

**Flood Risk Assessment
and SuDS Statement**
June 2024



**Hillcrest and Tussucks
The Causeway
Therfield**

Hanson Services Ltd

Document History

JOB NUMBER: 4405/2024
DOCUMENT REF: Hillcrest & Tussucks FRA & SuDS
REVISIONS: A

Revision	Comments	By	Checked	Authorised	Date
A	Client Draft	RC	JC	MD	17.06.2024
B					
C					
D					
E					
F					

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The content of this report is based on information available as of June 2024, the validity of the statements made may therefore vary over time as planning guidance / policies and the evidence base change.

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1 Introduction

- 1.1 EAS has been commissioned to provide a Flood Risk Assessment and SuDS report to inform a planning application for a residential development on land at Hillcrest and Tussucks, The Causeway, Therfield, SG8 9PP (Grid Ref: TL 33591 37377) (hereafter referred to as 'the site').
- 1.2 The full planning application is for the construction of 7 residential dwellings with associated landscaping and parking.
- 1.3 This report will directly address comments received from the Lead Local Flood Authority in relation to a withdrawn application at the site (planning reference: 23/02417/FP).
- 1.4 The site location plan is included in **Appendix A** and the proposed development plans are in **Appendix B**.
- 1.5 The site is wholly located in Flood Zone 1 on the Flood Map for Planning. Flood Zone 1 is defined as having a less than a 0.1% (1 in 1,000) annual probability of river flooding. The site is located outside of all modelled surface water flood extents. This report will assess all sources of flooding and detail mitigation measures where necessary.
- 1.6 This FRA also includes a surface water drainage strategy to demonstrate compliance with national and local policy requirements.
- 1.7 The contents of this FRA are based on the advice set out in the National Planning Policy Framework (NPPF) last updated December 2023, Annex 3: Flood risk vulnerability classification, also from the NPPF and PPG 'Guidance for Flood Risk and Coastal Change', updated in August 2022.
- 1.8 This report is based on the Environment Agency flood maps, geology mapping, OS mapping, topographic survey, Strategic Flood Risk Assessment, and national & local policy.
- 1.9 This document includes the following sections:
 - Section 2 - describes the relevant policy;
 - Section 3 - site description, including site levels, proximity to watercourses etc.;
 - Section 4 - outlines potential sources of flooding;
 - Section 5 – details the proposed drainage strategy;
 - Section 6 – includes suitable maintenance and management measures;
 - Section 7 – identifies a high-level approach to surface water drainage and groundwater protection during the construction phase; and
 - Section 8 – summarises and concludes the report.

2 Policy Context

Introduction

2.1 This section sets out the policy context. This report is based on the advice set out in the National Planning Policy Framework (NPPF) last updated December 2023 and the Planning Practical Guidance (PPG) updated in August 2022.

2.2 Paragraph 173 footnote 59 of the NPPF states:

“A site-specific flood risk assessment should be provided for all developments in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.”

2.3 The flood zones are defined as:

- Flood Zone 1 - less than a 0.1% (1 in 1000) annual probability of river or tidal flooding.
- Flood Zone 2 - between a 0.1% and 1% (1 in 1000 and 1 in 100) annual probability of river flooding; or between a 0.1% and 0.5% (1 in 1000 and 1 in 200) annual probability of flooding from tidal sources.
- Flood Zone 3a- This zone comprises land assessed as having a 1% (1 in 100) or greater annual probability of river flooding; and for tidal flooding at least a 0.5% (1 in 200) annual probability of flooding from tidal sources.
- Flood Zone 3b - This zone comprises land where water has to flow or be stored in times of flood. This classification is usually classified as land which had a 3.33% (1 in 30) annual probability of flooding.

2.4 Paragraph 165 discusses the suitability of development location, particularly with regards to future risks induced by climate change:

“Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere”.

2.5 Paragraph 166 of the National Planning Policy Framework (NPPF) sets out how:

“Strategic policies should be informed by a strategic flood risk assessment, and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards”.

2.6 Paragraphs 175 NPPF discusses the application of sustainable drainage systems:

“Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:

- a. Take account of advice from the lead local flood authority;*
- b. Have appropriate proposed minimum operational standards;*
- c. Have maintenance arrangements in place to ensure an acceptable standard of operation of the lifetime of the development; and*
- d. Where possible, provide multifunctional benefits.”*

2.7 The site is shown to be located within the Flood Zone 1 on the Flood Map for Planning. Flood Zone 1 is defined as having a less than 0.1% annual probability of river flooding.

2.8 The EA Flood Map has been enclosed in **Appendix C**.

Local Policy

North Herts Local Plan 2011-2031

2.9 The North Herts Local Plan was adopted in November 2022.

2.10 Policy NE7: Reducing Flood Risk

Planning permission for development proposals will be granted provided that (as applicable):

- a) Development is located outside of medium and high-risk flood areas (flood zone 2 and 3) and other areas affected by other sources of flooding where possible;*
- b) Where (a) is not possible, application of the sequential and exception tests is demonstrated where development is proposed in areas of flood risk using the Strategic Flood Risk Assessment (SFRA) and Environment Agency flood maps;*
- c) A FRA has been prepared in accordance with national guidance that considers the lifetime of the development, climate change impacts and safe access and egress; North Hertfordshire Local Plan 2011-2031 159*
- d) It will be located, designed and laid out to ensure the risk of flooding is reduced whilst not increasing flood risk elsewhere;*
- e) The impact of any residual flood risk will be minimised through flood resistant, resilient design and construction;*
- f) Any flood protection and mitigation measures necessary will not cause harm to nature conservation, heritage assets, and/ or landscape and recreation and, where possible, will have a positive impact in these respects; and*
- g) Overland flow routes and functional floodplain areas are protected from all development other than that which is “water compatible” and this must be designed and constructed*

to remain operational and safe for users during flood events, resulting in no net loss of flood plain storage and not impeding water flows or increasing flood risk elsewhere.

2.11 Policy NE8: Sustainable Drainage Systems

Planning permission for development will be granted provided that:

- a) The most appropriate sustainable drainage solution is used taking into account technical, viability and design issues to reduce the risk of surface water flooding, enhance biodiversity, water quality and provide amenity benefits;*
- b) It aims to mimic the natural drainage patterns and processes as far as possible; and*
- c) Drainage solutions follow the SuDS hierarchy.*

North Hertfordshire District Council Strategic Flood Risk Assessment 2008 (Updated in Sep 2016)

- 2.12 The North Hertfordshire SFRA was updated in 2016 as a result of improved accuracy of mapping information following the 2008 document.
- 2.13 In both the original and updated SFRA, the site has not been specifically detailed to have experienced historic fluvial flooding or sewer flooding.

Hertfordshire Interactive Flood Risk Management Viewer

- 2.14 Hertfordshire provides an interactive mapping website which displays the difference sources of flood risk across Hertfordshire County. The result of this mapping in relation to the proposed site is outlined below.
- 2.15 The interactive map can be viewed here: <https://webmaps.hertfordshire.gov.uk/waterman/index.htm>.
- 2.16 The mapping confirms the site is located in Flood Zone 1.
- 2.17 There are no Hertfordshire County Council recorded incidents of flooding at the site. There is a recorded incident of flooding approximately 200m south of the site within Police Row however no further details have been provided.
- 2.18 There are no 'Main Rivers' or 'Ordinary Watercourses' at or within the vicinity of the site.
- 2.19 The site is not located within a 'Surface Water Management Plan Hotspot'.
- 2.20 The site remains outside the 30yr, 100yr and 1000yr modelled surface water flood extents.
- 2.21 The site is not located in an areas considered to be susceptible to groundwater flooding.

3 Existing Site Assessment

Site Description

- 3.1 EAS has been commissioned to provide a Flood Risk Assessment and SuDS report to inform a planning application for a residential development on land at Hillcrest and Tussucks, The Causeway, Therfield, SG8 9PP (Grid Ref: TL 33591 37377). The site location plan is included in **Appendix A**.
- 3.2 Proposals consist of the construction of 7 dwellings. The proposed development plans are in **Appendix B**.
- 3.3 The site currently consists of a two-storey residential dwelling and ancillary buildings with grassed areas and areas of hardstanding.
- 3.4 The site is bound to the north and west by residential dwellings. To the south the site is bound by a school with residential dwellings beyond. To the east the site is bound by undeveloped agricultural land.

Local Watercourses

- 3.5 A pond is located to the immediate south-east of the site. Whilst the topographical survey did not identify any incoming pipes or headwalls, it is assumed that the pond currently serves the existing property.
- 3.6 There are no 'Ordinary Watercourses' or 'Main Rivers' within the site or within the vicinity of the site.
- 3.7 There are no other large waterbodies e.g. reservoirs within the vicinity of the site.

Site Levels

- 3.8 The topographic survey is included in **Appendix D**. The site falls from around 167.5mAOD in the north-eastern corner to around 162.0mAOD in the south-western corner. This results in an average fall across the site of 1 in 17.
- 3.9 The dwellings are primarily proposed in areas between 167mAOD and 164mAOD.

Geology

- 3.10 With reference to the British Geological Survey, the site is located within an area with a bedrock of Lewes Nodular Chalk Formation and Seaford Chalk Formation – chalk with superficial deposits of Lowestoft Formation - diamicton.

Infiltration Tests

- 3.11 Infiltration tests were undertaken in April 2023 and the investigation report is enclosed in **Appendix E**. A total of 5 trial pits were dug varying in depth from 1.8m to 2.2m.

- 3.12 Topsoil was present to a maximum depth of 0.55mbgl at TP01, TP02 and TP04 and is described as being 'dark brown slightly gravelly clay with rootlets'. Made ground was present at surface level at TP03 and TP05 with the base of the made ground layer reaching a maximum depth of 1mbgl at the location of TP04. Lowestoft Formation was present at all trial pit locations and was present to a maximum depth of 2.2mbgl at TP05.
- 3.13 Infiltration tests were conducted in line with BRE365 and for 4 out of the 5 pits, only a single test was able to be performed due to poor infiltration rates. Testing was carried out for the required 3 times at TP05.
- 3.14 TR05 was dug to a depth of 2.2m and at around 0.8m below ground level a layer of 'structureless white chalk' was discovered. TP04 also recorded the presence of 'coarse chalk' at a depth of 1m below ground level. The slowest rate recorded was 4.29×10^{-6} m/s.
- 3.15 As the majority of the trial pits failed, pursuing a shallow infiltration strategy is not considered to be viable. Nonetheless, the presence of chalk suggests a borehole strategy could be feasible and is discussed in more detail in section 5 of this report.
- 3.16 Groundwater was not encountered in all 5 trial pits.
- 3.17 Also included in **Appendix E** is a local borehole log reference TL33NW7. This borehole record shows the Upper Chalk Strata is around 10ft (3m) below ground level.

Public Sewer Mapping

- 3.18 Thames Water sewer mapping was obtained and is enclosed in **Appendix F**.
- 3.19 There are no adopted surface water sewers within the local area.
- 3.20 A 50mmdia combined rising main is present across the northern half of the site and flows west into MH5302 (CL:165.24 IL:163.91) in the north-western corner of the site.
- 3.21 A 150mmdia foul sewer flows south within The Causeway.

4 Potential Sources of Flooding

Fluvial

- 4.1 A copy of the Environment Agency's Flood Map for Planning is enclosed in **Appendix C**. The site is shown to be wholly located in Flood Zone 1. Flood Zone 1 is defined as having a less than 0.1% annual probability of river flooding (1 in 1000).

Surface Water

- 4.2 Surface water flooding refers to flooding caused when the intensity of rainfall, particularly in urban areas, can create runoff which temporarily overwhelms the capacity of the local drainage systems or does not infiltrate into the ground. The water ponds on the ground and flows towards low-lying land. This source of flood risk is also known as 'pluvial'.
- 4.3 The EA long term risk maps (available on the GOV.UK website) show the site remains outside all modelled surface water flood extents. The low-risk scenario indicates an annual probability of surface water flooding between 1% and 0.1%, (i.e. the least frequent but worst-case scenario). In this scenario there is limited flooding within The Causeway with depths below 300mm to the south of the site access and as such access and egress will continue to be available.
- 4.4 A copy of the Long-Term Flood Map is enclosed in **Appendix G**.

Reservoir

- 4.5 The site is not located within a reservoir flood extent on the Long-Term Flood Map.

Groundwater

- 4.6 Onsite investigations did not encounter groundwater and the Hertfordshire Interactive Flood Risk Management Viewer revealed the site is not in a location where there is a susceptibility to groundwater flooding.
- 4.7 With reference to Defra's Magic Map (available at: <https://magic.defra.gov.uk/magicmap.aspx>) the site is located above a Principal Aquifer. A Principle Aquifer is defined as:
- "strategically important rock units that have high permeability and water storage capacity"*
- 4.8 The site is located in an area with medium to high groundwater vulnerability and a soluble rock risk is also present. A geotechnical engineer alongside further borehole investigations and confirmation of the chalk density will inform the parameters in which a borehole soakaway would need to be installed.
- 4.9 The sustainable drainage system will need to ensure sufficient treatment stages are present to manage pollution from runoff and to prevent the mobilisation of pollutants that could find a pathway to the groundwater.

Sewer

- 4.10 The closest manhole to the site located within The Causeway is MH5301 and this has a cover level of 163.73mAOD. Levels within the site and in the location of the proposed properties ranging from 164mAOD up to 167mAOD and therefore should a sewer flood occur, flows would remain within the carriageway and would be unable to flow into the site.
- 4.11 There is a residual risk posed by the diverted foul rising main within the site. The indicative diversionary route is via the internal access road therefore should a sewer flood occur flows may remain within the carriageway. However, all properties have a finished floor level 150mm above the surrounding ground level providing a level of protection.

Summary

- 4.12 The site is considered to be at low risk of all assessed sources of flooding and no specific mitigation measures are considered to be required.

5 Proposed SuDS Strategy

Relevant SuDS Policy

- 5.1 SuDS mimic natural drainage patterns and provide a method of surface water drainage which can decrease the quantity of water discharged, and hence reduce the risk of flooding. SuDS design should meet the “four pillars” of SuDS of: water quantity, water quality, amenity and biodiversity, wherever possible.
- 5.2 The SuDS management train incorporates a hierarchy of techniques and considers all three SuDS criteria of flood reduction, pollution reduction, and landscape and wildlife benefits. In decreasing order of preference, the preferred means of disposal of surface water runoff is:
 - Discharge to ground.
 - Discharge to a surface water body.
 - Discharge to a surface water sewer.
 - Discharge to a combined sewer.
- 5.3 The philosophy of SuDS is to replicate as closely as possible the natural drainage from a site predevelopment and to treat runoff to remove pollutants, resulting in a reduced impact on the receiving watercourses. The benefits of this approach are as follows:
 - Reducing runoff rates, thus reducing the flood risk downstream;
 - Reducing pollutant concentrations, thus protecting the quality of the receiving water body;
 - Groundwater recharge;
 - Contributing to the enhanced amenity and aesthetic value of development areas; and
 - Providing habitats for wildlife in developed areas, and opportunity for biodiversity enhancement.

Surface Water Drainage Parameters

- 5.4 The following best practice design parameters have been considered:
 - The local 2070s ‘Upper End’ Climate Change allowance is 40% and has been applied to the hydraulic drainage network design.
 - The Hydraulic Model has been for a 1:2yr Storm Event, 1:30yr Storm Event, 1:30yr + 40% Climate Change Event, 1:100yr Storm Event and 1:100yr + 40% Climate Change Storm Event.
 - FEH22 rainfall data has been used.
 - The CV Value for Winter and Summer storms has been set to 1.0.

- A 5min time of entry has been used.
- 10% urban creep allowance has been applied to the roof area, totalling 60.7m².
- Half-Drain Time – In line with Hertfordshire's LLFA Guidelines, lined devices (tanks and lined ponds, lined permeable paving) to half-drain within 48hrs (2880mins) and unlined devices are to half-drain in 24 hrs (1440 mins).
- Exceedance Routes – Exceedance routes shall be demonstrated.

Pre-Development Runoff Rates and Discharge Volumes - Greenfield

5.5 Greenfield runoff rates were estimated using the ReFH2 method on the Causeway Flow software. The results of which are included in **Appendix H**. The proposed impermeable area of the site is 0.1785ha, the following greenfield runoff rates for a range of storm events have been scaled accordingly:

- 1 in 2 year – 4.8l/s/ha – 0.9 l/s
- 1 in 30 year – 13.1l/s/ha – 2.3 l/s
- 1 in 100 year – 17.0l/s/ha – 3.0 l/s

5.6 Greenfield runoff volumes in the 1 in 100 year, 360 minute storm scenario is 35.1m³.

Post Development Runoff Rate

- 5.7 The proposal seeks to infiltrate to ground via 2 deep bore soakaways. An average generic rate of 1x10⁻⁴ m/s for chalk has been utilised.
- 5.8 Deep bore soakaway testing is being undertaken to confirm infiltration rates.

Site Specific SuDS

The various SuDS methods have been considered in relation to site-specific constraints. Table 5.1 outlines the constraints and opportunities to each of the SuDS devices in accordance with the hierarchical approach outlined in The SUDS Manual CIRIA C753. It also indicates what could and could not be incorporated within the development, based upon site-specific criteria.

Device	Description	Constraints / Comments	Appropriate
Living roofs (source control)	Provide soft landscaping at roof level which reduces surface water runoff.	Not suitable for the pitch of residential roofs.	No
Infiltration devices & Soakaways (source control)	Store runoff and allow water to percolate into the ground via natural infiltration.	A deep bore soakaway has been proposed.	Yes

Pervious surfaces (source control)	Storm water is allowed to infiltrate through the surface into a storage layer, from which it can either infiltrate and/or slowly release to sewers.	Where site levels allow, permeable paving has been proposed.	Yes
Rainwater harvesting (source control)	Reduces the annual average rate of runoff from the Site by reusing water for non-potable uses e.g., toilet flushing, recycling processes.	Water butts are proposed to the rear of each property	Possibly
Swales (permeable conveyance)	Broad shallow channels that convey / store runoff, and allow infiltration (ground conditions permitting).	No proposed	No
Filter drains & perforated pipes (permeable conveyance)	Trenches filled with granular materials (which are designed to take flows from adjacent impermeable areas) that convey runoff while allowing infiltration.	Not proposed	No
Infiltration basins (end of pipe treatment)	Depressions in the surface designed to store runoff and allow infiltration.	Spatial constraints and poor shallow infiltration rates means this feature has not been proposed.	No
Wet ponds & constructed wetlands (end of pipe treatment)	Provide water quality treatment & temporary storage above the permanent water level.	Spatial constrains means this feature has not been proposed	No
Attenuation Underground (end of pipe treatment)	Oversized pipes or geo-cellular tanks designed to store water below ground level.	Attenuation storage tanks are proposed where necessary.	Yes
Raingardens	Rain gardens are relatively small depressions in the ground that can act as infiltration points for roof water and other 'clean' surface water.	A raingarden planter has been proposed for each property	Yes

Table 5.1 - Site-Specific Sustainable Drainage Techniques

Borehole Testing

- 5.9 This report and the surfaced water drainage strategy will be updated upon receipt of the borehole test results.

Proposed SuDS Strategy

- 5.10 Based the absence of adopted surface water sewers or a watercourse in the vicinity of the site, discharge of surface water to ground via infiltration appears to be the only option available to drain surface water runoff. Shallow infiltration has been proven unsuccessful and therefore a borehole soakaway has been proposed.
- 5.11 As outlined in Table 5.1 above, a number of SuDS Features shall be utilised to form the Surface Water Drainage Strategy in order to meet the 4 Pillars of SuDS.
- Water Quantity – Permeable Paving, Attenuation Storage Tanks, Raingarden Planters and Rainwater Harvesting Butts;

- Water Quality – Permeable Paving, Raingarden Planters and Rainwater Harvesting Butts;
 - Biodiversity – Raingarden Planters.
 - Amenity – Raingarden Planters.
- 5.12 The proposed strategy consists of directing roof runoff into permeable paving subbase where possible. All road areas are to be permeable paving, split into 4 sections based on the site topography. Surface water flows are then to be directed to two borehole soakaways to the rear of plot 5.
- 5.13 To provide further attenuation, two geocellular storage tanks are proposed.
- 5.14 The permeable paving is to provide 60.1m³ of storage and the tanks provide 111.5m³ of storage. This storage is sufficient to manage all storm events up to and including a 1 in 100 + 40%CC storm event. The Causeway Flow outputs are included in **Appendix H** and the proposed SuDS layout is contained in **Appendix I**.
- 5.15 The attenuation features within the site meet the requirements to half drain within 24hrs following a 100yr plus 40% climate change storm event. As such no additional long-term storage is required.
- 5.16 Where flows cannot pass through the permeable paving subbase, a downstream defender is proposed to ensure suitable pollution mitigation.
- 5.17 A foul water rising main is present through the northern half of the site. As two dwellings are proposed on the route of this rising main, a diversion is proposed running to the south of plot 5 and along the road, reconnecting to the existing sewer run to the west of plot 4.
- 5.18 A maintenance strip is to be provided to allow access to the borehole soakaways and diverted rising main.

Exceedance Events

- 5.19 The proposed surface water drainage strategy is designed to accommodate a 1:100yr + 40% climate change storm event. In the unlikely scenario where a storm event exceeds in excess of a 1 in 100 + 40%CC storm event, exceedance flows shall be directed away from the residential buildings. Flows will follow the topography of the site in a south-westerly direction. The exceedance flow routes are included on a plan in **Appendix I**.

Water Quality

- 5.20 The drainage system has been designed in order to meet the water quality requirements set out by Table 26.2 of the CIRIA SuDS Manual C753 which sets out the specific pollution hazard indices for different surfaces.
- 5.21 Tables 5.3 below identifies the different levels of pollution hazard indices to be mitigated.

Land Use	Hazard Level	Pollution Hazard Indices		
		Suspended Solids	Metals	Hydrocarbons
Residential roofs	Very low	0.2	0.2	0.05
Individual property driveways and low traffic roads	Low	0.5	0.4	0.4
Pollution Mitigation Required		0.5	0.4	0.4

Table 5.3 Land Use Pollution Hazard Ratings. Extracted from the CIRIA SuDS Manual C753 Simple Index Approach Tool

SuDS Component	Pollution Mitigation Indices		
	Suspended Solids	Metals	Hydrocarbons
Permeable Paving	0.7	0.6	0.7

Table 5.4 Land Use Pollution Hazard Ratings. Extracted from the CIRIA SuDS Manual C753 Simple Index Approach Tool

- 5.22 From Table 5.3 – 5.4 above, the permeable paving will meet the required level of pollution mitigation is provided and exceeded for removing total suspended solids, metals and hydrocarbons from the surface water runoff.
- 5.23 A further stage of treatment is to be provided by raingarden planters.
- 5.24 For runoff that is unable to pass through permeable paving, a downstream defender is proposed. This will meet the pollution mitigation requirements for the site.
- 5.25 Hydro-International have provided a specification sheet showing that this device can achieve mitigation for TSS at 0.5; Metals at 0.4 and Hydrocarbons at 0.5. Details of the Downstream Defender Select is contained in **Appendix J** as well as advice from Hydro-International on sizing Downstream Defenders.

Sewer Diversion

- 5.26 The 50mmdia combined rising main is subject to a S185 diversion application. At the time of writing, there has been no correspondence with Thames Water regarding this. However, an indicative diversionary route has been plotted on DR01 enclosed in **Appendix I**.

6 Maintenance of Development Drainage

- 6.1 The maintenance of the SuDS/drainage infrastructure will remain the responsibility of an appointed management/maintenance company; other than individual pipework, raingarden planters and other features within private curtilage, which will be the responsibility of the house owner.
- 6.2 Regular inspections and maintenance should be carried out, particularly after periods of heavy rainfall. Maintenance tasks and frequencies for permeable paving, raingarden planters and geocellular storage are detailed in the CIRIA SUDS Manual (C753) and are summarised below in Tables 6.1 - 6.3 below.

Maintenance Schedule	Required Action	Frequency
Regular maintenance	Brushing and vacuuming.	Three times per year at end of winter, mid-summer, after autumn leaf fall, or as required based on site specific observations of clogging or manufacturer's recommendations.
Occasional maintenance	Stabilise and mow contributing and adjacent areas.	As required.
	Removal of weeds.	As required.
Remedial actions	Remediate any landscaping which, through vegetation maintenance of soil slip, has been raised to within 50mm of the level of the paving.	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance of a hazard to the user.	As required
	Rehabilitation of surface and upper sub-surface.	As required (if infiltration performance is reduced as a result of significant clogging.)
Monitoring	Initial inspection	Monthly for 3 months after installation. 3 monthly, 48 hours after large storms.
	Inspect for evidence of poor operation and/or weed growth. If required, take remedial action.	Annually.
	Inspect silt accumulation rates and establish appropriate brushing frequencies.	
	Monitor inspection chambers.	Annually.

Table 6.1: Maintenance tasks for permeable paving (Source: CIRIA C753, The SUDS Manual)

Maintenance Schedule	Required Action	Typical Frequency
Regular Inspections	Inspect infiltration surfaces for silting and ponding, record de-watering time of the facility and assess standing water levels in underdrain (if appropriate) to determine if maintenance is necessary.	Quarterly.
	Check operation of underdrains by inspection of flows after rainfall.	Annually.
	Assess plants for disease infection, poor growth, invasive species etc and replace as necessary.	Quarterly.
	Inspect inlets and outlets for blockage.	Quarterly.
Regular Maintenance	Remove litter and surface debris and weeds.	Quarterly (or more frequently for tidiness or aesthetic reasons).
	Replace any plants, to maintain planting density.	As required.
	Remove sediment, litter and debris build-up from around inlets or from forebays.	Quarterly or biannually.
Occasional Maintenance	Infill any holes or scour in the filter medium, improve erosion protection if required.	As required.
	Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch.	As required.
Remedial Actions	Remove and replace filter medium and vegetation above	As required but likely to be > 20 years.

Table 6.2: Maintenance tasks and frequencies for bioretention systems (raingarden planters) (The SUDS Manual C753, CIRIA)

Maintenance Schedule	Required Action	Frequency
Routine Maintenance	Remove litter and debris and inspect for sediment, oil and grease accumulation Change the filter media Remove sediment, oil, grease and floatables	Sixth Monthly As recommended by the manufacturer As necessary-indicated by a system inspections or immediately following significant spill
Remedial Actions	Replace malfunctioning parts or structures	As required
Monitoring	Inspect for evidence of poor operation Inspect filter media and establish appropriate replacement frequencies Inspect sediment accumulation rates and establish appropriate removal frequencies	Six Monthly Six Monthly Monthly during first half year of operation, then every six months

Table 6.3: Example operation and maintenance requirements for propriety treatment systems (The SUDS Manual C753, CIRIA)

Maintenance Schedule	Required Action	Frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action. Remove debris from the catchment surface (where it may cause risks to performance). Remove sediment from pre-treatment structures and/or internal forebays.	Monthly for 3 months, then annually. Monthly Annually or as required.
Remedial actions	Repair/rehabilitate inlets, outlet, overflows and vents.	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed. Survey inside of tank/crate system for sediment build-up and remove if necessary.	Annually Every 5 years or as required.

Table 6.4: Maintenance tasks for cellular storage tank (Source: CIRIA C753, The SUDS Manual)

- 6.3 Inspection chambers and manhole covers should be lifted each year to remove visible debris and check for blockages. It is suggested that this is undertaken every November after the heaviest leaf-fall has occurred.
- 6.4 Any control chambers/orifice plate filters should be regularly inspected (every 4 months) and cleared of silt and debris if necessary.
- 6.5 Should a blockage occur at any time, it is advised to seek professional help to jet the drainage system to clean and clear the system.
- 6.6 It is good practice to ensure that gutters and downpipes are occasionally inspected to ensure they are in good order and free of leaves & debris. Once every 6 months should be sufficient.

7 Conclusion

- 7.1 EAS has been commissioned to provide a Flood Risk Assessment and SuDS report to inform a planning application for a residential development on land at Hillcrest and Tussucks, The Causeway, Therfield, SG8 9PP (Grid Ref: TL 33591 37377).
- 7.2 Proposals consist of the construction of 7 residential dwellings with associated landscaping and parking.

Flood Risk

- 7.3 The site is located wholly in Flood Zone 1 and has not been identified to be at risk from all assessed sources. No specific mitigation measures are considered to be required.

SuDS Strategy

- 7.4 The proposed strategy consists of directing roof runoff into permeable paving subbase where possible. All road areas are to be permeable paving, split into 4 sections based on the site topography. Surface water flows are then to be directed to two borehole soakaways to the rear of plot 5. To provide further attenuation, two geocellular storage tanks are proposed.
- 7.5 The proposed drainage strategy provides suitable pollution mitigation to exceed the requirements for the runoff from the site. Where flows cannot pass through the permeable paving subbase, a downstream defender is proposed to ensure suitable pollution mitigation.
- 7.6 A rising main sewer diversion is proposed for the foul water Thames Water sewer passing through the northern half of the site.

Maintenance of the Proposed Drainage System

- 7.7 The maintenance of the SuDS/drainage infrastructure will remain the responsibility of an appointed management/maintenance company; other than individual pipework, raingarden planters and other features within private curtilage, which will be the responsibility of the house owner.
- 7.8 Regular inspections and maintenance should be carried out, particularly after periods of heavy rainfall. Maintenance tasks and frequencies for permeable paving, raingarden planters, proprietary treatment stages, and geocellular storage are detailed in the CIRIA SuDS Manual (C753) and are summarised below in Section 6 of this report.

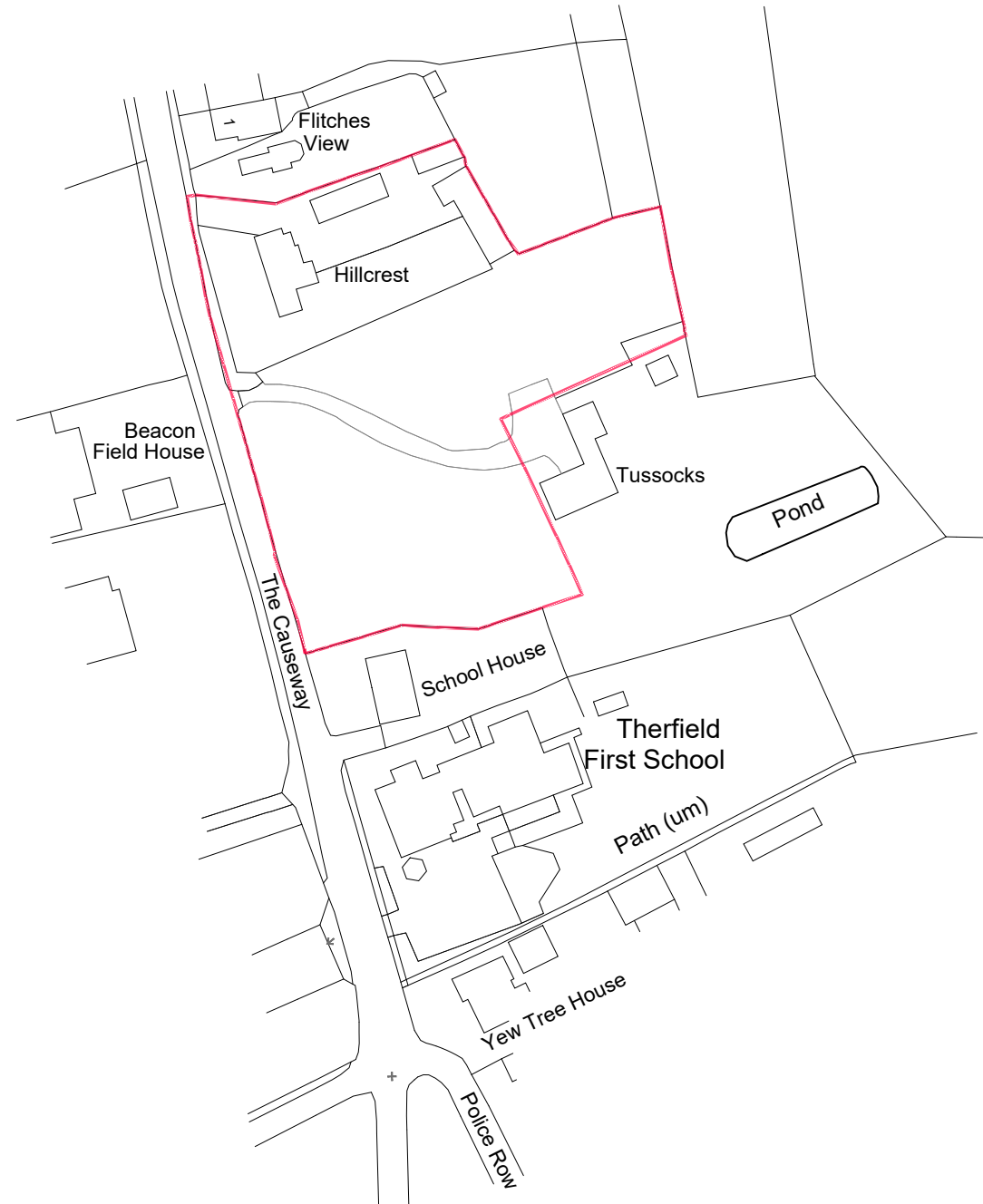
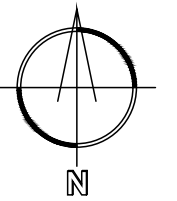
Conclusion

- 7.9 The proposed development has been demonstrated to be acceptable on flood risk and drainage grounds.

Appendices

Appendix: A – Location Plan	24
Appendix: B – Proposed Plans	25
Appendix: C – EA Flood Map for Planning	26
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Appendix: A – Location Plan



LOCATION PLAN 1:1250
ORNANCE SURVEY LICENCE NUMBER 100053143

A 04-06-24 SCHEME UPDATED

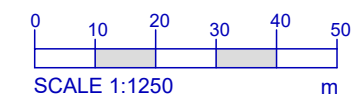
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DO NOT SCALE THESE DRAWINGS. USE WRITTEN DIMENSIONS ONLY.
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COMMENCEMENT OF WORK.



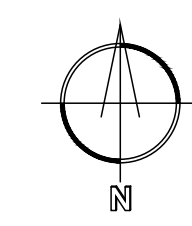
LOCATION PLAN

HILLCREST & TUSOCKS THE CAUSEWAY THERFIELD



DATE: APR 23	SCALE @ A3: 1:1250	REVISION
DRAWING NO. 478.01		A

Appendix: B – Proposed Plans



SITE PLAN 1:200

REV:	DATE:	DESCRIPTION:
E	20-03-24	PLAN UPDATED
D	09-02-24	PLAN UPDATED
C	04-10-23	PLAN UPDATED
B	03-10-23	PLAN UPDATED
A	29-09-23	PLOT 5 AMENDED

DO NOT SCALE THESE DRAWINGS. USE WRITTEN DIMENSIONS ONLY.
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SITE PLAN

HILLCREST & TUSSOCKS
THE CAUSEWAY
THERFIELD

DATE:	SCALE @ A1:	REVISION:
SEPT. 23	1:200	
DRAWING NO:	478.03	E

Appendix: C – EA Flood Map for Planning

Flood map for planning

Your reference
<Unspecified>

Location (easting/northing)
533590/237372

Created
17 Jun 2024 7:50

Your selected location is in flood zone 1, an area with a low probability of flooding.

You will need to do a flood risk assessment if your site is **any of the following**:

- bigger than 1 hectare (ha)
- In an area with critical drainage problems as notified by the Environment Agency
- identified as being at increased flood risk in future by the local authority's strategic flood risk assessment
- at risk from other sources of flooding (such as surface water or reservoirs) and its development would increase the vulnerability of its use (such as constructing an office on an undeveloped site or converting a shop to a dwelling)

Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.

Flood risk data is covered by the Open Government Licence **which** sets out the terms and conditions for using government data. <https://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/>

Use of the address and mapping data is subject to Ordnance Survey public viewing terms under Crown copyright and database rights 2022 OS 100024198. <https://flood-map-for-planning.service.gov.uk/os-terms>

Flood map for planning

Your reference
<Unspecified>

Location (easting/northing)
533590/237372

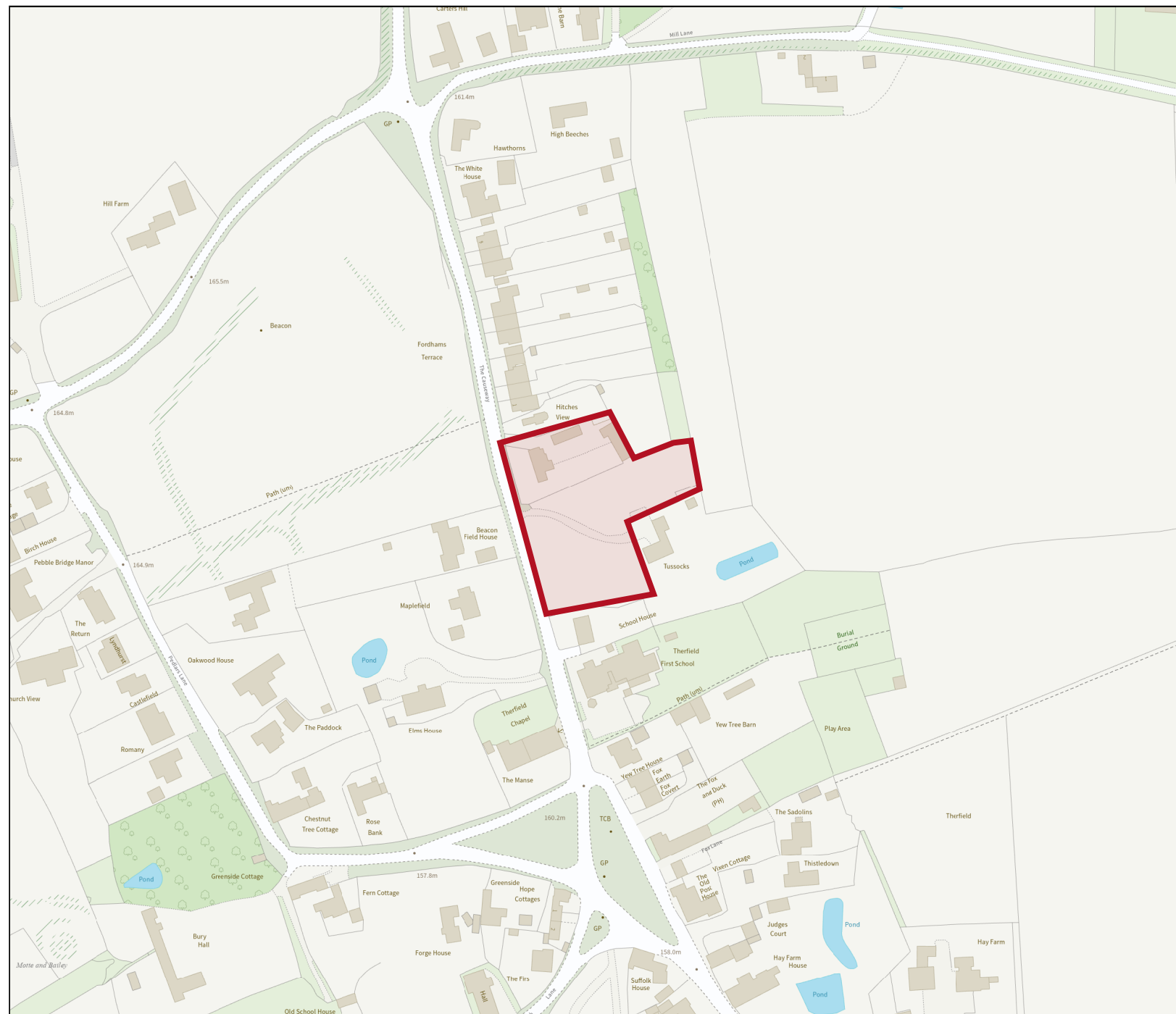
Scale
1:2500

Created
17 Jun 2024 7:50

-  Selected area
-  Flood zone 3
-  Flood zone 2
-  Flood zone 1
-  Flood defence
-  Main river
-  Water storage area

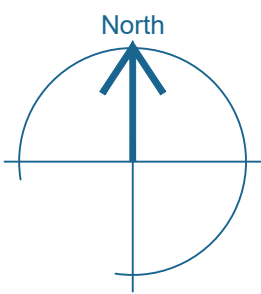
0 20 40 60m

Page 2 of 2



Appendix: D – Topographic Survey

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This survey is related to OSGB36(15) coordinate system by GPS 'rapid static' methods. No scale factor has been applied to the survey information. All horizontal distances taken from this drawing are ground distances.

Co-ordinate Table			
Station	Easting	Northing	Level
1	533551.180	237361.460	163.267
2	533544.508	237407.188	164.736
3	533549.815	237400.435	165.752
4	533563.596	237379.552	165.247
5	533574.641	237385.433	166.080
300	533567.526	237402.450	166.557
301	533587.258	237400.038	167.363
302	533588.876	237410.988	167.577
303	533594.752	237414.584	167.601

All levels related to Ordnance Survey active GPS network, at survey station 2.

DISCLAIMERS

Every effort has been made to confirm tree species on site, yet it is advised to confirm these details with an arborist before proceeding with any design.

Every effort has been made to confirm drainage run, type and size on site, yet it is advised to check these details against statutory authority records before proceeding with any design.

KEY	
Survey control station	Banking
Gate (single)	Foliage Line
Gate (double)	Drainage run, direction of flow and pipe size
Tree Spread and Girth shown to scale	Approximate Position
Step Up	Ramp Up

ABBREVIATIONS

Air Handling Unit	AHU	Water Meter	WM
Beltina Beeson	BB	Even Level	EL
Bollard	BD	Ridge Level	RL
Borehole	BH	Roof Level	RFL
BT Inspection Cover	BT	Soft Level	SFL
Cable Television Cover	CTV	Threshold Level	THL
Drainage Channel	DC	Parapet Wall Level	PWL
Electricity Cover	EC	Finished Floor Level	FFL
Electricity Pole	EP	Head Level	HL
Earth Rod	ER	Sill Level	SL
Fire Hydrant	FH	Cover Level	CL
Gas Valve	GV	Invert Level	IL
Gate Post	GP	No Visible Pipes	NVP
Gully	GY	Unable to Lift	UTL
Inspection Cover	IC	Ford Water	FW
Junction Box	JB	Sump Level	SUL
Kerb Outlet	KO	Surface Water	SW
Lamp Post	LP	Brick Paviers	BP
Manhole	MH	Concrete	CON
Marker Post	MP	Concrete Paving Slabs	CPS
Post	P	Flower Bed	FIB
Pipe	PE	Shrub Bed	SIB
Road Sign	RS	Tackle Paving	TAC
Rodding Eye	RE	Unsurfaced	US
Marker Post	MK	Brick Wall	BW
Sign Post	SP	Retaining Wall	RW
Stop Valve	SV	Chamirak Fence	CLF
Stop Tap	ST	Chestnut Paving Fence	CPF
Telegraph Pole	TP	Iron Railing Fence	IRF
Traffic Light	TL	Metal Security Fence	MSF
Vent Pipe	VP	Post and Chain Fence	PCF
Post and Rail Fence	PRF	Post and Wire Fence	PWF
Wooden Panel Fence	WPF		

Client

TOM HANSON

Project

**HILLCREST
THE CAUSEWAY, THERFIELD
SG8 9PP**

Title

TOPOGRAPHICAL SURVEY

Drawing Number

TS22-399-1

Revision	Description	Rev. By	Date
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Scale 1:100@A0

Sheet 1 of 1

Drawn by RM

Checked by NEM

Date of Survey AUGUST 2022



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237400N

237350N

237300N

535000E

535000E

535000E

535000E

535000E

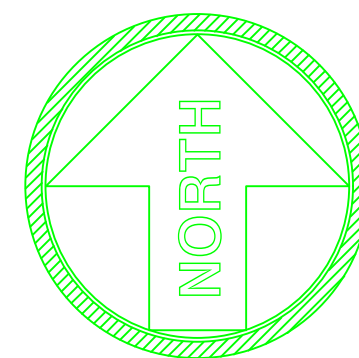
2374450N

237400N

237350N

237300N

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Co-ordinate Table			
Station	Easting	Northing	Level
1	535557.674	237355.669	162.454
2	535562.038	237358.209	163.220
3	535604.693	237365.907	165.942

GPS Note:
This survey is related to OSGB36(15) coordinate system by GPS 'rapid static' methods. No scale factor has been applied to the survey information. All horizontal distances taken from this drawing are ground distances.

Every effort has been made to confirm tree species on site, yet it is advised to confirm these details with an arborist before proceeding with any design.

Every effort has been made to confirm drainage run, type and size on site, yet it is advised to check these details against statutory authority records before proceeding with any design.

Revision	Description	Date

LEGEND

Survey control station		Building	
Banking		Fence	
Gate (single)		Contour	
Gate (double)		Wall	
Tree Spread and Girth shown to scale		Ordnance Survey	
		Value	15.37m

Abbreviations

Bellina Beacon	BD	Pipe	PE
Bollard	BD	Road Sign	RS
Borehole	BH	Rodding Eye	RE
British Telecom Box	BTB	Service Marker	MK
BT Inspection Cover	BT	Sign Post	SP
Concrete Paving Slabs	CPS	Sluice Valve	SV
Cable Television Cover	CTV	Stop Top	ST
Electricity Cable Pit	EC	Stop Cock	SC
Electricity Pole	EP	Telegraph Pole	TGP
Earth Rod	ER	Telephone Call Box	TL
Fire Hydrant	FH	Traffic Light	TL
Flag Staff	FS	Unsurfaced	US
Gas Valve	GV	Vent Pipe	VP
Gate Post	GP	Water Meter	WM
Gully	G	Eaves Level	EL
Inspection Cover	IC	Ridge Level	RL
Kerb Outlet	KO	Roof Level	RFL
Lamp Post	LP	Soffit Level	SFL
Manhole	MH	Threshold Level	THL
Marker Post	MK	Panopt Wall Level	PWL
Parking Meter	PM	Finished Floor Level	FTL
Post	P		
Retaining Wall	RTW	Cover Level	CL
Barbed Wire Fence	BWF	Invert Level	IL
Close Boarded Fence	CBF	No Visible Connection	NVC
Chainlink Fence	CLF	Unable to Lift	UTL
Chestnut Paling Fence	CPT	Surface Water	SW
Post and Chain Fence	PCF	Foul Water	FW
Post and Rail Fence	PRF	Flower Bed	F/B
Post and Wire Fence	PWF	Shrub Bed	S/B
Wooden Panel Fence	WPF		



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Accredited

Client
SIMON KINGSLEY

Project
**TUSOCKS, THE CAUSEWAY
THERFIELD, ROYSTON
HERTS, SG8 0PP**

Title
TOPOGRAPHICAL SURVEY

Drawn by
WR

Checked by
PG

Scale
1:200@A0

Date
MAY 2018

Drawing Number
TS18-197Q\1

Revision

Sheet
1

of
1

All levels related to Ordnance Survey active GPS network, at survey station 2

Value
163.220m

2 0 10 metres
SCALE BAR

Appendix E – Infiltration testing results

Our Ref: CW/62242/Inf
Your Ref:

21 April 2023

Hanson Services Ltd
c/o PJB Planning Ltd
2 West Street,
Ware,
Hertfordshire,
SG12 9EE

BY EMAIL ONLY TO:
peter@pjbplanning.co.uk

Dear Sirs,

**Re: Hillcrest & Tussocks, The Causeway, Therfield –
Infiltration Assessment**

As you are aware we recently attended the above site to undertake infiltration testing to inform the drainage strategy for the proposed residential redevelopment of the site. The findings of this testing are summarised in this letter and shall be read in accordance with our limitations of investigation, which are enclosed.

Site Location & Description

The site is located at Hillcrest and Tussocks, The Causeway, Therfield, Royston, Cambridgeshire, SG8 9PP. A site location plan is presented as Figure 1 and is enclosed.

At the time of investigation, the site comprised 2no. separate areas – Hillcrest & Tussocks. Hillcrest, the smaller parcel of land in the north, comprised a two-storey residential dwelling with associated garages, hardstanding, and a driveway. Tussocks, the larger parcel of land in the south, comprised a two-storey residential dwelling with garden areas, a pond, numerous mature trees, a parking area and a driveway. These areas were separated by a coniferous hedge approximately 2m in height, with access to both parcels possible from The Causeway to the immediate east.

Fieldwork

The fieldwork on which this letter is based was undertaken between 11th April & 13th April 2023 and comprised the mechanical excavation of 5no. trial pits (TP01-TP05). An exploratory hole location plan is enclosed as Figure 2 and indicates the location of the trial pits with respect to the existing site layout.

Disturbed samples were recovered from throughout the depth of each exploratory hole for record keeping purposes. The exploratory hole logs are enclosed and give descriptions and depths of the strata encountered, together with details of samples taken and other relevant information.

Cont'd.../



also at: London 020 7448 9910, Cambridge 01223 314794, Bristol 01172 020070 and
Norwich 01603 230240
Richard Jackson is a trading name of Richard Jackson Ltd. Registration No. 2744316 England.
Registered Office 847 The Crescent, Colchester, CO4 9YQ.

847 The Crescent,
Colchester, Essex CO4 9YQ

Telephone: 01206 228800
www.rj.uk.com

Where applicable, investigation techniques, sampling and logging of soils complied with the requirements of British Standard BS:5930:- 'Code of Practice for Site Investigations' (2015).

Trial Pitting

A mechanical excavator was used to form 5no. trial pits (TP01-TP05) to depths of between 1.80m below ground level (bgl) (TP02) and 2.20m bgl (TP05).

Trial pits were positioned to provide a representative coverage of the site, taking into account existing site constraints.

Infiltration Testing

Infiltration testing was undertaken in 5no. locations (TP01-TP05) in accordance with current guidance as given in BRE Digest 365 'Soakaway Design' (2016).

The trial pits were installed with a monitoring pipe and data logger, before being backfilled with gravel to maintain stability during testing. The trial pits were then filled with clean water from a water tank, with the fall in water level monitored at regular intervals.

In accordance with the requirements of BRE Digest 365, 3no. tests were undertaken in TP05. A single test was undertaken in the remaining 4no. locations (TP01-TP04) due to the observed poor infiltration.

In order to derive soil infiltration rates for TP05, the recommended calculation in BRE Digest 365 (2016) has been used. Table 1 provides a summary of the calculated infiltration rates. Full results are enclosed.

Table 1: Results of Infiltration Testing

Exploratory Hole	Infiltration Rate (m / s)		
	Test 1	Test 2	Test 3
TP05	5.64×10^6	4.29×10^6	5.65×10^6

As noted above, infiltration rates have not been determined for the encountered soils in 4no. locations (TP01-TP04) due to the insufficient infiltration observed. Table 2 provides a summary of the duration of monitoring and the observed fall in water level. Full results of the infiltration testing are enclosed.

Table 2: Summary of Infiltration Tests

Exploratory Hole	Monitoring Period Duration (mins)	Observed change in water level (m)
TP01	1,653	0.11
TP02	1,575	0.07
TP03	1,737	0.24
TP04	1,693	0.39

Ground Conditions

The British Geological Survey (BGS) 1:50,000 scale online mapping of the area indicates superficial Lowestoft Formation to exist beneath the site, underlain by a bedrock of undifferentiated Lewes Nodular and Seaford Chalk Formations.

This investigation encountered the following sequence of strata from ground level:

- Topsoil / Made Ground
- Lowestoft Formation

Groundwater was not encountered during this investigation.

Topsoil / Made Ground

Topsoil was encountered from ground level in 3no. locations (TP01, TP02 & TP04), with the thickness ranging from 0.20m bgl (TP01) to 0.55m bgl (TP02). The topsoil was typically encountered as dark brown slightly gravelly clay with rootlets.

Made Ground was encountered from ground level in 2no. locations (TP03 & TP05), and beneath topsoil in TP04. The base of the made ground ranged from 0.40m bgl (TP03 & TP05) to 1.00m bgl (TP04). The made ground was typically encountered as black or dark brown slightly gravelly clay, with gravel of clinker, brick, flint, and chalk. The made ground encountered in TP04 at 0.40m – 1.00m bgl was recorded as possible former topsoil, described as a dark brown slightly gravelly clay.

Lowestoft Formation

Soils interpreted to represent the Lowestoft Formation were encountered beneath topsoil or made ground in each of the 5no. locations (TP01-TP05), with the base of the Lowestoft Formation remaining unproven at the maximum depth of the investigation of 2.20m bgl (TP05).

The Lowestoft Formation was typically encountered as orangish brown slightly gravelly silty clay with gravel of flint, occasional flint cobbles, and iron staining, overlying a light brown slightly gravelly clay with gravel of chalk.

In TP05, underlying the typical above-described Lowestoft Formation, was a structureless chalk comprising a clayey sandy matrix, with intact clasts of weak low to medium density chalk.

The British Geological Survey (BGS) online mapping of the area identifies chalk rafts within the Lowestoft Formation indicated to be present beneath the site. The conditions encountered in TP05 are assumed to represent one of these chalk rafts. The nature of this deposit should be considered with respect to the recorded infiltration rate in this material.

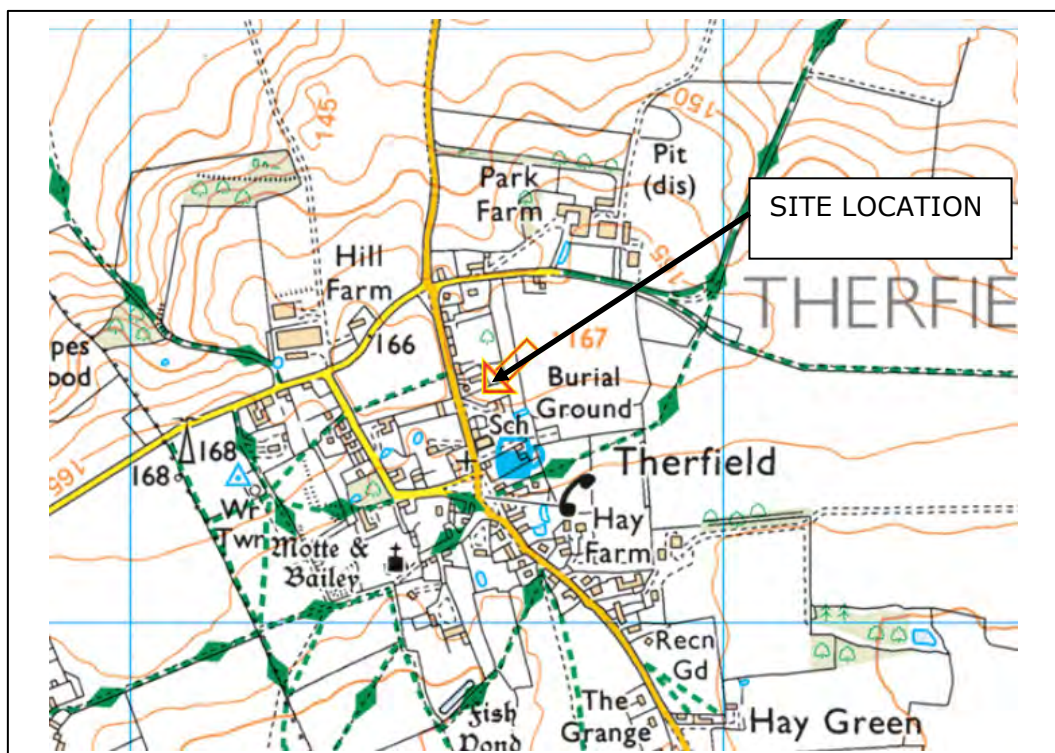
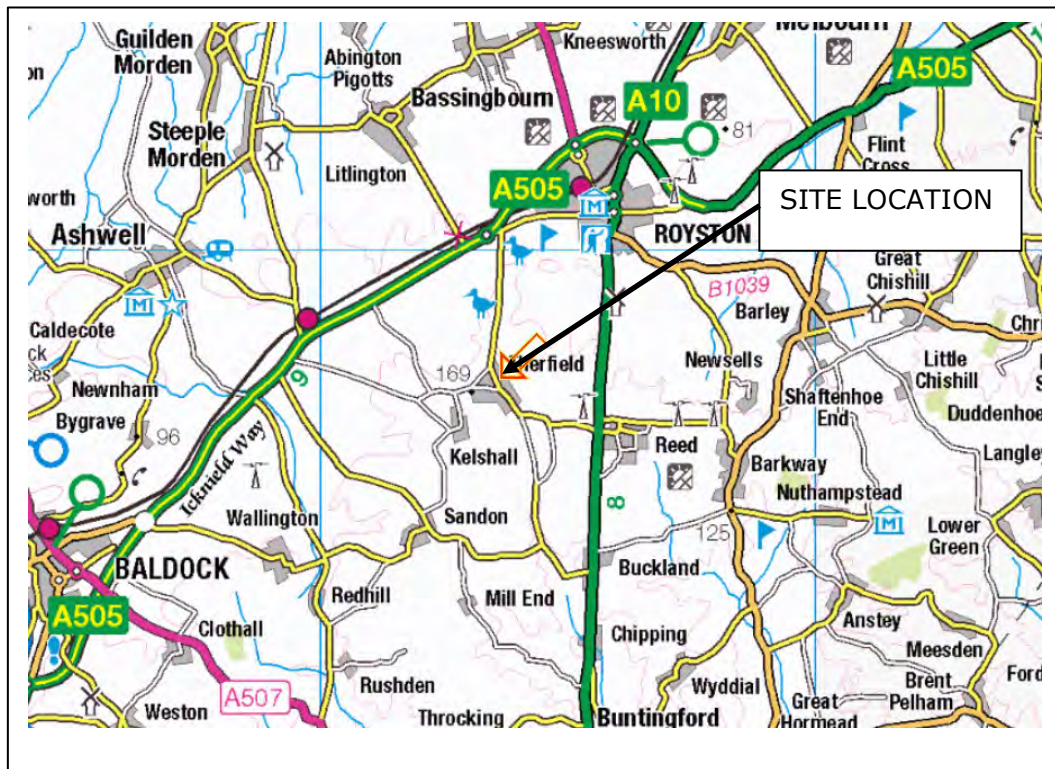
General

We trust that the above and enclosed are clear and acceptable, however, should you have any questions or queries please do not hesitate to contact us.

Yours sincerely

Camilla Watson BSc, FGS
Graduate Geotechnical Engineer
on behalf of Richard Jackson Limited

Enc Figure 1 – Site Location Plan
 Figure 2 – Exploratory Hole Location Plan
 Exploratory Hole Logs
 Soakage Tests Calculations
 Limitations of Investigation



REPRODUCED FROM ORDNANCE SURVEY MAP WITH THE PERMISSION OF THE CONTROLLER OF HIS MAJESTY'S STATIONARY OFFICE, © CROWN COPYRIGHT RICHARD JACKSON LTD – ACC No. 100002572

Richard Jackson
Engineering Consultants

Consulting Civil & Structural Engineers
847 The Crescent, Colchester, CO4 9YQ
Tel: 01206 228 800

Hillcrest & Tussocks, The Causeway,
Therfield, Royston, Cambridgeshire,
SG8 9PP

SITE LOCATION PLAN

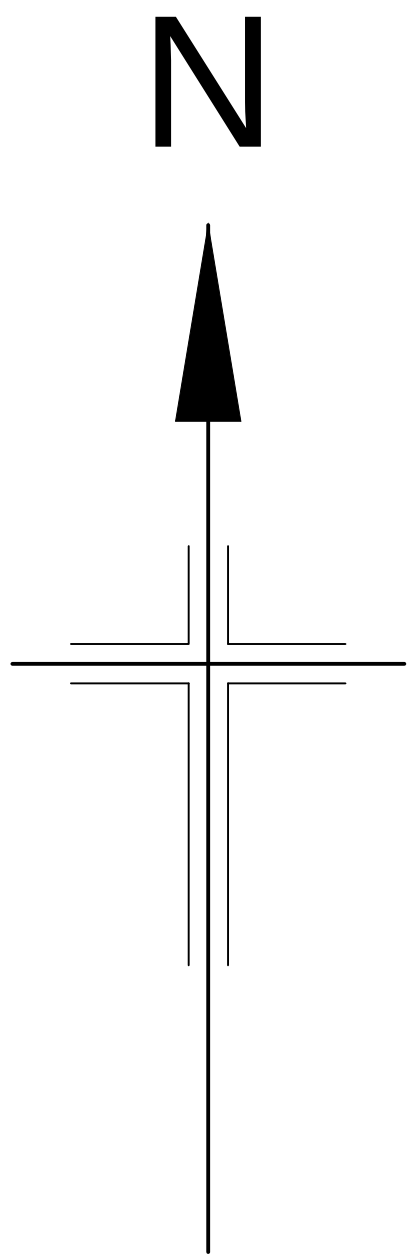
FIGURE 1

SCALE: N.T.S.

JOB NO: 62242

KEY

TRIAL PIT
LOCATIONS



REV	DATE	DESCRIPTION	DRAWN	CHKD

REVISIONS

This drawing is to be read in conjunction with all other Engineer's drawings and all other project information. Any discrepancy between the Engineer's drawings and other project information is to be reported to the Engineer immediately.



Project
**HILLCREST & TUSOCKS,
THE CAUSEWAY, THERFIELD**

Title
**EXPLORATORY HOLE
LOCATION PLAN**

Client
HANSON SERVICES LTD

Scale 1:150 @ A0	Drawn MB	Date 20/04/23
Job Manager CW	Checked CW	Approved CW

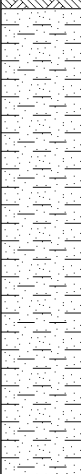
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The Old Church, St. Matthews Road, Norwich, Norfolk NR2 1SP
The Wheelhouse, Broomfield, Gloucestershire GL2 0JF

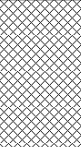
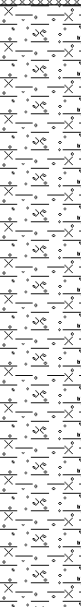
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Tel: 020 7448 9810
Tel: 0203 314764
Tel: 01603 299248
Tel: 01272 220204

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Website: <http://www.rj-uk.com>

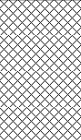
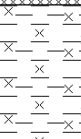
Drawing No. 62242-G-FIG02	Revision
Drawing Status ☒ INFORMATION ☐ TENDER	☐ APPROVAL ☐ CONSTRUCTION ☐ AS CONSTRUCTED ☐ COSTING

Richard Jackson Engineering Consultants					847 The Crescent, Colchester, Essex, CO4 9YQ		Trial Pit No. TP01 Sheet 1 of 1							
Project Name: Hillcrest & Tussocks, The Causeway, Therfield			Project No. 62242		Co-ords: Orientation:		Date 11/04/2023							
Location: Royston, Cambridgeshire, SG8 9PP					Level (m, aOD):		Dimensions (m) 1.40		Scale 1:20					
Client: Hanson Services Ltd					Depth (m): 2.00		0.50		Logged CW					
Ground water	Samples & In Situ Testing			Level (m)	Depth (m)	Legend	Stratum Description							
	Depth	Type	Results											
					0.20		Dark brown slightly gravelly silty CLAY with rootlets. Gravel is subangular to rounded fine flint and chalk. TOPSOIL							
	0.60	D1			0.80		Dark brown slightly gravelly silty CLAY. Gravel is subangular to rounded fine to medium chalk. LOWESTOFT FORMATION					1		
	1.20	D2					Light brown slightly gravelly CLAY. Gravel is subangular to rounded fine to medium chalk. LOWESTOFT FORMATION							
	1.90	D3			2.00		End of Pit at 2.000m					2		
												3		
												4		
Groundwater: Groundwater not encountered.							Key							
Stability: Gravel filled for soakage testing.							D B ES		Disturbed Bulk Environmental		IVN PID PP		Hand Vane PID Reading Pocket Penetrometer	
Remarks: Soakage testing undertaken between 0.80m and 1.80m bgl.									Groundwater strike				Standing water level	

 Richard Jackson Engineering Consultants					847 The Crescent, Colchester, Essex, CO4 9YQ		Trial Pit No. TP02 Sheet 1 of 1							
Project Name: Hillcrest & Tussocks, The Causeway, Therfield			Project No. 62242		Co-ords: Orientation:		Date 11/04/2023							
Location: Royston, Cambridgeshire, SG8 9PP					Level (m, aOD):		Dimensions (m) 1.40		Scale 1:20					
Client: Hanson Services Ltd					Depth (m): 1.80		0.50		Logged CW					
Ground water	Samples & In Situ Testing			Level (m)	Depth (m)	Legend	Stratum Description							
	Depth	Type	Results											
	0.40	D1			0.55		Dark brown slightly sandy CLAY with rootlets and occasional subangular to rounded fine flint and chalk gravel. TOPSOIL					1		
	1.10	D2					Light brown slightly gravelly silty CLAY. Gravel is subangular to rounded fine to medium chalk. LOWESTOFT FORMATION							
	1.70	D3			1.80		...becoming subangular to rounded fine to coarse chalk gravel from 1.20m.							
							End of Pit at 1.800m					2		
												3		
												4		
Groundwater: Groundwater not encountered.							Key							
Stability: Stable sidewalls.							D B ES		Disturbed Bulk Environmental		IVN PID PP		Hand Vane PID Reading Pocket Penetrometer	
Remarks: Soakage testing undertaken between 0.70m to 1.70m bgl.									Groundwater strike				Standing water level	

Richard Jackson Engineering Consultants					847 The Crescent, Colchester, Essex, CO4 9YQ		Trial Pit No. TP03 Sheet 1 of 1							
Project Name: Hillcrest & Tussocks, The Causeway, Therfield			Project No. 62242		Co-ords: Orientation:		Date 11/04/2023							
Location: Royston, Cambridgeshire, SG8 9PP					Level (m, aOD):		Dimensions (m) 1.50		Scale 1:20					
Client: Hanson Services Ltd					Depth (m): 2.00		0.50		Logged CW					
Ground water	Samples & In Situ Testing			Level (m)	Depth (m)	Legend	Stratum Description							
	Depth	Type	Results											
					0.40		Dark brown slightly gravelly CLAY with roots and rootlets. Gravel is subangular to rounded fine to medium flint, chalk, brick and clinker. MADE GROUND					1		
	0.80	D1					Orangish brown slightly gravelly silty CLAY with occasional subangular to rounded flint cobbles and iron staining. Gravel is subangular to rounded fine to medium flint. LOWESTOFT FORMATION							
	1.30	D2					...becoming mottled beige from 1.10m.							
	1.80	D3					...yellow fine to medium sand parting at 1.70m.							
					2.00		End of Pit at 2.000m					2		
												3		
												4		
Groundwater: Groundwater not encountered.							Key							
Stability: Stable sidewalls.							D B ES		Disturbed Bulk Environmental		IVN PID PP		Hand Vane PID Reading Pocket Penetrometer	
Remarks: Soakage testing undertaken between 0.80m to 1.80m bgl.									Groundwater strike				Standing water level	

Richard Jackson Engineering Consultants					847 The Crescent, Colchester, Essex, CO4 9YQ		Trial Pit No. TP04 Sheet 1 of 1							
Project Name: Hillcrest & Tussocks, The Causeway, Therfield			Project No. 62242		Co-ords: Orientation:		Date 11/04/2023							
Location: Royston, Cambridgeshire, SG8 9PP					Level (m, aOD):		Dimensions (m) 1.30		Scale 1:20					
Client: Hanson Services Ltd					Depth (m): 2.00		0.50		Logged CW					
Ground water	Samples & In Situ Testing			Level (m)	Depth (m)	Legend	Stratum Description							
	Depth	Type	Results											
	0.50	D1			0.35		Dark brown slightly gravelly CLAY with root and rootlets. TOPSOIL							
					0.40							Light brown slightly gravelly CLAY. Gravel is subangular to rounded fine to medium chalk. MADE GROUND Dark brown slightly gravelly CLAY. Gravel is subangular to rounded fine to medium chalk and flint. (POSSIBLE FORMER TOPSOIL) MADE GROUND		
	1.30	D2			1.00		Light brown slightly gravelly CLAY. Gravel is subangular to rounded fine to coarse chalk. LOWESTOFT FORMATION							
	1.70	D3			2.00						End of Pit at 2.000m			
Groundwater: Groundwater not encountered.							Key							
Stability: Stable sidewalls.							D B ES		Disturbed Bulk Environmental		IVN PID PP		Hand Vane PID Reading Pocket Penetrometer	
Remarks: Soakage testing undertaken between 0.70m to 1.70m bgl.									Groundwater strike				Standing water level	

Richard Jackson Engineering Consultants					847 The Crescent, Colchester, Essex, CO4 9YQ		Trial Pit No. TP05 Sheet 1 of 1							
Project Name: Hillcrest & Tussocks, The Causeway, Therfield			Project No. 62242		Co-ords: Orientation:		Date 11/04/2023							
Location: Royston, Cambridgeshire, SG8 9PP					Level (m, aOD):		Dimensions (m) 1.50		Scale 1:20					
Client: Hanson Services Ltd					Depth (m): 2.20		0.60		Logged CW					
Ground water	Samples & In Situ Testing			Level (m)	Depth (m)	Legend	Stratum Description							
	Depth	Type	Results											
	0.70	D1			0.40		Black and dark brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to medium clinker, ash, slate and flint. MADE GROUND					1		
							Orangish brown silty CLAY with occasional subangular to rounded fine to medium flint gravel. LOWESTOFT FORMATION							
	1.50	D2			0.80		Structureless white CHALK recovered as intact weak low to medium density fine to medium gravel sized chalk clasts in a clayey sandy matrix with occasional iron staining. LOWESTOFT FORMATION					2		
	2.00	D3			2.20		End of Pit at 2.200m					3		
												4		
Groundwater: Groundwater not encountered.							Key							
Stability: Stable sidewalls.							D B ES		Disturbed Bulk Environmental		IVN PID PP		Hand Vane PID Reading Pocket Penetrometer	
Remarks: Soakage testing undertaken between 1.10m to 2.20m bgl.									Groundwater strike				Standing water level	

$$\text{Soil Infiltration Rate (f)} = V_{p_{75-25}} / (a_{p_{50}} * t_{p_{75-25}})$$

<u>Infiltration TP01 - Test 1 of 1</u>		
Date: 12/04/2023		
<u>Trial Pit Dimensions</u>		
Length (m)	1.40	
Width (m)	0.50	
Depth (m)	2.00	
Effective Depth (m)	1.04	
tp ₇₅ (mins)	N/A	
tp ₂₅ (mins)	N/A	
<u>Calculations</u>		
V _{p₇₅₋₂₅}	Insufficient	
a _{p₅₀}	infiltration for	
tp ₇₅₋₂₅	calculation	
f =	n/a	m/s
f =	n/a	m/h

<u>Infiltration TP02 - Test 1 of 1</u>		
Date: 12/04/2023		
<u>Trial Pit Dimensions</u>		
Length (m)	1.40	
Width (m)	0.50	
Depth (m)	1.80	
Effective Depth (m)	0.59	
tp ₇₅ (mins)	N/A	
tp ₂₅ (mins)	N/A	
<u>Calculations</u>		
V _{p₇₅₋₂₅}	Insufficient	
a _{p₅₀}	infiltration for	
tp ₇₅₋₂₅	calculation	
f =	n/a	m/s
f =	n/a	m/h

<u>Infiltration TP03 - Test 1 of 1</u>		
Date: 12/04/2023		
<u>Trial Pit Dimensions</u>		
Length (m)	1.50	
Width (m)	0.50	
Depth (m)	2.00	
Effective Depth (m)	1.00	
tp ₇₅ (mins)	N/A	
tp ₂₅ (mins)	N/A	
<u>Calculations</u>		
V _{p₇₅₋₂₅}	Insufficient	
a _{p₅₀}	infiltration for	
tp ₇₅₋₂₅	calculation	
f =	n/a	m/s
f =	n/a	m/h

<u>Infiltration TP04 - Test 1 of 1</u>		
Date: 12/04/2023		
<u>Trial Pit Dimensions</u>		
Length (m)	1.30	
Width (m)	0.50	
Depth (m)	2.00	
Effective Depth (m)	0.61	
tp ₇₅ (mins)	N/A	
tp ₂₅ (mins)	N/A	
<u>Calculations</u>		
V _{p₇₅₋₂₅}	Insufficient	
a _{p₅₀}	infiltration for	
tp ₇₅₋₂₅	calculation	
f =	n/a	m/s
f =	n/a	m/h

$$\text{Soil Infiltration Rate (f)} = V_{p_{75-25}} / (a_{p_{50}} * t_{p_{75-25}})$$

<u>Infiltration TP05 - Test 1 of 3</u>		
Date: 12/04/2023		
<u>Trial Pit Dimensions</u>		
Length (m)	1.50	
Width (m)	0.60	
Depth (m)	2.20	
Effective Depth (m)	1.11	
tp ₇₅ (mins)	149.5	
tp ₂₅ (mins)	12.5	
<u>Calculations</u>		
V _{p₇₅₋₂₅}	0.15	
a _{p₅₀}	3.23	
tp ₇₅₋₂₅	137	
f = 5.64E-06 m/s		
f = 2.03E-02 m/h		

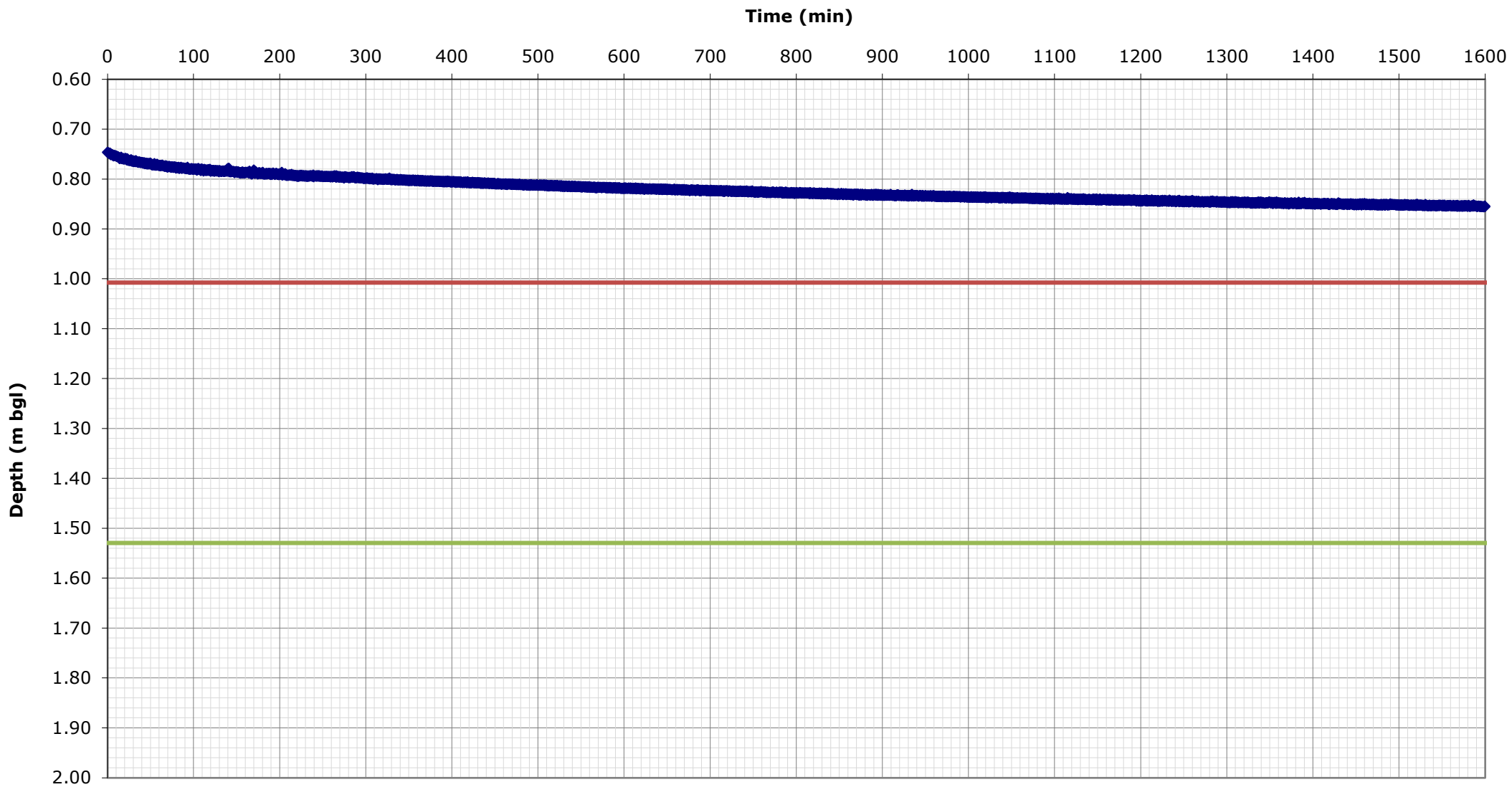
<u>Infiltration TP05 - Test 2 of 3</u>		
Date: 12/04/2023		
<u>Trial Pit Dimensions</u>		
Length (m)	1.50	
Width (m)	0.60	
Depth (m)	2.20	
Effective Depth (m)	1.07	
tp ₇₅ (mins)	200.5	
tp ₂₅ (mins)	22	
<u>Calculations</u>		
V _{p₇₅₋₂₅}	0.14	
a _{p₅₀}	3.15	
tp ₇₅₋₂₅	178.5	
f = 4.29E-06 m/s		
f = 1.54E-02 m/h		

<u>Infiltration TP05 - Test 3 of 3</u>		
Date: 13/04/2023		
<u>Trial Pit Dimensions</u>		
Length (m)	1.50	
Width (m)	0.60	
Depth (m)	2.20	
Effective Depth (m)	1.02	
tp ₇₅ (mins)	149	
tp ₂₅ (mins)	15.5	
<u>Calculations</u>		
V _{p₇₅₋₂₅}	0.14	
a _{p₅₀}	3.05	
tp ₇₅₋₂₅	133.5	
f = 5.65E-06 m/s		
f = 2.04E-02 m/h		

NB Volume adjusted by a factor of 0.3 to allow for presence of gravel in trial pit

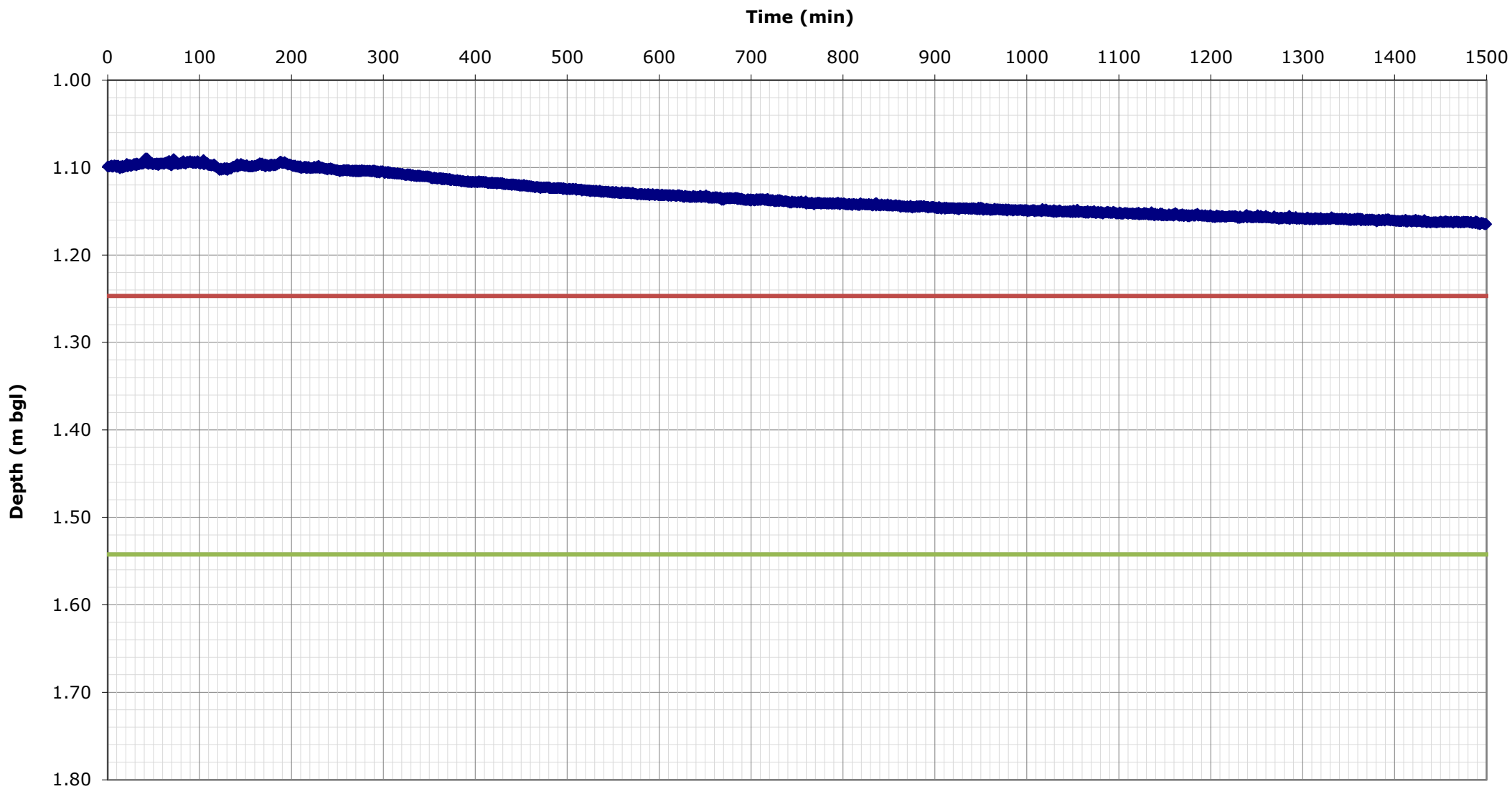
62242 - Hillcrest & Tussocks, The Causeway, Therfield - TP01 - Test 1 of 1

25% Effective Storage Depth 75% Effective Storage Depth Measured data



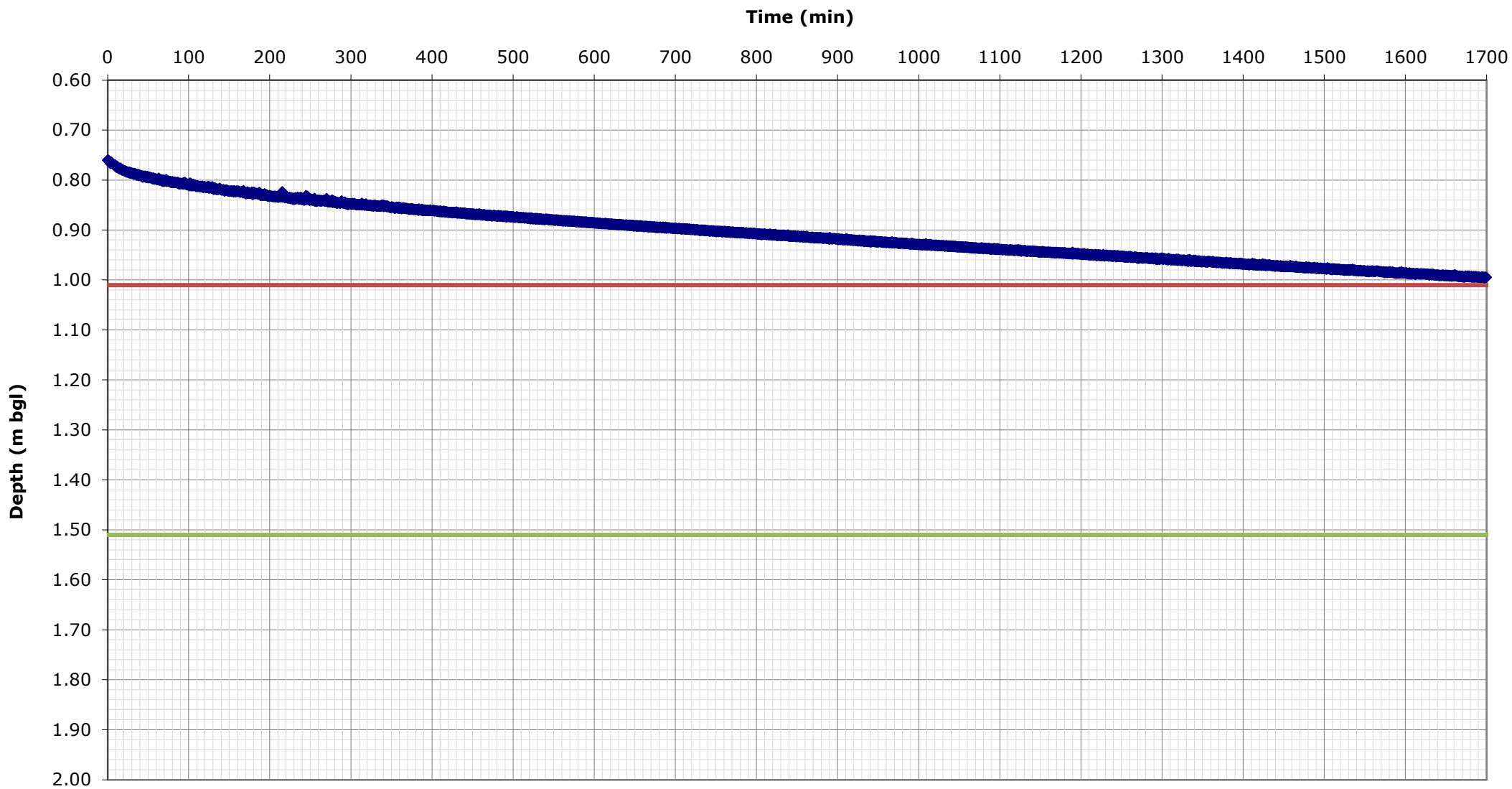
62242 - Hillcrest & Tussocks, The Causeway, Therfield - TP02 - Test 1 of 1

25% Effective Storage Depth 75% Effective Storage Depth Measured data



62242 - Hillcrest & Tussocks, The Causeway, Therfield - TP03 - Test 1 of 1

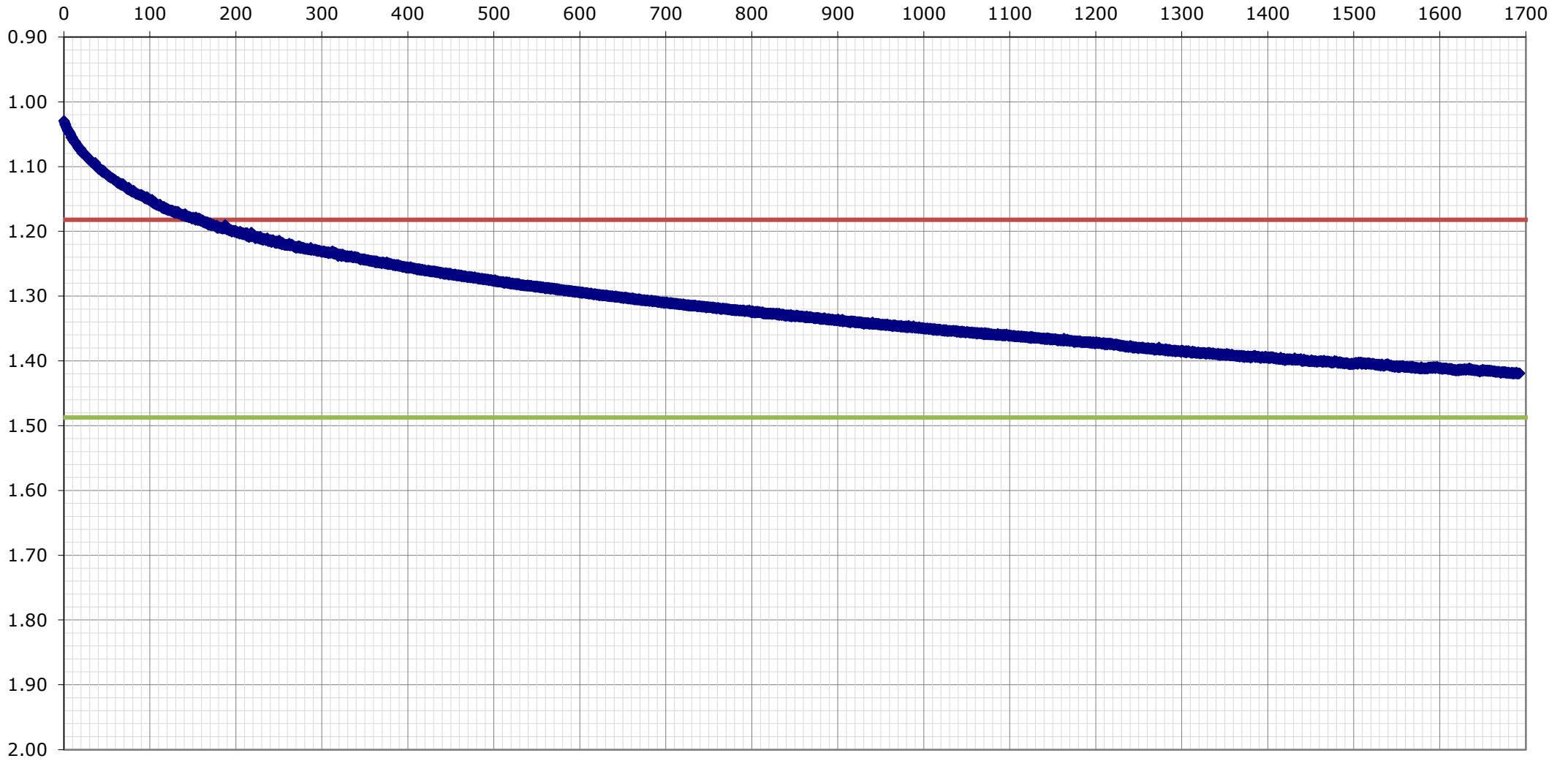
25% Effective Storage Depth 75% Effective Storage Depth Measured data



62242 - Hillcrest & Tussocks, The Causeway, Therfield - TP04 - Test 1 of 1

25% Effective Storage Depth 75% Effective Storage Depth Measured data

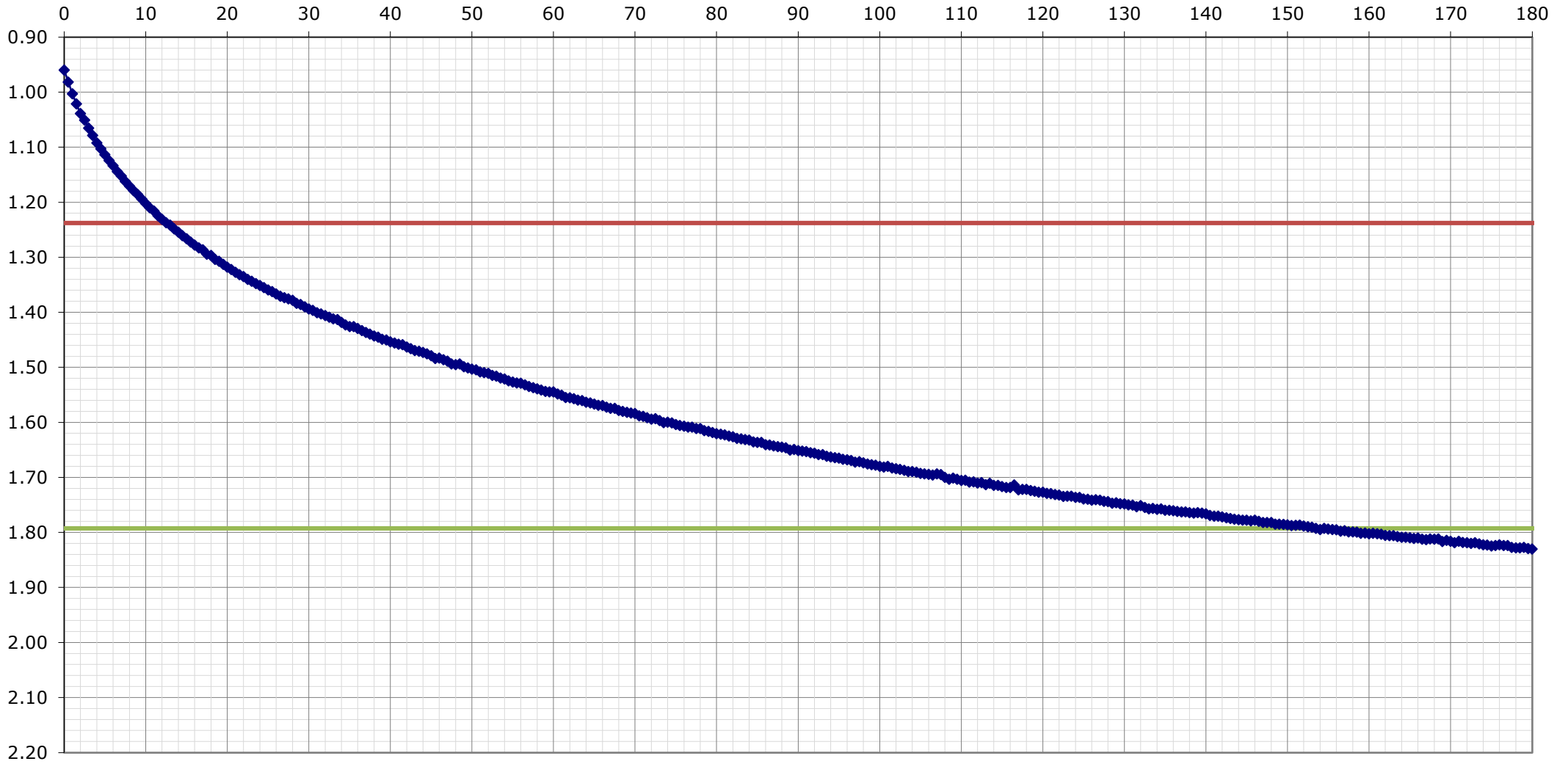
Time (min)



62242 - Hillcrest & Tussocks, The Causeway, Therfield - TP05 - Test 1 of 3

25% Effective Storage Depth 75% Effective Storage Depth Measured data

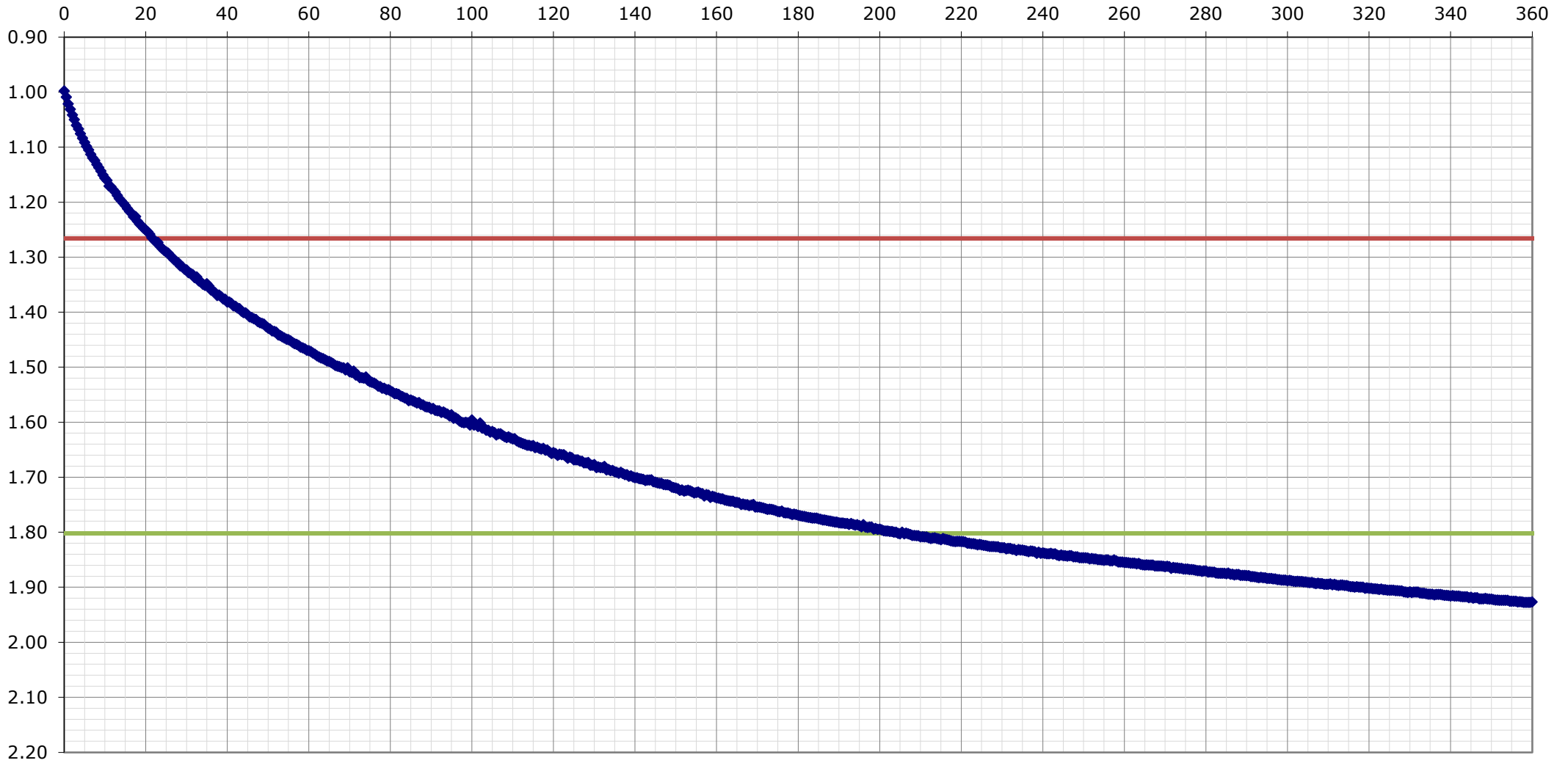
Time (min)



62242 - Hillcrest & Tussocks, The Causeway, Therfield - TP05 - Test 2 of 3

25% Effective Storage Depth 75% Effective Storage Depth Measured data

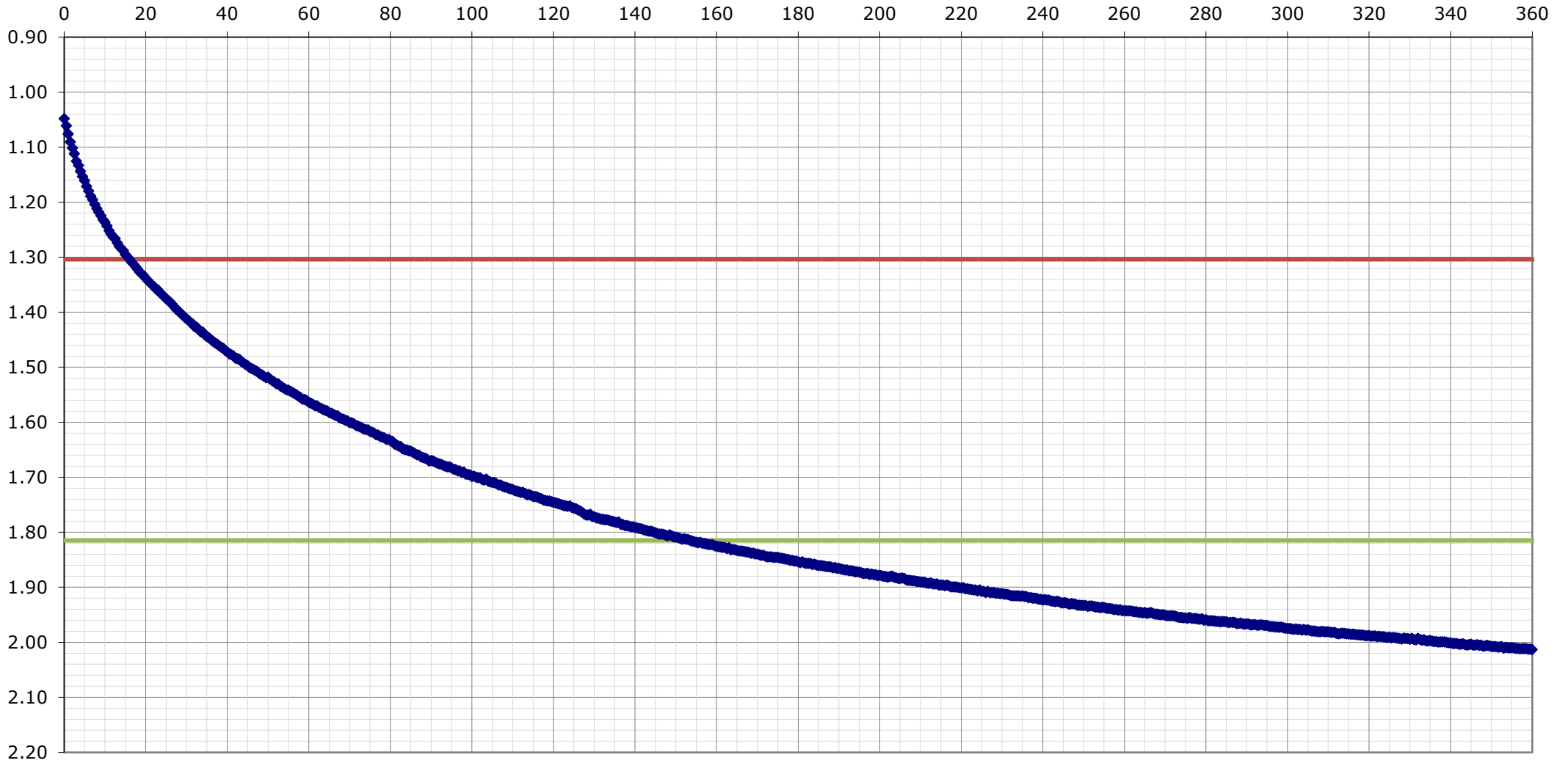
Time (min)



62242 - Hillcrest & Tussocks, The Causeway, Therfield - TP05 - Test 3 of 3

25% Effective Storage Depth 75% Effective Storage Depth Measured data

Time (min)



Limitations of Investigation

This report is based on the results of the exploratory boreholes, the laboratory testing carried out on samples recovered from those boreholes and on details of the scheme provided by the Client.

This report has been prepared for the benefit of Hanson Services Ltd and its contents should not be relied upon by others without the written authority of Richard Jackson Ltd. If any unauthorised third party makes use of this report they do so at their own risk and Richard Jackson Ltd owes them no duty of care or skill.

All information provided by others is taken as being in good faith as being accurate, but Richard Jackson Ltd cannot, and does not; accept any liability for the detailed accuracy, errors or omissions in such information.

Subsoils are by their nature hidden from view and no investigation can be exhaustive to the extent that all soil conditions are revealed. Conditions may well be present beneath the site which was not evident from the investigations carried out.

Geological data, with the exception of geological maps held by Richard Jackson Ltd, Ordnance Survey maps and aerial photographs have not been inspected, nor has any other data relating to site conditions past or present, or any information regarding underground services, other than as indicated. Groundwater levels can be subject to considerable seasonal variations, and the conditions encountered in the exploratory holes may not reflect long-term conditions.

There can be no guarantee that the samples analysed represent the highest concentrations of contamination present beneath the site. The chemical analysis results have been assessed to standards appropriate at the time of investigation.

Unless a greater period of retention of samples is agreed, it is our normal practice to discard all samples one month after submission of our final report.



221/89 The Rectory, Therfield. (Disused)

TL33 NW/7
3355.3697

Was. B.H. p. 251. Surface +509. Shaft x 5. Brick lined to 15. Before 1859.
R.W.L. +275. Jan.; +317. Apr. 1883; +251½. Mar.; +259. July 1888; +247½. June; +235½. Dec.
1901. Dry. Jan. 1902-June 1903. R.W.L. +285½. June; +260½. Dec. 1913; +342½. June 1917. Dry.
Jan. R.W.L. +234. Mar.; +242. June 1923; +254½. Jan.; +241. Dec. 1934; +261½. Apr.; +242½. Dec.
1943. Dry. Aug. 1948-Mar. 1949. R.W.L. +248½. Jan.; +277. Dec. 1958; +269. June; +255. Dec.
1962; +255. Jan.; +272. June 1964.

Boulder Clay	...	...	10	10
Uck	...	...	266	276
Mck	...	...		

GEOLOGICAL
CLASSIFICATION

NATURE OF STRATA

THICKNESS
ft.

DEPTH
ft.

Boulder clay 10'

Shilt clay

10

10

Uck

Chalk

266

276

Mck

} 266'

pp. L.P. Thomas 21/2/65.

Water Supply of ...
Bucks. & Herts.

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221/89 The Rectory, Therfield. (Disused)

TL33/4

W.S.B.H. p. 251. Surface +509. Shaft x 5. Brick lined to 15. Before 1859.
R.W.L. +275. Jan.; +317. Apr. 1883; +251½. Mar.; +259. July 1888; +247½. June; +235½. Dec.
1901. Dry. Jan. 1902-June 1903. R.W.L. +285½. June; +260½. Dec. 1913; +342½. June 1917. Dry.
Jan. R.W.L. +234. Mar.; +242. June 1923; +254½. Jan.; +241. Dec. 1934; +261½. Apr.; +242½. Dec.
1943. Dry. Aug. 1948-Mar. 1949. R.W.L. +248½. Jan.; +277. Dec. 1958; +269. June; +255. Dec.
1962; +255. Jan.; +272. June 1964.

Boulder Clay	...	...	10	10
Uck)	...	...	266	276
Mck)	...	...		

GEOLOGICAL
CLASSIFICATION

NATURE OF STRATA

THICKNESS
ft.

DEPTH
ft.

Boulder clay 10'

Shilt clay

10

10

Uck

Chalk

266

276

Mck

} 266'

pp. L.P. Thomas 26/2/68.

Therfield.

Ordnance Map 221, new ser. (Herts 4, SE., 8, NE.). Geologic Map 47.

1. Rectory.

Communicated by the Rev. J. G. HALE. 1903.

509 ft. above Ordnance Datum. Sir G. FORDHAM gives the figure 512.
In 1897, after the very wet autumn of 1896, there was 62 ft. of water at the end of May. There was no water after 31st December, 1901.
Stiff clay (found in tank close by) ... 10 } 276 ft.
Chalk ... 266 }

The following particulars from a paper by Sir G. FORDHAM in Trans. Herts. Nat. Hist. Soc. 1890. Vol. vi, pp. 31, etc.
Well originally 10 ft. less in depth (266 ft.).

A monthly record of the water-level was kept by the Rev. J. G. HALE, from 1st January, 1883.

The chart (plate ii) shows the monthly water-levels in the wells at Therfield, Barley (see p. 179) and Odsey (just over the border, in Cambridgeshire) from 1st January, 1883, to 1st March, 1889, in the first case; from 1st April, 1878, to 1st October, 1887 (with some gaps) in the second; and from 1st December, 1879, to 1st October, 1889 (also with gaps) in the third.

Sir G. FORDHAM has been kind enough to take much trouble in looking up the record, and we are indebted to him for the following information.

The records were continued after Mr. Hale's death; but for a short time the present rector, the Rev. A. R. HUMPHREYS, was unable to find those from 1889 to 1905. Of those from 1906 onward, the first two years are in Mr. HALE's handwriting. Since his death the gardener has kept the records.

In 1908 the method of measurement was changed, and, instead of the depth of water in the well, the depth to the surface of the water is given [this is a better and more convenient form, as it avoids all question as to the depth of the well] and this is only a reversion to the method of 1883-5, when both figures were given. Also from 1909 onwards the measurements were taken on the first day of a month, instead of on the last, as was the case from 1888 to 1908. The first seems also to have been the day before 1888.

The following is a condensed account of this long record, giving the highest and lowest monthly records.

1883. Depth to water 192 ft. in April, 234 in January.

1884. Depth to water 213 ft. 10 in. in April, 235 ft. 8 in. in December.

150 yds. S.S.E. of W. Mary's Ch.

lies on E.E.L.D.'s field-slip Herts 4 SE/E

Information from Trans. Herts. Nat. Hist. Soc. 9. 1897 :-

Therfield Rectory Level of Surface +509.2

Water levels:-

31/12/95 +253.9.

30/3/97 +254.2

Bottom of Well + 233.2 A.O.D.

Visited. Disused for at least 25 years.

Shaft x 5' brick-lined for first c 15' then chalk. OD 509'.

Automatic Sea Recorder attached to well-Lead and continuous readings taken for the Lea Valley Water Board. (since May 1956).

R.W.L. 254' 6 1/2" b.s. (measured on this visit).

(June 1960 261' b.s.)

Water Supply of Bucks. & Herts.

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9
+ 509
Ordnance Map.
monthly
1:10 gauge scale
1. W.G./SC.
Nov 23. 9. 64

Therfield, cont.

1885. Depth to water 239½ ft. in January. In August it was found that the measuring string had stretched largely. Depth of water in well 19½ in December.
1886. Depth of water in the well 47½ ft. in August, 20 ft. 10 in. in January.
1887. Depth of water 48 ft. on 1st May, 2½ on 31st December.
1888. Depth of water 26 ft. in July, 18½ in March.
1889. Depth of water 41 ft. 5 in., in July and August, 20 ft. 2 in. in January.
1890. Only two records, March 37½ ft., September 33.
1891. Only four records, January 21 ft. 8 in., March, August, and October 14½ ft.
1892. Depth of water in the well 52 ft. 4 in. in April, 31 ft. 4 in. in October. No records for February, August and November.
1893. Depth of water 64 ft. in April, 26½ in December. No records for January, October and November.
1894. Depth of water 30 ft. in April and May, 16 ft. 10 in. in November. No records for March, June, August, September and December.
1895. Depth of water 32½ ft. in May, 20½ in December. No records for January, July and September to November.
1896. In June the depth of water was 33 ft., in March 29½. July the only other month recorded.
1897. Depth of Water 62½ ft. in May, 28 in December. No records for January, April and August to November.
1898. Depth of water 17½ ft. in May, 3½ in December. No records for January to March.

On 29th November an assistant of B. LATHAM's examined the well, and made the depth 274½ ft., or 1½ less than ARCHDEACON ROBINSON recorded in 1859. This may be accounted for by what may have fallen in from the sides or otherwise since that time.

1899. Water in well 16 ft. 10 in. in June, 4 ft. in January. February omitted.
1900.¹ Water in well 30 ft. 1 in. in June, 5 ft. 2 in. in January.
1901.¹ Water in well 8 in. in December, 12 ft. 8 in. in June.

¹ In 1900 and 1901 the water-level is also given ; but the figures do not agree with those for water in the well. But it is said that after the Surveyor's visit in November, 1898 the depth of the well was taken as 274½ ft., instead of 276; but it is thought that the latter is right, and after 1901 that figure was reverted to.

1902. No water in the well, until June, 1903.
1903. Latter half, water in well 16½ ft. in December, 6 in July.
1904. Water in well 51 ft. 2 in. in March, 19 ft. in December.
1905. Water in well 16 ft. 10 in. in January, 5½ ft. in December.
1906. Depth of water in the well 15 ft. 5 in. on 30th June, 4½ ft. on 30th November and 31st December.
1907. Depth of water 18½ ft. on 30th April, 7 ft. on 31st January.
1908. The water-level, below the sill of the well, 261½ ft. on 30th April, 239 ft. 10 in. on 29th February.
1909. Water-level 269 ft. 2 in. on 1st April, 262 ft. 2 in. on 1st January (which was 3 ft. 1 in. higher than on 31st December, 1908).
1910. Water-level 264 ft. 1 in., in January, 236 ft. 10 in. in July.
1911. Water-level 255 ft. 7 in. in December, 235 ft. 7 in. in May.
1912. Water-level 257 ft. 5 in. in February, 230 ft. 8 in. in June.
1913. Water-level 248 ft. 7 in. in December, 223 ft. 8 in. in June.
1914. Water-level 259½ ft. in December, 247 in July.
1915. Water-level 260 ft. in January, 216 ft. 5 in. in June.
1916 (half). Water-level 226½ ft. in April, 194 ft. 8 in. in June.

On Plate I of SIR G. FORDHAM's paper a section is given showing the changes of water-level from Therfield northward to the foot of the chalk-escarpment at Litlington, where the nearest springs occur, about four miles off.

Water Supply of
Bucks. & Herts.

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Therfield Rectory Well
Water Levels 1883-1904

22 221/89
TL33/4

Water level measured in Feet & Inches from curb on the 1st of each month

Well 276' deep.

Curb 512' O.D.

TL33/4

		Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Total rain
1883	Well	234	224	207-10	192	193-4	197	201	205-6	209-6	214-3	218-10	221-6	209-94
362	Rain	1-57	3-40	.83	2-07	1-32	3-87	3-04	.97	4-26	1-82	2-52	1-14	26-81
1884	Well	220-5	218	215-6	213-10	214-2	217	220-6	223-8	228-6	232	234-8	235-8	222-83
289	Rain	1-82	.63	1-06	1-18	.40	1-76	2-57	2-15	1-90	1-64	1-55	1-96	18-68
1885	Well	239-9	242-0	244	243-10	242-10	241	240	240-4	252-3	253-6	255-7	256-9	245-98
266	Rain	1-72	1-92	.94	2-37	3-30	2-26	.46	1-77	3-85	4-91	3-36	.89	27-75
1886	Well	255-2	250-4	244-4	237	233-8	233-2	230-4	228-9	230	234	239-10	243-9	238-36
274	Rain	2-82	.31	1-60	1-45	5-06	.68	2-71	1-56	1-18	3-21	3-07	2-87	26-52
1887	Well	246-6	245-4	236-6	229-2	228	230-7	233-8	236-10	240-8	240-8	246-7	250	238-71
273	Rain	1-46	.72	1-39	1-29	2-86	.56	.64	1-16	3-47	1-80	2-79	1-32	19-46
1888	Well	254	256-9	257-9	256-6	253-9	250-9	250	250-10	252-10	254-10	256-6	257-8	254-43
258	Rain	.81	1-43	3-02	2-13	.98	2-04	4-13	2-78	1-76	.78	3-81	1-21	24-89
1889	Well	255-10	253-10	253-10	244	241-2	237-7	234-7	234-7	237	—	—	244-3	243-66
268	Rain	1-09	1-81	1-40	2-93	3-94	1-75	3-42	1-89	2-17	4-18	1-01	1-21	26-80
1890	Well	—	—	238-6	—	—	—	—	—	243	—	—	—	240-75
271	Rain	2-11	.74	2-31	.67	1-95	2-47	5-42	1-75	.33	1-96	2-29	.85	22-85
1891	Well	254-4	—	258-4	—	—	—	—	259-2	—	261-6	—	—	258-33
254	Rain	1-70	.02	1-87	.91	3-53	2-13	3-23	4-47	1-64	5-49	2-23	3-38	30-60
1892	Well	243	—	227-6	223-8	225-2	225-2	233-6	—	242	244-8	—	241-3	233-99
278	Rain	1-14	2-16	1-21	1-03	1-49	3-12	3-65	3-31	3-03	1-79	4-20	1-90	28-03
1893	Well	—	226-3	216-10	212	216-2	220-9	226-9	231-7	238	—	—	249-6	226-43
286	Rain	2-13	3-17	.29	.15	.81	.72	4-01	3-40	1-22	3-88	2-20	1-55	23-53
1894	Well	250-6	250	—	246	246	—	249-10	—	—	257-2	259-10	—	251-33
261	Rain	1-80	1-60	.99	1-02	1-81	1-94	2-60	3-17	1-61	2-95	3-60	1-71	24-80
1895	Well	—	252-9	248	244-8	242-3	244	—	249-3	—	—	—	253-3	248-17
264	Rain	2-62	.33	1-75	1-03	.78	.51	4-45	6-12	.86	2-38	3-72	1-84	26-39
1896	Well	—	—	246-9	—	—	243	244-10	—	—	—	—	—	244-86
267	Rain	.86	.44	3-30	1-13	.40	2-64	.96	2-47	5-59	3-33	1-12	3-30	25-54
1897	Well	—	240	225	—	213-3	220-6	223-3	—	—	—	—	248	228-33
284	Rain	2-38	2-55	3-45	1-50	1-31	2-72	1-23	3-49	3-02	.85	1-08	1-91	25-49
1898	Well	—	—	—	261-6	258-6	260-4	261	263-6	266-8	268-10	269-2	271	264-50
247	Rain	.82	.90	1-41	1-68	3-19	2-53	1-43	1-32	.27	3-06	2-30	2-76	21-67
1899	Well	270-6	262-10	258-4	258-1	257-8	258	260-2	263-9	265-5	268-8	270-4	269-08	269-08
249	Rain	2-05	1-45	.67	2-82	1-74	1-44	1-78	.81	1-97	2-26	3-22	1-57	21-78
1900	Well	269-4	266-1	257	246-4	246-4	244-5	245-10	252-6	254-4	258	262-4	265-3	255-44
256	Rain	2-74	4-28	.78	.91	1-37	3-08	1-15	3-39	.43	2-02	2-09	2-32	24-56
1901	Well	269-4	270-7	270	268-2	265	261-10	263	263-11	266-8	269-10	272-7	273-10	267-89
244	Rain	.75	1-11	2-66	2-42	1-12	1-52	2-68	1-56	1-25	1-51	1-05	2-93	20-56
1902	Well	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
—	Rain	.46	.96	1-15	.72	2-32	2-92	1-32	4-19	1-03	1-33	1-39	1-25	19-04
1903	Well	Dry	Dry	Dry	Dry	Dry	X	270	264-10	260-8	259-5	256	249-6	
—	Rain	2-38	.56	2-88	1-44	3-92	6-02	5-14	3-33	1-94	5-21	2-33	1-63	36-78
1904	Well	241	225-10	224-10	226-8	226	226-6	227	242	244-9	249-3	253-3	257	238-61
273	Rain	2-11	2-99	1-64	.93	1-70	1-04	3-00	2-50	1-26	1-32	1-36	1-86	21-71

x 1 half inch down on June 13th

Total rain for 1882-29-61"

* On 1 Aug. 1885 the measuring line was altered & found to have stretched 11 1/2 ins. in the well and sunk 4 inches the sudden change in water level.

Therfield Rectory Well.

Water Levels 1905 - 1916

TL33/4

Water level measured in Feet & Inches below curb on the last day of each month.
Well 276' deep Curb 512' O.D.

		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total rain
1905	Well	259-2	261-4	263	263-2	262-6	262-2	263-5	265-3	266-9	268-3	270	270-9	264-65
247	Rain	1-19	1-25	2-32	2-13	1-17	3-58	0-89	2-90	2-16	1-35	2-26	0-99	22-19
1906	Well	271-6	271	267-4	262-2	260-9	260-7	261-6	263-4	265-10	268-4	271-6	271-6	266-27
246	Rain	2-93	1-77	1-87	1-10	1-24	3-47	0-83	1-09	1-63	3-75	4-63	2-38	26-69
1907	Well	269	263	259-6	257-6	258	258	258	258-6	259	260	262-3	264-10	260-63
251	Rain	0-91	1-31	0-87	3-08	3-02	1-56	2-24	2-52	0-64	2-33	2-46	3-48	24-42
1908	Well	246-6	239-10	243-6	261-6	256-6	249-8	248-2	249	251-8	248-11	254-7	259-1	250-74
261	Rain	1-07	1-07	2-44	2-95	1-43	2-17	3-69	2-33	1-37	0-97	0-78	1-79	22-06
1909	Well	262-2	265-2	268-10	269-2	264-6	264	264-8	264-5	265-2	266-6	267-8	264-1	265-52
246	Rain	0-83	0-38	2-23	1-45	1-60	4-28	3-46	2-47	2-35	4-36	0-89	3-06	28-36
1910	Well	264-1	260-2	252-9	244-10	239-6	237	236-10	239-10	243-8	246-0	248-9	252-9	247-18
265	Rain	1-67	2-31	1-02	2-82	3-53	1-56	2-20	1-71	1-16	2-55	3-42	3-89	27-84
1911	Well	253-8	247-4	239-4	236-2	235-7	237-9	236-11	239-2	241	247-11	251-4	255-7	243-39
269	Rain	1-39	1-06	2-16	0-84	1-69	2-68	0-46	1-06	1-12	2-60	2-72	4-38	22-16
1912	Well	256-8	257-5	253-3	244-6	235-9	230-8	231	237	241-6	245-3	248	249	243-66
268	Rain	3-33	1-40	3-40	0-13	1-53	2-85	1-97	6-22	2-49	2-19	1-81	2-53	29-85
1913	Well	247	243-7	234	225-2	224	223-8	229-4	234-4	236-3	241-5	244-11	246-7	236-02
276	Rain	2-68	0-79	2-20	2-38	2-06	0-96	2-65	1-29	2-15	3-43	2-02	0-98	23-59
1914	Well	252-1	253-7	255-5	255-4	252-7	249	247	248-9	250-2	252-8	255-8	259-3	252-62
259	Rain	1-14	1-89	3-61	1-11	1-17	1-84	2-00	1-07	0-94	2-05	3-07	6-05	25-94
1915	Well	260	256-8	241-8	224-4	217-8	216-5	224-2	228-4	231-2	228-8	224-8	220-4	231-17
281	Rain	3-51	2-99	1-61	0-92	1-98	1-05	3-98	2-95	1-29	1-43	1-90	4-17	27-78
1916	Well	217-6	217-6	222-	226-6	199-3	194-8	199-9	193-9	187-9	181-5	176-2	180-6	199-76
312	Rain	1-04	3-93	4-19	1-35	2-85	3-03	1-83	2-91	2-27	2-53	3-36	2-81	30-61

These two sheets of water levels received from Mr. H. Fordham, 27-4-49. J.K.I.

221/89

Record missing 2-4-49

The attached list of water levels should be attached to record.

J.K.I.
2-4-49.

Feb. 1952 - 248 ft to water.

April 1952 - 248 ft 6" to water

see WA/221/covers.

TL 33/4
221
89

EXTRACT FROM WATER SUPPLY OF BUCKS & HERTS

1921 pp. 251 - 252.

Well at the Rectory, THERFIELD.

<u>Year.</u>	<u>Highest R.W.L.</u>	<u>Lowest R.W.L.</u>
1883	234' in Jan.	192' in April
1884	213'10" in April	235'8" in December
1885	239'9" " Jan.	256'9" " December
1886	228'9" " August	255'2" " January.
1887	228' " May	253' " December
1888	250' " July	257'9" " March
1889	234'7" " July & Aug.	255'10" " January
1890	238'6" " March	243' " September
(These are the only two records for the year.)		
1891	254'4" in January	261'6" " March,
(These are the only four records for the year).		
1892.	223'8" in April.	244'8" " October.
(No records for February, August & November).		
1893	212' in April	249'6" " December.
(No records for January, October & November).		
1894	246' in April	259'2" " November.
(No records for March, June, August, September, & December).		
1895	243'3" in May	255'3" " December
(No records for January, July, September - November).		
1896	243' in June	246'9" in March
(July is the only other month recorded).		
1897	213'3" in May	248' " December.
(No record for January, April and August - November).		
1898	258½' in May	272'6" in December.
(No records for January - March).		
1899	257'8" in June	270'6" " January.
1900	245'11" " June	270'10" " January.
1901	263'4" " June	275'4" " December
1902	(No water in well until June, 1903).	
1903	259'6" in December.	Dry in June.
1904	214'10" " March	257' in December.
1905	259'2" " January	270'9" " December.
1906	260'7" " June	271'6" " Nov. & Dec.
1907	257'6" " April	269' " January.
1908	239'10" " February	261'6" " April
1909	262'2" " January	269'2" " April
1910	236'10" " July	264'1" " January
1911	235'7" " May	255'7" " December.
1912	230'8" " June	257'5" " February.
1913	225'8" " June	248'7" " December.
1914	247' " July	259'5" " December.
1915	216'5" " June	260' " January
1916 (half)	194'8" " June	226'6" " April.

All figures given are below well top (o/n + 509).

Thornfield Rectory Well Water level 1916-1949⁺

Water level measured in Feet + Inches from Curb on last day of month
Well 276' deep Curb 512' O.D. TL 3314

		Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
312	1916	Well 217-6	217-6	222-0	226-6	199-3	196-8	199-9	193-9	187-9	181-5	176-2	180-6	199-76
		Rain 1-04	3-93	4-19	1-35	2-85	3-03	1-83	2-91	.77	2-53	3-36	2-81	30-61
337	1917	Well 183-11	181-3	173-2	172-0	167-8	166-6	166-8	188-1	170-7	174-9	176-9	175-9	175-17
		Rain 1-51	.70	1-61	1-48	2-29	2-16	6-1	5-75	1-64	4-36	1-35	.68	24-64
331	1918	Well 175-3	172-8	170-8	173-2	172-9	172-3	175-10	182-3	187-8	192-8	196-11	199-3	180-94
		Rain 2-53	.80	.83	3-86	1-80	.89	2-48	.96	6-32	1-30	2-35	2-14	26-26
318	1919	Well 198-2	198-10	188-0	177-0	176-0	179-0	184-0	191-0	199-0	210-0	22-6	216-6	194-17
		Rain 3-76	3-59	2-43	4-47	.30	1-67	3-52	2-73	1-12	.65	1-88	4-25	30-37
294	1920	Well 219-10	217-5	212-11	211-3	210-7	211-9	213-9	215-9	219-5	223-9	227-3	224-7	217-77
		Rain 2-69	.37	1-37	3-60	1-20	1-70	4-06	1-26	1-80	.90	.85	1-78	21-21
253	1921	Well 232-3	234-3	257-0	257-8	258-4	259-5	260-10	262-10	266-8	266-5	268-1	270-9	271-11
		Rain 2-30	.24	1-04	1-38	1-05	.96	.27	.92	1-23	.87	1-64	1-18	13-08
237	1922	Well 273-3	274-1	275-2	275-0	276-9	276-7	276-7	276-7	276-7	275-9	275-9	276-7	276-8
		Rain 2-34	1-89	1-74	2-76	1-78	1-05	3-65	2-34	2-61	.74	1-26	1-46	24-12
240	1923	Well Well dry	275-0	271-0	268-2	268-11	268-3	269-0	270-8	271-10	273-1	273-6	271-81	
		Rain 1-28	3-01	1-84	1-41	1-45	.82	2-88	3-84	2-02	3-95	1-47	2-30	26-27
252	1924	Well 272-6	268-4	264-0	261-10	259-10	257-6	255-6	255-3	256-7	258-11	258-11	255-1	260-36
		Rain 2-72	.56	.71	3-00	4-21	2-32	4-50	2-53	2-86	4-12	2-85	3-08	33-46
276	1925	Well 247-1	238-7	228-1	221-2	222-10	227-2	232-2	236-10	241-4	245-0	248-0	244-8	236-49
		Rain 1-11	3-18	1-29	1-69	2-33	.37	2-66	2-70	3-09	3-13	1-73	1-51	24-79
274	1926	Well 248-10	243-18	231-10	226-6	227-2	224-2	232-4	235-10	239-6	242-9	245-9	247-9	237-60
		Rain 2-77	2-82	.17	3-14	1-96	2-76	3-31	1-18	2-48	2-39	3-62	.37	26-97
276	1927	Well 247-9	247-1	240-1	230-1	224-7	224-11	228-11	233-3	237-6	240-6	241-2	238-8	236-21
		Rain 2-39	3-44	2-00	1-79	.90	2-98	2-71	3-19	5-20	1-74	2-73	2-69	31-76
267	1928	Well 223-8	208-8	204-8	208-2	213-2	218-11	224-3	229-7	234-7	239-4	243-4	246-10	244-54
		Rain 2-76	1-23	1-59	1-00	2-05	2-22	2-58	3-02	.82	3-07	1-80	2-68	24-82
282	1929	Well 249-10	247-10	245-10	244-7	244-7	246-1	248-1	250-5	252-11	256-2	258-2	258-11	229-82
		Rain 1-54	.64	.08	1-67	2-00	.87	2-94	.64	.24	3-36	5-16	4-04	23-18

* Well remeasured and true depth to Water ascertained

Therfield Rectory Well. Water levels cont. 2.

27 TL3314
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			Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total Rain
269	1930	Well	254-11	247-5	240-5	236-9	235-7	235-7	237-1	240-1	243-1	246-1	248-10	249-2	242-92
		Rain	2-20	46	1-49	1-95	3-26	1-98	2-92	2-59	4-42	1-10	4-29	2-47	29-13
279	1931	Well	245-2	237-10	229-10	226-10	226-10	227-4	228-10	231-10	233-0	233-6	234-6	236-0	232-61
		Rain	1-86	229-11	15	3-42	2-76	1-30	4-94	4-60	2-40	68	2-56	89	27-50
275	1932	Well	235-10	234-10	234-4	235-10	237-0	235-6	233-2	234-5	237-0	240-10	243-40	245-10	237-37
		Rain	1-36	34	1-65	2-38	5-22	90	1-85	2-79	1-64	4-49	1-69	46	24-77
269	1933	Well	245-8	244-10	242-4	238-10	238-10	235-10	237-10	240-4	243-7	246-9	249-9	252-7	242-93
		Rain	1-29	1-81	1-81	96	2-11	2-08	68	1-12	2-82	1-82	1-44	49	18-43
249	1934	Well	254-9	256-11	258-9	260-8	261-11	262-11	263-9	264-6	265-6	266-4	267-4	268-0	262-63
		Rain	1-53	47	1-80	1-91	63	1-81	2-03	2-16	1-29	1-59	2-03	3-67	20-92
248	1935	Well	268-2	268-2	265-10	263-4	261-4	260-4	261-2	262-5	263-5	265-5	266-3	266-3	264-34
		Rain	1-75	2-04	58	2-96	1-32	2-61	95	1-09	3-92	2-79	4-02	2-24	26-27
264	1936	Well	268-3	257-3	249-3	242-9	241-3	242-6	244-6	244-6	244-6	246-6	248-6	247-6	247-69
		Rain	3-52	2-08	1-01	1-56	84	4-92	5-53	53	2-92	1-71	3-21	1-76	24-59
277	1937	Well	243-6	224-0	220-0	221-6	225-0	228-6	234-6	240-0	246-0	251-0	253-6	246-3	230-57
		Rain	4-06	3-05	3-61	2-91	3-12	2-89	3-62	1-10	1-91	2-79	1-76	3-08	33-90
277	1938	Well	228-3	221-11	217-11	219-11	224-11	230-5	236-1	241-7	245-3	248-9	251-9	254-9	235-13
		Rain	2-62	46	38	28	2-11	61	1-45	1-56	2-55	2-67	2-69	3-55	20-87
272	1939	Well	256-0	247-6	236-6	232-6	230-6	229-6	231-0	234-4	238-4	241-4	244-4	242-6	239-69
		Rain	4-79	61	2-09	3-06	1-93	2-31	2-16	3-10	1-41	4-84	3-52	1-09	30-91
273	1940	Well	248-0	242-4	232-10	223-2	222-2	226-8	232-8	238-8	244-8	250-2	254-5	256-5	239-95
		Rain	1-99	1-59	3-09	1-76	1-37	43	3-74	28	66	2-41	6-51	1-42	25-25
272	1941	Well	255-9	251-1	238-5	224-7	222-5	225-5	230-9	235-9	240-9	245-9	249-11	253-9	239-83
		Rain	2-34	1-85	3-26	1-23	2-40	1-18	2-31	4-05	89	1-99	2-50	1-33	25-33
257	1942	Well	255-9	255-9	253-7	249-11	248-3	244-3	251-11	254-11	257-9	260-9	263-3	265-6	254-8
		Rain	2-33	1-26	1-35	77	2-30	1-08	2-87	1-41	1-30	3-80	2-42	2-31	22-90
256	1943	Well	266-2	256-2	250-0	247-2	247-8	250-0	252-8	255-8	258-11	261-9	264-3	266-5	256-4
		Rain	4-56	78	59	96	1-86	2-56	77	1-77	1-35	2-55	1-47	1-22	20-44

x Well remeasured and depth to water found to be 246-3

Therfield Rectory Well

W.D. Lane 221 80

TL33/4

		Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total Rain
238	1944	Well 268.5	270.5	271.7	271.11	271.11	273.1	273.1	274.7	275.7	276.7	277.5	278.8	273.01
		Rain 1.36	1.06	.24	1.71	1.26	1.45	1.66	2.48	3.15	3.53	2.90	1.05	22.35
240	1945	Well 277.8	274.10	270.10	267.6	266.6	266.6	267.6	269.6	271.10	273.10	275.10	276.8	271.58
		Rain 1.45	1.40	.58	1.15	2.60	2.27	2.42	1.84	2.77	2.52	.46	2.71	23.17
240	1946	Well -	277.6	274.10	271.0	268.9	268.5	268.11	270.3	272.0	273.9	274.11	272.5	272.07
		Rain 1.56	1.80	1.29	1.50	2.29	2.49	3.27	3.41	2.46	1.66	4.50	2.04	29.27
262	1947	Well 268.11	264.5	253.11	227.5	225.5	231.1	240.1	248.7	254.1	258.7	263.1	266.7	250.18
		Rain 1.49	1.39	5.19	2.00	.90	2.32	1.84	.02	1.15	.17	1.17	2.84	20.36
236	1948	Well 270.3	272.9	273.5	273.5	274.1	274.8	275.10	277.2	278.4	274.4	280.2	280.2	275.89
		Rain 2.49	.84	.91	1.41	2.46	3.68	1.38	4.13	1.88	2.26	1.53	1.86	26.33
	1949	Well 280.2	278.4	276.4										
		Rain 1.21	1.28	1.15										

See also Pigeon holes in
Conference room and Strong Room
on 6th Floor.

No record entered since July 1951.

Feb. 1952 R.W.L. 24.8" w.g. Preston letter 15/2/52.

Month of March 1952 water rose - R.W.L. 24.5 1/2.

" April Rise of 4 1/2".

" May " " 3' 10"

letter from W.G. Preston.

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TL33/4
221/89

Station THERFIELD RECTORY

Datum point O.D. 509

Observation well during test on

Date and Time	Water Level R.W.L. to O.D.	Rate G.P.H.	Notes	Date and Time	Water Level R.W.L. to O.D.	Rate G.P.H.	Notes
27.9.57	255.5			29.10.59	266.0		
29.10.57	252.4			30.11.59	262.3		
28.11.57	250.1			31.12.59	259.1		
18.12.57	249.05			1.2.60	257.25		
16.1.58	248.5			1.3.60	258.3		
14.2.58	250.25			2.4.60	256.8		
13.3.58	254.5			3.5.60	259.3		
10.4.58	260.9			2.6.60	260.8		
9.5.58	265.5			4.7.60	260.8		
10.6.58	266.9			2.8.60	259.1		
11.7.58	266.4			3.9.60	256.6		
8.8.58	270.5			3.10.60	254.0		
3.9.58	273.3			31.10.60	252.0		
29.10.58	272.4			1.11.60	252		
1.12.58	273.85			1.1.61	265		
31.12.58	277.0			1.2.61	285		
29.1.59	285.5			1.4.61	303		
11.2.59	292.0			1.5.61	301		
26.2.59	298.5			1.7.61	290		
23.3.59	301.0			1.8.61	284		
24.4.59	298.0			1.9.61	277		
26.5.59	293.0			1.10.61	271		
25.6.59	298.0			1.11.61	267		
25.6.59	287.7			1.12.61	263		
27.7.59	281.5			1.1.62	259		
26.8.59	276.0			1.2.62	258		
28.9.59	270.4			1.3.62	262		

D 022752/1/3671 4m 6/62 DL

10:

TL 33/4
221/
89

Station THERFIELD RECTORY

Datum point _____ O.D. 509

Observation well during test on

Date and Time	Water Level	Rate G.P.H.	Notes	Date and Time	Water Level	Rate G.P.H.	Notes
	R.W.L. to O.D.						
1.4.62	267						
1.5.62	270						
1.6.62	271						
1.7.62	269						
1.8.62	268						
1.9.62	264						
1.10.62	261						
1.11.62	257						
1.12.62	255						
31.12.62	253						
For further levels							
see WS/50 / Lee Valley Water Co.							
DATA Bank							

D 022752/1/3671 4m 6/62 DL

ADDITIONAL INFORMATION SHEET

Date of completion
of well catalogue

Date of publication

Licence No.:

221 / TL33/4 89

Additional Sheet No.

O.D.
arrangements

DATE	*	ADDITIONAL INFORMATION	INIT.
9.2.70		O.D. & wooden flap (measuring point) is 507.96 Newlyn. Int- from Lee Conservancy phone	mjc
4.2.74		Surface + RWL figs amended accordingly: Surface + 508. RWL + 274. Jan.; + 316. Apr. 1883; + 250 $\frac{1}{4}$. Mar; + 258 July 1888; + 246 $\frac{1}{4}$. June; + 234 $\frac{1}{4}$. Dec. 1901; + 284 $\frac{1}{4}$. June; + 259 $\frac{1}{2}$. Dec. 1913; + 341 $\frac{1}{2}$. June 1917; + 233. Mar.; + 241 June 1923; + 253 $\frac{1}{4}$. Jan.; + 240. Dec. 1934; + 260 $\frac{1}{4}$. Apr.; + 241 $\frac{1}{2}$. Dec. 1943. ... + 247 $\frac{1}{2}$. Jan.; + 276. Dec. 1958; + 268. June; + 254. <u>Dec. 1962</u> ; + 254. Jan.; + 271. June 1964.	BH
		Data Bank	
FILMED	* INSERT WELL REFERENCE LETTER, IF MORE THAN ONE WELL AT SITE		P.T.O.
Section 6	Pumping test	Observ. well	Recorder
		E.R. log	GEOLOGICAL SURVEY, WATER DEPARTMENT SOUTH KENSINGTON, LONDON, S.W.7.

4130) Wt.34984/P.S.127 5m 9/63 G.W.B.Ltd. Gp.863

GEOLOGICAL SURVEY,
 WATER DEPARTMENT
 SOUTH KENSINGTON,
 LONDON, S.W.7.

Contact BGS: ngdc@bgs.ac.uk



WATER RESOURCES BOARD WELL RECORD		SHEET 1		W.R.B. REF. No. TL33/4
				R.A. LICENCE No.
1. WELL IDENTITY		NATIONAL GRID REFERENCE TL 33553697		
Well at <u>The Field Rectory</u>		I.G.S. REF. No. <u>221/89</u>		
<u>150 yds SSE of St Mary's ch.</u>		RIVER AUTHORITY <u>Lae</u>		
Town <u>The Field</u>		HYDROMETRIC AREA <u>38</u>		
County <u>Herts</u>		SUB-CATCHMENT		
Owner of well				
Well made by				
Date of sinking				
Information from <u>198/RA</u>				
Date received <u>2.2.68</u>				
2. WELL DESCRIPTION				
Level of ground surface m. If well top is not at above* m.				
above sea level (O.D.) <u>509</u> ft. ground level how far below ft.				
Shaft m. deep; Diameter at top m. ; at bottom m.				
ft. ft. ft. ft.				
Bore m. deep; Diameter at top m. ; at bottom m.				
ft. ft. ft. ft.				
Details of headings				
DETAILS OF PERMANENT LINING TUBES				
Length m. ; Diam. m. ; Plain m. ; Slotted m. ; Top m. above* surface				
ft. ft. ft. ft. ft. below surface				
Length m. ; Diam. m. ; Plain m. ; Slotted m. ; Top m. above* surface				
ft. ft. ft. ft. ft. below surface				
Length m. ; Diam. m. ; Plain m. ; Slotted m. ; Top m. above* surface				
ft. ft. ft. ft. ft. below surface				
Details of well screen				
DETAILS OF REST WATER LEVELS DURING CONSTRUCTION				
Water struck at depths of below well top				
Rest level of water m. above* O.D.* m. deep. Date				
ft. below well top when bore ft.				
Rest level of water m. above* O.D.* m. deep. Date				
ft. below well top when bore ft.				
Rest level of water on completion of bore m. above* O.D.* m. deep. Date				
ft. below well top when bore ft.				
Method of drilling				
Brief details of well development e.g. acid treatment etc.				

* delete as applicable

(46452-1) 1

[illegible]



WATER RESOURCES BOARD WELL RECORD		W.R.B. REF No. TC33/4
SHEET 2		R.A. LICENCE No.
4. HYDROGEOLOGY		
Topography AT WELL SITE		
Local depression ☐ , Flat surface ☐ , Hill top ☐ , Hillside ☐ , Valley bottom ☐ , Terrace ☐		
MAJOR AQUIFER		Lithology
Depth to top of aquifer m. ft.		Thickness penetrated m. ft.
Top of aquifer m. ft.		$\frac{AOD^*}{BOD}$ Total thickness of aquifer m. ft.
Coefficient of storage		Transmissibility..... $\frac{m^2/day^*}{galls/day/ft.}$
MINOR AQUIFER (a)		Lithology
Depth to top of aquifer m. ft.		Thickness penetrated m. ft.
Top of aquifer m. ft.		$\frac{AOD^*}{BOD}$ Total thickness of aquifer m. ft.
Coefficient of storage		Transmissibility..... $\frac{m^2/day^*}{galls/day/ft.}$
MINOR AQUIFER (b)		Lithology
Depth to top of aquifer m. ft.		Thickness penetrated m. ft.
Top of aquifer m. ft.		$\frac{AOD^*}{BOD}$ Total thickness of aquifer m. ft.
ADDITIONAL NOTES:		

* delete as applicable

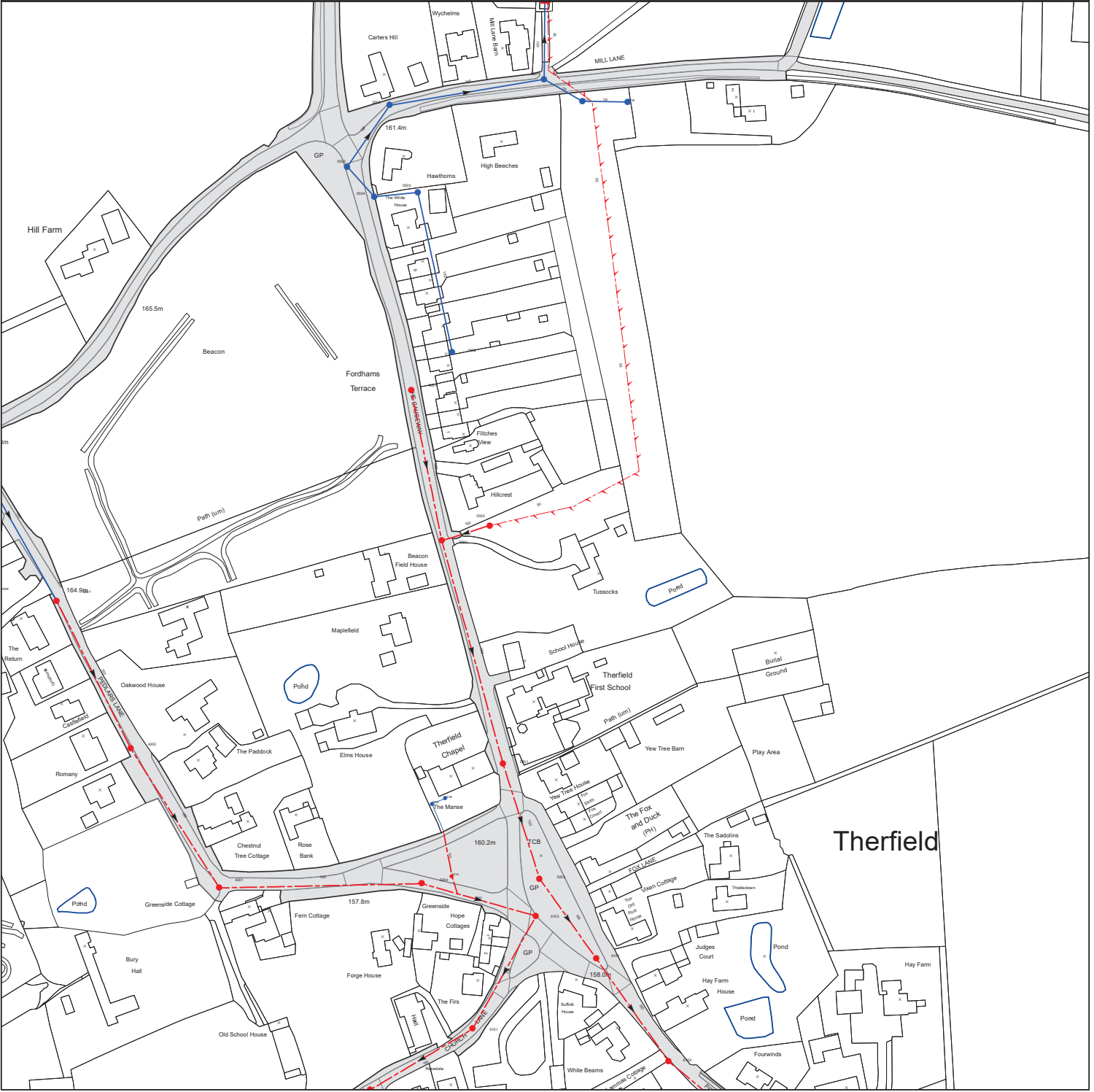
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WATER RESOURCES BOARD CONTINUATION SHEET		G.S. Ref. Number	Well Ref. Number TL33/4
Date and Initials GR 335369	NOTES: (Rule off after each entry)		
	Oct 1965 April 1966		
	O.D. + 243ft + 278ft chalk water level		
	WATER LEVEL DATA:		
Date of Observation	R.W.L.*	P.W.L.*	Rate of Abstraction
* State whether ^{feet} metres and whether ^{above} below surface or ^{above} below Ordnance Datum			

Appendix F - Thames Water Asset Location Plan



The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified before any works are undertaken. Crown copyright Reserved

Scale: 1:1789 Width: 500m Printed By: G1KANAGA Print Date: 12/09/2023 Map Centre: 533597,237369 Grid Reference: TL3337SE	Comments:
--	-------------------------

ALS/ALS Standard/2023_4883042

NB: Level quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates no Survey information is available.

REFERENCE	COVER LEVEL	INVERT LEVEL
6102		
5204	158.41	156.22
5101	157.08	155.52
5201	160.83	159.42
5202	159.69	158.11
3301	164.91	161.5
4201	158.32	156.71
5402		
5503	162.33	161.02
5502	161.87	160.35
651A		
521B		

REFERENCE	COVER LEVEL	INVERT LEVEL
5401	165.27	164.34
5301	163.73	162.3
5302	165.24	163.91
5103	158.49	155.88
6101	158.78	156.56
4202	161.36	160.07
5505	164.7	163.61
6501	161.11	159.55
5504	163.32	162.03
521A		
651B		
521C		

Appendix G – Surface Water Flood Mapping



EA Surface Water Maps

Appendix H – Causeway Flow Calculations

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	30	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	0.900
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
2	0.014	5.00	166.200	1200	19.996	54.410	1.050
1	0.014	5.00	166.400	1200	15.108	101.807	1.050
3			166.400	1200	18.084	79.915	1.680
4	0.028	5.00	167.200		86.521	84.591	1.000
5			167.000	1200	71.219	83.741	4.229
6	0.018	5.00	164.400		94.762	-68.850	1.050
7			165.000	1200	83.189	-19.473	1.730
8	0.061	5.00	163.500		-15.309	-19.473	1.000
9	0.044	5.00	165.700		71.016	13.560	1.000
10			165.700		80.783	5.951	3.459
10_OUT			166.800		136.043	10.627	4.691

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
2.000	2	3	6.200	0.600	165.150	164.720	0.430	14.4	150	5.04	50.0
1.000	1	3	17.000	0.600	165.350	164.920	0.430	39.5	150	5.18	50.0
1.001	3	5	18.000	0.600	164.720	164.467	0.253	71.1	150	5.43	50.0
3.000	4	5	4.000	0.600	166.200	165.942	0.258	15.5	100	5.03	50.0
1.002	5	10	27.980	0.600	162.771	162.491	0.280	100.0	150	5.89	50.0
4.000	6	7	8.000	0.600	163.350	163.270	0.080	100.0	150	5.13	50.0
4.001	7	10	34.280	0.600	163.270	162.391	0.879	39.0	150	5.49	50.0
5.000	8	10	37.645	0.600	162.500	162.343	0.157	240.0	300	5.62	50.0
6.000	9	10	5.621	0.600	164.700	164.491	0.209	26.9	100	5.06	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
2.000	2.666	47.1	2.5	0.900	1.530	0.014	0.0	24	1.430
1.000	1.605	28.4	2.5	0.900	1.330	0.014	0.0	30	0.994
1.001	1.193	21.1	5.1	1.530	2.383	0.028	0.0	50	0.984
3.000	1.971	15.5	5.1	0.900	0.958	0.028	0.0	39	1.768
1.002	1.005	17.8	10.1	4.079	3.059	0.056	0.0	81	1.037
4.000	1.005	17.8	3.3	0.900	1.580	0.018	0.0	44	0.769
4.001	1.616	28.6	3.3	1.580	3.159	0.018	0.0	34	1.080
5.000	1.010	71.4	11.0	0.700	3.057	0.061	0.0	79	0.738
6.000	1.494	11.7	8.0	0.900	1.109	0.044	0.0	61	1.606

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.003	10	10_OUT	31.700	0.600	162.241	162.109	0.132	240.0	300	6.42	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.003	1.010	71.4	32.3	3.159	4.391	0.179	0.0	142	0.986

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
2.000	6.200	14.4	150	Circular	166.200	165.150	0.900	166.400	164.720	1.530
1.000	17.000	39.5	150	Circular	166.400	165.350	0.900	166.400	164.920	1.330
1.001	18.000	71.1	150	Circular	166.400	164.720	1.530	167.000	164.467	2.383
3.000	4.000	15.5	100	Circular	167.200	166.200	0.900	167.000	165.942	0.958
1.002	27.980	100.0	150	Circular	167.000	162.771	4.079	165.700	162.491	3.059
4.000	8.000	100.0	150	Circular	164.400	163.350	0.900	165.000	163.270	1.580
4.001	34.280	39.0	150	Circular	165.000	163.270	1.580	165.700	162.391	3.159
5.000	37.645	240.0	300	Circular	163.500	162.500	0.700	165.700	162.343	3.057
6.000	5.621	26.9	100	Circular	165.700	164.700	0.900	165.700	164.491	1.109
1.003	31.700	240.0	300	Circular	165.700	162.241	3.159	166.800	162.109	4.391

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
2.000	2	1200	Manhole	Adoptable	3	1200	Manhole	Adoptable
1.000	1	1200	Manhole	Adoptable	3	1200	Manhole	Adoptable
1.001	3	1200	Manhole	Adoptable	5	1200	Manhole	Adoptable
3.000	4		Junction		5	1200	Manhole	Adoptable
1.002	5	1200	Manhole	Adoptable	10		Junction	
4.000	6		Junction		7	1200	Manhole	Adoptable
4.001	7	1200	Manhole	Adoptable	10		Junction	
5.000	8		Junction		10		Junction	
6.000	9		Junction		10		Junction	
1.003	10		Junction		10_OUT		Junction	

Simulation Settings

Rainfall Methodology	FEH-22	Drain Down Time (mins)	2880	100 year (l/s)	17.0
Summer CV	1.000	Additional Storage (m³/ha)	0.0	Check Discharge Volume	✓
Winter CV	1.000	Check Discharge Rate(s)	✓	100 year 360 minute (m³)	197
Analysis Speed	Normal	2 year (l/s)	4.8		
Skip Steady State	x	30 year (l/s)	13.1		

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440
----	----	----	-----	-----	-----	-----	-----	-----	-----	-----	------

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	40	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Betterment (%)	0
Greenfield Method	ReFH2	Q 1 year (l/s)	
Region	England, Wales, NI	Q 30 year (l/s)	
Include Baseflow	x	Q 100 year (l/s)	
Positively Drained Area (ha)	1.000		

Pre-development Discharge Volume

Site Makeup	Greenfield	Return Period (years)	100
Greenfield Method	ReFH2	Storm Duration (mins)	360
Region	England, Wales, NI	Betterment (%)	0
Include Baseflow	x	Runoff Volume (m³)	197
Positively Drained Area (ha)	1.000		

Node 4 Online Orifice Control

Flap Valve	x	Replaces Downstream Link	✓	Diameter (m)	0.020
Downstream Link	3.000	Invert Level (m)	166.200	Discharge Coefficient	0.600

Node 9 Online Orifice Control

Flap Valve	x	Replaces Downstream Link	✓	Diameter (m)	0.020
Downstream Link	6.000	Invert Level (m)	164.700	Discharge Coefficient	0.600

Node 6 Online Orifice Control

Flap Valve	x	Replaces Downstream Link	✓	Diameter (m)	0.020
Downstream Link	4.000	Invert Level (m)	163.350	Discharge Coefficient	0.600

Node 10 OUT Deep Bore Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.36000	Invert Level (m)	162.109	Borehole Diameter	0.125
Side Inf Coefficient (m/hr)	0.36000	Time to half empty (mins)	92	Borehole Depth (m)	30.000
Safety Factor	2.0	Diameter (m)	1.200	Inf Depth (m)	23.000
Porosity	1.00	Depth (m)		Number Required	2

Node 8 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	162.770	Slope (1:X)	40.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	990	Depth (m)	0.600
Safety Factor	2.0	Width (m)	6.580	Inf Depth (m)	
Porosity	0.30	Length (m)	50.000		

Node 4 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	166.570	Slope (1:X)	50.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	252	Depth (m)	0.500
Safety Factor	2.0	Width (m)	13.750	Inf Depth (m)	
Porosity	0.30	Length (m)	14.000		

Node 9 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	164.970	Slope (1:X)	50.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	500	Depth (m)	0.600
Safety Factor	2.0	Width (m)	11.620	Inf Depth (m)	
Porosity	0.30	Length (m)	24.000		

Node 6 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	163.920	Slope (1:X)	50.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	170	Depth (m)	0.350
Safety Factor	2.0	Width (m)	7.600	Inf Depth (m)	
Porosity	0.30	Length (m)	24.000		

Node 10 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	162.241
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	1335

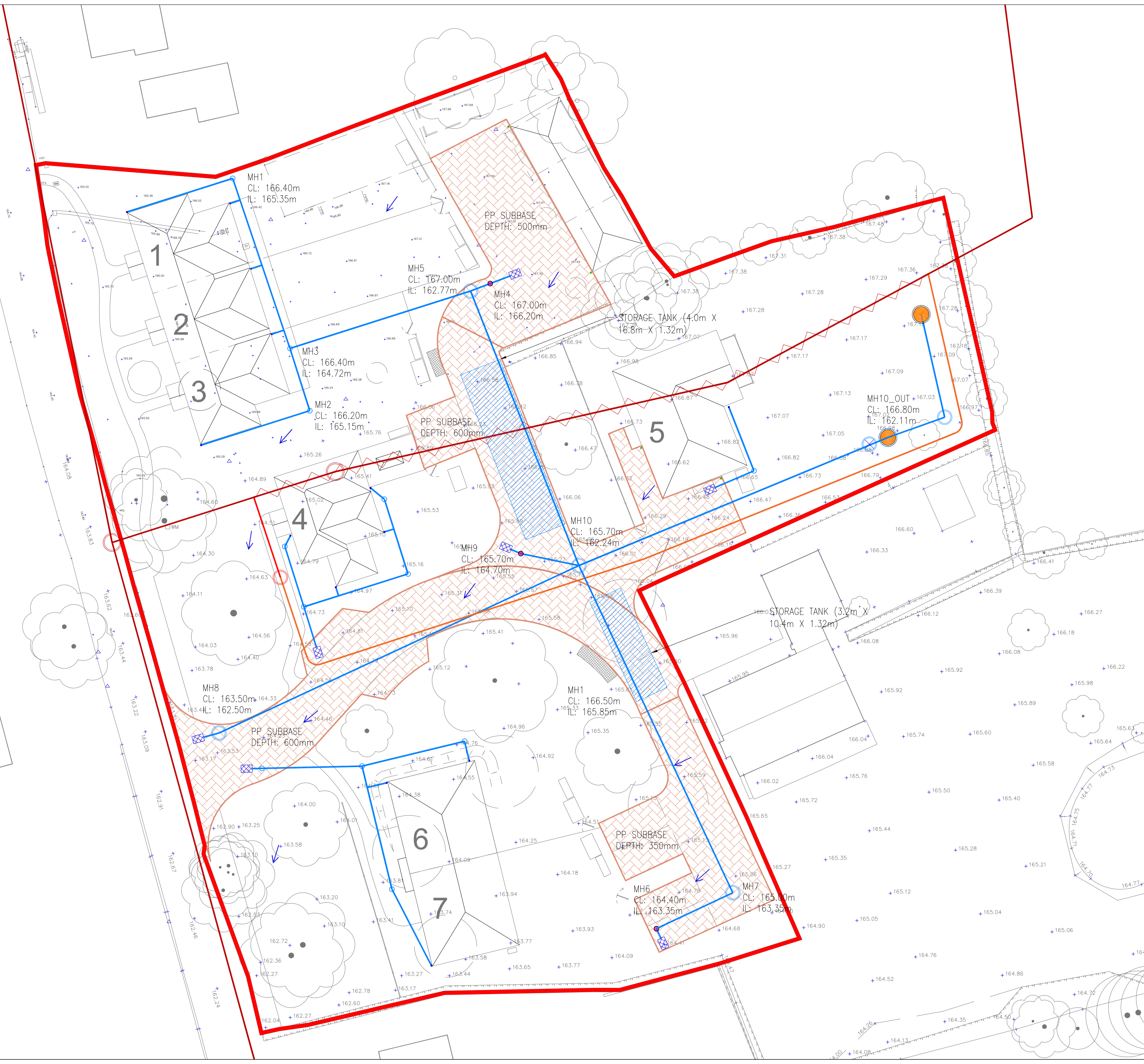
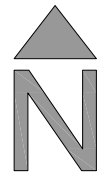
Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	100.5	0.0	1.320	100.5	0.0	1.321	0.0	0.0

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.96%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	2	10	165.201	0.051	11.6	0.0574	0.0000	OK
15 minute summer	1	10	165.420	0.070	11.6	0.0786	0.0000	OK
15 minute summer	3	11	164.921	0.201	23.1	0.2278	0.0000	SURCHARGED
180 minute winter	4	176	166.982	0.782	5.2	15.7074	0.0000	FLOOD RISK
960 minute winter	5	1020	163.409	0.638	2.0	0.7216	0.0000	SURCHARGED
120 minute winter	6	102	164.351	1.001	4.5	7.7271	0.0000	FLOOD RISK
960 minute winter	7	1020	163.409	0.139	0.7	0.1572	0.0000	OK
960 minute winter	8	1020	163.409	0.909	2.9	7.7863	0.0000	FLOOD RISK
240 minute winter	9	236	165.555	0.855	6.7	28.9036	0.0000	FLOOD RISK
960 minute winter	10	1020	163.409	1.168	6.2	111.5189	0.0000	SURCHARGED
960 minute winter	10_OUT	1020	163.409	1.300	3.2	3.6843	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	2	2.000	3	11.6	1.049	0.246	0.0708
15 minute summer	1	1.000	3	11.5	1.482	0.405	0.1318
15 minute summer	3	1.001	5	22.3	1.296	1.060	0.3082
180 minute winter	4	Orifice	5	0.7			
960 minute winter	5	1.002	10	2.0	0.619	0.114	0.4926
120 minute winter	6	Orifice	7	0.8			
960 minute winter	7	4.001	10	0.7	0.562	0.025	0.5936
960 minute winter	8	5.000	10	2.8	0.390	0.039	2.6509
240 minute winter	9	Orifice	10	0.8			
960 minute winter	10	1.003	10_OUT	3.2	0.378	0.044	2.2323
960 minute winter	10_OUT	Infiltration		0.9			

Appendix I – Proposed SuDS Layout



KEY

- SITE BOUNDARY (TOTAL SITE AREA 0.51ha)
- PERMEABLE PAVING
- PROPOSED GEO-CELLULAR STORAGE TANK
- SURFACE WATER PIPE NETWORK
- SURFACE WATER MANHOLE
- PERMAVOID DIFFUSER UNIT
- RAINWATER DOWNPIPE
- RAINWATER DOWNPIPE FITTED WITH A SHOE
- ORIFICE PLATE WITH SUITABLE FILTER
- DEEP BORE SOAKAWAY, INFILTRATING AT 1x10-4m/s
- DOWNSTREAM DEFENDER
- FLOW ARROW
- SURFACE WATER PIPE NETWORK
- FOUL WATER SEWER DEMARCATION CHAMBER
- FOUL WATER RISING MAIN DIVERSION
- FOUL WATER SEWER DIVERSION

REV	DATE	BY	DESCRIPTION	CHK	APD
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1st Floor Millers House, Roydon Road,
Stanstead Abbots, Hertfordshire, SG12 8HN
Tel: 01920 871777
www.eostp.co.uk

CLIENT:
HANSON SERVICES LTD

ARCHITECT:

PROJECT:
HILLCREST & TUSSUCKS
THE CAUSEWAY, THERFIELD

TITLE:
SURFACE WATER DRAINAGE STRATEGY

SCALE: A2: 1:250	DESIGN-DRAWN: RC/JC	DATE: 14.06.2024
PROJECT No: 4405	DRAWING No: DR01	

Appendix J – Downstream Defender Specification

Downstream Defender® Select

Design Data

The Downstream Defender® Select is the **new generation of advanced hydrodynamic separator** for treatment of urban surface water runoff. Its customisable performance and extended range of chamber sizes allows engineers to tailor their drainage designs to meet specific pollutant removal standards. The Downstream Defender® Select also offers easier installation with much more flexibility of pipe sizes and connections and can accept up to three inlets.



Key Features

- » Selectable performance levels for pollutant targets and retention.
- » Extended range of chamber sizes.
- » Can accept up to three inlet pipes.
- » Can accept a range of pipe sizes.
- » No moving parts and no power requirement.
- » Available in concrete or plastic chambers.

Fig 1. Downstream Defender® Select. **Advanced Vortex** models in concrete and plastic shown with *Hydro-Logic® Smart Monitoring* and *enhanced hydrocarbon (oil) retention* options.

Targeted pollutant removal

The Downstream Defender® Select performance can be tailored to remove some or all of the following pollutants:

Sediment (Total Suspended Solids)



The Downstream Defender® Select is a highly effective sediment/TSS removal device. It can be sized in a number of ways to suit the application and level of protection required (see Table 2).

Gross Pollutants



100% removal of floatable debris, such as food wrappers, Styrofoam cups and drinks cartons.

Sediment Bound Hydrocarbons (including Polycyclic Aromatic Hydrocarbons - PAHs)



PAHs have low solubility in water and are readily adsorbed onto sediment particles. Effective removal of sediment particles will also ensure the removal of many PAHs.

Liquid Hydrocarbons (oils)



Effective spill containment device at low flow rates. Note these systems are not considered oil separators according to the BS EN 858-1 and must not be used in applications where full certification is required.

Sediment Bound Heavy Metals and Nutrients



As an efficient device for removal of fine sediment, the Downstream Defender® Select is also effective for the removal of sediment bound pollutants.

Downstream Defender® Select model options

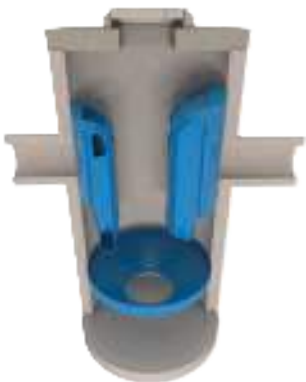
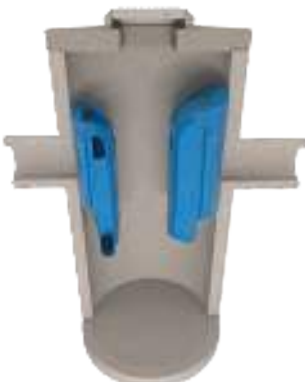
Downstream Defender® Select Model			
	Advanced Vortex	Vortex Plus	Vortex
	Our recommended model which provides sediments, litter and hydrocarbon (oil) removal with enhanced sediment retention up to four times the treatment flow rate. 	Provides sediments, litter and hydrocarbon (oil) removal, with sediments retained at up to two times the treatment flow rate. 	A simpler model providing removal of sediments, with retention up to two times the treatment flow rate. 
Key Pollutants			
Sediments	Coarse and fine	Coarse and fine	Coarse and fine
Sediment retention	Retained up to 4 x treatment flow rate	Retained up to 2 x treatment flow rate	Retained up to 2 x treatment flow rate
Litter, debris	✓	✓	✗
Liquid hydrocarbons (oils)	✓	✓	✗
Hydrocarbon (oil) retention	Option for increased retention on request	Option for increased retention on request	✗
Sediment bound metals	✓	✓	✓

Table 1 - Downstream Defender® Select pollutant removal performance

The Downstream Defender® Select may be sized for different target particle sizes and removal efficiencies – contact us for site specific design.

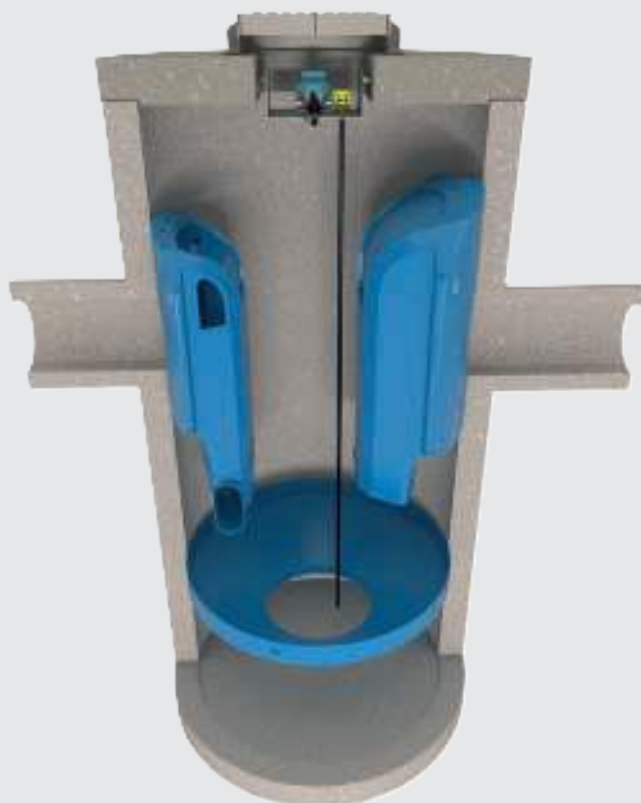
Enhancement Options

Make Maintenance Smart

To help with SuDS maintenance plans and to ensure that maintenance is cost-effective, add Hydro-Logic® Smart Maintenance to any model and get automated maintenance alerts.

Hydro-Logic® Smart Maintenance can also reduce risk and save costs by reducing the need for inspection visits for units installed alongside roads or rail tracks.

The Hydro-Logic® Flexi Logger and ATEX/IECEX sensors capture real-time data for flow levels and/or sediment build-up. Level monitoring will enable the detection of blockages relating to the unit, and sediment level monitoring can be set to a trigger point and self-report to the client's maintenance team when maintenance is due.



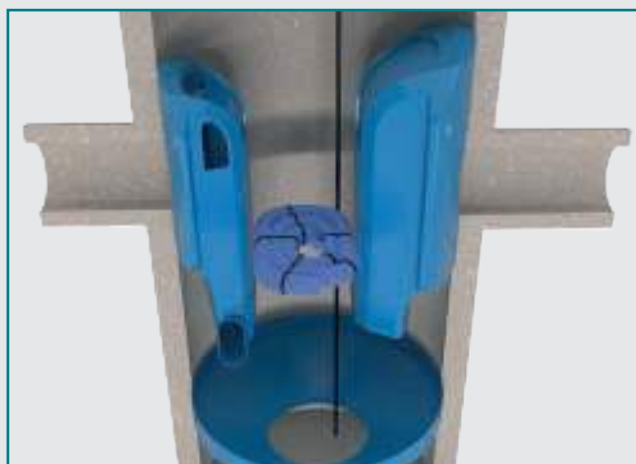
*Fig 2. Downstream Defender® Select
Hydro-Logic® Smart Maintenance.
Available for all models.*

Improve hydrocarbon retention

The option of storing hydrocarbons (oils) as solids can be added, providing increased retention, even at flow rates where the unit is bypassing.

This option is available for the [Advanced Vortex](#) and [Vortex Plus](#) models only.

Fig 3. Enhanced hydrocarbon (oil) retention option for the Downstream Defender® Select. Available for the [Advanced Vortex](#) and [Vortex Plus](#) models only.

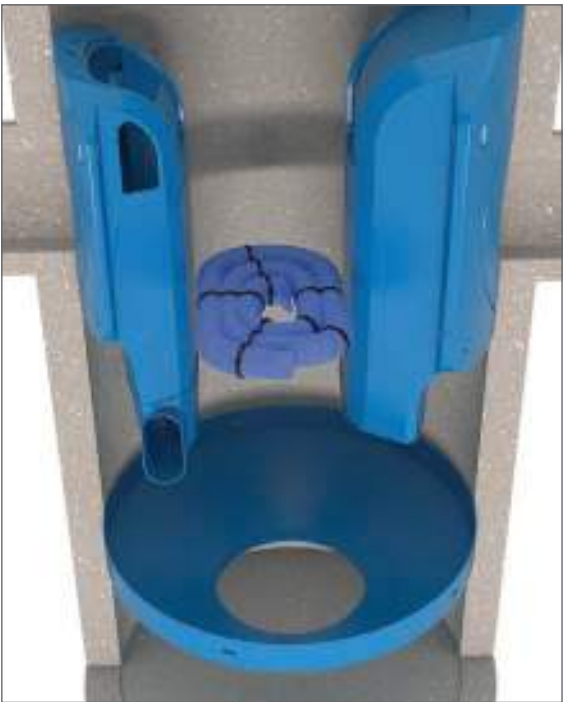


Pollutant retention

It is important to ensure that pollutants in a rainfall event are retained throughout subsequent events. The Downstream Defender® Select offers engineers the option of specifying the retention performance of sediments. The **Vortex** and **Vortex Plus** models provide sediment retention up to twice the treatment flow rate, and the **Advanced Vortex**, with its benching skirt creating a calm sediment storage zone, provides sediment retention up to four times the treatment flow rate.

An option for enhancing the retention of hydrocarbons (oils) by storing them as a solid is available, ensuring no wash out during extremely high flows. This option is only available for the **Advanced Vortex** and **Vortex Plus** models

Fig 4. Downstream Defender® Select with enhanced sediment retention and enhanced hydrocarbon (oil) retention options.



The Simple Index Approach (SIA)

The Simple Index Approach outlined in CIRIA C753 The SuDS Manual is a water quality design method for sites with a low to medium risk pollution hazard level. Sites with a high risk pollution hazard level should consider a more precautionary approach.

The approach assigns pollution hazard indices to the given land use for three pollutant groups, total suspended solids (TSS), metals and hydrocarbons. SuDS components are then selected until their combined pollution mitigation index score is greater than the pollution hazard index for each pollutant group.

Model	Downstream Defender® Select Mitigation Indices ^{(a)(b)}		
	Total Suspended Solids (TSS)	Metals	Hydrocarbons (Oils)
Vortex	0.3	0.2	0.2
Vortex Plus	0.5	0.4	0.5
Advanced Vortex	0.5	0.4	0.5
Notes: (a) All mitigation indices supplied by Hydro International Ltd are calculated using the methods laid out in the British Water How To Guide: Applying the CIRIA SuDS Manual Simple Index Approach to Proprietary / Manufactured Stormwater Treatment Devices. The Advanced Vortex and Vortex Plus models have also been independently verified by the WRc, with the WRc Performance Declaration available on request. (b) Mitigation Indices quoted for the Downstream Defender® Select are valid when the unit is designed according to the Treatment Flow Rate (see Table 3).			

Table 2 - SuDS Mitigation Indices for Downstream Defender® Select

Sizing a Downstream Defender® Select

The Downstream Defender® can be sized for different treatment goals and objectives. For design purposes, the selected model's Treatment Flow Rate should be greater than or equal to the site's Water Quality Flow Rate.

The hydraulic capacity of the selected model should be considered with respect to the peak discharge flow rate from the site.

If there is no treatment objective, just betterment, do not use a treatment flow rate and only compare the hydraulic capacity to the peak discharge flow rate.

Model diameter (m)	Treatment flow rate ^{(a)(b)} (l/s)	Hydraulic capacity ^(c) with recommended pipe size (l/s)	Hydraulic capacity ^(d) with maximum pipe size (l/s)	Maximum catchment area m ²	Maximum headloss at treatment flow rate (mm)
1.0	21	46	70	2800	160
1.2	30	84	107	4000	170
1.5	48	144	170	6400	220
1.8	69	217	278	9200	230
2.1	94	271	355	12500	240
2.4	123	422	529	16400	250
3.0	192	652	787	25600	260

Notes:

(a) The Treatment Flow Rate is based on an annualised removal efficiency of >50% of all particles up to 1000 microns with a mass-median particle size (D50) of 63 microns and a specific gravity of 2.65. The testing was conducted in line with the British Water Code of Practice.

(b) Alternative sizing based on different sediment grades available on request.

(c) Maximum flow rate that can pass through the chamber with a maximum headloss of 500mm. Figures shown are when using the recommended pipe size in Table 5.

(d) Maximum flow rate that can pass through the chamber with a maximum headloss of 500mm. Figures shown are when using the maximum pipe size in Table 5.

Table 3 - Downstream Defender® Select design information.

Model diameter (m)	Oil Storage Capacity (l)		Minimum sediment storage capacity ^(c) (m ³)
	Minimum liquid hydrocarbon (oil) storage capacity up to Treatment Flow Rate ^(a)	Solid state storage capacity with enhanced retention option ^(b)	
1.0	256	43-70	0.31
1.2	442	43-70	0.45
1.5	849	85-140	0.71
1.8	1458	85-140	1.02
2.1	2550	128-210	1.39
2.4	3586	170-280	1.81
3.0	6811	231-350	2.83

Notes:

- (a) Liquid oil storage capacity is valid up to the Treatment Flow Rate. Oil capture and retention is only available for the **Advanced Vortex** and **Vortex Plus** models only.
- (b) Permanent oil storage capacity when using the enhanced oil retention option (available for the **Advanced Vortex** and **Vortex Plus** models only).
- (c) Additional sediment storage capacity for all Downstream Defender[®] Select models (**Advanced Vortex**, **Vortex Plus** and **Vortex**) can be provided to extend maintenance intervals if required.

Table 4 - Downstream Defender[®] Select capacities.

Design your own Downstream Defender[®] Select with our Online Design Tool



Register free and design your own Downstream Defender[®] Select and try out different performance objectives.

Project designs can be saved and submitted for a free review by our expert technical team if required. General arrangement drawings and quotes can also be requested from the tool for any saved design.

visit hydro-int.design

Pipe sizes

Downstream Defender® Select can accept a range of **inlet / outlet pipe** sizes, removing the need for complicated pipe connections or couplers. The inlet pipe size must always be equal to or smaller than the outlet pipe size.

Additional pipe sizes may be accommodated, please contact us for assistance.

Chamber size	1.0 m	1.2 m	1.5 m	1.8 m	2.1 m	2.4 m	3.0 m
Pipe sizes	150	150	300	375	375	500	600
	225 ^{a)}	225	375 ^{a)}	400	400	600 ^{a)}	675 ^{b)}
	300	300 ^{a)}	400	450 ^{a)}	450	675 ^{b)}	750 ^{a)}
		375	450	500	500 ^{a)}	750	900
				600	600		
					675 ^{b)}		

Notes:

a) The recommended pipe size for optimum performance.

b) 675 mm is only available for concrete chambers.

Table 5 - Downstream Defender® Select pipe sizes.

Setting out

The Downstream Defender® Select can accommodate a change in pipe direction to suit site specific requirements and accept up to three inlet pipes.

Pipe angles can be adjusted to suit. Minimum angle between inlets and outlet is 90°.

For ease of installation the Downstream Defender® Select can now accept a range of pipe sizes.

Head loss across the chamber is kept to a minimum (see Table 3). The inlet and outlet pipes should be sized in accordance with Table 5.

Inlet and outlet pipe connections are at the same invert level.

Additional manhole sections can be provided to extend the chamber to meet site cover and invert levels or provide additional pollutant storage where required.



Fig 5. Downstream Defender® Select Advanced Vortex with *three inlet pipes*.

Dimensions and weights for concrete chambers

Material	Chamber Diameter - Internal (mm) (C)	Chamber Diameter External (mm) (includes base slab and any extrusions)	Recommended Inlet and Outlet Internal Diameter (mm) ⁽¹⁾	Minimum Depth to Invert (mm) (A) ⁽²⁾	Total Chamber Height Including cover (mm) (B) ⁽³⁾	Maximum Component Lift Weight (kg) ⁽⁴⁾
Concrete	1050	1420	225	1550	2390	2770
Concrete	1200	1460	300	1757	2831	2320
Concrete	1500	1760	375	2050	3276	3530
Concrete	1800	2160	450	2650	4090	5250
Concrete	2100	2650	500	2857	4364	6670
Concrete	2400	2950	600	3321	5375	8600
Concrete	3000	3480	750	3518	5433	14080

Notes:

- (1) Recommended inlet and outlet internal diameter. For alternative pipe sizes to allow for easier connections, please see Table 5.
- (2) Minimum depth to invert shown. Depth to invert can be increased if required.
- (3) Minimum chamber depth shown. Additional sediment storage capacity or increased depth to invert can be provided if required. Total chamber height for concrete units **includes** the cover.
- (4) Maximum component weight is based on a single inlet and includes internal components.

Table 6 - Downstream Defender® Select dimensions and weights for concrete chambers

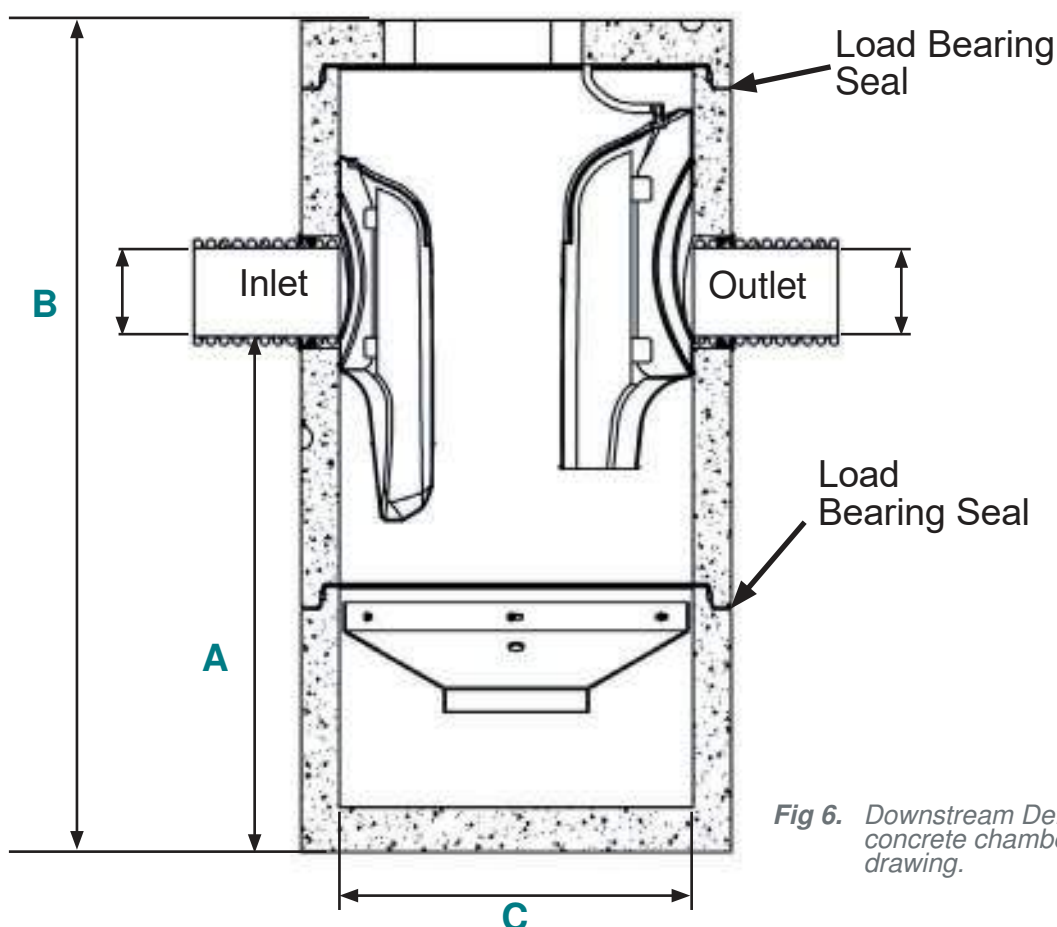


Fig 6. Downstream Defender® Select concrete chamber dimension drawing.

For General Arrangement drawings please email stormwater@hydro-int.com or submit a request at hydro-int.design

Dimensions and weights for plastic chambers

Material	Chamber Diameter - Internal (mm) (C)	Chamber Diameter External (mm) (includes base slab and any extrusions) (5)	Recommended Inlet and Outlet Internal Diameter (mm) (1)	Minimum Depth to Invert (mm) (A) (2)	Total Chamber Height Excluding Cover (mm) (B) (3)	Maximum Component Lift Weight (kg) (4)
HDPE Single Wall	1030	1282	225	1350	2012	125
HDPE Single Wall	1200	1435	300	1612	2512	170
HDPE Single Wall	1500	1735	375	1976	3012	240
HDPE Single Wall	1800	2317	450	2270	3490	410
HDPE Single Wall	2100	2630	500	2570	3920	750
HDPE Single Wall	2400	2930	600	2820	4440	950
HDPE Single Wall	3000	3530	750	3570	5270	1200

Notes:

- (1) Recommended inlet and outlet internal diameter. For alternative pipe sizes to allow for easier connections, please see Table 5.
- (2) Minimum depth to invert shown. Depth to invert can be increased if required.
- (3) Minimum chamber depth shown. Additional sediment storage capacity or increased depth to invert can be provided if required. Total chamber height for plastic units **excludes** the cover.
- (4) Maximum component weight is based on a single inlet and includes internal components.
- (5) Maximum external diameter includes lifting lugs and base slab.

Table 7 - Downstream Defender® Select dimensions and weights for plastic chambers

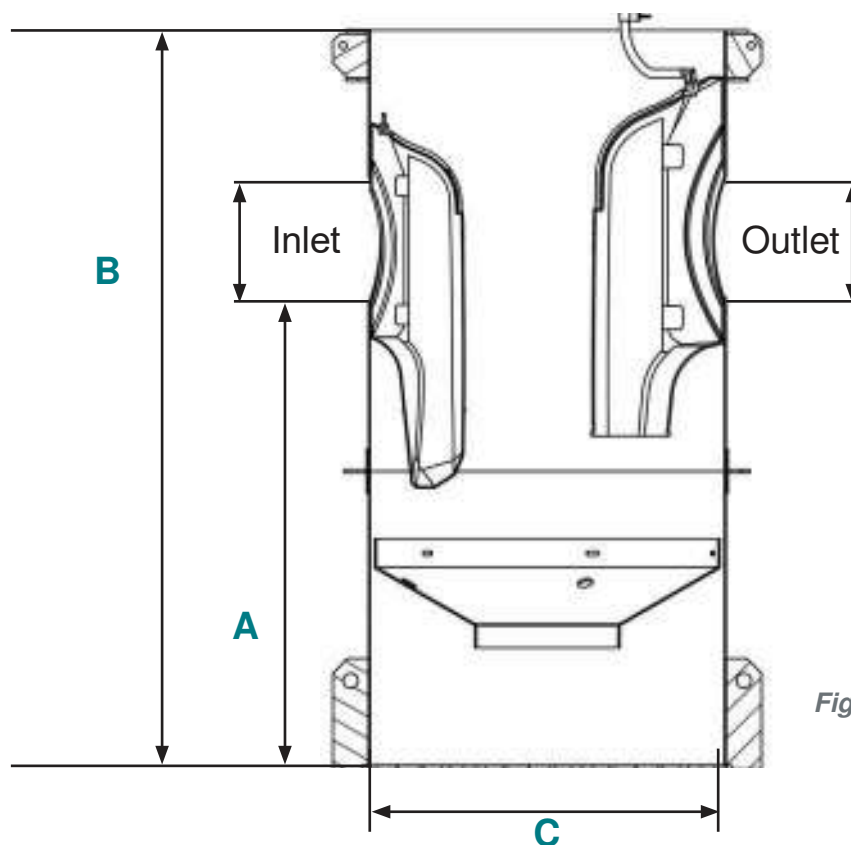


Fig 7. Downstream Defender® Select plastic chamber dimension drawing.

For General Arrangement drawings please email stormwater@hydro-int.com or submit a request at hydro-int.design

Maintenance for a Downstream Defender® Select

Periodic removal of captured pollutants is essential to the continuous, long-term functioning of your Downstream Defender® Select. The device will capture and retain sediment and oil until the sediment and oil storage volumes are full to capacity. When sediment and oil storage capacities are reached, the Downstream Defender® Select will no longer be able to store removed sediment and oil. Pollutant storage capacities are provided in Table 4.

If a Hydro-Logic® Smart Maintenance system is installed in the Downstream Defender® Select, when captured sediment volumes reach a predetermined level, the system will send an automated alert to request maintenance.

Maintenance events may include hydrocarbons (oils), floatables and sediment removal. These can be removed safely from the surface, no entry into the Downstream Defender® Select is required. The Hydro-Logic® Smart Maintenance system will need to be removed to allow access for the Jet Vac truck / Vacuum Tanker. This is easily done by carefully lifting the bracket holding the Hydro-Logic® Smart Maintenance package out of the unit and putting them to one side prior to inserting the Vacuum Tanker hose into the unit. The internal components of the Downstream Defender® Select do not need to be removed as the jet / vacuum hose can access the full depth of the unit through the centre of the chamber.



Determining a maintenance schedule

The frequency of clean-out is determined in the field after installation. During the first year of operation, the unit should be inspected every six months or sooner to determine the rate of sediment and floatables accumulation. A simple probe such as a Sludge Judge® can be used to determine the level of accumulated solids stored in the sump.

To enable the provision of maintenance plans for planning applications, a typical maintenance schedule for a Downstream Defender® Select would be:

Activity	Frequency
Inspection	• Regularly during first year of installation. • Every 6 months after the first year of installation
Hydrocarbons (oils) and floatables removal	• Once per year, or as needed with sediment removal. • Following a spill in the drainage area.
Sediment removal	• As and when alerted by the Hydro-Logic® Smart Maintenance system, or • At intervals as determined by the first year's inspections • Following a spill in the drainage area.
Note: For most clean-outs it is not necessary to remove the entire volume of liquid in the vessel. Only removing the first few inches of oils/floatables and the sediment storage volume is required.	

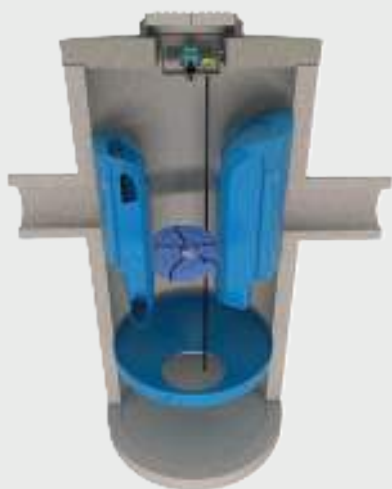
Table 8 - Typical maintenance schedule for a Downstream Defender® Select

We can provide full inspection and maintenance services for the Downstream Defender® Select, as well as for any other Sustainable Drainage Systems (SuDS) on your site - providing peace of mind and saving you time and money.

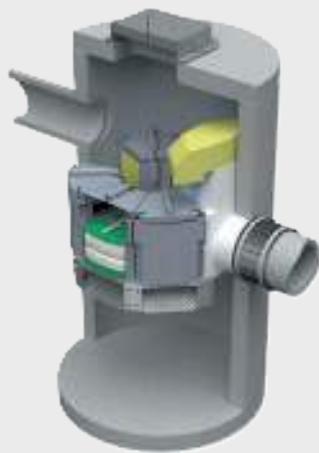
For more information, please call 01275 878371 or email sudservices@hydro-int.com

Our full range of stormwater treatment solutions

We have a range of stormwater treatment devices to treat stormwater flows of varying quality. All our solutions can work alongside, enable or enhance natural SuDS, helping to meet or improve on biodiversity and amenity targets.



Downstream Defender® Select



Up-Flo™ Filter



Hydro Biofilter™

Product		Description	Targeted pollutants						
			Sediments		Litter, debris	Liquid hydrocarbons	Sediment bound hydrocarbons, nutrients and heavy metals	Dissolved metals	Nutrients
Downstream Defender® Select	Vortex	Vortex separator	Coarse & fine	Retained up to 2 x treatment flow rate	✗	✗	✓	✗	✗
	Vortex Plus	Vortex plus separator	Coarse & fine	Retained up to 2 x treatment flow rate	✓	✓ Option for increased retention on request	✓	✗	✗
	Advanced Vortex	Advanced hydrodynamic vortex separator	Coarse & fine	Retained up to 4 x treatment flow rate	✓	✓ Option for increased retention on request	✓	✗	✗
Up-Flo™ Filter	Sand	Fluidised bed up flow filtration system with Sand media	Very fine sediment		✓	✓	✓	✗	✓
	CPZ	Fluidised bed up flow filtration system with CPZ media	Very fine sediment		✓	✓	✓	✓	✓
Hydro Biofilter™		Biofiltration system	Very fine and dissolved sediments		✓	✓	✓	✓	✓

To find out more about our range of stormwater treatment solutions visit hydro-int.com.

[Downstream Defender® Select](#)

[Up-Flo™ Filter](#)

[Hydro Biofilter™](#)

Patent: www.hydro-int.com/patents

Tel: +44 (0)1275 337937 stormwater@hydro-int.com

Hydro International
Unit 2, Rivermead Court, Kenn Business Park
Windmill Road, Kenn, Clevedon, BS21 6FT

Downstream Defender® Select Design Data E/0223