AMBIENTAL

ENVIRONMENTAL ASSESSMENT

Surface Water Drainage Strategy

Deerfields Farm, Bodicote
OX15 4AD

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Document Issue Record

Project: Surface Water Drainage Strategy

Prepared for: Mr N. Morris

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Site Location: Deerfields Farm, Bodicote, OX15 4AD

Proposed Development: 29 new residential dwellings, associated landscaping, highways, and car parking.

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Contents

1. Summary

1.1 Ambiental Environmental Assessment has been appointed by Mr. N. Morris to compile a surface water drainage strategy for the proposed residential development at Deerfields Farm, Bodicote.

1.2 This document has considered the options for Sustainable Drainage at the site, and has outlined a suitable strategy, that is designed not to increase the peak rate of surface water run-off from the site.

1.3 It is understood that the development is for the provision of 29 residential dwellings, within an area adjacent to other recently developed residential properties.

1.4 With reference to the Environment Agency (EA) Flood Map for Planning, the proposed development is located within Flood Zone 1. The proposed development is considered 'More Vulnerable' under the National Planning Policy Framework (NPPF). A desktop review of other flood risks has determined that the risk to the site from tidal, fluvial, pluvial, groundwater, and sewer flooding is low.

1.5 In order to mitigate against the potential increase in surface water run-off resulting from the increase in hardstanding area, it is proposed to utilise Sustainable Drainage Systems (SuDS), in the form of 600mm of attenuating sub-base permeable paving, restricted by the provision of orifice flow control, in accordance with the guidance of the SuDS Manual.

1.6 The provision of permeable paving will provide sufficient pollution control to ameliorate the pollution potential for the ground level hardstanding parking areas. The highway gullies will be provided with 'smart sponges' to provide adequate water quality treatment.

1.7 Following the guidelines contained within the NPPF, the SuDS Manual, the Draft Sewers for Adoption 8, a SuDS based drainage strategy is proposed that provides sufficient surface water attenuation to manage the 1:100 year +40% rainfall event, without increasing flood risk to others.

2. Policy Compliance

2.1 This report deals with the surface water management requirements as outlined in the National Planning Policy Framework and supporting documents, and has been developed in accordance with the guidance and legislation set out in the below documents:

National Policy & Guidance

- Water Industry Act (1999)
- EU Water Framework Directive (2000)
- Making Space for Water, DEFRA (2005)
- EU Floods Directive (2007)
- The Flood Risk Regulations (2009)
- Flood and Water Management Act (2010)
- Flood Risk and Coastal Change Planning Practice Guidance (PPG, 2014)
- Non-statutory Sustainable Drainage Technical Standards (2015)
- CIRIA SuDS Manual (C753, 2015)
- The Building Regulations, Part H (2015)
- Town and Country Planning, Development Management Procedure, (England) Order (2015)
- British Standards, Drain and sewer systems outside buildings (BS EN 752:2017)
- Draft Sewers for Adoption 8 (SFA8, August 2018)
- National Planning Policy Framework (NPPF, 2019)
- Flood Risk Assessments: Climate Change Allowances, Environment Agency (2019)
- Preparing a Flood Risk Assessment: Standing Advice, Environment Agency and DEFRA (2019)
- Oxfordshire Lead Local Flood Authority, Local Standards and Guidance for Surface Water Drainage on Major Development in Oxfordshire.

2.2 A key component of the Flood Risk provisions of the NPPF are the requirements which ensure that proposals do not increase the risk of flooding to others. Where development proposals increase the amount of hardstanding area (roofs, roads, car parks, service yards, etc.), the amount of rainfall that is converted to surface water flow is greater than that which would have been generated as a result of the rain falling on an area of open land. The cumulative impact of creating more hard standing areas within a catchment, can therefore result in more surface water within the drainage system, which can contribute to local flooding.

2.3 Under the requirements of the non-statutory technical standards for sustainable drainage systems (SuDS), where practicable peak surface water discharge rates should be limited to as close to the pre-development (greenfield) surface water run-off rate as possible.

2.4 Under the guidance of Sewers for Adoption, surface water restrictions should, where suitable sediment control systems are provided upstream, be designed to minimise the risk of blockage, by limiting the minimum aperture size of the restriction, to 50mm (SfA 8, C7.12.3.c).

2.5 Sub-chapter 20.5 section c) of The SuDS Manual specifies that the minimum diameter outflow control for orifice plates for permeable pavements can be 20mm; due to the runoff flowing through a 6-20mm clean crushed stone aggregate (CCA) trapping all objects greater than 20mm in diameter. The orifice plates should also be provided with a filter mesh and the manhole access cover sealed.

2.6 The non-statutory technical guidance for SuDS identifies that an allowance for urban creep (10% increase in area), should be made.

2.7 The current Environment Agency guidance on climate change (Table 1) is in the process of being reviewed, in line with the UK Climate Projections 2018. However, this document has been produced based on the current climate change allowances for use in Flood Risk Assessments. Current climate change predictions are that there will be increases in winter precipitation volumes, which are likely to increase the occurrences of floods. Predictions of summer precipitation volumes are that these will decrease, however summer storms will increase in intensity, leading to more flash flooding events. These factors combined are predicted to result in the probability of surface water flooding increasing for all.

Applies across all of England	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper End	10%	20%	40%
Central	5%	10%	20%

Table 1: Environment Agency, Rainfall Climate Change Allowances

2.8 Based on residential dwellings having an expected lifespan of 100 years, the surface water drainage strategy will need to be tested to ensure properties do not flood as a result of the 1 in 100 plus 40% climate change scenario.

3. Development Description and Site Area

Proposed Development and Location

3.1 The proposed development is located at Deerfields Farm, Bodicote, OX15 4AD (Figure 1). The site is currently occupied by farm buildings and some hardstanding area. The site is around 1.1 Ha in size.

Figure 1 Location Map, identifying the location of the proposed development (Source: OS)

3.2 The site is currently a 'greenfield site' having been used for agricultural uses. It is understood that the development is for 29 new residential dwellings, access road, car parking and landscaping. A copy of the development proposal drawings is included as Appendix 1.

Topography

3.3 Elevations on site are generally around 120mAOD (2m LiDAR data). Analysis of topographic levels (Figure 2) indicates that the site generally slopes to the north east. Note the LiDAR data appears to pre-date the recent residential development north east of the site.

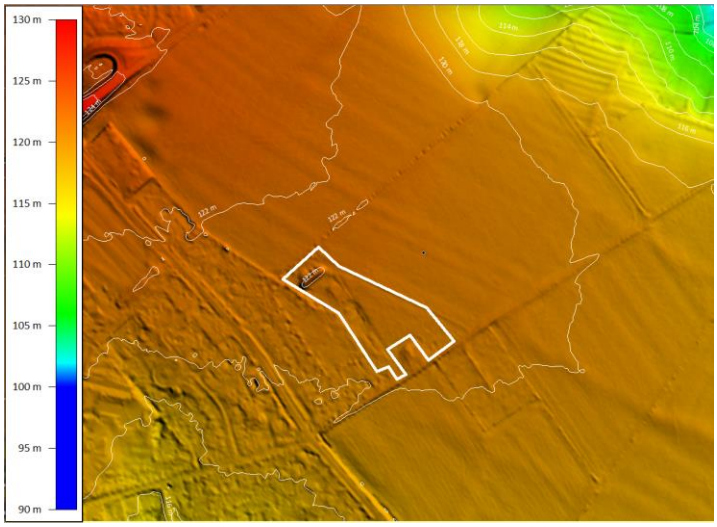


Figure 2 Topography (Source: 2m LiDAR data)

Geology

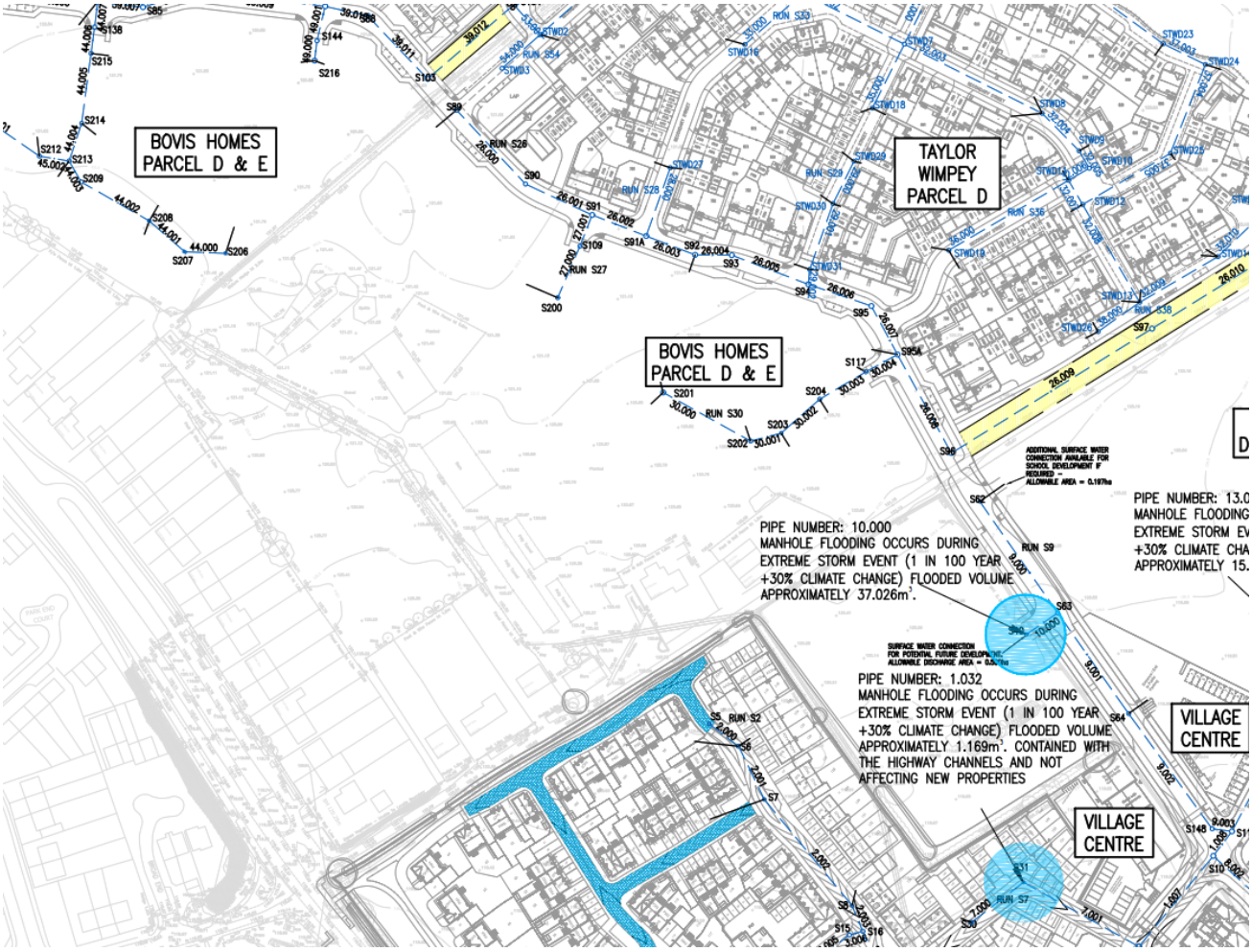
3.4 The British Geological Survey (BGS) Geology of Britain Viewer indicates that the bedrock underlying the site is Whitby Mudstone Formation.

3.5 In September 2019 Geo-Environmental attended the site to undertake infiltration testing, a copy of the findings of the infiltration testing are provided in Appendix 2.

3.6 The testing was undertaken at a shallow level to represent permeable paving, and at a deeper level to represent a traditional soakaway. The results of all the tests indicated that infiltration would not be appropriate at this site. Groundwater was not encountered in any of the tests.

Sewer Network

3.7 The Thames Water Asset Records provided do not include the recently completed residential development drainage infrastructure. However, copies of the plans submitted as part of the Discharge of Conditions Related to drainage for the adjacent schemes, are provided below which indicate the presence of surface water drainage infrastructure to the north.



3.8 It has not been possible to locate published details of the constructed surface water infrastructure around the site at this stage, however it is understood from the documents on the Chewell District Council, Planning Online Register, that the surface water sewer network was to be offered for adoption, and therefore could be considered as a public sewer network.

3.9 In order to determine the location of the nearest surface water manhole in Silverweed Road, a CCTV survey has been commissioned. However, the full results of this survey have not yet been received, the partial results are provided as Appendix 3. Verbally the CCTV contractor has indicated that there is a surface water manhole in the access to the site, from Silverweed Road. With a depth to invert of 1.93m, and a 150mm stub connection from the chamber towards the site. The contractor noted that the benching of the chamber was in poor condition and may need to be rehabilitated before it could be used to convey flows from the site.

4. Flood Risk Review

4.1 In order to inform the requirements for the surface water drainage strategy a high-level flood risk review has been undertaken based on publicly available data sources, which is presented as Table 2.

Flood Source	Assessed Risk	Mitigation Required?
Tidal and Fluvial	Site is located in Flood Zone 1 and is therefore at low risk of flooding from this source. (Figure 3)	No mitigation required.
Surface Water	Site is located in a Low Risk surface water flood extent. (Figure 4)	No mitigation required.
Groundwater	Intrusive geo-technical investigations indicate that groundwater was not detected within 3m of the ground surface. Figure 5 presents the BGS record mapping which indicates that the site is underlain by Mudstone.	Should groundwater (potentially perched) be encountered during construction, suitable mitigation measures should be employed to mitigate the risk. Basement areas (if proposed) or other below ground structures should be appropriately treated to minimise the risk of groundwater intrusion.
Sewer Flooding	No records of sewer flooding in the area have been identified. As the sewers in the area are of recent construction, it is understood that these have been designed to modern standards.	All new connections to the public sewer network should be provided with non-return valves or other suitable mechanisms to prevent back flow into the private drainage network.
Residual Risk: Breach	The site is not in an area that benefits from flood defences and is therefore not at risk of flooding as a result of a breach in the flood defences.	No mitigation required.
Residual Risk: Reservoir Flooding	The site is not in an area that is indicated to be at risk of reservoir flooding. (Figure 6)	No mitigation required.
Records of historical flooding	None identified.	No mitigation required.

Table 2: Flood Risk Review

4.2 Using the principles of the Sequential Test, the proposed development is 'More Vulnerable'. The site is located within Flood Zone 1 (as defined by the EA) and therefore, under the NPPF, does not require the application of the Exception Test.

4.3 As the site is at a low risk of flooding, and apart from mitigation measures to deal with the surface water run-off created by the development, no other specific mitigation measures will be required for flood risk management.

4.4 The low flood risk attributable to the site, means that a specific flood evacuation plan would not be required. However, all property owners and private residents are advised to periodically check the flood risk to their property, and take appropriate steps, if their flood risk profile is assessed to have changed.

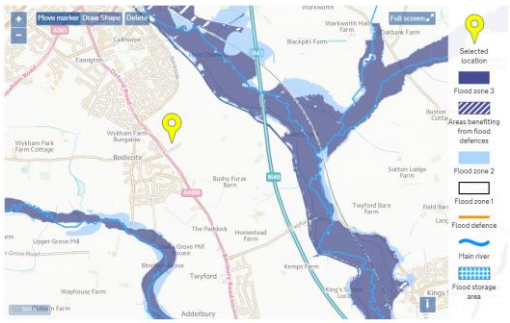


Figure 3 EA Flood Map for Planning. (Source: EA)

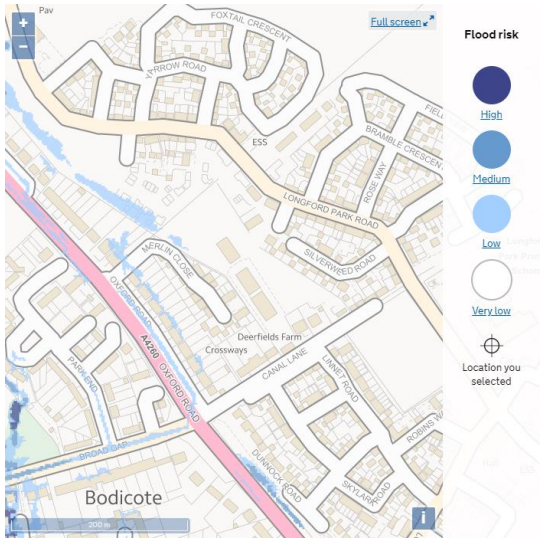


Figure 4 EA Surface Water Flood Risk Map. (Source: EA)

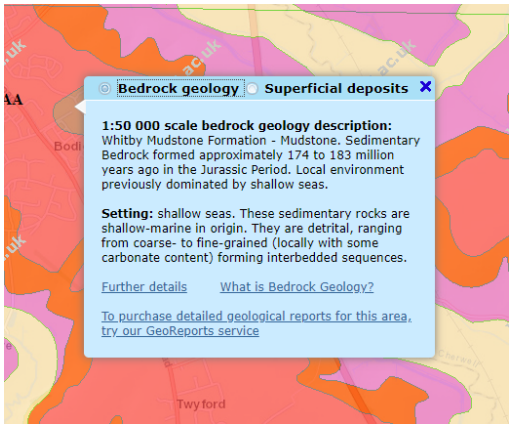


Figure 5 BGS Geological Map. (Source: BGS)

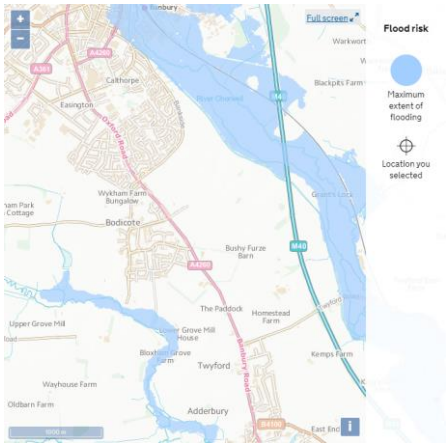


Figure 6 EA Risk of Reservoir Flooding. (Source: EA)

5. Surface Water Drainage Strategy

Introduction

5.1 A central component of sustainable surface water management is to demonstrate how the increases in impermeable surfaces, and the associated increases in surface water run-off, will be mitigated. Fundamentally it needs to demonstrate that:

- The total rate of surface water discharged from the site will not be greater post development than it was predevelopment; and,
- The water quality discharged from the site, will not be polluted by particles and other material mobilised from the ground surfaces as a result of rainfall events.

5.2 The above objectives are achieved through the provision of surface water storage (attenuation) and the provision of Sustainable Drainage Systems (SuDS). Surface water run-off generated by development sites, where impermeable surface areas are increased, have the potential to exacerbate flood risk to others, by increasing the peak rate of surface water discharged from the site.

Scale of Change

5.3 In order to determine the potential impact of the proposed development (without mitigation), compared to the baseline situation, an assessment of the existing and proposed area schedule and resultant rates of surface water run-off has been undertaken, and is presented in Table 3.

Surface Type	**Baseline**	**Proposed**
	Area (m^2)	**Area (m^2)**
Soft Landscaping	4,571.1 (41.5%)	6,267.7 (56.9%)
Impermeable Surfaces.	6,439.9 (58.5%)	4743.3 (43.1%)
Roofs	-	*2,103.3*
Roads	-	*385.5*
Car Parking	-	*2254.5*
Other	-	-
Total	11,011	11,011

Table 3: Comparison of Surface Water flow Rates pre and post development

5.4 The difference between the pre-development impermeable area and the post development impermeable area will result in a decrease of 1,696.6m^2, or 15.4 % of the total site area.

5.5 The run-off rate for the soft landscaping area has been assessed using the HR Wallingford Greenfield Runoff Rate Tool, a copy of the calculation is provided as Appendix 4, the FEH method has been applied based on a soil Host factor of 7. The calculations indicate that for 1 Hectare of soft landscaping the resultant 1:100 year Return Period (RP) run-off rate would be 14.22 l/s, or 15.6l/s for the 1.1Ha site.

Surface Water Disposal Point

5.6 The point of disposal for the surface water drainage has been considered as detailed in Building Regulations Part H, as summarised in Table 4.

Hierarchy (most preferred first)	Suitability	Comment
Discharge to the Ground (Infiltration)	X	Infiltration Testing indicates poor soakage rates, therefore infiltration drainage not proposed. Infiltration devices should not be built within 5m of a building or road, or in areas of unstable land[1].
Discharge to Surface Water (lake, watercourse, canal, etc.)	X	There are no open surface water features neighbouring the site, therefore a direct connection could not be achieved.
Discharge to Surface Water Sewer, Highway Drain or another Drainage System	✓	It is understood that drainage provisions have been installed within the highway of the adjacent plots.
Discharge to Combined Sewer	✓	The properties on Canal Lane may need to discharge into the combined system in this area.
Discharge to Foul Sewer	X	Surface water drainage connections to foul drainage should be avoided. However, the Water Industry Act, 1991, 106.2.b.ii, identifies that surface water can be discharged into the foul sewer with the consent of the sewer undertaker.

Table 4: SuDS Hierarchy

Infiltration Potential

5.7 On site intrusive infiltration testing has identified that infiltration forms of drainage at the site would not be possible (Appendix 2).

Sustainable Drainage (SuDS) Assessment

5.8 The suitability of SuDS components has been assessed (Table 5) to determine which methods are appropriate to be used within the proposed development.

SuDS Component	Description	Constraints and Opportunities	Suitability
Infiltrating SuDS	Infiltration can contribute to reducing runoff rates and volumes while supporting baseflow and groundwater recharge processes. The suitability and infiltration rate depends on the permeability of the surrounding soils	Infiltration testing has precluded the use of infiltration forms of drainage.	X
Permeable Pavement	Pervious surfaces can be used in combination with aggregate sub-base and/or geocellular/modular storage to attenuate and/or infiltrate runoff from surrounding surfaces and roofs. Liners can be used where ground conditions are not suitable for infiltration	Permeable paving should be provided within suitable hardstanding areas. A clear zone for the provision of utility services should be allowed for outside of the permeable paving. Furthermore, infiltrating paving should be located at least 1.5 m away from proposed and existing building.	✓

[1] Building Regulations, Part H, Paragraph 3.25 a, (2010).

SuDS Component	Description	Constraints and Opportunities	Suitability
Green Roofs	Green Roofs provide areas of visual benefit, ecological value, enhanced building performance and the reduction of surface water runoff. They are generally more costly to install and maintain than conventional roofs but can provide many long-term benefits and reduce the on-site storage volumes	The volume of surface water attenuation achieved by green roofs, is limited, and they are generally not suited to traditional pitched roofs. The development proposals aim to mimic the traditional pitch roof approach of other nearby properties. Bin stores or other flat roofed buildings should be provided with green roofs.	-
Rainwater Harvesting	Rainwater Harvesting is the collection of rainwater runoff for use. It can be collected form roofs or other impermeable area, stored, treated (where required) and then used as a supply of water for domestic, commercial and industrial properties	As the volume within a Rain Water Harvesting system does not contribute to the overall attenuation, these systems have not been considered further here. However, opportunities during detailed design should be considered, this could be through the provision of water butts.	-
Swales	Swales are designed to convey, treat and attenuate surface water runoff and provide aesthetic and biodiversity benefits. They can replace conventional pipework as a means of conveying runoff, however space constraints of some sites can make it difficult incorporating them into the design	Open landscaped features are generally situated within landscaped corridors as part of larger multi-dwelling developments, to facilitate conveyance to central attenuation facilities. The development layout, does not have significant areas of public open space which could be used to provide communal SuDS features. It is considered unlikely that an open surface feature would provide a suitable method of conveyance within private residential properties. If open SuDS features were proposed these would need to be subject to specific legal agreements to ensure that the effectiveness of these devices within private property was maintained over the life-time of the development. Consideration of the long-term maintenance has to be factored into the decision-making process.	-
Rills and Channels	Rills and Channels keep runoff on the surface and convey runoff along the surface to downstream SuDS components. They can be incorporated into the design to provide a visually appealing method of conveyance, they also provide effectiveness in pre-treatment removal of silts		-
Bioretention Systems	Bioretention systems can reduce runoff rates and volumes and treat pollution through the use of engineer soils and vegetation. They are particularly effective in delivering interception, but can also be an attractive landscape feature whilst providing habitat and biodiversity		-
Retention Ponds and Wetlands	Ponds and Wetlands are features with a permanent pool of water that provide both attenuation and treatment of surface water runoff. They enhance treatment processes and have great amenity and biodiversity benefits. Often a flow control system at the outfall controls the rates of discharge for a range of water levels during storm events		-
Detention Basins	Detention Basins are landscaped depressions that are usually dry except during and immediately following storm events and can be used as a recreational or other amenity facility. They generally appropriate to manage high volumes of surface water from larger sites such as a neighbourhoods		-
Geocellular Systems	Attenuation storage tanks are used to create a below-ground void space for the temporary storage of surface water before infiltration, controlled release or use. The inherent flexibility in size and shape means they can be tailored to suit the specific characteristics and requirements of any site	If necessary, these could be provided to complement the other SuDS solutions.	-

SuDS Component	Description	Constraints and Opportunities	Suitability
Proprietary Treatment Systems	Proprietary treatment systems are manufactured products that remove specific pollutants from surface water runoff. They are especially useful where site constraints preclude the use of other methods and can be useful in reducing the maintenance requirements of downstream SuDS	If necessary, these could be provided to complement the other SuDS solutions.	-
Filter Drains and Filter Strips	Filter drains are shallow trenches filled with stone, gravel that create temporary subsurface storage for the attenuation, conveyance and filtration of surface water runoff. Filter strips are uniformly graded and gently sloping strips of grass or dense vegetation, designed to treat runoff from adjacent impermeable areas by promoting sedimentation, filtration and infiltration	These may be used to provide interception drainage for overland flows from offsite.	-

Table 5: SuDS Selection Matrix (x = not suitable, - = limited potential, ✓= suitable)

Water Quality

5.9 In order to protect the downstream receiving water body, a key element of SuDS is that they have the potential to improve the quality of surface water discharged from a site. In order to assess this, the "Pollution hazard indices for different land use classifications", provided in the CIRIA SuDS Manual (C753) as table 26.2 has been reviewed. The indices use four different methods of assessing pollution potential based on the hazard level, total suspended solids (TSS), metals, and Hydrocarbons.

5.10 The Pollution Hazard Indices are summarised in Table 6 (reference: Table 26.3.CIRIA SuDS Manual 2015)

LAND USE	Pollution Hazard Level	Total suspended Solids (TSS)	Metals	Hydrocarbons
Residential Roofs	Very Low	0.20	0.20	0.05
Individual property driveways	Low	0.50	0.40	0.40
Commercial Yard and delivery areas	Medium	0.70	0.60	0.70
Sites with heavy pollution (haulage yards, trunk roads etc.)	High	0.80	0.80	0.90
Standard to be achieved		0.50	0.40	0.40

Table 6 Summary of Pollution hazard Indices for different Land Use.

5.11 From review of the available SuDS which could be implemented, Table 7 assesses the potential water quality index score against the most appropriate approach given the constraints at the site.

LAND USE	Treatment Stage	Total suspended Solids (TSS)	Metals	Hydrocarbons
Permeable Pavement	Primary	0.70	0.60	0.70
Total Provision		**0.70**	**0.60**	**0.70**
Adequate Provision		Yes	Yes	Yes

Table 7 Cumulative Score for Proposed SuDS Management Train

5.12 Runoff from roof areas is considered to generally be uncontaminated. However, to prevent any potential sediment from impacting the storage structure, Sediment Traps should be provided on the downpipes' outlet to the storage structure to prevent sedimentation, with rodding access provided either side for

cleaning and maintenance. All rainwater downpipes should discharge into either water butts or rain-planters.

Long Term Storage

5.13 Long-term storage is usually required to address the additional runoff caused by the development, compared to the volume that would be contributed from the site in its Greenfield state. The specialised literature CIRIA 753 'The SUDS Manual' provides two approaches for the rates of discharge in relation to runoff mitigation:

Approach 1

"Where there is extra volume generated by the development that has to be discharged (because there are no opportunities for it to be infiltrated and/or used on site), this volume should be released at a very low rate (e.g. <2 l/s/ha or as agreed with the local drainage approving body and/or environmental regulator) and the 1:100 year greenfield allowable runoff rate reduced to take account of this extra discharge." (Kellagher, 2002).

Approach 2

"An alternative approach to managing the extra runoff volumes from extreme events separately from the main drainage system is to release all runoff (above the 1 year event) from the site at a maximum rate of 2 l/s/ha or QBAR, whichever is the higher value (or as agreed with the drainage approving body and/or environmental regulator). This avoids the need to undertake more detailed calculations and modelling."

5.14 For the purposes of this report, Approach 2 is adopted, as the proposal is to limit the flows to a value of QBAR. The proposal is subject to the requirements of Sewers for Adoption 8, which specifies a minimum flow control aperture of 50mm, or where drained through permeable paving a 20mm orifice.

Permissible Surface Water Discharge Rate

5.15 As outlined previously, a key component of the NPPF regarding flood risk is to ensure that new developments do not increase the risk of flooding to others. As a minimum, the existing rate of surface water discharge should be maintained, based on the calculations of the current rate of total surface water discharge for the site, presented in Table 3.

5.16 The requirements of the Long Term Storage indicate that either the QBAR rate, or 2l/s/ha, whichever is greater, should be adopted. The Greenfield Rate calculations in Appendix 2 indicate that the QBAR rate for 1 Ha, would be 4.66 l/s. Scaling the QBAR rate to the size of the proposed impermeable area (4743.3m^2) yields a permissible discharge rate of 2.2 l/s.

5.17 In accordance with the Ciria SuDS Manual, the smallest orifice restriction within permeable paving should be 20mm, and the Draft Sewers for Adoption indicates a 50mm orifice size for all other circumstances, as indicated in British Standards. At detailed design the adopting Sewer Authority should confirm the permissible flow control required for the site.

5.18 It is understood from discussions with the CCTV survey contractor, that a surface water sewer manhole has been provided to facilitate the site drainage, at a depth to invert of 1.93m. Levels across the site are, based on 2m LiDAR, generally flat, it is considered that a gravity surface water drainage system can be provided for the site. At this stage an assessment of the final design ground levels across the site has not been undertaken.

5.19 Initial calculations of the volume of surface water attenuation required using the HR Wallingford SuDS Tool, indicate that for a 0.47 Ha impermeable catchment, for the 1:100 +40% rainfall event, allowing for a 10% urban creep factor would require 390m^3 of surface water attenuation to restrict the surface water run-off from the site to 2.2 l/s.

5.20 Based on the site layout, three of the proposed dwellings are located fronting onto Canal Lane. It would not be possible to connect these dwellings into the main site drainage without running surface water sewers through the private gardens of the neighbouring properties, which could represent a long term access and maintenance constraint. It is considered more appropriate to discharge surface water run-off from these properties towards the combined sewer in Canal Road.

5.21 The three properties fronting onto Canal Lane, have a proposed combined impermeable area of 586.5m^2.

5.22 Each of the properties on Canal Lane is to be provided with a private driveway. The current surface water management proposals for these dwellings, is that each of these private driveways to be surfaced with attenuating permeable paving, with the flow control discharge restricted by a 20mm orifice plate (which is considered the smallest flow control practicable), which would outfall to the combined sewer in Canal Lane. Based on the footprint of the building and the size of the private car parking area, a permeable paving using 30% void ratio sub-base and 400mm depth would provide approximately; 38m^3, of surface water attenuation, across the three plots. Given the small scale of the plot level catchments being drained, it is unlikely that this full attenuation volume would be utilised, during a 1:100+40% surface water flood event.

5.23 However, it is noted that page 21 of the Oxfordshire SuDS Guidance, indicates that a 50mm orifice plate is the minimum acceptable (L12), provided it has passed through a filtration system. Should Oxfordshire County Council as Lead Local Flood Authority confirm that the 50mm orifice size should be implemented, a 50mm orifice plate for each of these dwellings should be provided. This should be confirmed at the detailed design stage and would not alter the surface water attenuation strategy for these plots.

5.24 It is acknowledged that by providing individual flow controls for each of the proposed dwellings along Canal Lane, the cumulative peak rate of surface water discharge would be greater than the preferred QBar rate. However, given the small size of the plots and the physical limitations on flow control sizing, the surface water discharge from these plots is considered to be restricted as far as reasonably practicable.

5.25 The residual of the development parcels will discharge to the previously constructed manhole, Silverweed Road, (as part of the adjacent scheme) which is understood to have been installed with a 150mm diameter spur for connection from the site.

5.26 The development proposals include for parking areas at each end of the development, which should be provided with permeable paving, similar to that used on the private driveways. Surface water run-off from the roof areas should be directed to water butts or rain-planters, with overflows connected to the permeable pavement.

5.27 At this stage highway SuDS have not been included on the estate road, and it is considered that road gullies equipped with smart sponges would provide sufficient surface water quality improvement. Surface water attenuation for the highway catchment area would be provided through the use of tank sewers.

5.28 XP Storm Micro-drainage software (Calculations in Appendix 2) has been used to model the main site drainage, and indicates that the site would not be predicted to flood during a 1:100+40% climate change scenario. The calculations indicate that to make use of the attenuation capacity of the permeable paving it should be constructed 0.6m deep.

5.29 A 10% urban creep allowance has not been included; however, any additional hardstanding areas should be provided for by the use of attenuating permeable paving.

5.30 A summary of the drainage strategy is presented on Drawing 4748-DR01 & DR02, in Appendix 2.

Drainage Exceedance

5.31 In the event of extreme rainfall events, flooding may occur within the site, the surface water runoff flows would be dictated by the local topography on site. Design of external ground levels need to be undertaken at detailed design stage to finalise overland conveyance routes. All the proposed residential dwellings should be located at least 150mm above surrounding ground levels. Landscaped areas should be designed to direct overland flows away from properties, especially where doors or access points are proposed.

Adoption and Maintenance

5.32 For the proposed residential dwellings, the rainwater downpipes should be directed to water butts or rain-planters, these would be the responsibility of the property owners. An overflow from the water butts or rain-planters would be provided into the permeable paving.

5.33 Where permeable paving is to be constructed on private drives, these will become the responsibility of the property owner.

5.34 Where permeable paving is to be constructed over a communal area (courtyard) this will be the responsibility of the maintenance contractor for the site.

5.35 The proposed surface water carrier sewer is to be offered for adoption, and would therefore become a Public Sewer Asset. If the sewer is not adopted, then it would remain private and be maintained under the specification of the maintenance contractor for the site.

5.36 A long-term maintenance regime schedule is presented as Table 8.

Item	Visual Inspection	Cleanse / De-sludge	CCTV Survey	Comments
Pipework, chambers etc.	5 years	10 years	10 years	Cleansing to be carried out as necessary.
Gullies/Channels	1 year	1 year	N/A	
Catchpits/Water Butts/Rainplanters	1 year	As required	N/A	
Permeable Block Paving	Yearly	'Swept' clean of debris every 2 years.	N/A	Lift blocks and remove sand bedding and replace and re-bed paving – refer to individual manufacturer's recommendations.
Orifice Plate	Every month for the first 3 months and every 6 months thereafter	As necessary & 1 year	10 years	Cleansing to be carried out as necessary and at least every year. Refer to manufacturer's recommendations.
Green Roofs	1 year	As required	N/A	Re-seeding and maintenance to be timed to minimise potential for ecological disruption
Rainwater Harvesting	1 year	As required	N/A	Cleansing to be carried as necessary.
Proprietary Treatment Systems	In accordance with manufacturer's warranty / recommendations			

Table 8 Proposed Schedule of Maintenance for Below Ground Drainage.

5.37 For traditional piped elements the annual inspection should take place after the autumn leaf fall, in order to ensure sufficient capacity during the wetter winter months. Leaf fall is a significant issue especially for traditional (gully and pipe) based drainage systems, with gully grids at risk of being silted over, preventing the effectual operation of the drainage system.

5.38 In addition to a long-term maintenance regime, it is recommended that all drainage elements implemented on site should be inspected following the first rainfall event post construction and monthly for the first quarter following construction.

5.39 It is essential that the surface water drainage system is maintained and operated in accordance with the Manufacturers Specifications as well as good practice.

5.40 A pre-occupation commissioning survey to confirm all elements of the surface water drainage system operate as per the design, should be undertaken, with special attention to the orifice flow control. This survey should include a CCTV survey of all below ground drainage assets.

6. Conclusion

6.1 Ambiental Environmental Assessment has been appointed by Mr. N. Morris to compile a surface water drainage strategy for the proposed residential development at Deerfields Farm, Bodicote.

6.2 This document has considered the options for Sustainable Drainage at the site, and has outlined a suitable strategy, that is designed not to increase the peak rate of surface water run-off from the site.

6.3 It is understood that the development is for the provision of 29 residential dwellings, within an area adjacent to other recently developed residential properties.

6.4 With reference to the Environment Agency (EA) Flood Map for Planning, the proposed development is located within Flood Zone 1. The proposed development is considered 'More Vulnerable' under the National Planning Policy Framework (NPPF). A desktop review of other flood risks has determined that the risk to the site from tidal, fluvial, pluvial, groundwater, and sewer flooding is low.

6.5 In order to mitigate against the potential increase in surface water run-off resulting from the increase in hardstanding area, it is proposed to utilise Sustainable Drainage Systems (SuDS), in the form of 600mm of attenuating sub-base permeable paving, restricted by the provision of orifice flow control, in accordance with the guidance of the SuDS Manual.

6.6 The provision of permeable paving will provide sufficient pollution control to ameliorate the pollution potential for the ground level hardstanding parking areas. The highway gullies will be provided with 'smart sponges' to provide adequate water quality treatment.

6.7 Following the guidelines contained within the NPPF, the SuDS Manual, the Draft Sewers for Adoption 8, a SuDS based drainage strategy is proposed that provides sufficient surface water attenuation to manage the 1:100 year +40% rainfall event, without increasing flood risk to others.

Appendix I - Site Plans

Ambiental Environmental Assessment
Sussex Innovation Centre,
Science Park Square,
Brighton, BN1 9SB

Revision

C	Revised layout	IRK	24.01.19
D	Revised pedestrian access	IRK	28.01.19

Proposed Site Plan

client
Mr N Morris

project
Land at Deerfields Farm
Canal Lane
Banbury

drawing
Site Layout

date 04/18	scale 500 @ A3
drawn IRK	checked by IAN

BROWN & CO
ARCHITECTURE + PLANNING
Brown & Co. The Atrium, St George's Street, Norwich. NR3 1AB.
Brown & Co Registered Office:
Granta Hall, Finkin Street, Grantham, Lincolnshire, NG31 6QZ.
Registration no: 0C302092. Registered in England & Wales. T: 01603 620326.

17	24	04	D

Appendix II - Infiltration Testing

Ambiental Environmental Assessment
Sussex Innovation Centre,
Science Park Square,
Brighton, BN1 9SB

23rd September 2019

Our ref: GE18402/RG01/190923

Steven Brown
Ambiental (Royal Haskoning DHV)
Science Park Square
Brighton
BN1 9SB

Dear Steven,

RE: Land at Deerfields Farm, Canal Lane, Bodicote, Banbury, Oxfordshire OX15 4FU

Further to your instruction, we write to present the results of Investigation and infiltration testing undertaken on this site on the 18th September 2019. The investigation positions were agreed Royal Haskoning DHV prior to attending site and comprised three deeper tests to determine the suitability for soakaways and three shallow tests to determine the suitability of use of Sustainable Urban Drainage Systems (SUDs) on site. In addition an additional location was added on site to look at possible variation across the site. The investigation locations are presented in Figure 1.

Background

Whilst the final end use of the proposed site is not known at this time it is understood that infiltration testing was required on the site in order to determine if infiltration forms of surface water disposal would be viable for the site.

Site Description

The site was accessed via an open access track off Canal Lane. The site was comprised of an irregularly shaped plot of land containing three rectangular open sided barns surrounded by areas of hardstanding along with stockpiles of waste material and soil towards the north west of site and a strip off grass along the north eastern boundary.

At the time of the intrusive investigation works the site appeared to be in use as a storage yard for working and scrap vehicles, disused welfare units, general agricultural machinery and general waste. The northernmost and the central barn were being utilised as hay storage with the southernmost barn being used to store agricultural machinery.

The land surrounding the site consisted of; residential properties to the south-east, south and southwest; with newly developed properties to the north-west, north and north east.

Whilst the final end use of the proposed site is not known at this time it is understood that infiltration testing was required on the site in order to determine if infiltration forms of surface water disposal would be viable for the site.

Encountered Conditions

The ground conditions encountered within each investigation locations were relatively consistent with those anticipated from published maps. A generalised summary of the encountered conditions is presented in Table 1.

Top (m bgl)	Base (m bgl)	Description
0.00	0.20	TOPSOIL: Firm brown silty very gravelly CLAY with frequent rootlets.
0.00	0.40	MADE GROUND: (TP2 & TP5 only) Brown silty sandy gravelly CLAY with frequent brick fragments and whole bricks.
0.20	1.00 - 1.11	MARLSTONE ROCK FORMATION: Brown clayey silty cobbley medium to coarse angular limestone and mudstone GRAVEL.
1.00 - 1.11	2.88+	MARLSTONE ROCK FORMATION: Black and reddish brown LIMESTONE rock. Recovered as brown very clayey gravelly limestone and mudstone COBBLES up to 300mm.

Table 1 Summary of ground conditions encountered within trial pit locations

Groundwater was not encountered within any of the exploratory holes during the intrusive investigation. Monitoring to determine any possible variation in groundwater levels over time did not form part of the scope of investigation.

The nature of the geology beneath the site meant that the proposed depth of 3m bgl for trial pits TP1, TP2, TP3 and TP7. A depth of 2.88m bgl was achieved within TP7 with the aid of a hydraulic breaker attachment, however there were no indications of more favourable conditions for soakaways at this depth. For further details of the ground conditions encountered, reference should be made to the trial pit logs included within Appendix A.

Soakage Testing

Soakage testing was undertaken broadly in accordance with BRE Digest 365 Soakaway Design in all seven trial pits, with testing limited to a single day as agreed with Steven Brown from Ambiential (Royal Haskoning DHV) while on site. Testing was undertaken in TP1, TP2, TP3 and TP7 at depths between 1.11m and 1.59m bgl, suitable for likely proposed conventional stormwater soakaways, deeper excavations were not achievable due to unfavourable geology beneath the site.

Testing in TP4, TP5 and TP6 was undertaken at depths between 0.59m and 0.67 bgl to inform the design of permeable pavement. It was only possible to complete a single test in each pit within the single day test period agreed.

The results of the testing are summarised in Table 2 below. The soakage test results are included within Appendix B.

Location	Pit depth (m bgl)	Permeability (m/s)		
		Test 1	Test 2	Test 3
TP1	1.59	Insufficient fall in water to complete test	Insufficient time for further testing	Insufficient time for further testing
TP2	1.11	Insufficient fall in water to complete test	Insufficient time for further testing	Insufficient time for further testing
TP3	1.32	Insufficient fall in water to complete test	Insufficient time for further testing	Insufficient time for further testing

TP4	0.59	Insufficient fall in water to complete test. *(Estimated time to complete one testing run approximately 10 hours)*	Insufficient time for further testing	Insufficient time for further testing
TP5	0.60	Insufficient fall in water to complete test *(Estimated time to complete one testing run approximately 10 hours 15 mins)*	Insufficient time for further testing	Insufficient time for further testing
TP6	0.67	Insufficient fall in water to complete test *(Estimated time to complete one testing run approximately 9 hours)*	Insufficient time for further testing	Insufficient time for further testing
TP7	2.88	Insufficient fall in water to complete test	Insufficient time for further testing	Insufficient time for further testing

Table 2 Summarised results of soakage testing

Conclusion

The soakage pits undertaken failed to complete a full drainage cycle within the single day or testing agreed. The deeper pits showed no movement of the water with very slow movement noted within the shallow pits. Therefore permeability values could not be derived from the soakage test results. In order to derive values for the shallow pits the test would likely need to run for in excess of 9 hrs.

As such it is considered that the use of soakaways are unlikely to be effective on the site. Alternative methods for storm water disposal should be sought or considered.

Closure

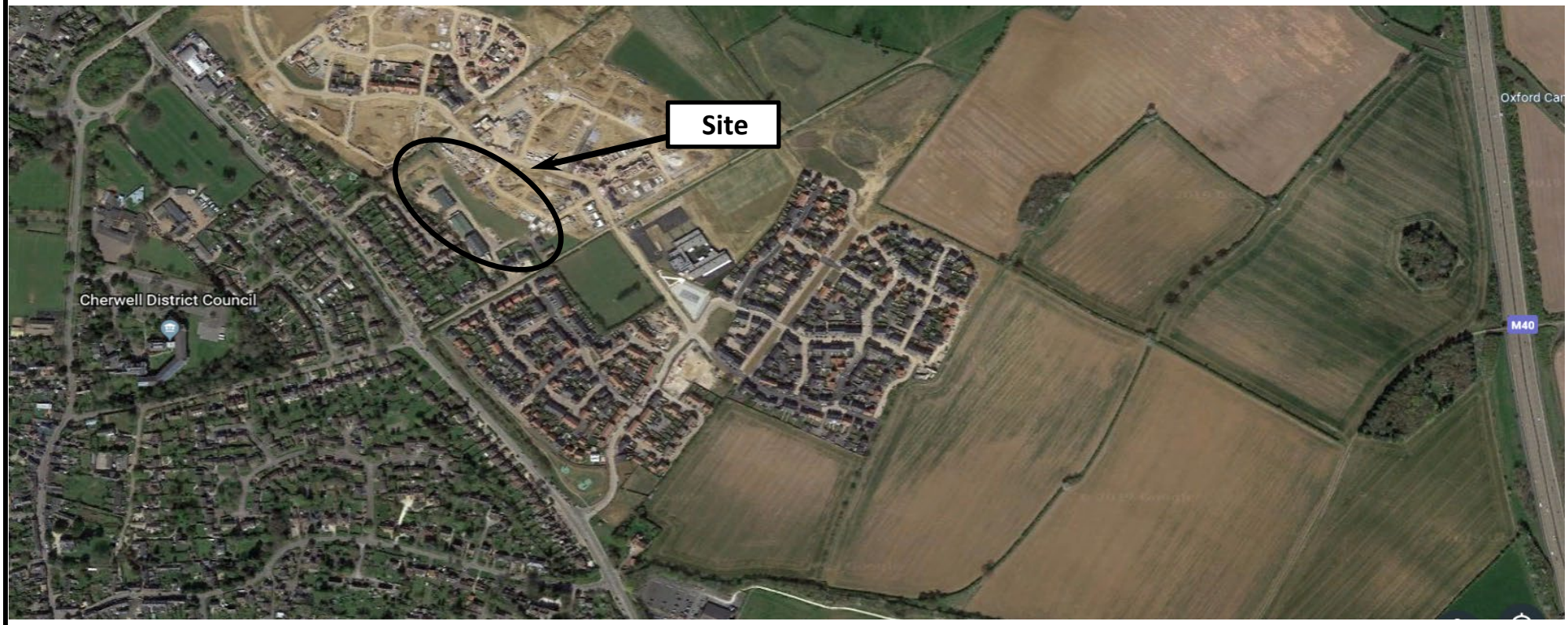
We trust we have interpreted your request correctly and provided sufficient information for your current requirements. Should you have any queries please do not hesitate to contact us.

Yours sincerely
For and on Behalf of Geo-Environmental

ROBERT GARDNER MSc, BSc (Hons), FGS
Consulting Engineer
robert.gardner@gesl.net

Enc
Figure 1 - Site Location Plan
Figure 2 - Exploratory Hole Location Plan
Appendix A - Exploratory Hole Logs
Appendix B - Soakage Test Results
Appendix C - Plates Sheet

FIGURES



Project:	Land at Deerfields Farm, Banbury OX15 4AD			**Title**	Site Location Plan
Client:	Royal Haskoning DHV			**Geo-Environmental Services Ltd** **Unit 7 Danworth Farm, Cuckfield Road** **Hurstpierpoint, West Sussex BN6 9GL** **+44(0)1273 832972 www.gesl.net**	Geo-Environmental
Ref No:	GE18402	**Revision:**	0		
Drawn:	LL	**Date:**	13/09/2019		
Figure:	1	**Scale:**	Not To Scale		

N

Project:	Land at Deerfields Farm, Banbury OX15 4AD			**Title**	Site Plan
Client:	Royal Haskoning DHV			**Geo-Environmental Services Ltd** **Unit 7 Danworth Farm, Cuckfield Road** **Hurstpierpoint, West Sussex BN6 9GL** **+44(0)1273 832972 www.gesl.net**	Geo-Environmental
Ref No:	GE18402	**Revision:**	0		
Drawn:	LL	**Date:**	13/09/2019		
Figure:	2	**Scale:**	Not To Scale		

Project:	Land at Deerfields Farm, Banbury			**Title**	Exploratory hole plan
Client:	Ambiental			**Geo-Environmental Services Ltd** **Unit 7 Danworth Farm, Cuckfield Road** **Hurstpierpoint, West Sussex BN6 9GL** **+44(0)1273 832972 www.gesl.net**	Geo-Environmental
Ref No:	GE18402	**Revision:**	v1		
Drawn:	RG	**Date:**	23/09/2019		
Figure:	1	**Scale:**	Not To Scale		

APPENDICES

Geo-Environmental
Unit 7, Danworth Farm
Hurstpierpoint
BN6 9GL
www.gesl.net

Trial Pit Log

TrialPit No: TP1
Sheet 1 of 1

Project Name: Deerfields, Banbury	Project No. GE18402	Co-ords: 446542.70 - 238272.26 Level: 120.75	Date 18/09/2019
Location: Deerfields Farm, Banbury, OX15 4AD		Dimensions (m): 2.00 × 0.60 Depth 1.59	Scale 1:25
Client: Ambiental / Royal Haskoning DHV			Logged RG

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	120.55		Grass over firm brown silty very gravelly CLAY with frequent rootlets. Gravel is medium to coarse angular limestone and mudstone. TOPSOIL
							Brown clayey silty cobbly medium to coarse angular limestone and mudstone GRAVEL. Cobbles are up to 300mm wide MARLSTONE ROCK FORMATION
				1.10	119.65		Black and reddish brown LIMESTONE rock. Recovered as brown very clayey gravelly limestone and mudstone COBBLES up to 300mm wide. Gravel is coarse angular limestone and mudstone. Dig refusal at 1.59m bgl. MARLSTONE ROCK FORMATION
				1.59	119.16		End of Pit at 1.59m

Water Strikes

Depth Strike	Rose to (mbgl)

Remarks: Dig Refusal at 1.59m bgl.

Stability

AGS

Geo-Environmental
Unit 7, Danworth Farm
Hurstpierpoint
BN6 9GL
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Trial Pit Log

TrialPit No
TP2
Sheet 1 of 1

Project Name: Deerfields, Banbury	Project No. GE18402	Co-ords: 446517.72 - 238256.34 Level: 120.52	Date 18/09/2019
Location: Deerfields Farm, Banbury, OX15 4AD		Dimensions (m): Depth 1.11, 0.45 x 2.00	Scale 1:25
Client: Ambiental / Royal Haskoning DHV			Logged RG

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							Hardstanding over brown silty sandy gravelly CLAY with frequent brick fragments and whole bricks. Sand is fmc. Gravel is fmc of brick, concrete and limestone. MADE GROUND
				0.40	120.12		Brown clayey silty cobbly medium to coarse angular limestone and mudstone GRAVEL. Cobbles are up to 300mm wide. Dig refusal at 1.11m bgl. MARLSTONE ROCK FORMATION
				1.11	119.41		End of Pit at 1.11m

1
2
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4
5

Water Strikes

Depth Strike	Rose to (mbgl)

Remarks Dig Refusal at 1.11m bgl.

Stability

AGS

Geo-Environmental
Unit 7, Danworth Farm
Hurstpierpoint
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Trial Pit Log

TrialPit No: TP3
Sheet 1 of 1

Project Name:	Deerfields, Banbury	Project No. GE18402	Co-ords: 446495.94 - 238337.30 Level: 121.41
Location:	Deerfields Farm, Banbury, OX15 4AD	Dimensions (m): Depth 1.32	0.45 × 2.00
Client:	Ambiental / Royal Haskoning DHV		Date 18/09/2019 Scale 1:25 Logged RG

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	121.21		Grass over firm brown silty very gravelly CLAY with frequent rootlets. Gravel is medium to coarse angular limestone and mudstone. TOPSOIL
							Brown clayey silty cobbly medium to coarse angular limestone and mudstone GRAVEL. Cobbles are up to 300mm wide MARLSTONE ROCK FORMATION
				1.00	120.41		Black and reddish brown LIMESTONE rock. Recovered as brown very clayey gravelly limestone and mudstone COBBLES up to 300mm wide. Gravel is coarse angular limestone and mudstone. Dig refusal at 1.32m bgl. MARLSTONE ROCK FORMATION
				1.32	120.09		End of Pit at 1.32m

1 2 3 4 5

Water Strikes

Depth Strike	Rose to (mbgl)

Remarks: Dig Refusal at 1.32m bgl.

Stability

AGS

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Unit 7, Danworth Farm
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BN6 9GL
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Trial Pit Log

TrialPit No
TP4
Sheet 1 of 1

Project Name: Deerfields, Banbury	Project No. GE18402	Co-ords: 446520.72 - 238300.54 Level: 121.08	Date 18/09/2019
Location: Deerfields Farm, Banbury, OX15 4AD		Dimensions (m): 1.50 × 0.45 Depth 0.59	Scale 1:25
Client: Ambiental / Royal Haskoning DHV			Logged RG

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	120.88		Grass over firm brown silty very gravelly CLAY with frequent rootlets. Gravel is medium to coarse angular limestone and mudstone. TOPSOIL
							Brown clayey silty cobbly medium to coarse angular limestone and mudstone GRAVEL. Cobbles are up to 200mm wide MARLSTONE ROCK FORMATION
				0.59	120.49		End of Pit at 0.59m

1
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5

Water Strikes

Depth Strike	Rose to (mbgl)

Remarks

Stability

AGS

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Unit 7, Danworth Farm
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Trial Pit Log

TrialPit No: TP5
Sheet 1 of 1

Project Name:	Deerfields, Banbury	Project No. GE18402	Co-ords: 446495.79 - 238292.67 Level: 120.90
Location:	Deerfields Farm, Banbury, OX15 4AD	Dimensions (m): Depth 0.60	1.50 × 0.45
Client:	Ambiental / Royal Haskoning DHV		Date: 18/09/2019 Scale: 1:25 Logged: RG

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							Grass over brown silty slightly gravelly CLAY with frequent rootlets and roots up to 20mm and rare scrap electrical cables. MADE GROUND
				0.40	120.50		
				0.60	120.30		Brown clayey silty cobbly medium to coarse angular limestone and mudstone GRAVEL. Cobbles are up to 200mm wide MARLSTONE ROCK FORMATION End of Pit at 0.60m

1
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Water Strikes

Depth Strike	Rose to (mbgl)

Remarks

Stability

AGS

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Unit 7, Danworth Farm
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Trial Pit Log

TrialPit No: TP6
Sheet 1 of 1

Project Name:	Deerfields, Banbury	Project No. GE18402	Co-ords: 446531.45 - 238285.24 Level: 120.91
Location:	Deerfields Farm, Banbury, OX15 4AD	Dimensions (m): Depth 0.67	1.50 × 0.45
Client:	Ambiental / Royal Haskoning DHV		Date 18/09/2019 Scale 1:25 Logged RG

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	120.71		Grass over firm brown silty very gravelly CLAY with frequent rootlets. Gravel is medium to coarse angular limestone and mudstone. TOPSOIL
							Brown clayey silty cobbly medium to coarse angular limestone and mudstone GRAVEL. Cobbles are up to 200mm wide MARLSTONE ROCK FORMATION
				0.67	120.24		End of Pit at 0.67m

1
2
3
4
5

Water Strikes

Depth Strike	Rose to (mbgl)

Remarks

Stability

AGS

Geo-Environmental
Unit 7, Danworth Farm
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Trial Pit Log

TrialPit No: TP7
Sheet 1 of 1

Project Name:	Deerfields, Banbury	Project No. GE18402	Co-ords: 446538.20 - 238277.73 Level: 120.81	Date 18/09/2019
Location:	Deerfields Farm, Banbury, OX15 4AD	Dimensions (m): Depth 2.88	2.50 × 1.50	Scale 1:25
Client:	Ambiental / Royal Haskoning DHV			Logged RG

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	120.61		Grass over firm brown silty very gravelly CLAY with frequent rootlets. Gravel is medium to coarse angular limestone and mudstone. TOPSOIL
							Brown clayey silty cobbly medium to coarse angular limestone and mudstone GRAVEL. Cobbles are up to 300mm wide MARLSTONE ROCK FORMATION
				1.10	119.71		Black and reddish brown LIMESTONE rock. Recovered as brown very clayey gravelly limestone and mudstone COBBLES up to 300mm wide. Gravel is coarse angular limestone and mudstone. (Breaker used to achieve depth) MARLSTONE ROCK FORMATION
				2.60	118.21		
				2.70	118.11		Black and reddish brown LIMESTONE rock. Recovered as brown clayey sandy gravelly limestone and mudstone COBBLES up to 300mm wide. Sand is fine. Gravel is coarse angular limestone and mudstone. (Breaker used to achieve depth) MARLSTONE ROCK FORMATION
				2.88	117.93		Black and reddish brown LIMESTONE rock. Recovered as brown very clayey gravelly limestone and mudstone COBBLES up to 300mm wide. Gravel is coarse angular limestone and mudstone. (Breaker used to achieve depth). Dig refusal at 2.88m bgl. MARLSTONE ROCK FORMATION
							End of Pit at 2.88m

Water Strikes

Depth Strike	Rose to (mbgl)

Remarks: Breaker used to achieve depth. Dig Refusal at 2.88m bgl.

Stability

AGS

Geo-Environmental	**Soakaway Test Results (after BRE Digest 365)**	**Geo-EnvironmentalServices Limited** **Unit 7 Danworth Farm, Cuckfield Road,** **Hurstpierpoint, West Sussex BN6 9GL** **+44(0)1273 832972 www.gesl.net**

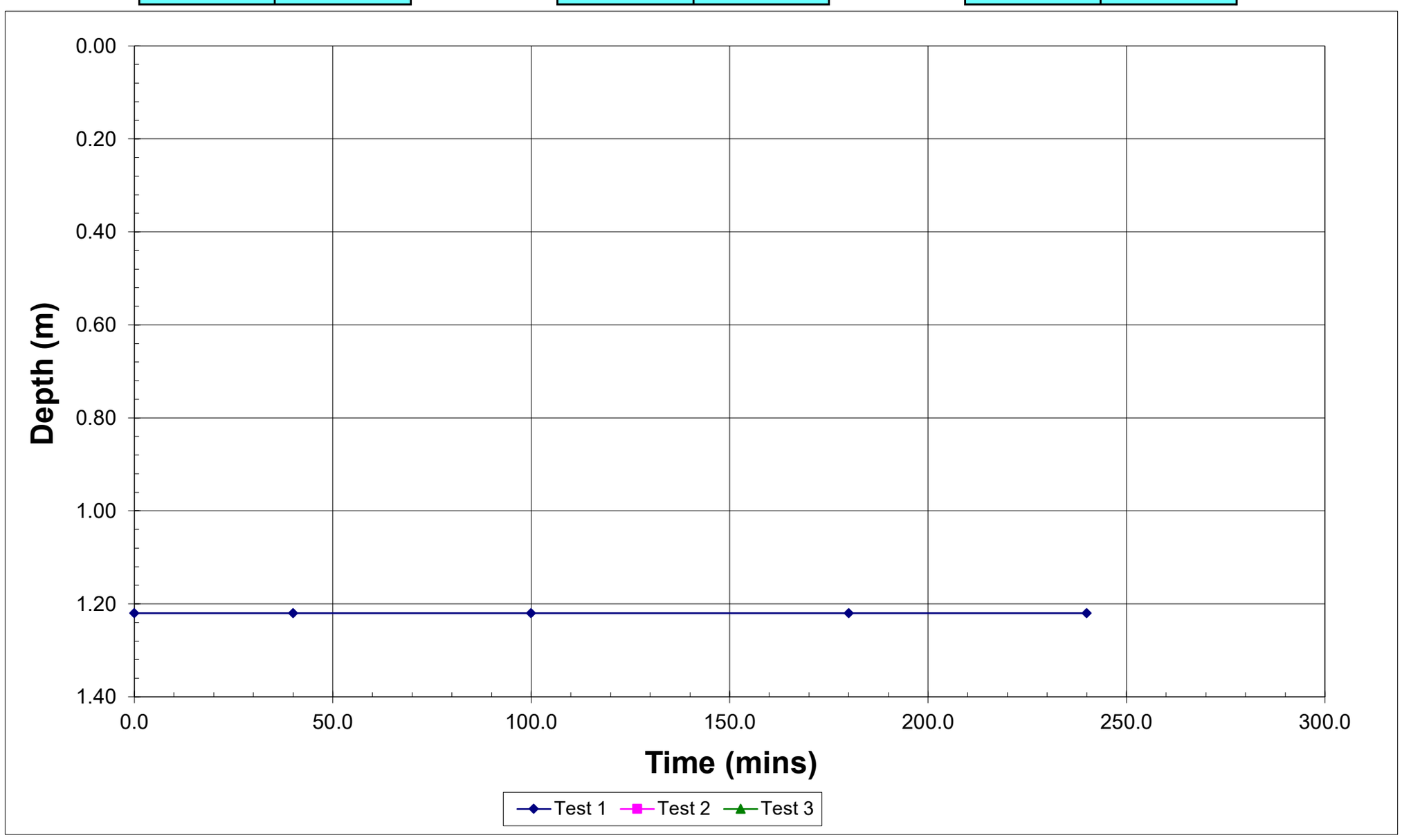
Project Name :	Deerfields, Banbury	**Job No. :**	GE18402
Client :	Ambiental / Royal Haskoning DHV	**Date :**	18/09/2019

Pit reference	**TP1**
Pit depth (m)	1.59
Pit width (m)	0.60
Pit length (m)	2.00
Depth to standing water (m)	

Test 1	
Time (min)	**Depth (m)**
0.0	1.22
40.0	1.22
100.0	1.22
180.0	1.22
240.0	1.22

Test 2	
Time (min)	**Depth (m)**

Test 3	
Time (min)	**Depth (m)**



	Test 1	Test 2	Test 3
Max. depth (m)	1.59	1.59	1.59
Effective depth (m)	0.37	1.59	1.59
75% effective depth (m)	1.31	0.40	0.40
50% effective depth (m)	1.41	0.80	0.80
25% effective depth (m)	1.50	1.19	1.19
t75 (min)			
t50 (min)			
t25 (min)			
Vp 75-25	0.22	0.95	0.95
ap 50	2.162	5.334	5.334
tp 75-25	0.00	0.00	0.00

Soil infiltration rate (m/s)	**Insufficient fall in water to complete test**	
Soil infiltration rate (mm/hr)	**Insufficient fall in water to complete test**	

Geo-Environmental	**Soakaway Test Results (after BRE Digest 365)**	**Geo-EnvironmentalServices Limited** **Unit 7 Danworth Farm, Cuckfield Road,** **Hurstpierpoint, West Sussex BN6 9GL** **+44(0)1273 832972 www.gesl.net**

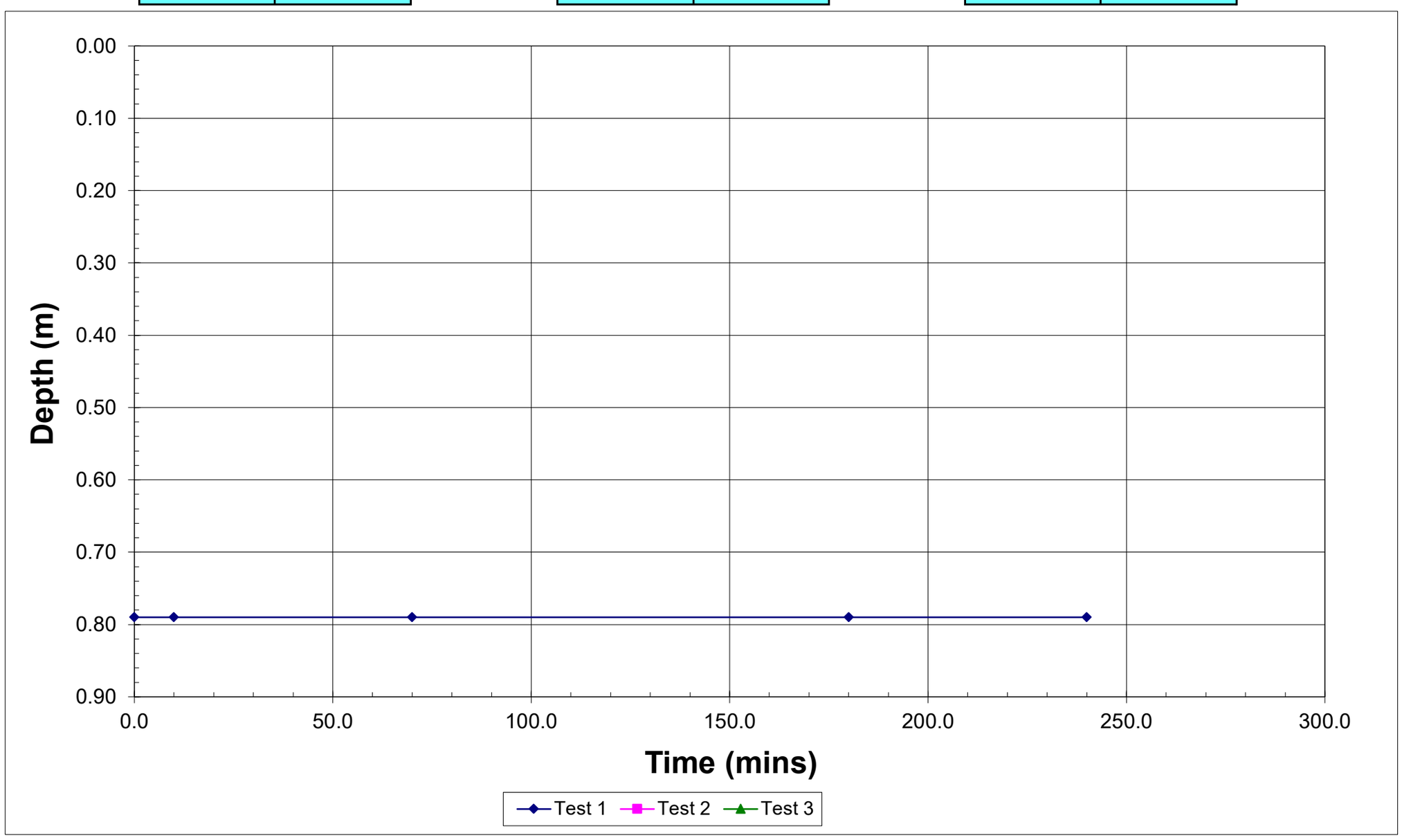
Project Name :	Deerfields, Banbury	**Job No. :**	GE18402
Client :	Ambiental / Royal Haskoning DHV	**Date :**	18/09/2019

Pit reference	**TP2**
Pit depth (m)	1.11
Pit width (m)	0.45
Pit length (m)	2.00
Depth to standing water (m)	

Test 1	
Time (min)	**Depth (m)**
0.0	0.79
10.0	0.79
70.0	0.79
180.0	0.79
240.0	0.79

Test 2	
Time (min)	**Depth (m)**

Test 3	
Time (min)	**Depth (m)**



Max. depth (m)	1.11	1.11	1.11
Effective depth (m)	0.32	1.11	1.11
75% effective depth (m)	0.87	0.28	0.28
50% effective depth (m)	0.95	0.56	0.56
25% effective depth (m)	1.03	0.83	0.83
t75 (min)			
t50 (min)			
t25 (min)			
Vp 75-25	0.14	0.50	0.50
ap 50	1.684	3.6195	3.6195
tp 75-25	0.00	0.00	0.00

Soil infiltration rate (m/s)	**Insufficient fall in water to complete test**	
Soil infiltration rate (mm/hr)	**Insufficient fall in water to complete test**	

Geo-Environmental	**Soakaway Test Results (after BRE Digest 365)**	**Geo-EnvironmentalServices Limited** **Unit 7 Danworth Farm, Cuckfield Road,** **Hurstpierpoint, West Sussex BN6 9GL** **+44(0)1273 832972 www.gesl.net**

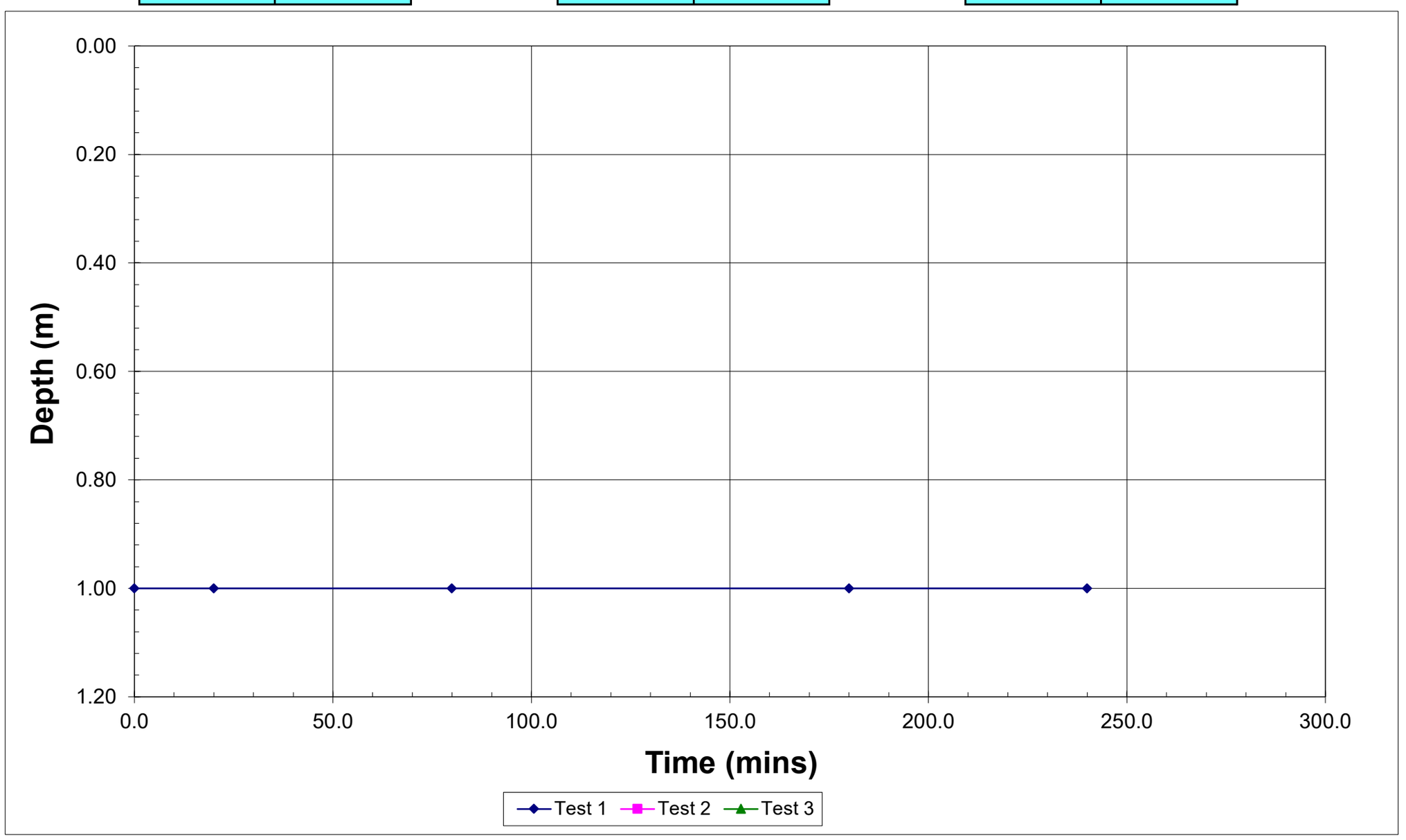
Project Name :	Deerfields, Banbury	**Job No. :**	GE18402
Client :	Ambiental / Royal Haskoning DHV	**Date :**	18/09/2019

Pit reference	**TP3**
Pit depth (m)	1.32
Pit width (m)	0.45
Pit length (m)	2.00
Depth to standing water (m)	

Test 1	
Time (min)	**Depth (m)**
0.0	1.00
20.0	1.00
80.0	1.00
180.0	1.00
240.0	1.00

Test 2	
Time (min)	**Depth (m)**

Test 3	
Time (min)	**Depth (m)**



	Test 1	Test 2	Test 3
Max. depth (m)	1.32	1.32	1.32
Effective depth (m)	0.32	1.32	1.32
75% effective depth (m)	1.08	0.33	0.33
50% effective depth (m)	1.16	0.66	0.66
25% effective depth (m)	1.24	0.99	0.99
t75 (min)			
t50 (min)			
t25 (min)			
Vp 75-25	0.14	0.59	0.59
ap 50	1.684	4.134	4.134
tp 75-25	0.00	0.00	0.00

Soil infiltration rate (m/s)	**Insufficient fall in water to complete test**	
Soil infiltration rate (mm/hr)	**Insufficient fall in water to complete test**	

Geo-Environmental	**Soakaway Test Results (after BRE Digest 365)**	**Geo-EnvironmentalServices Limited** **Unit 7 Danworth Farm, Cuckfield Road,** **Hurstpierpoint, West Sussex BN6 9GL** **+44(0)1273 832972 www.gesl.net**

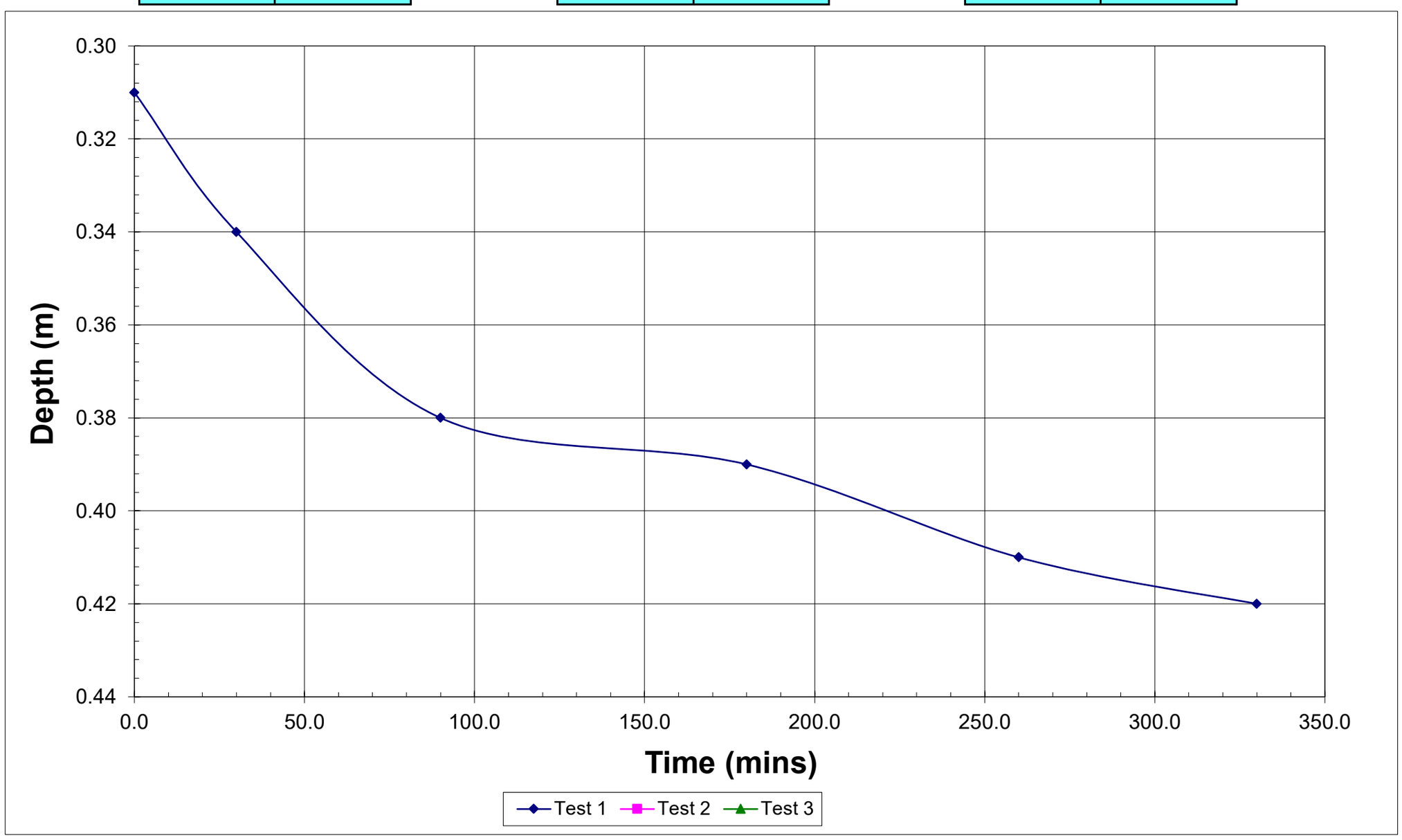
Project Name :	Deerfields, Banbury	**Job No. :**	GE18402
Client :	Ambiental / Royal Haskoning DHV	**Date :**	18/09/2019

Pit reference	**TP4**
Pit depth (m)	0.59
Pit width (m)	0.45
Pit length (m)	1.50
Depth to standing water (m)	

Test 1	
Time (min)	**Depth (m)**
0.0	0.31
30.0	0.34
90.0	0.38
180.0	0.39
260.0	0.41
330.0	0.42

Test 2	
Time (min)	**Depth (m)**

Test 3	
Time (min)	**Depth (m)**



Max. depth (m)	0.59	0.59	0.59
Effective depth (m)	0.28	0.59	0.59
75% effective depth (m)	0.38	0.15	0.15
50% effective depth (m)	0.45	0.30	0.30
25% effective depth (m)	0.52	0.44	0.44
t75 (min)	90.00		
t50 (min)	260.00		
t25 (min)	600.00		
Vp 75-25	0.09	0.20	0.20
ap 50	1.221	1.8255	1.8255
tp 75-25	510.00	0.00	0.00

Soil infiltration rate (m/s)	**2.5E-06**		
Soil infiltration rate (mm/hr)	**9.11E+00**		

Geo-Environmental	**Soakaway Test Results (after BRE Digest 365)**	**Geo-EnvironmentalServices Limited** **Unit 7 Danworth Farm, Cuckfield Road,** **Hurstpierpoint, West Sussex BN6 9GL** **+44(0)1273 832972 www.gesl.net**

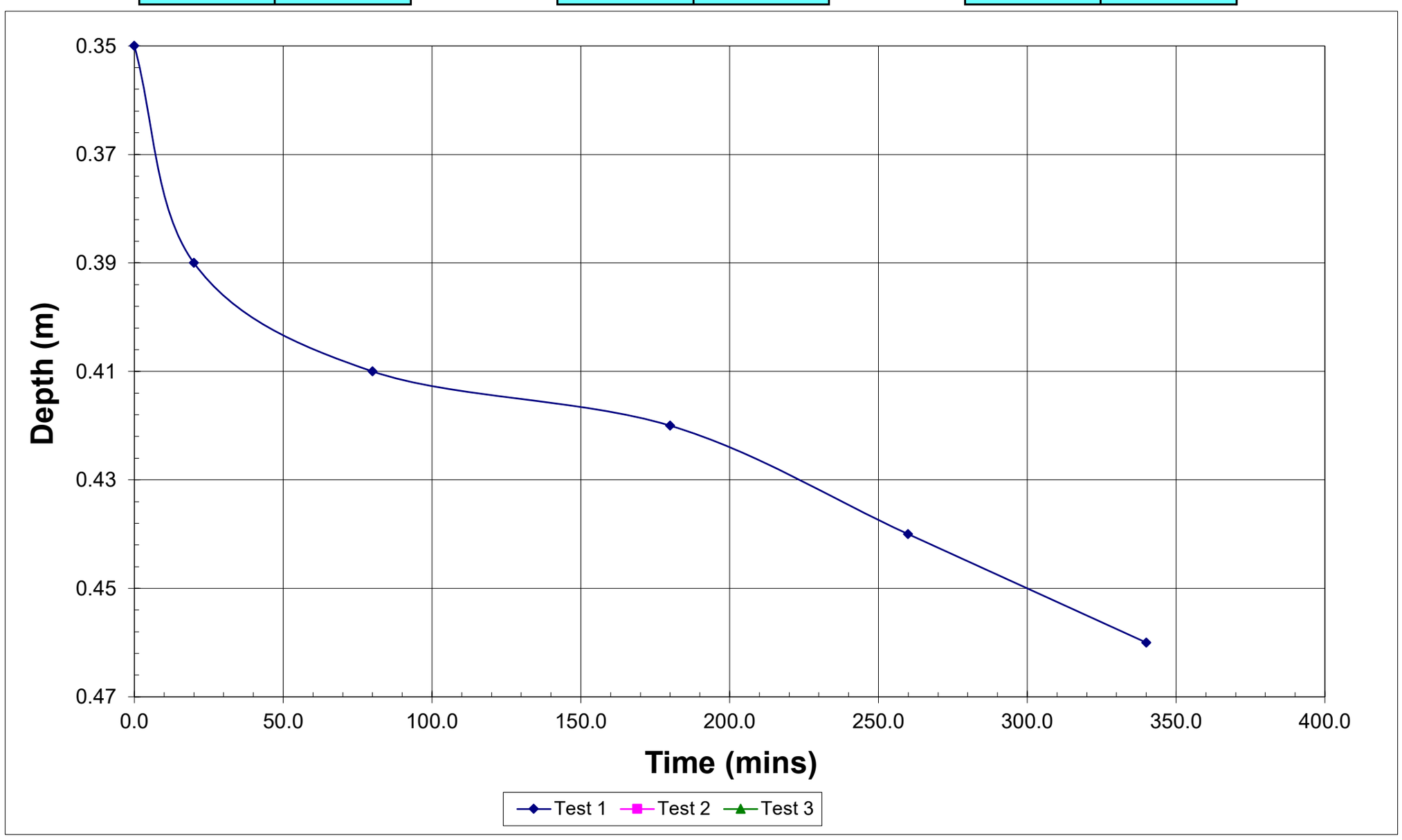
Project Name :	Deerfields, Banbury	**Job No. :**	GE18402
Client :	Ambiental / Royal Haskoning DHV	**Date :**	18/09/2019

Pit reference	**TP5**
Pit depth (m)	0.60
Pit width (m)	0.45
Pit length (m)	1.50
Depth to standing water (m)	

Test 1	
Time (min)	**Depth (m)**
0.0	0.35
20.0	0.39
80.0	0.41
180.0	0.42
260.0	0.44
340.0	0.46

Test 2	
Time (min)	**Depth (m)**

Test 3	
Time (min)	**Depth (m)**



Max. depth (m)	0.60	0.60	0.60
Effective depth (m)	0.25	0.60	0.60
75% effective depth (m)	0.41	0.15	0.15
50% effective depth (m)	0.48	0.30	0.30
25% effective depth (m)	0.54	0.45	0.45
t75 (min)	80.00		
t50 (min)	400.00		
t25 (min)	615.00		
Vp 75-25	0.08	0.20	0.20
ap 50	1.1625	1.845	1.845
tp 75-25	535.00	0.00	0.00

Soil infiltration rate (m/s)	**2.3E-06**		
Soil infiltration rate (mm/hr)	**8.14E+00**		

Geo-Environmental	**Soakaway Test Results (after BRE Digest 365)**	**Geo-EnvironmentalServices Limited** **Unit 7 Danworth Farm, Cuckfield Road,** **Hurstpierpoint, West Sussex BN6 9GL** **+44(0)1273 832972 www.gesl.net**

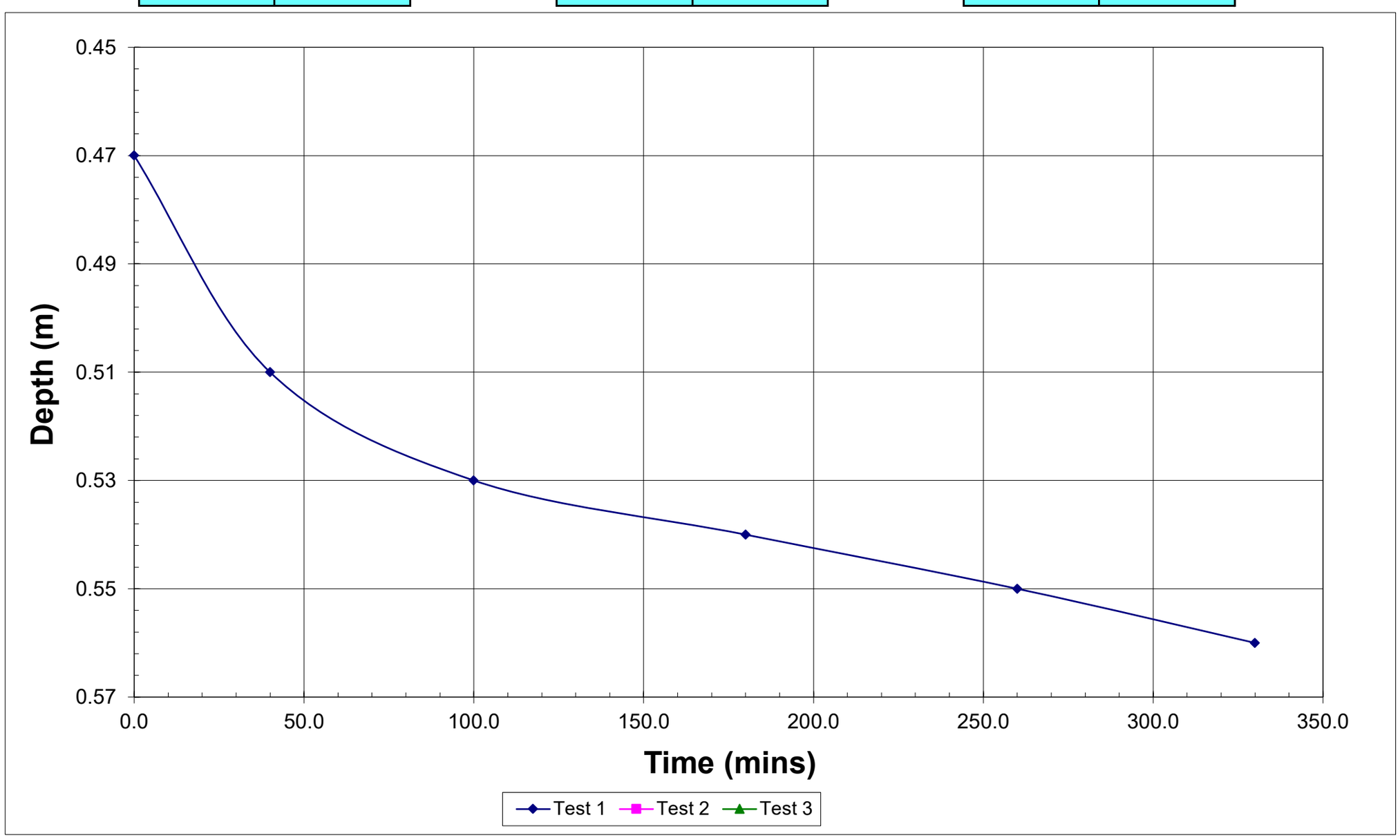
Project Name :	Deerfields, Banbury	**Job No. :**	GE18402
Client :	Ambiental / Royal Haskoning DHV	**Date :**	18/09/2019

Pit reference	**TP6**
Pit depth (m)	0.67
Pit width (m)	0.45
Pit length (m)	1.50
Depth to standing water (m)	

Test 1	
Time (min)	**Depth (m)**
0.0	0.47
40.0	0.51
100.0	0.53
180.0	0.54
260.0	0.55
330.0	0.56

Test 2	
Time (min)	**Depth (m)**

Test 3	
Time (min)	**Depth (m)**



Max. depth (m)	0.67	0.67	0.67
Effective depth (m)	0.20	0.67	0.67
75% effective depth (m)	0.52	0.17	0.17
50% effective depth (m)	0.57	0.34	0.34
25% effective depth (m)	0.62	0.50	0.50
t75 (min)	60.00		
t50 (min)	380.00		
t25 (min)	530.00		
Vp 75-25	0.07	0.23	0.23
ap 50	1.065	1.9815	1.9815
tp 75-25	470.00	0.00	0.00

Soil infiltration rate (m/s)	**2.2E-06**		
Soil infiltration rate (mm/hr)	**8.09E+00**		

Geo-Environmental	**Soakaway Test Results (after BRE Digest 365)**	**Geo-EnvironmentalServices Limited** **Unit 7 Danworth Farm, Cuckfield Road,** **Hurstpierpoint, West Sussex BN6 9GL** **+44(0)1273 832972 www.gesl.net**

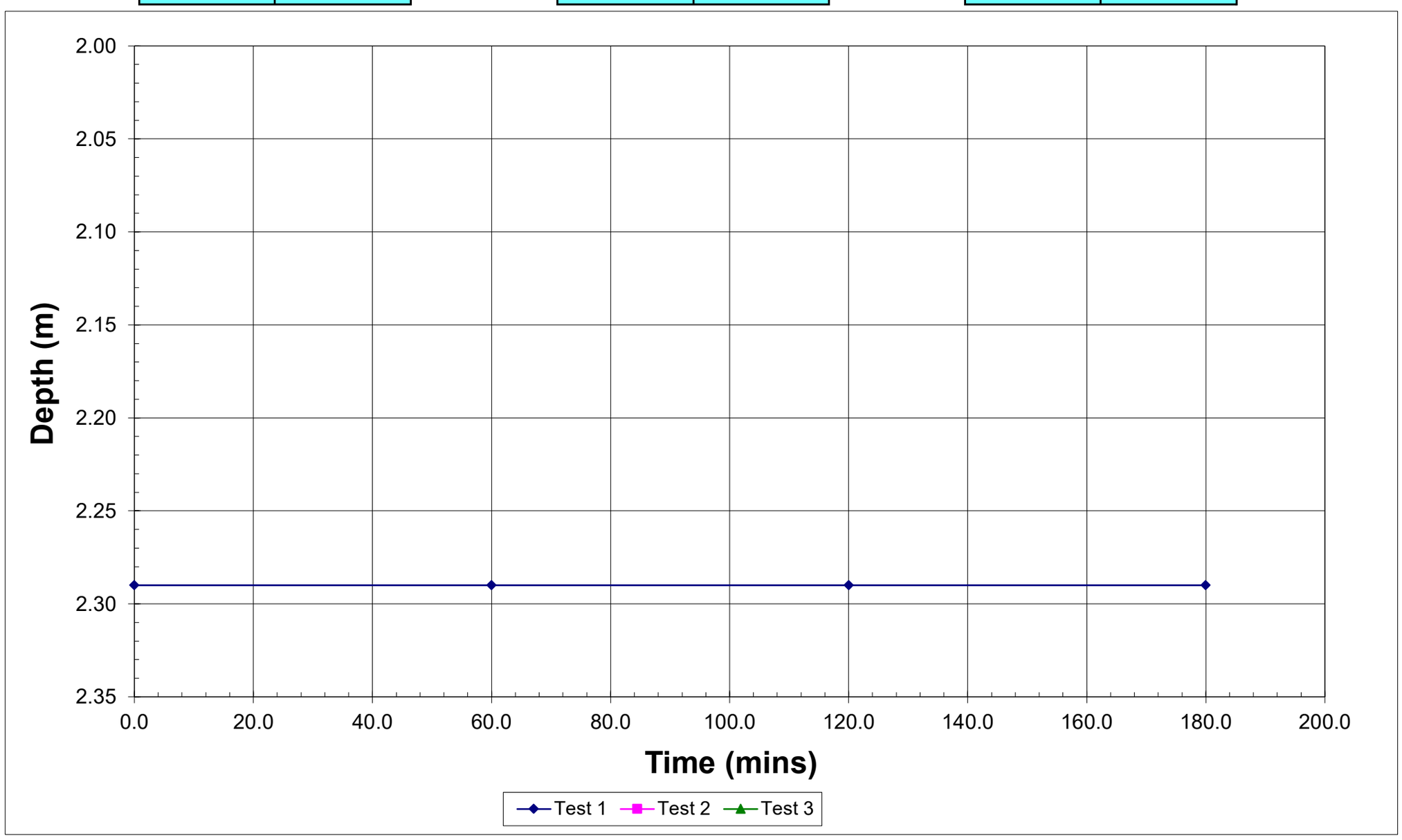
Project Name :	Deerfields, Banbury	**Job No. :**	GE18402
Client :	Ambiental / Royal Haskoning DHV	**Date :**	18/09/2019

Pit reference	**TP7**
Pit depth (m)	2.88
Pit width (m)	1.50
Pit length (m)	2.50
Depth to standing water (m)	

Test 1	
Time (min)	**Depth (m)**
0.0	2.29
60.0	2.29
120.0	2.29
180.0	2.29

Test 2	
Time (min)	**Depth (m)**

Test 3	
Time (min)	**Depth (m)**



	Test 1	Test 2	Test 3
Max. depth (m)	2.88	2.88	2.88
Effective depth (m)	0.59	2.88	2.88
75% effective depth (m)	2.44	0.72	0.72
50% effective depth (m)	2.59	1.44	1.44
25% effective depth (m)	2.73	2.16	2.16
t75 (min)			
t50 (min)			
t25 (min)			
Vp 75-25	1.11	5.40	5.40
ap 50	6.11	15.27	15.27
tp 75-25	0.00	0.00	0.00

Soil infiltration rate (m/s)	**Insufficient fall in water to complete test**	
Soil infiltration rate (mm/hr)	**Insufficient fall in water to complete test**	

Plate 1 inside southernmost barn

Plate 2 Grassy area looking north

Plate 3 Grassy area looking north-west

Plate 4 Location of TP2 between southernmost and central barn looking west

Plate 5 Storage area on western side of barns

Plate 6 Location of TP2 looking east

Plate 7 Storage area behind barns looking northwest

Plate 8 Northernmost barn

Plate 9 Location of TP5

Plate 10 Location of TP3 near stockpiled material

Plate 11 Grassy area looking south from position of TP3

Appendix III - CCTV Drainage Survey

Ambiental Environmental Assessment
Sussex Innovation Centre,
Science Park Square,
Brighton, BN1 9SB

Happy Drains Ltd
Unit 12A Chalex Industrial Estate, Manor Hall Road, Southwick, BN42 4NH
Tel: 0800 849 8099 Email: service@happydrains.co.uk

Ref C0011385

Date 21/10/2019

Royal Haskoning DHV
Deerfields Farm
Canal Lane
Bodicote
Banbury
OX15 4FU

Dear Sir/Madam

1. DESCRIPTION OF PROPERTY

Detached Residential Property

2. DRAINAGE SYSTEM

This is a foul drainage system accessible by Manhole. The pipework is circular in shape, 100-150MMmm in diameter and both pvc & vitrified clay material. Further specific variations can be found in the report content.

3. SHARED

The sections identified within the property boundary are for the sole use of this property and therefore the responsibility of the site owner to maintain.

The sections as shared or beyond the property boundary generally are the legal responsibility of the local water company to maintain.

4. CIRCUMSTANCES

- A pre-purchase requirement

5. Summary

No defects were noted and the system is in a sound structural condition.

If you require more information or wish to discuss this matter, please contact us.

Yours sincerely

Happy Drains Ltd

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Section Inspection - MH1X

Section	Inspection	Date	Time	Client`s Job Ref	Weather	Pre Cleaned	PLR
1	1	21/10/19	6:19	C0011385	No Rain Or Snow	Yes	MH1X

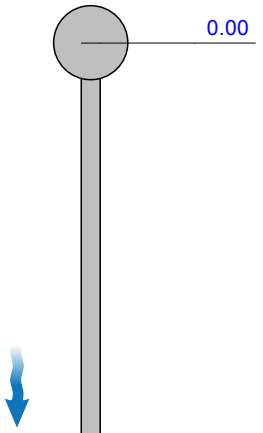
Operator	Vehicle	Camera	Preset Length	Criticality Grade	Alternative ID
ROB	HVL CITY FLEX	Solopro 2	Not Specified	Category A	Not Specified

Town or Village:	Bodicote	**Inspection Direction:**	Downstream	**Upstream Node:**	MH1
Road:	Canal Lane	**Inspected Length:**	4.54 m	**Upstream Pipe Depth:**	0.650 m
Location:	Road	**Total Length:**	4.54 m	**Downstream Node:**	MH2
Surface Type:	Asphalt Footway	**Joint Length:**	0.80 m	**Downstream Pipe Depth:**	0.750 m

Use:	Combined	**Pipe Shape:**	Circular		
Type of Pipe:	Gravity drain/sewer	**Dia/Height:**	100 mm	**Width:**	100 mm
Year Constructed:		**Material:**	Vitrified clay pipe		
Flow Control:	No flow control	**Lining Type:**	No Lining		
Inspection Purpose:	Routine inspection of condition	**Lining Material:**	No Lining		

Comments:
Recommendations:

Scale: **1:50** **Position [m]** **Code** **Observation** **Grade**



0.00m // 00:00:00 //
MH1X_90d1a7f8-ad48-46c9-81

4.54m // //
MH1X_d52715a9-a497-4f09-b4

Construction Features					Miscellaneous Features				
Structural Defects					Service & Operational Observations				
STR No. Def	**STR Peak**	**STR Mean**	**STR Total**	**STR Grade**	**SER No. Def**	**SER Peak**	**SER Mean**	**SER Total**	**SER Grade**
0	0.0	0.0	0.0	1.0	0	0.0	0.0	0.0	1.0

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service@happydrains.co.uk

Section Inspection - FMH1X

Section	Inspection	Date	Time	Client`s Job Ref	Weather	Pre Cleaned	PLR
2	2	21/10/19	6:30	C0011385	No Rain Or Snow	Yes	FMH1X

Operator	Vehicle	Camera	Preset Length	Criticality Grade	Alternative ID
ROB	HVL CITY FLEX	Solopro 2	Not Specified	Category A	Not Specified

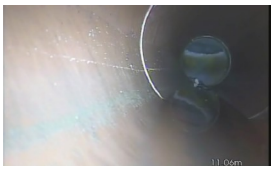
Town or Village:	Bodicote	**Inspection Direction:**	Downstream	**Upstream Node:**	FMH1
Road:	Canal Lane	**Inspected Length:**	11.06 m	**Upstream Pipe Depth:**	1.240 m
Location:	Road	**Total Length:**	11.06 m	**Downstream Node:**	FMH2
Surface Type:	Asphalt Footway	**Joint Length:**	0.80 m	**Downstream Pipe Depth:**	1.350 m

Use:	Foul	**Pipe Shape:**	Circular		
Type of Pipe:	Gravity drain/sewer	**Dia/Height:**	150 mm	**Width:**	150 mm
Year Constructed:	2019	**Material:**	Polyvinyl chloride		
Flow Control:	No flow control	**Lining Type:**	No Lining		
Inspection Purpose:	Routine inspection of condition	**Lining Material:**	No Lining		

Comments:
Recommendations:

Scale: 1:97	Position [m]	Code	Observation	Grade
Depth: 1.24 m				
FMH1				
	0.00	MH	Start node type, manhole, reference number: FMH1	
	11.06	MHF	Finish node type, manhole, reference number: FMH2	
FMH2				
Depth: 1.35 m				

0.00m // 00:00:00 //
FMH1X_3dc80f27-cb19-461a-8



11.06m // //
FMH1X_c6eef368-103e-4b4d-a

Construction Features					Miscellaneous Features				
Structural Defects					Service & Operational Observations				
STR No. Def	**STR Peak**	**STR Mean**	**STR Total**	**STR Grade**	**SER No. Def**	**SER Peak**	**SER Mean**	**SER Total**	**SER Grade**
0	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0

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Section Inspection - FMH2X

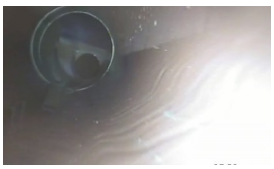
Section	Inspection	Date	Time	Client`s Job Ref	Weather	Pre Cleaned	PLR
3	3	21/10/19	6:37	C0011385	No Rain Or Snow	Yes	FMH2X

Operator	Vehicle	Camera	Preset Length	Criticality Grade	Alternative ID
ROB	HVL CITY FLEX	Solopro 2	Not Specified	Category A	Not Specified

Town or Village:	Bodicote	**Inspection Direction:**	Downstream	**Upstream Node:**	FMH2
Road:	Canal Lane	**Inspected Length:**	16.89 m	**Upstream Pipe Depth:**	1.350 m
Location:	Road	**Total Length:**	16.89 m	**Downstream Node:**	FMH3
Surface Type:	Asphalt Footway	**Joint Length:**	0.00 m	**Downstream Pipe Depth:**	1.420 m

Use:	Foul	**Pipe Shape:**	Circular		
Type of Pipe:	Gravity drain/sewer	**Dia/Height:**	150 mm	**Width:**	150 mm
Year Constructed:	2019	**Material:**	Polyvinyl chloride		
Flow Control:	No flow control	**Lining Type:**	No Lining		
Inspection Purpose:	Routine inspection of condition	**Lining Material:**	No Lining		

Comments:
Recommendations:

Scale: 1:147	Position [m]	Code	Observation	Grade
Depth: 1.35 m FMH2	0.00	MH	Start node type, manhole, reference number: FMH2	 0.00m // 00:00:00 // FMH2X_904a0489_ac54_4b07
				 0.00m // 00:00:00 // FMH2X_69014f6e_ce29_4b45_9
	16.89	MHF	Finish node type, manhole, reference number: FMH3	
FMH3 Depth: 1.42 m				

Construction Features					Miscellaneous Features				
Structural Defects					Service & Operational Observations				
STR No. Def	**STR Peak**	**STR Mean**	**STR Total**	**STR Grade**	**SER No. Def**	**SER Peak**	**SER Mean**	**SER Total**	**SER Grade**
0	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0

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Section Inspection - FMH3X

Section	Inspection	Date	Time	Client`s Job Ref	Weather	Pre Cleaned	PLR
4	4	21/10/19	6:44	C0011385	No Rain Or Snow	Yes	FMH3X

Operator	Vehicle	Camera	Preset Length	Criticality Grade	Alternative ID
ROB	HVL CITY FLEX	Solopro 2	Not Specified	Category A	Not Specified

Town or Village:	Bodicote	**Inspection Direction:**	Downstream	**Upstream Node:**	FMH3
Road:	Canal Lane	**Inspected Length:**	8.96 m	**Upstream Pipe Depth:**	1.420 m
Location:	Road	**Total Length:**	8.96 m	**Downstream Node:**	FMH4
Surface Type:	Asphalt Footway	**Joint Length:**	0.80 m	**Downstream Pipe Depth:**	1.560 m

Use:	Foul	**Pipe Shape:**	Circular		
Type of Pipe:	Gravity drain/sewer	**Dia/Height:**	150 mm	**Width:**	150 mm
Year Constructed:	2019	**Material:**	Polyvinyl chloride		
Flow Control:	No flow control	**Lining Type:**	No Lining		
Inspection Purpose:	Routine inspection of condition	**Lining Material:**	No Lining		

Comments:
Recommendations:

Scale: 1:78	Position [m]	Code	Observation	Grade
Depth: 1.42 m FMH3	0.00	MH	Start node type, manhole, reference number: FMH3	 0.00m // 00:00:00 // FMH3X_04b08466-ead5-46db
	8.96	MHF	Finish node type, manhole, reference number: FMH4	 8.96m // // FMH3X_ebb1e29c-a5f8-4ecd-b
FMH4 Depth: 1.56 m				

Construction Features					Miscellaneous Features				
Structural Defects					Service & Operational Observations				
STR No. Def	**STR Peak**	**STR Mean**	**STR Total**	**STR Grade**	**SER No. Def**	**SER Peak**	**SER Mean**	**SER Total**	**SER Grade**
0	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0

Land at Deerfields Farm - Canal Lane - Bodicote - Banbury - OX15 4FU

Appendix IV - Surface Water Calculations and Drawing

Ambiental Environmental Assessment
Sussex Innovation Centre,
Science Park Square,
Brighton, BN1 9SB

HR Wallingford
Working with water

Greenfield runoff estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	
Site name:	4748
Site location:	OX15 4FU

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site coordinates

Latitude:	52.04109° N
Longitude:	1.32309° W

Reference:	
Date:	2019-08-02 12:19

Methodology	IH124

Site characteristics

Total site area (ha)	1

Methodology

Qbar estimation method	Calculate from SPR and SAAR
SPR estimation method	Calculate from SOIL type

	Default	Edited
SOIL type	4	4
HOST class	---	---
SPR/SPRHOST	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm)	654	654
Hydrological region	6	6
Growth curve factor: 1 year	0.85	0.85
Growth curve factor: 30 year	2.3	2.3
Growth curve factor: 100 year	3.19	3.19

Notes:

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

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

Where flow rates are less than 5.0 l/s consents are usually set at 5.0l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set in which case blockage work must be addressed by using appropriate drainage elements

(3) Is SPR/SPRHOST ≤ 0.3?

Greenfield runoff rates

	Default	Edited
Qbar (l/s)	4.46	4.46
1 in 1 year (l/s)	3.79	3.79
1 in 30 years (l/s)	10.26	10.26
1 in 100 years (l/s)	14.22	14.22

Surface water storage requirements for sites

www.uksuds.com | Storage estimation tool

Calculated by:	Steven Brown
Site name:	4748
Site location:	OX15 4FU

This is an estimation of the storage volume requirements that are needed to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). It is not to be used for detailed design of drainage systems. It is recommended that hydraulic modelling software is used to calculate volume requirements and design details before finalising the design of the drainage scheme.

Site Details

Latitude:	52.04346° N
Longitude:	1.31692° W
Reference:	959433478
Date:	Oct 29 2019 14:53

Site characteristics

Total site area (ha):	0.474
Significant public open space (ha):	0
Area positively drained (ha):	0.474
Impermeable area (ha):	0.474
Percentage of drained area that is impermeable (%):	100
Impervious area drained via infiltration (ha):	0
Return period for infiltration system design (year):	10
Impervious area drained to rainwater harvesting (ha):	0
Return period for rainwater harvesting system (year):	10
Compliance factor for rainwater harvesting system (%):	66
Net site area for storage volume design (ha):	0.47
Net impermable area for storage volume design (ha):	0.47
Pervious area contribution to runoff (%):	30

* where rainwater harvesting or infiltration has been used for managing surface water runoff such that the effective impermeable area is less than 50% of the 'area positively drained', the 'net site area' and the estimates of Q_{BAR} and other flow rates will have been reduced accordingly.

Methodology

esti	IH124
Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	4	4
SPR:	0.47	0.47

Hydrological characteristics

	Default	Edited
Rainfall 100 yrs 6 hrs:	--	63
Rainfall 100 yrs 12 hrs:	--	91.63
FEH / FSR conversion factor:	1.19	1.19
SAAR (mm):	654	654
M5-60 Rainfall Depth (mm):	20	20
'r' Ratio M5-60/M5-2 day:	0.4	0.4
Hydological region:	6	6
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 10 year:	1.62	1.62
Growth curve factor 30 year:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Q_{BAR} for total site area (l/s):	2.11	2.11
Q_{BAR} for net site area (l/s):	2.11	2.11

Design criteria

Climate change allowance factor:	1.4
Urban creep allowance factor:	1.1
Volume control approach	Use long term storage
Interception rainfall depth (mm):	5
Minimum flow rate (l/s):	2.2

Site discharge rates

	Default	Edited
1 in 1 year (l/s):	2.2	2.2
1 in 30 years (l/s):	4.9	4.9
1 in 100 year (l/s):	6.7	6.7

Estimated storage volumes

	Default	Edited
Attenuation storage 1/100 years (m³):	326	326
Long term storage 1/100 years (m³):	64	64
Total storage 1/100 years (m³):	390	390

Science Park Square
Brighton
East Sussex

Date 30/10/2019 11:21 | Designed by Mark.Naumann
File 4748 2019-10-30 v006.MDX | Checked by
XP Solutions | Network 2018.1

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	30	PIMP (%)	100
M5-60 (mm)	19.800	Add Flow / Climate Change (%)	0
Ratio R	0.412	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	0	Maximum Backdrop Height (m)	5.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.333	4-8	0.079

Total Area Contributing (ha) = 0.412

Total Pipe Volume (m³) = 11.230

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	61.424	0.205	299.6	0.095	4.00	0.0	0.600	o	375	Pipe/Conduit	
S2.000	13.078	0.044	297.2	0.095	4.00	0.0	0.600	o	375	Pipe/Conduit	
S1.001	26.646	0.089	299.4	0.194	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.002	3.311	0.011	301.0	0.027	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	0.00	4.98	118.400	0.095	0.0	0.0	0.0	1.04	115.0	0.0
S2.000	0.00	4.21	118.239	0.095	0.0	0.0	0.0	1.05	115.5	0.0
S1.001	0.00	5.41	118.195	0.385	0.0	0.0	0.0	1.04	115.1	0.0
S1.002	0.00	5.51	118.106	0.412	0.0	0.0	0.0	0.57	10.1	0.0

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S1	120.000	1.600	Open Manhole	2100	S1.000	118.400	375				
S2	120.000	1.761	Open Manhole	2100	S2.000	118.239	375				
S2	120.000	1.805	Open Manhole	2100	S1.001	118.195	375	S1.000	118.195	375	
								S2.000	118.195	375	
S3	120.000	1.894	Open Manhole	2100	S1.002	118.106	150	S1.001	118.106	375	
S	120.000	1.905	Open Manhole	0		OUTFALL		S1.002	118.095	150	

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.017	0.017	0.017
	User	-	100	0.007	0.007	0.024
	User	-	100	0.007	0.007	0.031
	User	-	100	0.004	0.004	0.035
	User	-	100	0.007	0.007	0.041
	User	-	100	0.050	0.050	0.091
	User	-	100	0.005	0.005	0.095
2.000	User	-	100	0.011	0.011	0.011
	User	-	100	0.008	0.008	0.019
	User	-	100	0.006	0.006	0.025
	User	-	100	0.012	0.012	0.037
	User	-	100	0.058	0.058	0.095
1.001	User	-	100	0.014	0.014	0.014
	User	-	100	0.015	0.015	0.029
	User	-	100	0.016	0.016	0.045
	User	-	100	0.009	0.009	0.053
	User	-	100	0.015	0.015	0.069
	User	-	100	0.006	0.006	0.075
	User	-	100	0.007	0.007	0.082
	User	-	100	0.007	0.007	0.090
	User	-	100	0.076	0.076	0.166
	User	-	100	0.006	0.006	0.172
	User	-	100	0.005	0.005	0.177
	User	-	100	0.010	0.010	0.188
	User	-	100	0.005	0.005	0.193
	User	-	100	0.002	0.002	0.194
1.002	User	-	100	0.027	0.027	0.027
				Total	Total	Total
				0.412	0.412	0.412

Simulation Criteria for Storm

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.800	Storm Duration (mins)	30
Ratio R	0.412		

Online Controls for Storm

Orifice Manhole: S3, DS/PN: S1.002, Volume (m³): 9.3

Diameter (m) 0.028 Discharge Coefficient 0.600 Invert Level (m) 118.106

Storage Structures for Storm

Porous Car Park Manhole: S1, DS/PN: S1.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	20.0
Membrane Percolation (mm/hr)	1000	Length (m)	20.0
Max Percolation (l/s)	111.1	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	119.400	Membrane Depth (mm)	0

Porous Car Park Manhole: S2, DS/PN: S2.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	20.0
Membrane Percolation (mm/hr)	1000	Length (m)	20.0
Max Percolation (l/s)	111.1	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	119.400	Membrane Depth (mm)	0

Porous Car Park Manhole: S2, DS/PN: S1.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	25.0
Membrane Percolation (mm/hr)	1000	Length (m)	25.0
Max Percolation (l/s)	173.6	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	119.400	Membrane Depth (mm)	0

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	19.800
Region	England and Wales	Ratio R	0.411
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	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
S1.000	S1	480 Winter	1	+0%	1/30 Summer				119.427	0.652	0.000
S2.000	S2	480 Winter	1	+0%	1/15 Winter				119.428	0.814	0.000
S1.001	S2	480 Winter	1	+0%	1/15 Summer				119.427	0.857	0.000
S1.002	S3	480 Winter	1	+0%	1/15 Summer				119.425	1.169	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.01		0.8	SURCHARGED	
S2.000	S2	0.01		0.8	SURCHARGED	
S1.001	S2	0.02		2.2	SURCHARGED	
S1.002	S3	0.17		1.8	SURCHARGED	

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	19.800
Region	England and Wales	Ratio R	0.411
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	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
S1.000	S1	480 Winter	30	+0%	1/30 Summer				119.614	0.839	0.000
S2.000	S2	480 Winter	30	+0%	1/15 Winter				119.615	1.001	0.000
S1.001	S2	480 Winter	30	+0%	1/15 Summer				119.614	1.044	0.000
S1.002	S3	480 Winter	30	+0%	1/15 Summer				119.617	1.361	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.01		0.8	SURCHARGED	
S2.000	S2	0.01		0.8	SURCHARGED	
S1.001	S2	0.03		2.8	SURCHARGED	
S1.002	S3	0.19		1.9	SURCHARGED	

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 19.800	Cv (Summer) 0.750
Region	England and Wales	Ratio R 0.411	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	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
S1.000	S1	960 Winter	100	+40%	1/30 Summer				119.919	1.144	0.000
S2.000	S2	960 Winter	100	+40%	1/15 Winter				119.919	1.305	0.000
S1.001	S2	960 Winter	100	+40%	1/15 Summer				119.919	1.349	0.000
S1.002	S3	960 Winter	100	+40%	1/15 Summer				119.923	1.667	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.01		0.7	FLOOD RISK	
S2.000	S2	0.01		0.7	FLOOD RISK	
S1.001	S2	0.02		2.2	FLOOD RISK	
S1.002	S3	0.21		2.1	FLOOD RISK	

1. GENERAL

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MAYWEED ROAD

SILVERWEED R

INDICATIVE LOCATION OF EXISTING SURFACE WATER SEWER WITH SPUR INTO SITE.
DEPTH TO INVERT 1.93M
ANY WORKS TO THIS CHAMBER TO BE CO-ORDINATE WITH THE SEWER AUTHORITY

LOCATION TO BE CONFIRMED THROUGH TOPOGRAPHIC SURVEY.

FLOW CONTROL CHAMBER (S3)
COVER LEVEL 120.0 mAOD (TBC)
INVERT LEVEL 118.1 mAOD

ORIFICE DIAMETER 0.028m (28mm)
PREDICTED 1:100 + 40% FLOW RATE: 2.1 L/S.
HYDROBRAKE TO BE CONSIDERED AS AN ALTERNATIVE TO INCREASE FLOW CONTROL OPENING SIZE AND REDUCE THE RISK OF BLOCKAGE. TO BE CONFIRMED AT DETAILED DESIGN.

S-03

S-02

S-01

Play

Area

MERLIN CLOSE

1

7

11

ED 84y

ACCESS ROAD TO BE DRAINED BY GULLIES AND INTO THE MAIN NETWORK. RUNOFF FROM ACCESS ROAD CONSIDERED AS PART OF THE ATTENUATION CALCULATION FOR THE PERMEABLE PAVEMENT.

NOTE: IF SURFACE WATER CONNECTION TO SILVERWEED ROAD SEWER IS NOT AGREED. CONNECTION TO THE CANAL LANE PUBLIC COMBINED SEWER WOULD BE PROGRESSED UNDER S106 OF THE WATER INDUSTRY ACT.

HOWEVER THE CONNECTION TO THE NEW SURFACE WATER SEWER IN SILVERWEED ROAD WOULD BE PREFERRED.

ALL PRIVATE DRIVES AND THE COURTYARD AREAS AT EACH END OF THE SCHEME HAVE BEEN DESIGNED AS PERMEABLE PAVING WITH A 600MM CONSTRUCTION DEPTH AND 30% VOID RATIO.

THE PERMEABLE PAVING WOULD BE UNDERLAIN BY A PERFORATED PIPE, WITH A RODDING EYE AT THE UPSTREAM END TO PROVIDE MAINTENANCE ACCESS.

LEGEND

	PRIVATE SURFACE WATER DRAIN
	PERFORATED SURFACE WATER DRAIN
	MANHOLE / INSPECTION CHAMBER
	FLOW CONTROL MANHOLE
	EXISTING MANHOLE / INSPECTION CHAMBER
RE	RODDING EYE
	PERMEABLE PAVING

REV	DATE	BY	CKD	APP	DESCRIPTION
##	XX.XX.XX	--	--	--	--

PRELIMINARY DRAWING
FOR INFORMATION ONLY. NOT FOR CONSTRUCTION.

Client
BROWN AND CO.

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Project
DEERFIELD FARM
OX15 4FU

Drawing
SURFACE WATER DRAINAGE STRATEGY
DRAINAGE LAYOUT - SHEET 1 OF 2

Drawn by: SB Date: NOV - 2019

Drawing No. 4748 - DR01 Revision -

Drawing Scale: 1:200 @ A1
0 2m 4m 6m 8m 10m

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LEGEND

	PRIVATE SURFACE WATER DRAIN
	PERFORATED SURFACE WATER DRAIN
	MANHOLE / INSPECTION CHAMBER
	FLOW CONTROL MANHOLE
	EXISTING MANHOLE / INSPECTION CHAMBER
RE	RODDING EYE
	PERMEABLE PAVING

REV	DATE	BY	CKD	APP'D	DESCRIPTION
##	xx.xx.xx	..	..	..	

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Project
DEERFIELD FARM
OX15 4FU

Drawing
SURFACE WATER DRAINAGE STRATEGY
DRAINAGE LAYOUT - SHEET 2 OF 2

Drawn by: SB Date: NOV - 2019

Drawing No. 4748 - DR02 Revision -

Drawing Scale: 1:200 @ A1
0 2m 4m 6m 8m 10m

Drawing No: \\GN4fs\pro\4748\A\EA\PROJECTS\4748_RIHDHV_Deerfields\Plans\AMB\4748-001.dwg