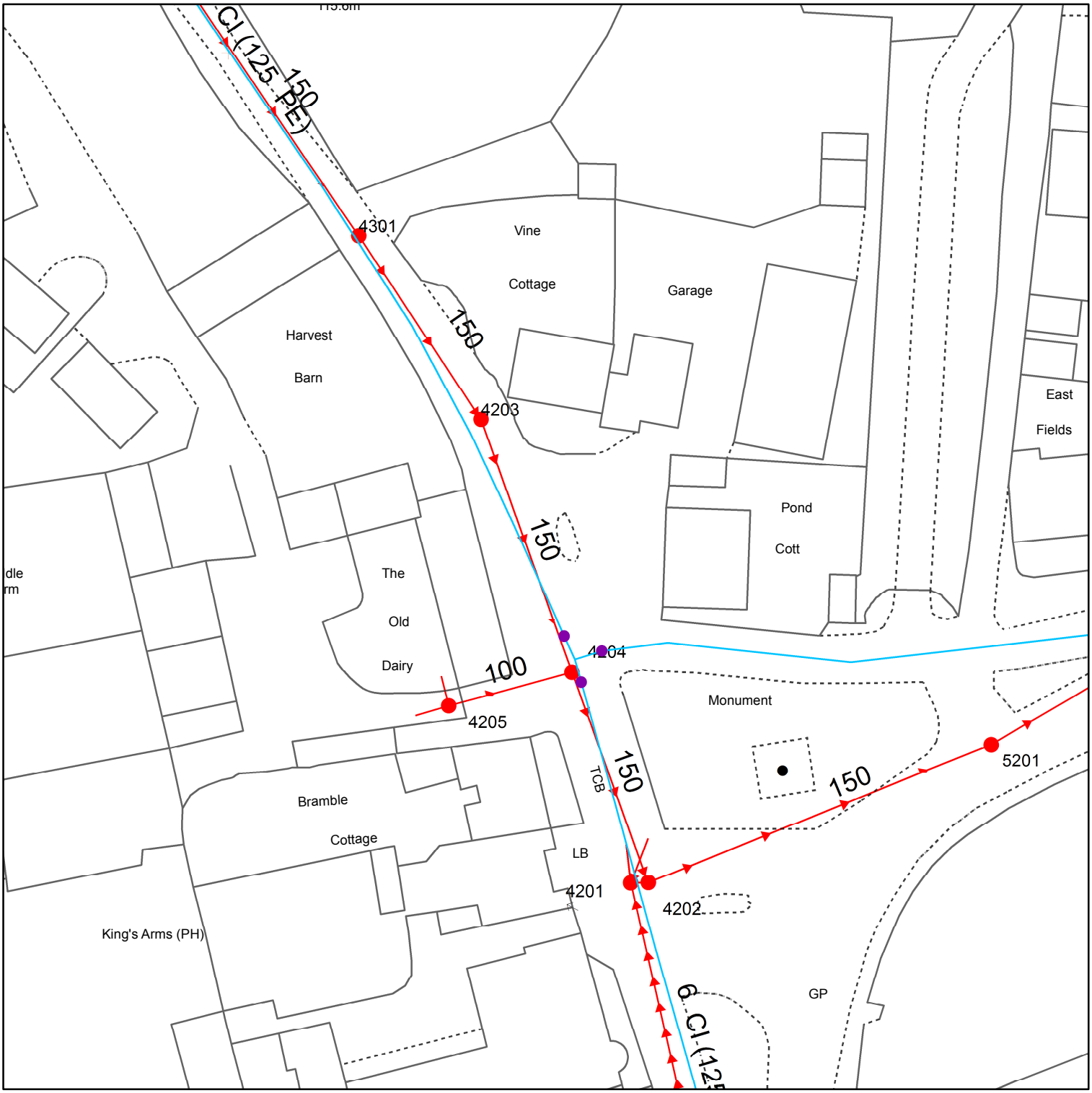
Soil Infiltration Worksheet: This worksheet has been produced in combination with the document 'BRE Digest 365- September 1991'. This worksheet can be used to determine soil infiltration rates from trial pit field measurements. Worksheet options are identified by a green background


Soil Infiltration Measurements - TP5, Test 1
Time (mins)
0
20
40
60
80
100
120
140
160
180
Depth (m)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
25%
75%

Appendix D

Sewer Plans

Wessex Water Network Map



WATER MAINS
- Distribution
- Washout
- Raw Water
- Abandoned
- Private

FITTINGS
- Hydrant
- Other

SEWERS — STRATEGIC / PUBLIC / PRIVATE / SECTION 104
- Foul
- Surface
- Combined
- Abandoned

OTHER WESSEX PIPES
- Rising Mains
- EDM — Effluent Disposal
- Overflow
- S — Syphon

NON-WESSEX / UNKNOWN
- Private Rising Mains
- CW — Culverted Watercourse
- H — Highway Drain
- ? — Use Unknown
- SU — Status Unknown

Colours generally indicate the use of the sewer/drain (i.e Red - Foul, Dark Blue - Surface, Magenta - Combined/Dual Use, Light Green - Highway Drain, Mid Green - Overflow) styles of line are shown on the key in sample/typical colours.

STRUCTURES
- Manhole - Foul
- Manhole - Surface
- Manhole - Combined
- Outfall
- Inlet
- Lamphole
- Bifurcation - Foul
- Bifurcation - Surface
- Bifurcation - Combined
- Combined Sewage Overflow
- Pumping Station - Surface
- Pumping Stn - Foul/Combined
- Gully
- Vent Column
- Rodding Eye
- Catchpit
- Flushing Chamber
- Soakaway
- Non Return Valve
- Washout
- Air Valve
- Hatch Box

OTHER STRUCTURES
- Attenuation Tank
- Storage Tank
- Chamber
- Tunnel
- Interceptor

Wessex Water
YTL GROUP

Date: 28/11/2019
Centre: 366464, 123265
Scale: 1:625
(when printed at A4 size)

N
W E
S

Wessex Water
YTL GROUP

N
W E
S

Enter a title here

Enter any subtitle here

Printed on : 26/11/2019 09:56

Enter any notes about the print here

WATER MAINS Public Private
Public
Raw Water
Abandoned
Valve Hydrant PRV Meter

SEWERS Public - Section 104 - Private
Foul
Combined
Surface
Abandoned sewers

OTHER WESSEX PIPES
Rising Mains
Effluent Disposal Main
Overflow

NON-WESSEX PIPES
Private Rising Mains
Culverted Water Course
Highway Drain

Information in this plan is provided for identification purposes only. No warranty as to accuracy is given or implied. The precise route of pipe work may not exactly match that shown. Wessex Water does not accept liability for inaccuracies. Sewers and lateral drains adopted by Wessex Water under the Water Industry (Schemes for Adoption of Private Sewers) Regulations 2011 are to be plotted over time and may not yet be shown.

In carrying out any works, you accept liability for the cost of any repairs to Wessex Water apparatus damaged as a result of your works. You are advised to commence excavations using hand tools only. Mechanical digging equipment should not be used until pipe work has been precisely located.

If you are considering any form of building works and pipe work is shown within the boundary of your property or a property to be purchased (or very close by) a surveyor should plot its exact position prior to commencing works or purchase. If you are proposing to build over or near Wessex Water's apparatus you should contact the Developer Services Team, tel: 01225 526333 or e-mail: developer.enquiries@wessexwater.co.uk to discuss your proposals to discuss your proposals.

Centre:366251.40 , 123504.33

Scale = 1:1250

Metres 20 40 60

Appendix E

Drainage Strategy

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

PLEASE REFER TO THE HEALTH AND SAFETY FILE FOR A FULL LIST OF THE HAZARDS ASSOCIATED WITH THIS WORK - THE FOLLOWING ARE THE MOST SIGNIFICANT ITEMS TO BE AWARE OF.

CONSTRUCTION

1. OPERATIVES TO TAKE PRECAUTIONS WHEN WORKING ADJACENT TO OR WITHIN DEEP EXCAVATIONS. METHOD STATEMENT TO BE PRODUCED BY CONTRACTOR PRIOR TO WORKS COMMENCING.
2. ATTENTION IS DRAWN TO THE EXISTENCE OF BOTH EXISTING UNDERGROUND AND OVERHEAD UTILITIES.

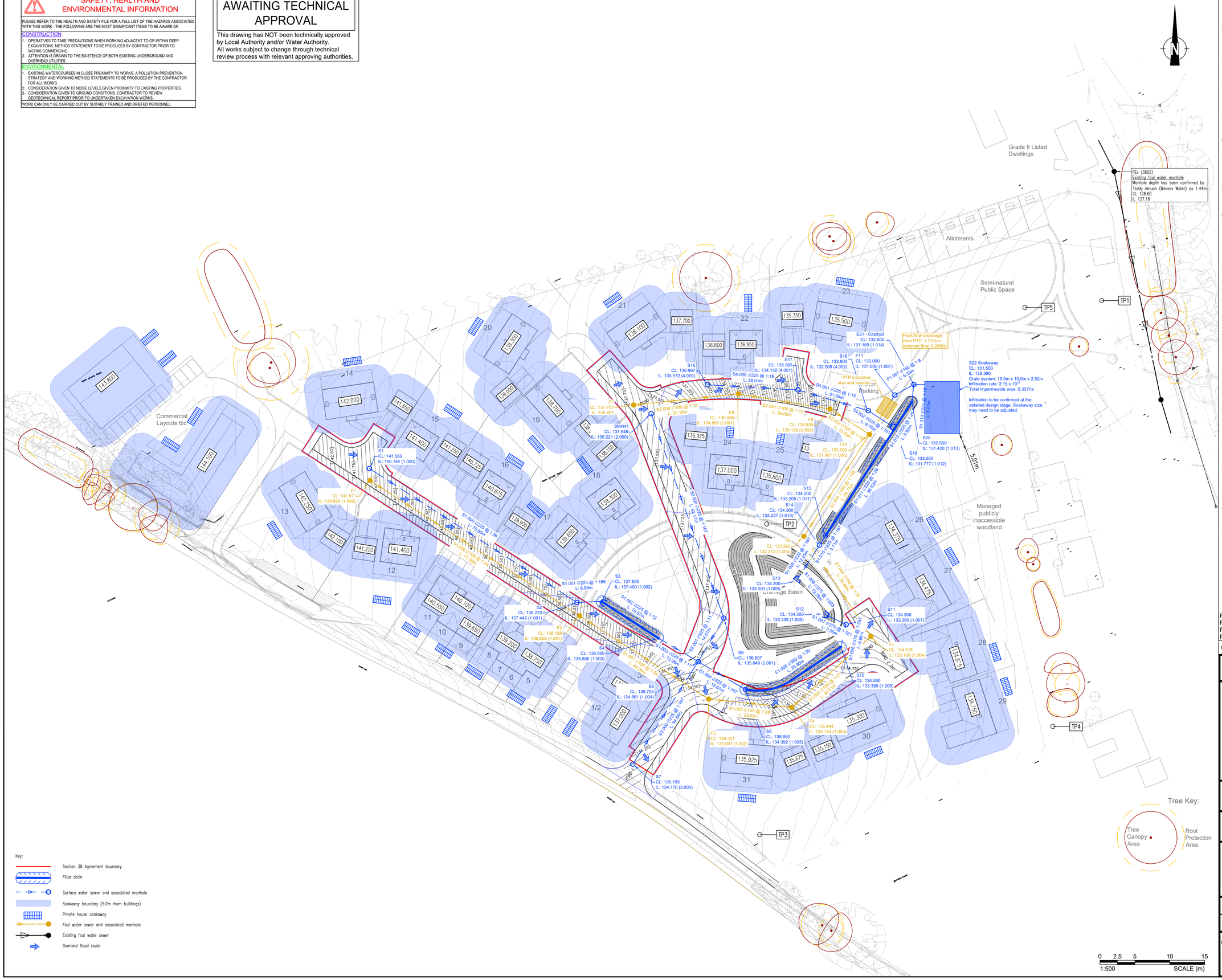
ENVIRONMENTAL

1. EXISTING WATERCOURSES IN CLOSE PROXIMITY TO WORKS, A POLLUTION PREVENTION STRATEGY AND WORKING METHOD STATEMENTS TO BE PRODUCED BY THE CONTRACTOR FOR ALL WORKS.
2. CONSIDERATION GIVEN TO NOISE LEVELS GIVEN PROXIMITY TO EXISTING PROPERTIES.
3. CONSIDERATION GIVEN TO GROUND CONDITIONS. CONTRACTOR TO REVIEW GEOTECHNICAL REPORT PRIOR TO UNDERTAKEN EXCAVATION WORKS.

WORK CAN ONLY BE CARRIED OUT BY SUITABLY TRAINED AND BRIEFED PERSONNEL.

AWAITING TECHNICAL APPROVAL

This drawing has NOT been technically approved by Local Authority and/or Water Authority.
All works subject to change through technical review process with relevant approving authorities.



NOTES:

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL DRAWINGS WITHIN APPENDIX 0/4, THE MANUAL OF CONTRACT DOCUMENTS FOR HIGHWAY WORKS (SHW) AND THE CONTRACT SPECIFICATION.
2. HIGHWAY WORKS WHERE INDICATED BEYOND THE PROPOSED ADOPTION BOUNDARY ARE TO BE CONSTRUCTED AS PART OF THIS CONTRACT BUT TO REMAIN PRIVATE.
3. FOR APPLICABLE SECTOR SCHEMES FOR WORKMANSHIP AND MATERIALS WITH ASSOCIATED APPENDICES; REFER TO APP 1/24 QUALITY MANAGEMENT SYSTEM PART E.
4. IN ACCORDANCE WITH THE CDM REGULATIONS RESIDUAL RISKS OF SIGNIFICANCE ARE INDICATED ON THE DRAWING ONLY BY MEANS OF A HAZARD TRIANGLE WITH APPROPRIATE NOTE.
5. THE CONTRACTOR SHALL CONDUCT THE WORKS WITH DUE REGARD TO THE ECOLOGICAL AND ENVIRONMENTAL REQUIREMENTS OF THE SCHEME.
6. THE CONTRACTOR SHALL TAKE SUCH STEPS TO SAFEGUARD AGAINST CONTAMINATION OF LOCAL WATERCOURSES.
7. TEMPORARY WORKS DESIGN ASSOCIATED WITH THE CONSTRUCTION OF THE WORKS SHALL BE RESPONSIBILITY OF THE CONTRACTOR.
8. VECTOS CANNOT ACCEPT ANY LIABILITY FOR UTILITY RECORDS. PRIOR TO CONSTRUCTION THE CONTRACTOR IS TO VERIFY THE STATUS, LOCATION AND ALIGNMENT OF APPARATUS.
9. PRIOR TO THE CONSTRUCTION OF THE DRAINAGE WORKS, THE CONTRACTOR SHALL SET OUT THE PROPOSED LOCATION OF THE DRAINAGE SYSTEM AND ANY LIGHTING, SIGNAGE AND SERVICES. IN THE EVENT OF CONFLICTS THE CONTRACTOR SHALL IMMEDIATELY INFORM THE SUPERVISOR AND AWAIT INSTRUCTIONS ON HOW TO PROCEED.
10. THE CONTRACTOR SHALL CONFIRM THAT ALL DEFECTS AND BLOCKAGES, AS IDENTIFIED ON NATIONAL HIGHWAYS DRAWING(S) HAVE BEEN RECTIFIED PRIOR TO COMMENCEMENT OF CONSTRUCTION.
11. THE LINE, LEVEL AND CONDITION OF ALL EXISTING DRAINAGE AT CONNECTION POINTS IS TO BE CONFIRMED BY THE CONTRACTOR PRIOR TO CONSTRUCTION. ANY DISCREPANCIES TO BE REPORTED TO THE ENGINEER IMMEDIATELY.
12. THE LOCATION AND DEPTH OF ALL EXISTING SERVICES IN RELATION TO THE DRAINAGE IS TO BE IDENTIFIED PRIOR TO CONSTRUCTION. ANY CONFLICTS ARE TO BE REPORTED TO THE ENGINEER IMMEDIATELY.
13. POST CONSTRUCTION THE CONTRACTOR SHALL PROVIDE AS-BUILT RECORDS FOR THE WORKS INCLUDING A FULLY INTEGRATED, CLEARLY REFERENCED CCTV SURVEY RECORD FOR EACH DRAIN RUN. THE RECORDS ARE TO BE SUBMITTED IN HARD COPY AND ELECTRONIC FORMAT ON CD IN TRIPLICATE.
14. COMBINED KERBDRAIN (CKD) INVERT LEVEL SHOWN ON CKD DRAWING AND SCHEDULE IS INVERT LEVEL OF OUTLET SUMP UNIT. CKD INVERT LEVEL ON CHAMBER SCHEDULE IS INLET CONNECTION PIPE LEVEL FROM CKD UNIT.
15. TOPOGRAPHICAL SURVEY BY GARTELL & SON LTD, REF. N/A , DATED 23.05.2019.
16. TOPOGRAPHICAL SURVEY DATA SUPPLIED BY CLIENT. ALL DIMENSIONS, LEVELS AND SURVEY GRID COORDINATES ARE TO BE CHECKED BY THE CONTRACTOR AND ANY DISCREPANCIES ON THIS DRAWING OR ON SITE MUST BE REPORTED TO THE PROJECT MANAGER IMMEDIATELY.
17. ALL LEVELS ARE GIVEN IN RELATION TO ABOVE ORDNANCE DATUM (AOB) UNLESS STATED OTHERWISE.
18. FINISHED FLOOR LEVELS ARE SUBJECT TO REVIEW AND SHOULD BE CONSIDERED +/- 450MM.

Rev	Details	Drawn	Checked	Auth	Date
P04	Foul water treatment added	PB	JAK	JAK	19.07.2023
P03	Flood routes added	PB	JAK	JAK	18.07.2023
P02	Levels updated to suit latest survey	PB	JAK	JAK	04.07.2023
P01	Initial issue	PB	JAK	JAK	22.05.2023

Drawing Status: FOR STAGE APPROVAL
Suitability: S4

vectos. | PART OF SLR
3rd Floor, Brew House
Jacob Street, Tower Hill
Bristol
BS2 0EQ
t: 0117 906 4280
e: vectos@vectos.co.uk

LRQA CERTIFIED ISO 9001

Client:

Project Title: HARVEST LANE, CHARLTON HORETHORNE

Drawing Title: DRAINAGE STRATEGY

Scale	Designed	Drawn	Checked	Authorised
1:500	PB	PB	JAK	JAK
Original Size	Date	Date	Date	Date
A1	22.05.2023	22.05.2023	22.05.2023	22.05.2023

Drawing Number: VD23849 - VEC - S104 - XXX - DR - CD - 3000
PIN/Proj. Ref. No. | Originator | Volume | Location | Type | Role | Number
Project Ref. No.: VD23849
Revision: P04

Appendix F

Surface Water Calculations

Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 1310 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	132.010	0.760	0.1	7.2	O K
30 min Summer	132.262	1.012	0.1	9.6	O K
60 min Summer	132.526	1.276	0.1	12.1	O K
120 min Summer	132.702	1.452	0.1	13.8	O K
180 min Summer	132.812	1.562	0.1	14.8	O K
240 min Summer	132.891	1.641	0.1	15.6	O K
360 min Summer	132.996	1.746	0.1	16.6	O K
480 min Summer	133.062	1.812	0.1	17.2	O K
600 min Summer	133.102	1.852	0.2	17.6	O K
720 min Summer	133.125	1.875	0.2	17.8	O K
960 min Summer	133.148	1.898	0.2	18.0	O K
1440 min Summer	133.172	1.922	0.2	18.3	O K
2160 min Summer	133.163	1.913	0.2	18.2	O K
2880 min Summer	133.135	1.885	0.2	17.9	O K
4320 min Summer	133.063	1.813	0.1	17.2	O K
5760 min Summer	132.995	1.745	0.1	16.6	O K
7200 min Summer	132.945	1.695	0.1	16.1	O K
8640 min Summer	132.905	1.655	0.1	15.7	O K
10080 min Summer	132.873	1.623	0.1	15.4	O K
15 min Winter	132.101	0.851	0.1	8.1	O K
30 min Winter	132.383	1.133	0.1	10.8	O K
60 min Winter	132.679	1.429	0.1	13.6	O K
120 min Winter	132.877	1.627	0.1	15.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	143.357	0.0	19
30 min Summer	95.749	0.0	34
60 min Summer	60.867	0.0	64
120 min Summer	35.160	0.0	124
180 min Summer	25.601	0.0	182
240 min Summer	20.475	0.0	242
360 min Summer	14.974	0.0	362
480 min Summer	12.011	0.0	482
600 min Summer	10.123	0.0	600
720 min Summer	8.801	0.0	720
960 min Summer	7.048	0.0	834
1440 min Summer	5.143	0.0	1070
2160 min Summer	3.724	0.0	1472
2880 min Summer	2.962	0.0	1876
4320 min Summer	2.153	0.0	2720
5760 min Summer	1.731	0.0	3512
7200 min Summer	1.479	0.0	4320
8640 min Summer	1.311	0.0	5096
10080 min Summer	1.192	0.0	5848
15 min Winter	143.357	0.0	19
30 min Winter	95.749	0.0	34
60 min Winter	60.867	0.0	64
120 min Winter	35.160	0.0	122

Summary of Results for 100 year Return Period (+45%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
180 min Winter	133.001	1.751	0.1	16.6	O K
240 min Winter	133.090	1.840	0.1	17.5	O K
360 min Winter	133.210	1.960	0.2	18.6	O K
480 min Winter	133.286	2.036	0.2	19.3	O K
600 min Winter	133.335	2.085	0.2	19.8	O K
720 min Winter	133.366	2.116	0.2	20.1	O K
960 min Winter	133.391	2.141	0.2	20.3	O K
1440 min Winter	133.402	2.152	0.2	20.4	O K
2160 min Winter	133.368	2.118	0.2	20.1	O K
2880 min Winter	133.309	2.059	0.2	19.6	O K
4320 min Winter	133.181	1.931	0.2	18.3	O K
5760 min Winter	133.067	1.817	0.1	17.3	O K
7200 min Winter	132.981	1.731	0.1	16.4	O K
8640 min Winter	132.911	1.661	0.1	15.8	O K
10080 min Winter	132.853	1.603	0.1	15.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
180 min Winter	25.601	0.0	180
240 min Winter	20.475	0.0	238
360 min Winter	14.974	0.0	354
480 min Winter	12.011	0.0	470
600 min Winter	10.123	0.0	582
720 min Winter	8.801	0.0	692
960 min Winter	7.048	0.0	902
1440 min Winter	5.143	0.0	1112
2160 min Winter	3.724	0.0	1576
2880 min Winter	2.962	0.0	2020
4320 min Winter	2.153	0.0	2896
5760 min Winter	1.731	0.0	3744
7200 min Winter	1.479	0.0	4544
8640 min Winter	1.311	0.0	5360
10080 min Winter	1.192	0.0	6152

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 366252 123472 ST 66252 23472
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.027

Time (mins) From:	To:	Area (ha)
0	4	0.027

Time Area Diagram

Total Area (ha) 0.000

Time (mins) From:	To:	Area (ha)
0	4	0.000

Model Details

Storage is Online Cover Level (m) 134.000

Cellular Storage Structure

Invert Level (m) 131.250 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.03924

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	10.0	10.0	2.251	0.0	43.6
2.250	10.0	43.6			

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for SWS1

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	2
FEH Rainfall Version	2013
Site Location	GB 366252 123472 ST 66252 23472
Data Type	Point
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.500
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	0.900
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for SWS1

- Indicates pipe length does not match coordinates
« - 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	70.800	2.702	26.2	0.071	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	6.982	0.042	166.2	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	19.500	1.600	12.2	0.019	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	13.202	1.239	10.7	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	62.165	0.372	167.1	0.070	5.00	0.0	0.600	o	225	Pipe/Conduit	
2.001	14.447	1.288	11.2	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
3.000	34.843	0.209	166.7	0.049	5.00	0.0	0.600	o	225	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	5.46	140.144	0.071	0.0	0.0	0.0	2.57	102.0	9.6
1.001	50.00	5.57	137.442	0.071	0.0	0.0	0.0	1.01	40.2	9.6
1.002	50.00	5.66	137.400	0.090	0.0	0.0	0.0	3.77	149.9	12.2
1.003	50.00	5.72	135.800	0.090	0.0	0.0	0.0	4.03	160.3	12.2
2.000	50.00	6.03	136.221	0.070	0.0	0.0	0.0	1.01	40.1	9.5
2.001	50.00	6.09	135.849	0.070	0.0	0.0	0.0	3.93	156.2	9.5
3.000	50.00	5.58	134.770	0.049	0.0	0.0	0.0	1.01	40.2	6.6

Network Design Table for SWS1

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
1.004	15.673	0.094	166.7	0.026	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.005	29.885	0.986	30.3	0.027	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.006	6.660	0.020	333.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.007	7.053	0.022	320.6	0.030	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.008	12.287	0.038	323.3	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.009	12.231	0.073	167.5	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.010	3.111	0.019	163.7	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.011	36.805	1.431	25.7	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
4.000	25.971	1.414	18.4	0.017	5.00	0.0	0.600	o	225	Pipe/Conduit	
4.001	21.000	1.650	12.7	0.028	0.00	0.0	0.600	o	225	Pipe/Conduit	
4.002	9.149	0.057	160.5	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.012	8.913	0.350	25.5	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.013	5.000	0.270	18.5	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.014	9.098	2.150	4.2	0.000	0.00	0.3	0.600	o	225	Pipe/Conduit	
1.015	10.000#	-0.100	-100.0	0.000	0.00	0.0	0.600	o	225	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)
1.004	50.00	6.35	134.561	0.235	0.0	0.0	0.0	1.01	40.1	31.8
1.005	50.00	6.52	134.392	0.262	0.0	0.0	0.0	2.87	202.6	35.5
1.006	50.00	6.63	133.380	0.262	0.0	0.0	0.0	0.99	109.0	35.5
1.007	50.00	6.75	133.360	0.292	0.0	0.0	0.0	1.01	111.2	39.5
1.008	50.00	6.95	133.338	0.292	0.0	0.0	0.0	1.00	110.7	39.5
1.009	50.00	7.16	133.300	0.292	0.0	0.0	0.0	1.01	40.0	39.5
1.010	50.00	7.21	133.227	0.292	0.0	0.0	0.0	1.02	40.5	39.5
1.011	50.00	7.44	133.208	0.292	0.0	0.0	0.0	2.59	103.0	39.5
4.000	50.00	5.14	135.572	0.017	0.0	0.0	0.0	3.07	122.0	2.3
4.001	50.00	5.24	134.158	0.045	0.0	0.0	0.0	3.69	146.6	6.1
4.002	50.00	5.38	132.508	0.045	0.0	0.0	0.0	1.03	40.9	6.1
1.012	50.00	7.50	131.777	0.337	0.0	0.0	0.0	2.60	103.5	45.6
1.013	50.00	7.53	131.420	0.337	0.0	0.0	0.0	3.06	121.5	45.6
1.014	50.00	7.55	131.150	0.337	0.3	0.0	0.0	6.41	254.7	45.9
1.015	49.01	8.91	131.100	0.337	0.3	0.0	0.0	0.12	4.9«	45.9

Free Flowing Outfall Details for SWS1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.015	Dummy	131.500	131.200	0.000	1200	0

Simulation Criteria for SWS1

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 0	Number of Storage Structures 4	Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	2
FEH Rainfall Version	2013
Site Location	GB 366252 123472 ST 66252 23472
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Storm Duration (mins)	30

Storage Structures for SWS1

Filter Drain Manhole: 4, DS/PN: 1.003

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.225
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.000
Safety Factor	2.0	Number of Pipes	1
Porosity	0.30	Slope (1:X)	21.2
Invert Level (m)	135.800	Cap Volume Depth (m)	0.000
Trench Width (m)	0.5	Cap Infiltration Depth (m)	0.000
Trench Length (m)	19.5		

Filter Drain Manhole: 10, DS/PN: 1.006

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.225
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.000
Safety Factor	2.0	Number of Pipes	1
Porosity	0.30	Slope (1:X)	30.3
Invert Level (m)	133.450	Cap Volume Depth (m)	0.000
Trench Width (m)	0.5	Cap Infiltration Depth (m)	0.000
Trench Length (m)	30.8		

Tank or Pond Manhole: 13, DS/PN: 1.009

Invert Level (m) 133.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	159.7	1.000	360.6	1.001	0.0

Cellular Storage Manhole: 22, DS/PN: 1.015

Invert Level (m)	128.400	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.07740	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.07740		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	150.0	150.0	2.501	0.0	275.0
2.500	150.0	275.0			

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SWS1

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 0 Number of Storage Structures 4 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 366252 123472 ST 66252 23472
Data Type	Point
Cv (Summer)	0.750
Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 45

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)
1.000	1	15 Winter	2	+0%					140.196	-0.173
1.001	2	15 Winter	2	+0%	100/15 Summer				137.540	-0.127
1.002	3	15 Winter	2	+0%					137.449	-0.176
1.003	4	15 Winter	2	+0%	100/15 Summer				135.848	-0.177
2.000	5	15 Winter	2	+0%	100/15 Summer				136.305	-0.141
2.001	6	15 Winter	2	+0%					135.891	-0.183
3.000	7	15 Winter	2	+0%	30/15 Summer				134.841	-0.154
1.004	8	15 Winter	2	+0%	30/15 Summer				134.751	-0.035
1.005	9	15 Winter	2	+0%					134.485	-0.207
1.006	10	15 Winter	2	+0%	30/15 Summer				133.588	-0.167
1.007	11	15 Winter	2	+0%	30/15 Summer				133.567	-0.168
1.008	12	15 Winter	2	+0%	100/15 Summer				133.530	-0.183
1.009	13	30 Winter	2	+0%	100/15 Summer				133.406	-0.119
1.010	14	30 Winter	2	+0%	30/30 Winter				133.351	-0.101
1.011	15	30 Winter	2	+0%					133.268	-0.165
4.000	16	15 Winter	2	+0%					135.596	-0.201
4.001	17	15 Winter	2	+0%					134.191	-0.192
4.002	18	15 Winter	2	+0%					132.577	-0.156
1.012	19	30 Winter	2	+0%					131.846	-0.156
1.013	20	30 Winter	2	+0%					131.494	-0.151
1.014	21	30 Winter	2	+0%					131.194	-0.181
1.015	22	360 Winter	2	+0%					128.760	-2.565

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SWS1

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.000	0.12			11.5	OK	
1.001	2	0.000	0.39			11.6	OK	
1.002	3	0.000	0.11			14.3	OK	
1.003	4	0.000	0.10		7	14.3	OK	
2.000	5	0.000	0.28			11.0	OK	
2.001	6	0.000	0.08			10.9	OK	
3.000	7	0.000	0.21			7.9	OK	
1.004	8	0.000	1.00			35.5	OK	
1.005	9	0.000	0.21			38.9	OK	
1.006	10	0.000	0.57		6	38.9	OK	
1.007	11	0.000	0.59			42.6	OK	
1.008	12	0.000	0.52			42.5	OK	
1.009	13	0.000	0.46			15.6	OK	
1.010	14	0.000	0.58			15.6	OK	
1.011	15	0.000	0.16			15.6	OK	
4.000	16	0.000	0.02			2.8	OK	
4.001	17	0.000	0.05			6.7	OK	
4.002	18	0.000	0.20			6.7	OK	
1.012	19	0.000	0.21			17.3	OK	
1.013	20	0.000	0.24			17.3	OK	
1.014	21	0.000	0.09			17.6	OK	
1.015	22	0.000	0.00		355	0.0	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SWS1

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 0 Number of Storage Structures 4 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 366252 123472 ST 66252 23472
Data Type	Point
Cv (Summer)	0.750
Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 45

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)
1.000	1	15 Winter	30	+0%					140.221	-0.148
1.001	2	15 Winter	30	+0%	100/15 Summer				137.600	-0.067
1.002	3	15 Winter	30	+0%					137.474	-0.151
1.003	4	15 Winter	30	+0%	100/15 Summer				135.873	-0.152
2.000	5	15 Winter	30	+0%	100/15 Summer				136.352	-0.094
2.001	6	15 Winter	30	+0%					135.911	-0.163
3.000	7	15 Winter	30	+0%	30/15 Summer				135.167	0.172
1.004	8	15 Winter	30	+0%	30/15 Summer				135.124	0.338
1.005	9	15 Winter	30	+0%					134.535	-0.157
1.006	10	15 Winter	30	+0%	30/15 Summer				133.789	0.034
1.007	11	15 Winter	30	+0%	30/15 Summer				133.756	0.021
1.008	12	15 Winter	30	+0%	100/15 Summer				133.713	0.000
1.009	13	30 Winter	30	+0%	100/15 Summer				133.510	-0.015
1.010	14	30 Winter	30	+0%	30/30 Winter				133.463	0.011
1.011	15	30 Winter	30	+0%					133.289	-0.144
4.000	16	15 Winter	30	+0%					135.605	-0.192
4.001	17	15 Winter	30	+0%					134.210	-0.173
4.002	18	15 Winter	30	+0%					132.620	-0.113
1.012	19	30 Winter	30	+0%					131.878	-0.124

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SWS1

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.000	0.25			24.4	OK	
1.001	2	0.000	0.82			24.7	OK	
1.002	3	0.000	0.23			31.1	OK	
1.003	4	0.000	0.22		6	31.2	OK	
2.000	5	0.000	0.60			23.3	OK	
2.001	6	0.000	0.17			23.2	OK	
3.000	7	0.000	0.40			15.2	SURCHARGED	
1.004	8	0.000	2.14			75.8	SURCHARGED	
1.005	9	0.000	0.45			82.9	OK	
1.006	10	0.000	1.24		5	85.2	SURCHARGED	
1.007	11	0.000	1.28			93.1	SURCHARGED	
1.008	12	0.000	1.10			90.2	OK	
1.009	13	0.000	0.80			27.5	OK	
1.010	14	0.000	1.02			27.2	SURCHARGED	
1.011	15	0.000	0.28			27.2	OK	
4.000	16	0.000	0.05			6.0	OK	
4.001	17	0.000	0.12			16.4	OK	
4.002	18	0.000	0.49			16.4	OK	
1.012	19	0.000	0.42			34.9	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SWS1

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)
1.013	20	30 Winter	30	+0%					131.530	-0.115
1.014	21	30 Winter	30	+0%					131.213	-0.162
1.015	22	480 Winter	30	+0%					129.142	-2.183

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.013	20	0.000	0.48			35.0	OK	
1.014	21	0.000	0.17			35.4	OK	
1.015	22	0.000	0.00			0.0	OK	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SWS1

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 0 Number of Storage Structures 4 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 366252 123472 ST 66252 23472
Data Type	Point
Cv (Summer)	0.750
Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 45

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)
1.000	1	15 Winter	100	+45%					140.252	-0.117
1.001	2	15 Winter	100	+45%	100/15 Summer				137.722	0.055
1.002	3	15 Winter	100	+45%					137.503	-0.122
1.003	4	15 Winter	100	+45%	100/15 Summer				136.100	0.075
2.000	5	15 Winter	100	+45%	100/15 Summer				136.550	0.104
2.001	6	15 Winter	100	+45%					136.038	-0.036
3.000	7	15 Winter	100	+45%	30/15 Summer				136.028	1.033
1.004	8	15 Winter	100	+45%	30/15 Summer				135.918	1.132
1.005	9	15 Winter	100	+45%					134.655	-0.037
1.006	10	15 Winter	100	+45%	30/15 Summer				134.084	0.329
1.007	11	15 Winter	100	+45%	30/15 Summer				133.961	0.226
1.008	12	15 Winter	100	+45%	100/15 Summer				133.808	0.095
1.009	13	30 Winter	100	+45%	100/15 Summer				133.669	0.144
1.010	14	30 Winter	100	+45%	30/30 Winter				133.532	0.080
1.011	15	30 Winter	100	+45%					133.318	-0.115
4.000	16	15 Winter	100	+45%					135.619	-0.178
4.001	17	15 Winter	100	+45%					134.230	-0.153
4.002	18	15 Winter	100	+45%					132.675	-0.058
1.012	19	60 Winter	100	+45%					131.909	-0.093

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SWS1

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.000	0.45			44.8	OK	
1.001	2	0.000	1.52			45.4	SURCHARGED	
1.002	3	0.000	0.42			57.1	OK	
1.003	4	0.000	0.38		3	53.4	SURCHARGED	
2.000	5	0.000	1.08			42.0	SURCHARGED	
2.001	6	0.000	0.31			43.0	OK	
3.000	7	0.000	0.70			26.4	FLOOD RISK	
1.004	8	0.000	3.61			128.2	SURCHARGED	
1.005	9	0.000	0.76			139.0	OK	
1.006	10	0.000	2.05		5	140.6	SURCHARGED	
1.007	11	0.000	2.08			151.0	SURCHARGED	
1.008	12	0.000	1.84			150.8	SURCHARGED	
1.009	13	0.000	1.36			46.9	SURCHARGED	
1.010	14	0.000	1.75			46.9	SURCHARGED	
1.011	15	0.000	0.48			46.9	OK	
4.000	16	0.000	0.10			11.0	OK	
4.001	17	0.000	0.23			30.2	OK	
4.002	18	0.000	0.89			30.0	OK	
1.012	19	0.000	0.65			54.0	OK	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SWS1

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)
1.013	20	60 Winter	100	+45%					131.564	-0.081
1.014	21	60 Winter	100	+45%					131.228	-0.147
1.015	22	720 Winter	100	+45%					129.970	-1.355

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.013	20	0.000	0.74			54.0	OK	
1.014	21	0.000	0.26			54.3	OK	
1.015	22	0.000	0.00			0.0	OK	

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Contact

London
Network Building,
97 Tottenham Court Road,
London W1T 4TP.
Tel: 020 7580 7373

Bristol
Brew House, Jacob Street,
Bristol, BS2 0EQ
Tel: 0117 203 5240

Cardiff
Helmont House, Churchill Way,
Cardiff CF10 2HE
Tel: 029 2072 0860

Exeter
6 Victory House,
Dean Clarke Gardens,
Exeter EX2 4AA
Tel: 01392 422 315

Birmingham
Great Charles Street,
Birmingham B3 3JY
Tel: 0121 2895 624

Manchester
Oxford Place, 61 Oxford Street,
Manchester M1 6EQ.
Tel: 0161 228 1008

Leeds
7 Park Row, Leeds LS1 5HD
Tel: 0113 512 0293

Bonn
Stockenstrasse 5, 53113,
Bonn, Germany
Tel: +49 176 8609 1360
www.vectos.eu

Registered Office
Vectos (South) Limited
Network Building,
97 Tottenham Court Road,
London W1T 4TP
Company no. 7591661