

**PHASE 2 GEOTECHNICAL AND
GEO-ENVIRONMENTAL SITE INVESTIGATION REPORT**

**LAND SOUTH OF NEW SMITHY AVENUE
THURLSTONE**

FOR

MR P. MULLINS

ISSUE 2



40630-003

17 January 2017

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GEO-ENVIRONMENTAL SITE INVESTIGATION REPORT**

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THURLSTONE**

FOR

MR P. MULLINS

ISSUE 2

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1.0 EXECUTIVE SUMMARY

1. This report presents the findings of a Phase 2 Geotechnical and Geo-Environmental Site Investigation carried out by Eastwood & Partners on behalf of Mr P. Mullins. A Phase 1 report, reference 40041-001, has previously been produced for the site, and should be read in conjunction with this report.
2. The site has an area of around 0.9 hectares and is located to the south of New Smithy Avenue in Thurlstone, near Penistone, South Yorkshire and is centred on National Grid Reference 423190, 403510. It is proposed to develop the site with residential dwellings.
3. The site is currently an undeveloped field with trees and hedges bordering it and a small separate garden area in the south east. The only development on the site in the past was a single building, possibly a barn or residential dwelling, in the east of the site which has since been removed. The surrounding area has been a combination of agricultural, residential and commercial/industrial uses. The commercial/industrial uses include quarries, mills, a blacking works and timber yard.
4. The geology at the site comprises the Grenoside Sandstone of the Pennine Lower Coal Measures. No superficial deposits are shown to be present. Significant amounts of made ground are not expected to be present.
5. The site is not considered to be at risk from shallow mining.
6. The site overlies a Secondary A Aquifer but is not within a groundwater source protection zone.
7. There are no landfill sites within 250 m of the site. No radon precautions will be required at the site.
8. The site is covered by topsoil up to 400 mm thick. A slightly clayey sand with sandstone gravel (subsoil) was then encountered below up to 0.7 m depth. Beneath this, weathered sandstone was encountered comprising gravelly sand becoming sandy gravel.
9. Strip or trench fill foundations taken through any made ground and onto the natural sandstone are expected to be appropriate for the proposed development at a minimum depth of 750 mm below current or proposed ground level, whichever is the lower.
10. The ground is considered to be non-shrinkable, and therefore foundations do not need to be deepened near to trees, and heave precautions are not required.

11. It is anticipated that precast or reinforced suspended concrete floors will be most suitable for the proposed dwellings. However, in-situ ground bearing slabs could be considered where there is less than 600 mm of made ground/reworked ground, which will depend on the amount of cut/fill below the plots during the development.
12. None of the samples of made ground or natural ground recorded concentrations of any contaminants that exceeded the assessment criteria for human health. Therefore no significant risks to human health, controlled waters or to plants are anticipated.
13. The site won topsoil is considered to be suitable for reuse across the site. A thickness of at least 150 mm of topsoil should be applied to all gardens and areas of soft landscaping as a growing medium for plants.
14. A Design Sulphate Class of DS-1 and Aggressive Chemical Environment for Concrete (ACEC) Class of AC-2z will be appropriate for the natural clay and sandstone encountered on site.
15. The conclusions made in this report are subject to agreement by the approving bodies, such as the Local Authority and NHBC.

1.0 INTRODUCTION

1.1 Terms of Reference

This report presents the findings of a Phase 2 intrusive geotechnical and geo-environmental site investigation carried out by Eastwood & Partners (Consulting Engineers) Ltd for, and on the behalf of Mr P. Mullins. Any other parties using the information in this report do so at their own risk and any duty of care is excluded.

1.2 Context

A Phase 1 Geotechnical and Geo-environmental report was prepared by Eastwood & Partners in December 2016, referenced PR/AJK/RAN/40041-001 (Issue 3), which should be read in conjunction with this Phase 2 report.

1.3 Aims and Objectives

The aims and objectives of this investigation were as follows:

- Review the previous Phase 1 data and outline conceptual model;
- Obtain additional information and incorporate with previous data enabling refinement and subsequent further testing of the conceptual model;
- To detail the ground conditions and their geotechnical properties enabling outline foundation proposals to be made for the proposed residential development;
- To undertake chemical testing enabling refinement and subsequent further testing of the conceptual model;
- To carry out tiered risk assessment to establish the likely risks to future receptors, involving the use of generic assessment criteria and where unacceptable risks are identified, site specific assessment criteria within a detailed quantitative risk assessment;
- To identify feasible remediation options if unacceptable risks are highlighted; and
- To develop an appropriate remediation strategy where remediation is required.

1.4 Scope of Investigation

The Phase 2 investigation consisted of intrusive works and laboratory analysis. The findings were used to test the conceptual model and produce a final risk assessment.

The intrusive works comprised the completion of trial pits to enable:

- Examination of the upper few metres of ground;
- In situ description of soils, enabling any localised lateral and vertical changes in soil conditions to be logged;
- Assessment of any contamination identified using visual and olfactory methods;
- Collection of soil samples for geotechnical and chemical testing; and
- Infiltration testing.

1.5 Limitations of Investigation

This report is based on the assumption that the site will be developed with residential dwellings which will be low rise, and of conventional construction with private gardens as well as communal areas of hard and soft landscaping. It is assumed that existing ground levels will not alter significantly. If this is not the case, then the advice given in this report may not be appropriate.

Where assessments of site areas affected in particular ways are given, these are approximate. All information, comments and opinions given in this report are based on the ground conditions encountered during the site work, on the results of laboratory testing carried out as part of the investigation and information gained from a geological, environmental and historical desk study. However, there may be conditions at the site that have not been taken into account, such as unpredictable soil strata and water conditions between or below investigation points. It should be noted that groundwater and gas levels vary due to seasonal or other effects, and may at times differ from those measured during the investigation.

This report only considers the ground and groundwater and does not cover any buildings or their fabric, or any existing hardstanding. Generally, testing has only been carried out for contaminants identified as potentially present with no assessment made of biological contamination. Risks to ecological receptors, such as bats, have not been considered.

2.0 SUMMARY OF PHASE 1 REPORT

2.1 The Site

The site has an area of approximately 0.9 hectares and is located to the south of New Smithy Avenue in Thurlstone, near Penistone, South Yorkshire. The site is approximately rectangular on plan, with its long axis being orientated east to west, and is centred on National Grid Reference 423190, 403510.

The site is currently an undeveloped, grassed field with a small garden area in the south east. It slopes down to the south east at a gradient of around 1 in 28 with a reduction in level of around 10 m from the north west to the south eastern corners. Trees and hedges are present along the site boundaries and a small number of mature trees are shown to be present by aerial photographs within the centre of the site, although the site topographical survey indicates that these may have now been removed.

The site is bordered by residential properties to the north, east and south and by open fields to the west.

2.2 History of the Site and Surrounding Area

Historical maps indicate that the majority of the site has been agricultural in nature since at least 1851. The only other development indicated is a rectangular building, possibly a barn or cottage, which is shown in the north eastern part of the site by 1931, and remained until circa 1969.

The immediately surrounding area has been mainly agricultural or residential use in the past, with some industry in the wider area. A sandstone quarry was present approximately 150 m west of the site from the mid 1850's, which remains, unfilled, to the present day.

2.3 Anticipated Ground Conditions

The ground conditions are expected to comprise a layer of topsoil overlying sandstone which is likely to have weathered to sand or clayey sand near to the surface.

Made ground may be present in an area to the east of the site in the location of a former building, but is not expected to be of significant thickness, unless cellars are present.

2.4 Groundwater

Groundwater is not expected at shallow depth beneath the site. The nearest surface water feature is a disused mill race around 80 m south of the site. The River Don is located approximately 80 m south of the site, but the river level is significantly lower than that of the site.

According to the Envirocheck report, the underlying bedrock strata are classified as a Secondary A Aquifer. Information within the Envirocheck Report also states that the site does not lie within a Groundwater Source Protection Zone.

2.5 Coal Mining

The geological map shows the Grenoside Sandstone Coal outcropping 220 m north of the site, but the seam will not be present below the site. The shallowest coal anticipated to be present is the Upper Band Coal, which is expected at around 65 m below ground level. This seam is generally recorded as being thin and no records of workings are provided in the geological memoirs. Therefore it is considered that the site is not at risk from shallow coal workings, and precautions against the effects of coal mining are not considered to be required.

2.6 Ground Gas

No radon precautions are required for new dwellings on this site.

The Envirocheck report records no active or historical landfill sites within 500 m of the site. There are a number of potentially infilled features in the vicinity of the site, but these are not considered to present a significant risk of gas generation to the proposed development.

Gas protective measures should not be required for the new dwellings.

2.7 Outline Conceptual Model

The following table details the possible sources and associated contaminants of concern, pathways and receptors, considered by the Phase 1 report as being potentially present:

Contaminant	Pathways	Receptor
- Heavy metals/metalloids and PAHs in any made ground. - PAHs in near surface soils/Topsoil	- Ingestion, inhalation and dermal contact - Direct contact - Migration - Root uptake	- Future Residents and visitors to the site. - Groundworkers - Plants and vegetation - Groundwater aquifer
	Leaching and migration	Secondary A Aquifer and River Don
Asbestos containing materials within soils or demolition rubble	Inhalation of fibres	- Future Residents and visitors to the site. - Groundworkers
Sulphates within made ground or the natural ground.	Direct contact.	Below ground concrete.

3.0 GROUND INVESTIGATION

3.1 Site Works

The site works were undertaken on 6 December 2016. Nine trial pits, referenced TP1 to TP9, were excavated across the site in order to determine the underlying ground conditions. The trial pits reached depths of between 1.7 m and 2.1 m bgl. Five of these trial pits were also used for infiltration testing (referenced SA1 to SA5).

Copies of the trial pit and borehole logs are presented in Appendix 2 and their locations are shown on the Exploratory Hole Location Plan, Drawing number 40630/001/B in Appendix 1.

Copies of the infiltration rate calculation sheets are presented in Appendix 3.

3.2 Laboratory Testing

Six samples of the topsoil, two samples of clay and two samples of the weathered sandstone were despatched for chemical testing. Soil samples were taken in 500 g plastic tubs and 250 ml amber glass jars and analysed at Chemtest Limited in Newmarket, using MCERTs accredited methodologies where available.

The chemical test results are presented in Appendix 3 and are discussed further in Section 6.

4.0 GROUND CONDITIONS

4.1 Topsoil

Topsoil was encountered in all of the trial pits and comprised dark brown clayey slightly gravelly sand with occasional sandstone gravel. The topsoil was between 200 mm and 400 mm thick.

4.2 Made Ground

Made ground was only encountered within TP5 and TP6 which were excavated along the northern boundary of the site and comprised sandstone cobbles thought to have been part of a former dry stone wall within the clayey sand between depths of 0.2 and 0.7 m bgl.

4.3 Natural Ground

Natural ground was encountered in all of the trial pits across the site. It was generally found to comprise weathered sandstone. Brown clayey sand was encountered from between 0.2 and 0.4 m to between 0.3 and 0.7 m depth. This comprises subsoil.

Below the subsoil, the natural ground was recovered as yellow gravelly sand or sandy gravel with medium to high cobble content in the upper layers. The sandstone cobbles recovered were described as moderately strong, angular, platy in shape and medium to coarse grained.

The weathered sandstone become more competent and harder to dig with depth with trial pits being terminated at depths of between 1.7 m and 2.1 m bgl within the hard ground.

4.4 Groundwater

Groundwater was not encountered in any of the trial pits.

4.5 Evidence of Contamination

No visual or olfactory evidence of possible significant contamination was identified in any of the trial pits.

5.0 GEOTECHNICAL APPRAISAL

5.1 General

The site is covered by topsoil to between 0.2 and 0.3 m depth with brown clayey sand below up to around 0.7 m depth with weathered sandstone beneath comprising gravelly sand over sandy gravel and cobbles with depth.

The natural weathered sandstone will be able to provide an allowable bearing pressure of at least 125 kN/m² in the upper layers, increasing to over 300 kN/m² in the more competent sandstone.

5.2 Foundations

It is considered that unreinforced strip or trench fill footings, taken through any made ground or soft ground and onto the weathered sandstone gravel will be appropriate. A minimum foundation depth of 750 mm below original or finished ground level, whichever is the lower, should be adopted.

As the soils are granular in nature, they can be assumed to be non-shrinkable. Therefore the soils will not be susceptible to shrink/swell movement due to moisture levels, and therefore foundations will not need to be deepened near to trees. Heave precautions are also not required.

5.3 Ground Slabs

A cast in situ ground bearing concrete floor slab could be considered where there is less than 600 mm of made ground/reworked ground. This will therefore depend on the amount of cut/fill required to level each plot and the proposed finished floor and ground levels.

It may therefore be more practical to assume that reinforced suspended or precast concrete floors with a 150 mm void below, and this option should be used for cost appraisal purposes at this stage.

5.4 Superstructure Precautions

No superstructure precautions are considered necessary due to the ground conditions encountered on the site.

5.5 Roadworks

At this stage we anticipate that CBR values of at least 3% should be achieved, however due to the uncertainty of the strength and composition of any made ground a low CBR value should be assumed at this early stage. CBR testing should be allowed for along roadways prior to construction so that an accurate value can be obtained.

5.6 Excavation Problems

The sides of excavations were generally stable within the trial pits. However, localised areas of instability were noted, mainly where larger cobbles of sandstone were removed, and therefore some allowance should be made for slightly widened foundation trenches due to localised collapses of the trench sides or where larger fragments need to be removed.

Temporary support will be required in accordance with current Health & Safety Regulations wherever access is required to trenches deeper than 1.2 m, or less where there is risk of collapse.

5.7 Obstructions

No significant obstructions were encountered during the intrusive investigation, although competent sandstone bedrock is present below about 2 m bgl, which may make deeper excavation difficult. However, for construction works, it is expected that a larger capacity excavator than the one used for the trial pits will be used on the site.

5.8 Surface Water Drainage

As the site is underlain by sandstone, it was considered that the use of infiltration drainage may be possible to dispose of surface water from the proposed development. To prove the suitability of the ground for this method of draining, infiltration tests were undertaken within a number of the trial pits.

Five soakaway tests were carried out across the site within the weathered sandstone. The results of the infiltration tests are shown in the table below:

Hole ID	Depth of Test (mm bgl)	Infiltration Rates		
		Test	BR365 Infiltration Rate ($\times 10^{-6}$) m/s	Average Infiltration Rate ($\times 10^{-6}$) m/s
SA1	1,900	Test 1	8,100	8,500
		Test 2	6,000	6,400
		Test 3	7,000	7,000
SA2	1,800	Test 1	3,000	2,900
		Test 2	3,000	3,000
SA3	2,000	Test 1	19,000	18,000
		Test 2	23,000	21,000
SA4	2,100	Test 1	31	36
SA5	1,880	Test 1	920	680
		Test 2	960	740

All of the soakaway tests carried out, except TP4/SA4, drained away between 19 seconds and 6.5 minutes. One trial pit, TP4/SA4, was carried out in slightly clayey gravelly sand and drained away after 130 minutes. However, this strata appears to be localised and the rate recorded in the test was still acceptable.

Based on the BRE rates calculated, it is considered that soakaway drainage will be suitable for surface water disposal.

The soakaway pit logs, test results and infiltration calculations are presented in Appendix 3.

6.0 CONTAMINATION APPRAISAL

6.1 Source Characterisation

This section of the report documents the works undertaken to obtain information to test and refine the outline conceptual model enabling a risk assessment to be produced and, where significant risks are expected, remediation recommendations.

6.2 Ground Conditions

Topsoil covered the majority of the site, with a thin layer of clayey sand below. Weathered sandstone was encountered beneath this subsoil layer. No significant made ground was found, with only the foundation of a suspected previous stone wall being encountered.

There is no reason to suspect that natural ground encountered on site will contain any elevated concentrations of contaminants, however naturally elevated contaminants such as arsenic are occasionally encountered. In addition, atmospheric fallout of contaminants such as benzo(a)pyrene can sometimes lead to elevated levels within near surface soils.

The chemical analysis undertaken for these materials are discussed in section 6.5.

6.3 Gas Precautions

No radon precautions are required for new dwellings on this site. No active or historical landfills are located within 250 m of the site.

As discussed in the phase 1 report, there are two areas of recorded potentially infilled land in the local area. One, a railway cutting, is located around 171 m south of the site and is not believed to have been backfilled. The other, a former quarry, is located around 194 m west of the site. The quarry is believed to have been backfilled however it is unlikely to have been backfilled with biodegradable wastes. At over 190 m from the site, the risk of gases migrating onto the development site is considered to be negligible.

The site is therefore not considered to be at risk from landfill gas migration.

6.4 Unexpected Contamination

No visual or olfactory observations of unexpected potential contamination were noted.

6.5 Chemical Testing

Six samples of the topsoil, two samples of clay and two samples of the weathered sandstone were despatched for chemical testing. Each of the samples were analysed for the suite of contaminants listed below:

Contaminant Type	Actual Contaminants
Metals/Metalloids	Arsenic, cadmium, chromium (III and VI), lead, mercury, nickel, selenium, copper and zinc
pH	pH
PAHs	Speciated Polycyclic Aromatic Hydrocarbons
Sulphates*	Acid soluble sulphate, water soluble sulphate and sulphur.
Asbestos**	Asbestos presence

*excluding topsoil

** Topsoil samples only

Testing was undertaken by Chemtest Limited, using MCERTs accredited methodologies, where available. A copy of the test results is included in Appendix 4.

6.6 Assessment Criteria

The proposed development of the site is to be residential with private gardens and public open space. Therefore, assessment criteria relating to residential with home grown produce have been used. Tables detailing the relevant assessment concentrations used are presented in Appendix 4.

6.7 Chemical Test Results

Some preliminary risk assessment is undertaken in this section of the report where determinants can be readily discounted.

None of the samples of topsoil, or natural ground recorded any levels of the contaminants tested for that were elevated above their respective residential end use assessment values. No asbestos containing materials were identified.

6.8 Sulphates

The results indicate that the water soluble sulphate concentrations within the natural ground range between <10 and 14 mg/l, compared with the upper limit of Design Sulphate Class 1 of 500 mg/l.

The concentrations of total potential sulphate are calculated as being between 0.03% and 0.12%, compared with an upper design limit of 0.24% for DS-1.

The pH of all of the samples was between 4.0 and 7.4.

Based on these results, the natural ground would be assigned a Design Sulphate Class of DS-1 and Aggressive Chemical Environment for Concrete (ACEC) Class of AC-2z.

6.9 Significant Pollutant Linkages

The significant pollutant linkages consequently identified are thus documented in the table below.

Significant Pollutant Linkages

Source	Pathway	Receptor
Low/acidic pH levels within the natural soils	Direct contact	Below ground concrete

7.0 RISK ASSESSMENT

7.1 Human Health: Future Site Users

The site is to be developed with residential housing with soft landscaped areas. None of the samples of topsoil or natural ground recorded concentrations of any contaminants that exceeded the assessment criteria for human health.

Elevated concentrations of contaminants have not been identified on site. Therefore there is no potential significant risk considered to be presented to future residents or visitors to the site, and no remedial measures are proposed.

All soils on site area considered to be suitable for re-use.

7.2 Human Health: During Construction

Ground workers employed during the construction phase of the development are most at risk of harm due to them having direct contact with the affected soils. However, the contact is generally of short duration, and all competent ground workers will be aware of the potential risks associated with handling soils. Therefore the overall risk to the health of construction workers is considered to be low, particularly as no significant levels of contamination have been recorded at this site.

All ground workers employed on the site should implement normal site procedures such as the wearing of gloves when handling soils, and the washing of hands prior to eating.

Any unusual, brightly coloured, ashy or odorous material encountered during construction should be brought to the attention of the site staff and investigated.

7.3 Plants

No elevated concentrations of any phytotoxic metals have been identified and therefore there should be no risk to plants. The site won topsoil will be suitable to be reused in gardens and areas of soft landscaping. A minimum of 150 mm of topsoil should be placed in soft landscaping areas.

7.4 Ground Gas

No radon precautions are required.

No risk of landfill gas generation or migration has been identified. Therefore no gas protective measures will be required for the development.

7.5 Controlled Waters

On the basis that no significant contamination was found on site, it is considered that there will be no risk to controlled waters.

7.6 Construction Materials

It is considered that a Design Sulphate Class of DS-1 and Aggressive Chemical Environment for Concrete (ACEC) Class of AC-2z will be appropriate for the natural ground encountered on site.

7.7 Unexpected Contamination

It is considered unlikely that further significant contamination will be encountered during the construction works on the site.

Should any unusual, brightly coloured, ashy or odorous material be encountered during construction this should be brought to the attention of the site staff and investigated.

Appendix 1

Exploratory Hole Location Plan – Drawing 40630/001B



INFORMATION WITHIN THIS DRAWING IS NOT NECESSARILY PRODUCED TO SCALE.
ALWAYS USE FIGURED DIMENSIONS AND CO-ORDINATES - IF IN DOUBT, ASK.

KEY:

Approximate location of trial pit excavated by Eastwood and Partners on 6 December 2016.

Approximate location of soakaway carried out by Eastwood and Partners on 6 December 2016.

B	Site boundary amended.	RJ	AJK	17.01.17
A	First Issue.			
REV	DESCRIPTION	SIG	CHK	DATE

MR AND MRS P MULLINS

NEW SMITHY AVENUE, THURLSTONE

EXPLORATORY HOLE LOCATION
PLAN

Eastwood & Partners

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SCALE WHEN PLOTTED AT A3 1:1000			DRAWING STATUS INFORMATION	
DRAWN JRB	CHECKED SRI	DATE 15.12.16	DRAWING NUMBER 40630-002	REV B

Appendix 2

Trial Pit Logs – TP1 to TP9

Project Name
 New Smithy Avenue

Project No.
 40630

Co-ords: -
 Level: -

Date
 06/12/2016

Location: Thurlstone

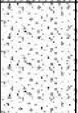
Dimensions: -

Scale
 1:25

Client: Phil Mullins

Depth
 1.90m

Logged By
 SRI

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
0.20	D					TOPSOIL: Dark brown clayey slightly gravelly SAND with occasional gravel of sandstone	
			0.40			Brown/yellow gravelly SAND with medium cobble content. Gravel and cobbles are sub-angular of moderately strong, medium to coarse grained sandstone (weathered sandstone)	
0.90	D		0.80			Moderately strong SANDSTONE recovered as yellow angular to sub-angular, platy, massive, medium to coarse grained sandy gravel and cobbles. (weathered sandstone)	1
			1.90			Trialpit Complete at 1.90 m	2
							3
							4

Remarks: Pit side collapse from 0.4 m to the base

Groundwater: None encountered



Project Name
 New Smithy Avenue

Project No.
 40630

Co-ords: -
 Level: -

Date
 06/12/2016

Location: Thurlstone

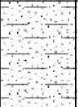
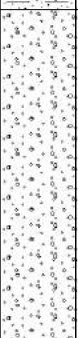
Dimensions: -

Scale
 1:25

Client: Phil Mullins

Depth
 1.80m

Logged By
 SRI

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
0.10	D					TOPSOIL: Dark brown slightly clayey SAND with some gravel of sandstone	
			0.30			Brown slightly clayey SAND with occasional gravel of angular sandstone	
			0.70			Yellow sandy GRAVEL with high cobble content. Gravel and cobbles are sub-angular of moderately strong, medium to coarse grained sandstone (weathered sandstone)	1
			1.80			Trialpit Complete at 1.80 m	2
							3
							4

Remarks: Fairly loose material - pit sides collapse

Groundwater: None encountered



Project Name
 New Smithy Avenue

Project No.
 40630

Co-ords: -
 Level: -

Date
 06/12/2016

Location: Thurlstone

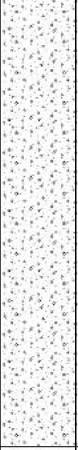
Dimensions: -

Scale
 1:25

Client: Phil Mullins

Depth
 2.00m

Logged By
 SRI

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
0.10	D					TOPSOIL: Dark brown slightly clayey SAND with occasional gravel of sandstone	
			0.30			Brown slightly clayey slightly gravelly SAND. Gravel is coarse, angular of sandstone	
			0.50			Yellow sandy GRAVEL with medium cobble content. Gravel and cobbles are sub-angular of moderately strong, medium to coarse grained sandstone (weathered sandstone)	1
			2.00			Trialpit Complete at 2.00 m	2
							3
							4

Remarks: Pit side collapse

Groundwater: None encountered



Project Name
 New Smithy Avenue

Project No.
 40630

Co-ords: -
 Level: -

Date
 06/12/2016

Location: Thurlstone

Dimensions: -

Scale
 1:25

Client: Phil Mullins

Depth
 2.10m

Logged By
 SRI

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
0.20	D		0.20			TOPSOIL: Dark brown slightly clayey SAND with occasional gravel of sandstone	
			0.30			Brown slightly clayey SAND with occasional gravel of angular sandstone	
0.80	D					Yellow slightly clayey gravelly SAND with medium cobble content. Gravel and cobbles are sub-angular of moderately strong, medium to coarse grained sandstone (weathered sandstone)	1
2.00	D		2.10				2
Trialpit Complete at 2.10 m							3
							4

Remarks:

Groundwater: None encountered



Project Name
 New Smithy Avenue

Project No.
 40630

Co-ords: -
 Level: -

Date
 06/12/2016

Location: Thurlstone

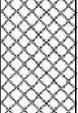
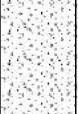
Dimensions: -

Scale
 1:25

Client: Phil Mullins

Depth
 1.80m

Logged By
 SRI

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
0.10	D					TOPSOIL: Dark brown slightly clayey SAND with occasional sandstone gravel	
			0.25			MADE GROUND: Brown gravelly SAND with medium cobble content. Gravel and cobble of sub-angular to sub-rounded sandstone (dry stone wall)	
			0.70			Yellow gravelly SAND with medium cobble content. Gravel and cobbles are sub-angular of moderately strong, medium to coarse grained sandstone (weathered sandstone)	1
			1.10			Moderately strong SANDSTONE recovered as yellow angular to sub-angular, platy, massive, medium to coarse grained sandy gravel and cobbles. (weathered sandstone)	
			1.80			Trialpit Complete at 1.80 m	2
							3
							4

Remarks:

Groundwater: None encountered



Project Name
 New Smithy Avenue

Project No.
 40630

Co-ords: -
 Level: -

Date
 06/12/2016

Location: Thurlstone

Dimensions: -

Depth
 2.10m



Scale
 1:25

Client: Phil Mullins

Logged By
 SRI

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
0.10	D		0.20			TOPSOIL: Dark brown slightly clayey SAND with occasional gravel of sandstone	
0.40	D		0.50			MADE GROUND: Brown gravelly SAND with medium cobble content. Gravel and cobble of sub-angular to sub-rounded sandstone (dry stone wall)	
			1.00			Yellow gravelly SAND with medium cobble content. Gravel and cobbles are sub-angular of moderately strong, medium to coarse grained sandstone (weathered sandstone)	
			2.10			Moderately strong SANDSTONE recovered as yellow angular to sub-angular, platy, massive, medium to coarse grained sandy gravel and cobbles. (weathered sandstone)	1
Trialpit Complete at 2.10 m							2
							3
							4

Remarks: Pit side collapse

Groundwater: None encountered



Project Name New Smithy Avenue	Project No. 40630	Co-ords: - Level: -	Date 06/12/2016
Location: Thurlstone		Dimensions: -	Scale 1:25
Client: Phil Mullins		Depth 1.80m	Logged By SRI

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
1.00	D		0.20			TOPSOIL: Dark brown slightly clayey SAND with occasional gravel of sandstone	1
						Brown slightly clayey SAND with occasional gravel of angular sandstone	
			0.40			Yellow slightly clayey gravelly SAND with medium cobble content. Gravel and cobbles are sub-angular of moderately strong, medium to coarse grained sandstone (weathered sandstone)	
					0.80		
			1.80				
					3		

Remarks:	
Groundwater: None encountered	

Project Name
New Smithy Avenue

Project No.
40630

Co-ords: -
Level: -

Date
06/12/2016

Location: Thurlstone

Dimensions: -

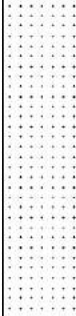
Depth
1.70m



Scale
1:25

Client: Phil Mullins

Logged By
SRI

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
0.10	D					TOPSOIL: Dark brown slightly clayey SAND with occasional gravel of sandstone	
			0.25			Brown slightly clayey SAND with occasional gravel of angular sandstone	
			0.40			Yellow slightly clayey gravelly SAND with medium cobble content. Gravel and cobbles are sub-angular of moderately strong, medium to coarse grained sandstone (weathered sandstone)	
0.50	D		0.60			Moderately strong SANDSTONE recovered as yellow angular to sub-angular, platy, massive, medium to coarse grained sandy gravel and cobbles. (weathered sandstone)	1
			1.70			Trialpit Complete at 1.70 m	2
							3
							4

Remarks: Pit side collapse

Groundwater:



Project Name
 New Smithy Avenue

Project No.
 40630

Co-ords: -
 Level: -

Date
 06/12/2016

Location: Thurlstone

Dimensions: -

Scale
 1:25

Client: Phil Mullins

Depth
 1.90m

Logged By
 SRI

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
0.10	D					TOPSOIL: Dark brown slightly clayey SAND with occasional gravel of sandstone	
			0.30			Brown slightly clayey SAND with occasional gravel of angular sandstone	
			0.60			Yellow sandy GRAVEL with high cobble content. Gravel and cobbles are sub-angular of moderately strong, medium to coarse grained sandstone (weathered sandstone). Some boulder size material recovered.	1
			1.90				2
						Trialpit Complete at 1.90 m	
							3
							4

Remarks: Pit side collapse

Groundwater: None encountered



Appendix 3

Infiltration Rate Calculations

(Consulting Engineers) Ltd

PROJECT:	New Smithy Avenue, Thurlstone	Job No. 40630	Date 09.12.16
SUBJECT:	Infiltration Test Results and Calculation of Infiltration Rates	Prepared DN	Checked AJK

Test No. SA1 - Test 1**Test Pit Dimensions**

Length = 1700 mm

Plan area = 1.19 m²

Width = 700 mm

Depth = 1900 mm (Total depth)

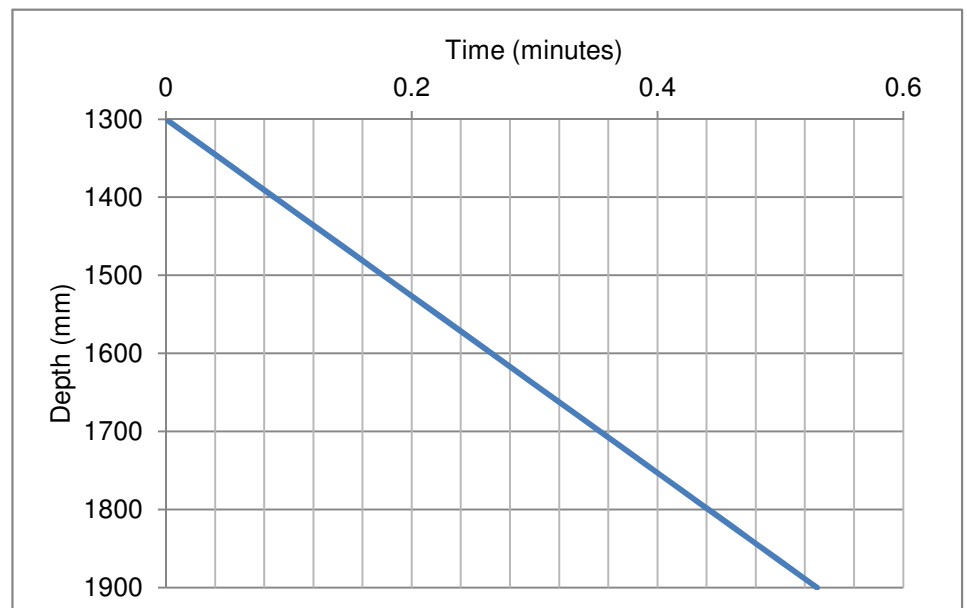
Approximate time to discharge water into the hole:

45 Seconds

Depth to water after completion of pumping:

1300 mm

Time (min)	Depth (mm)
0	1300
0.53	1900

**Depth (m)**

0.0-0.25

0.25-0.4

0.4-0.8

0.8-1.9

Description

TOPSOIL: dark brown clayey slightly gravelly SAND with occasional sandstone gravel

Brown clayey SAND with occasional sandstone gravel

Brown/yellow gravelly SAND. Gravel and cobbles of sandstone.

SANDSTONE recovered as angular sandy gravel and cobbles

PROJECT:	New Smithy Avenue, Thurlstone	Job No. 40630	Date 09.12.16
SUBJECT:	Infiltration Test Results and Calculation of Infiltration Rates	Prepared DN	Checked AJK

Test No. SA1 - Test 1

Soil Infiltration Rate in Accordance with BR365

$$f = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$$

Where: V_{p75-25} is the effective storage volume of water in the trial pit between 75% and 25% effective depth;

a_{p50} is the internal surface area of the trial pit up to 50% effective depth and including the base area

t_{p75-25} is the time for the water level to fall from 75% to 25% effective depth

Initial parameters

Depth to water = **1300** mm Average water depth: **300** mm

Start time = **0** min

Change in water depth: **600** mm

Final parameters

Depth to water = **1900** mm

Time interval: **0.53** min

End time = **0.53** min

Effective Storage Volume of Water in the Trial Pit = **0.714** m³
 75% Effective Depth = **1450** mm from ground level
 25% Effective Depth = **1750** mm from ground level
 Time at 75% Effective Depth = **0.12** minutes
 Time at 25% Effective Depth = **0.4** minutes

V_{p75-25} = **0.36** m³

a_{p50} = **2.63** m²

t_{p75-25} = **17** sec

f = **8.1E-03** m/sec

Average Soakaway Rate = **2.2E-02** m³/sec

Average soakaway area = **2.63** m² (sides + base)

BR365 Soil Infiltration Rate = 8.1E-03 m/sec

Average Infiltration Rate = 8.5E-03 m/sec

|

PROJECT:	New Smithy Avenue, Thurlstone	Job No. 40630	Date 09.12.16
SUBJECT:	Infiltration Test Results and Calculation of Infiltration Rates	Prepared DN	Checked AJK

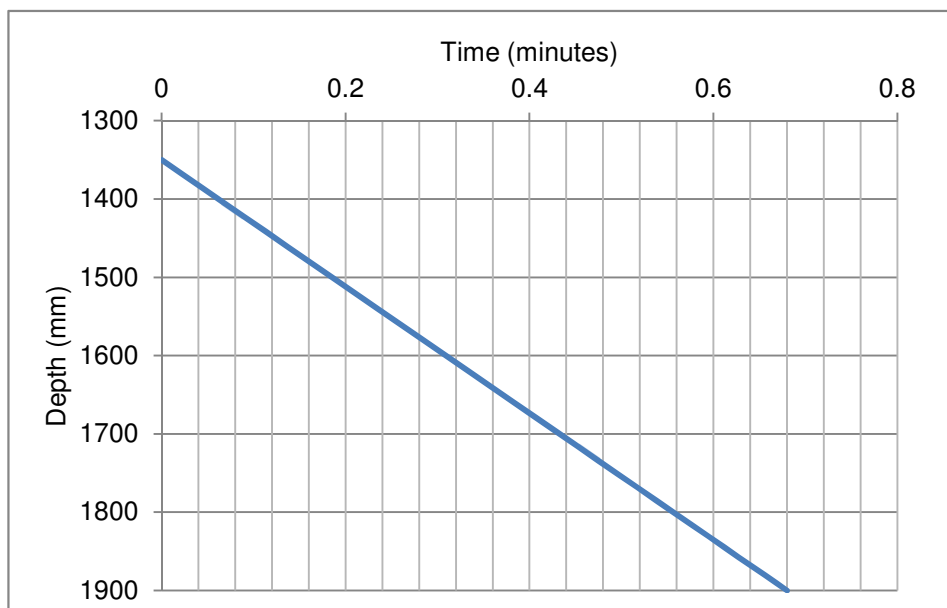
Test No. SA1 - Test 2

Test Pit Dimensions

Length = **1700** mm Plan area = **1.19** m²
 Width = **700** mm
 Depth = **1900** mm (Total depth)

Approximate time to discharge water into the hole: **35** Seconds
 Depth to water after completion of pumping: **1350** mm

Time (min)	Depth (mm)
0	1350
0.68	1900



Depth (m)	Description
0.0-0.25	TOPSOIL: dark brown clayey slightly gravelly SAND with occasional sandstone gravel
0.25-0.4	Brown clayey SAND with occasional sandstone gravel
0.4-0.8	Brown/yellow gravelly SAND. Gravel and cobbles of sandstone.
0.8-1.9	SANDSTONE recovered as angular sandy gravel and cobbles

PROJECT:	New Smithy Avenue, Thurlstone	Job No. 40630	Date 09.12.16
SUBJECT:	Infiltration Test Results and Calculation of Infiltration Rates	Prepared DN	Checked AJK

Test No. SA1 - Test 2

Soil Infiltration Rate in Accordance with BR365

$$f = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$$

Where: V_{p75-25} is the effective storage volume of water in the trial pit between 75% and 25% effective depth;

a_{p50} is the internal surface area of the trial pit up to 50% effective depth and including the base area

t_{p75-25} is the time for the water level to fall from 75% to 25% effective depth

Initial parameters

Depth to water = **1350** mm Average water depth: **275** mm
Start time = **0** min Change in water depth: **550** mm

Final parameters

Depth to water = **1900** mm Time interval: **0.68** min
End time = **0.68** min

Effective Storage Volume of Water in the Trial Pit = **0.6545** m³
75% Effective Depth = **1488** mm from ground level
25% Effective Depth = **1763** mm from ground level
Time at 75% Effective Depth = **0.16** minutes
Time at 25% Effective Depth = **0.52** minutes

V_{p75-25} = **0.33** m³

a_{p50} = **2.51** m²

t_{p75-25} = **22** sec

f = **6.0E-03** m/sec

Average Soakaway Rate = **1.6E-02** m³/sec
Average soakaway area = **2.51** m² (sides + base)

BR365 Soil Infiltration Rate = **6.0E-03** m/sec
Average Infiltration Rate = **6.4E-03** m/sec

PROJECT:	New Smithy Avenue, Thurlstone	Job No. 40630	Date 09.12.16
SUBJECT:	Infiltration Test Results and Calculation of Infiltration Rates	Prepared DN	Checked AJK

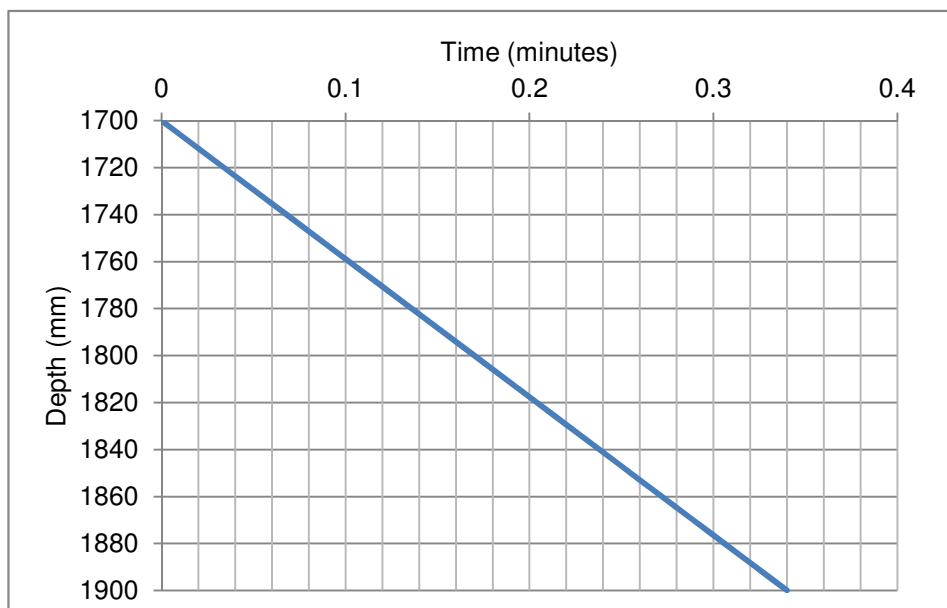
Test No.	SA1 - Test 3
----------	--------------

Test Pit Dimensions

Length = **1700** mm Plan area = **1.19** m²
Width = **700** mm
Depth = **1900** mm (Total depth)

Approximate time to discharge water into the hole: **60 Seconds**
 Depth to water after completion of pumping: **1700 mm**

Time (min)	Depth (mm)
0	1700
0.34	1900



Depth (m)	Description
0.0-0.25	TOPSOIL: dark brown clayey slightly gravelly SAND with occasional sandstone gravel
0.25-0.4	Brown clayey SAND with occasional sandstone gravel
0.4-0.8	Brown/yellow gravelly SAND. Gravel and cobbles of sandstone.
0.8-1.9	SANDSTONE recovered as angular sandy gravel and cobbles

PROJECT:	New Smithy Avenue, Thurlstone	Job No. 40630	Date 09.12.16
SUBJECT:	Infiltration Test Results and Calculation of Infiltration Rates	Prepared DN	Checked AJK

Test No. SA1 - Test 3

Soil Infiltration Rate in Accordance with BR365

$$f = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$$

Where: V_{p75-25} is the effective storage volume of water in the trial pit between 75% and 25% effective depth;

a_{p50} is the internal surface area of the trial pit up to 50% effective depth and including the base area

t_{p75-25} is the time for the water level to fall from 75% to 25% effective depth

Initial parameters

Depth to water = **1700** mm Average water depth: **100** mm

Start time = **0** min

Change in water depth: **200** mm

Final parameters

Depth to water = **1900** mm

Time interval: **0.34** min

End time = **0.34** min

Effective Storage Volume of Water in the Trial Pit = **0.238** m³
 75% Effective Depth = **1750** mm from ground level
 25% Effective Depth = **1850** mm from ground level
 Time at 75% Effective Depth = **0.09** minutes
 Time at 25% Effective Depth = **0.26** minutes

V_{p75-25} = **0.12** m³

a_{p50} = **1.67** m²

t_{p75-25} = **10** sec

f = **7.0E-03** m/sec

Average Soakaway Rate = **1.2E-02** m³/sec

Average soakaway area = **1.67** m² (sides + base)

BR365 Soil Infiltration Rate = 7.0E-03 m/sec

Average Infiltration Rate = 7.0E-03 m/sec

(Consulting Engineers) Ltd

PROJECT:	New Smithy Avenue, Thurlstone	Job No. 40630	Date 09.12.16
SUBJECT:	Infiltration Test Results and Calculation of Infiltration Rates	Prepared DN	Checked AJK

Test No. SA2 - Test 1**Test Pit Dimensions**Length = **1800 mm**Plan area = **1.26 m²**Width = **700 mm**Depth = **1800 mm (Total depth)**

Approximate time to discharge water into the hole:

46 Seconds

Depth to water after completion of pumping:

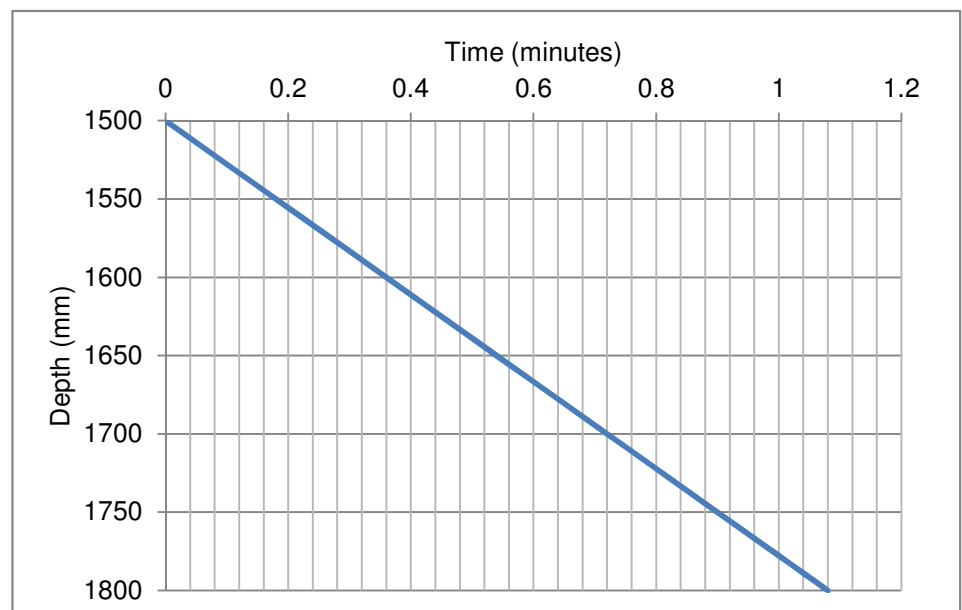
1500 mm**Time (min)****Depth (mm)**

0

1500

1.08

1800

**Depth (m)**

0-0.3

0.3-0.7

0.7-1.8

Description

TOPSOIL: dark brown slightly clayey sand with occasional gravel of sandstone

Brown slightly clayey SAND with sandstone gravel

Yellow sandy GRAVEL with high cobble content of angular-subangular moderately strong sandstone

PROJECT:	New Smithy Avenue, Thurlstone	Job No. 40630	Date 09.12.16
SUBJECT:	Infiltration Test Results and Calculation of Infiltration Rates	Prepared DN	Checked AJK

Test No. SA2 - Test 1

Soil Infiltration Rate in Accordance with BR365

$$f = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$$

Where: V_{p75-25} is the effective storage volume of water in the trial pit between 75% and 25% effective depth;

a_{p50} is the internal surface area of the trial pit up to 50% effective depth and including the base area

t_{p75-25} is the time for the water level to fall from 75% to 25% effective depth

Initial parameters

Depth to water = **1500** mm Average water depth: **150** mm

Start time = **0** min Change in water depth: **300** mm

Final parameters

Depth to water = **1800** mm Time interval: **1.08** min

End time = **1.08** min

Effective Storage Volume of Water in the Trial Pit = **0.378** m³
 75% Effective Depth = **1575** mm from ground level
 25% Effective Depth = **1725** mm from ground level
 Time at 75% Effective Depth = **0.28** minutes
 Time at 25% Effective Depth = **0.8** minutes

V_{p75-25} = **0.19** m³

a_{p50} = **2.01** m²

t_{p75-25} = **31** sec

f = **3.0E-03** m/sec

Average Soakaway Rate = **5.8E-03** m³/sec

Average soakaway area = **2.01** m² (sides + base)

BR365 Soil Infiltration Rate = 3.0E-03 m/sec

Average Infiltration Rate = 2.9E-03 m/sec

(Consulting Engineers) Ltd

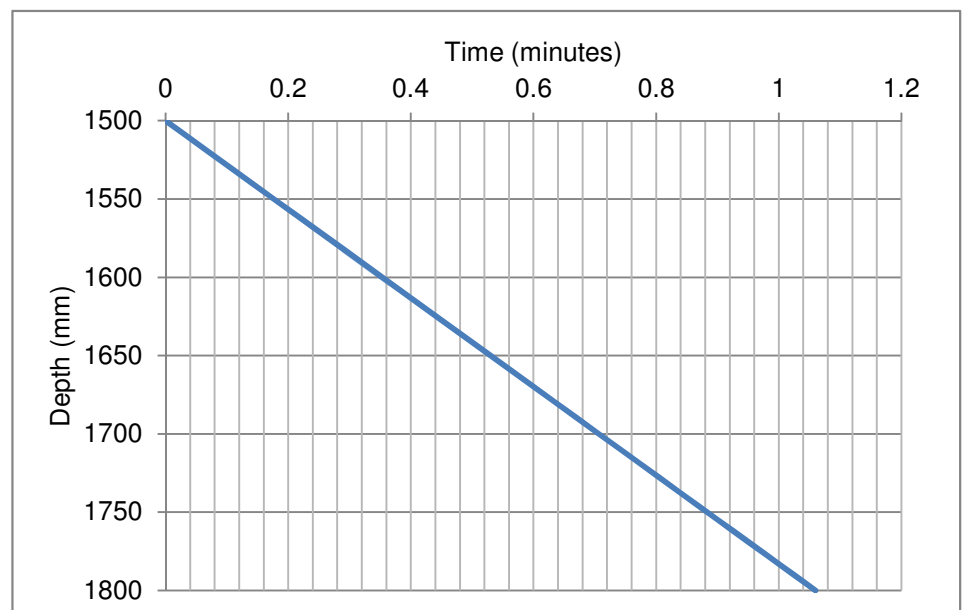
PROJECT:	New Smithy Avenue, Thurlstone	Job No. 40630	Date 9.12.16
SUBJECT:	Infiltration Test Results and Calculation of Infiltration Rates	Prepared DN	Checked AJK

Test No. SA2 - Test 2**Test Pit Dimensions**Length = **1800 mm**Plan area = **1.26 m²**Width = **700 mm**Depth = **1800 mm (Total depth)**

Approximate time to discharge water into the hole:

45 Seconds

Depth to water after completion of pumping:

1500 mm**Time (min)** **Depth (mm)**0 **1500**1.06 **1800****Depth (m)**

0-0.3

0.3-0.7

0.7-1.8

Description

TOPSOIL: dark brown slightly clayey sand with occasional gravel of sandstone

Brown slightly clayey SAND with sandstone gravel

Yellow sandy GRAVEL with high cobble content of angular-subangular moderately strong sandstone

PROJECT:	New Smithy Avenue, Thrurlstone	Job No. 40630	Date 09.12.16
SUBJECT:	Infiltration Test Results and Calculation of Infiltration Rates	Prepared DN	Checked AJK

Test No. SA2 - Test 2

Soil Infiltration Rate in Accordance with BR365

$$f = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$$

Where: V_{p75-25} is the effective storage volume of water in the trial pit between 75% and 25% effective depth;

a_{p50} is the internal surface area of the trial pit up to 50% effective depth and including the base area

t_{p75-25} is the time for the water level to fall from 75% to 25% effective depth

Initial parameters

Depth to water = **1500** mm Average water depth: **150** mm

Start time = **0** min

Change in water depth: **300** mm

Final parameters

Depth to water = **1800** mm

Time interval: **1.06** min

End time = **1.06** min

Effective Storage Volume of Water in the Trial Pit = **0.378** m³
 75% Effective Depth = **1575** mm from ground level
 25% Effective Depth = **1725** mm from ground level
 Time at 75% Effective Depth = **0.28** minutes
 Time at 25% Effective Depth = **0.8** minutes

V_{p75-25} = **0.19** m³

a_{p50} = **2.01** m²

t_{p75-25} = **31** sec

f = **3.0E-03** m/sec

Average Soakaway Rate = **5.9E-03** m³/sec

Average soakaway area = **2.01** m² (sides + base)

BR365 Soil Infiltration Rate = 3.0E-03 m/sec

Average Infiltration Rate = 3.0E-03 m/sec

(Consulting Engineers) Ltd

PROJECT:	New Smithy Avenue, Thurlstone	Job No. 40630	Date 09.12.16
SUBJECT:	Infiltration Test Results and Calculation of Infiltration Rates	Prepared DN	Checked AJK

Test No. SA3 - Test 1**Test Pit Dimensions**Length = **1800 mm**Plan area = **1.17 m²**Width = **650 mm**Depth = **2000 mm (Total depth)**

Approximate time to discharge water into the hole:

36 Seconds

Depth to water after completion of pumping:

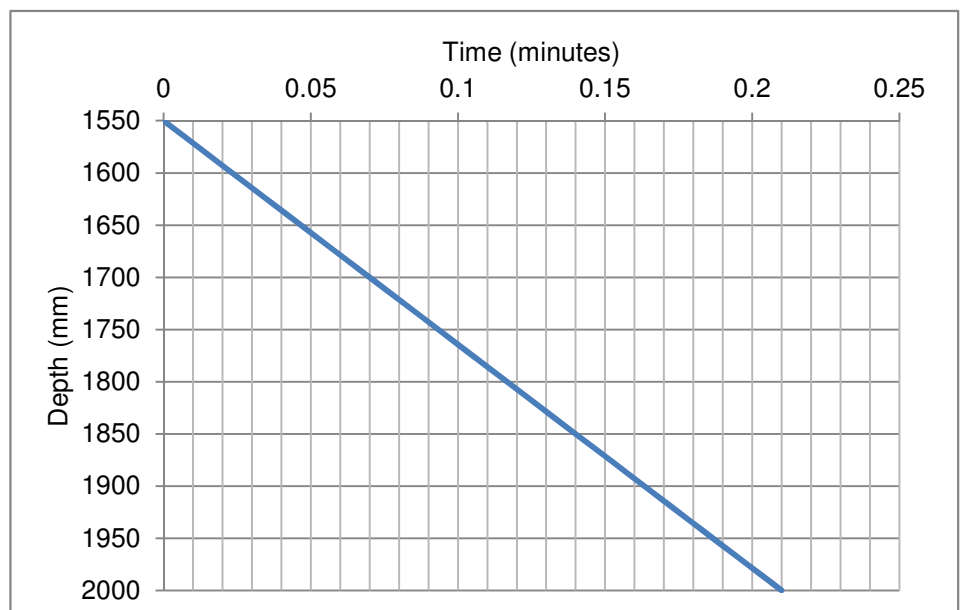
1550 mm**Time (min)****Depth (mm)**

0

1550

0.21

2000

**Depth (m)**

0-0.3

0.3-0.5

0.5-2.0

Description

TOPSOIL: Dark brown slightly clayey sand with occasional gravel of sandstone

Brown slightly clayey slightly gravelly SAND with occasional sandstone gravel

Yellow sandy gravel with medium cobble content. Gravel and cobbles are sub-angular of moderately strong sandstone

PROJECT:	Ne Smithy Avenue, Thurlstone	Job No. 40630	Date 09.12.16
SUBJECT:	Infiltration Test Results and Calculation of Infiltration Rates	Prepared DN	Checked AJK

Test No. SA3 - Test 1

Soil Infiltration Rate in Accordance with BR365

$$f = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$$

Where: V_{p75-25} is the effective storage volume of water in the trial pit between 75% and 25% effective depth;

a_{p50} is the internal surface area of the trial pit up to 50% effective depth and including the base area

t_{p75-25} is the time for the water level to fall from 75% to 25% effective depth

Initial parameters

Depth to water = **1550 mm** Average water depth: **225 mm**
 Start time = **0 min** Change in water depth: **450 mm**

Final parameters

Depth to water = **2000 mm** Time interval: **0.21 min**
 End time = **0.21 min**

Effective Storage Volume of Water in the Trial Pit = **0.5265 m³**
 75% Effective Depth = **1663 mm** from ground level
 25% Effective Depth = **1888 mm** from ground level
 Time at 75% Effective Depth = **0.055 minutes**
 Time at 25% Effective Depth = **0.155 minutes**

V_{p75-25} = **0.26 m³**
 a_{p50} = **2.27 m²**
 t_{p75-25} = **6 sec**
 f = **1.9E-02 m/sec**

Average Soakaway Rate = **4.2E-02 m³/sec**
 Average soakaway area = **2.27 m² (sides + base)**

BR365 Soil Infiltration Rate = 1.9E-02 m/sec
Average Infiltration Rate = 1.8E-02 m/sec

(Consulting Engineers) Ltd

PROJECT:	New Smithy Avenue, Thurlstone	Job No. 40630	Date 09.12.16
SUBJECT:	Infiltration Test Results and Calculation of Infiltration Rates	Prepared DN	Checked AJK

Test No. SA3 - Test 2**Test Pit Dimensions**Length = **1800 mm**Plan area = **1.17 m²**Width = **650 mm**Depth = **2000 mm (Total depth)**

Approximate time to discharge water into the hole:

31 Seconds

Depth to water after completion of pumping:

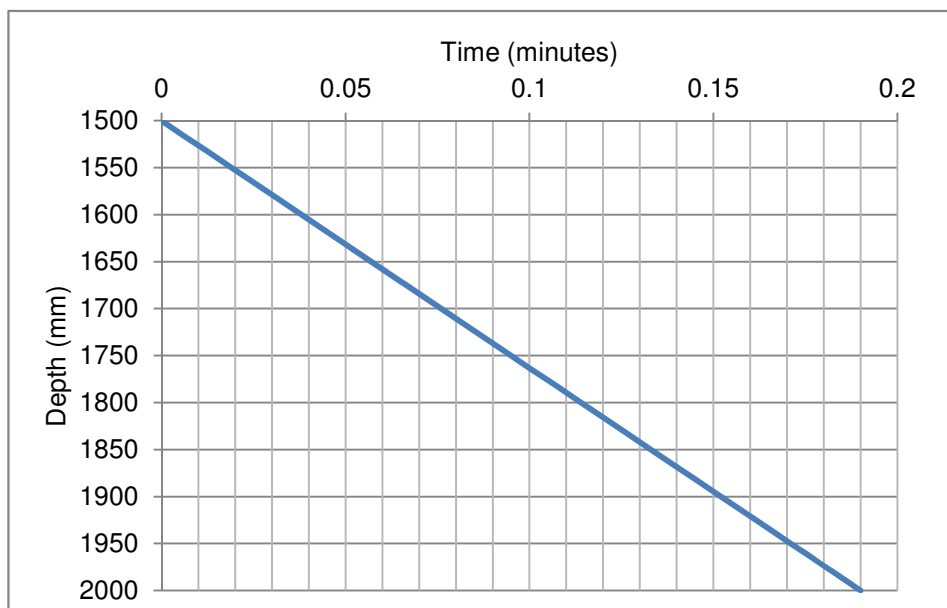
1550 mm**Time (min)****Depth (mm)**

0

1500

0.19

2000

**Depth (m)****Description**

0-0.3

TOPSOIL: Dark brown slightly clayey sand with occasional gravel of sandstone

0.3-0.5

Brown slightly clayey slightly gravelly SAND with occasional sandstone gravel

0.5-2.0

Yellow sandy gravel with medium cobble content. Gravel and cobbles are sub-angular of moderately strong sandstone

PROJECT:	New smithy Avenue, Thurlstone	Job No. 40630	Date 09.12.16
SUBJECT:	Infiltration Test Results and Calculation of Infiltration Rates	Prepared DN	Checked AJK

Test No. SA3 - Test 2

Soil Infiltration Rate in Accordance with BR365

$$f = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$$

Where: V_{p75-25} is the effective storage volume of water in the trial pit between 75% and 25% effective depth;

a_{p50} is the internal surface area of the trial pit up to 50% effective depth and including the base area

t_{p75-25} is the time for the water level to fall from 75% to 25% effective depth

Initial parameters

Depth to water = **1500** mm Average water depth: **250** mm

Start time = **0** min

Change in water depth: **500** mm

Final parameters

Depth to water = **2000** mm

Time interval: **0.19** min

End time = **0.19** min

Effective Storage Volume of Water in the Trial Pit = **0.585** m³
 75% Effective Depth = **1625** mm from ground level
 25% Effective Depth = **1875** mm from ground level
 Time at 75% Effective Depth = **0.05** minutes
 Time at 25% Effective Depth = **0.14** minutes

V_{p75-25} = **0.29** m³

a_{p50} = **2.40** m²

t_{p75-25} = **5** sec

f = **2.3E-02** m/sec

Average Soakaway Rate = **5.1E-02** m³/sec

Average soakaway area = **2.40** m² (sides + base)

BR365 Soil Infiltration Rate = 2.3E-02 m/sec

Average Infiltration Rate = 2.1E-02 m/sec

(Consulting Engineers) Ltd

PROJECT:	New Smithy Avenue, Thurlstone	Job No. 40630	Date 09.12.16
SUBJECT:	Infiltration Test Results and Calculation of Infiltration Rates	Prepared DN	Checked AJK

Test No. SA4 - Test 1**Test Pit Dimensions**Length = **1600 mm**Plan area = **1.04 m²**Width = **650 mm**Depth = **2100 mm (Total depth)**

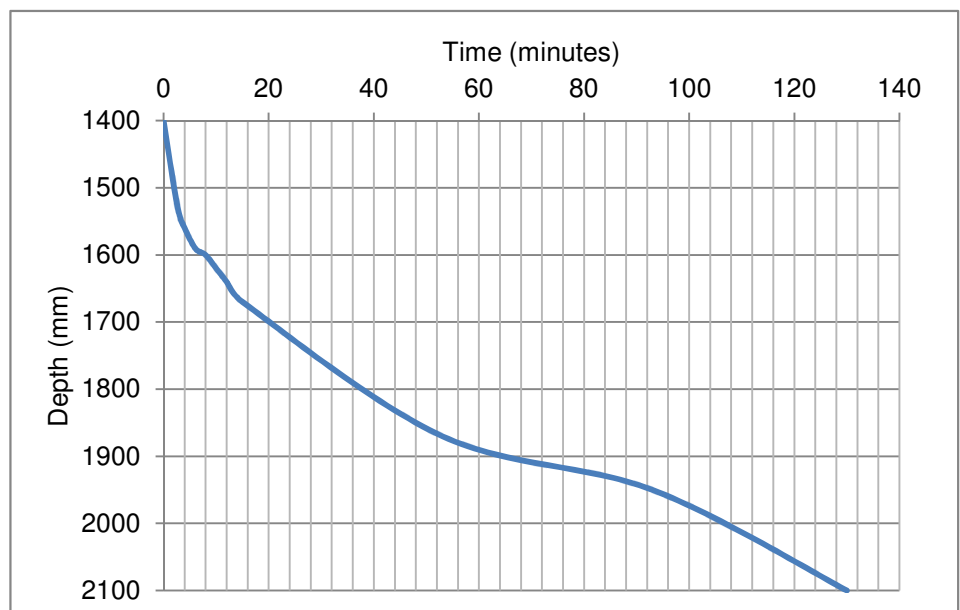
Approximate time to discharge water into the hole:

22 Seconds

Depth to water after completion of pumping:

1400 mm**Time (min) Depth (mm)**

0	1400
1	1450
2	1500
3	1540
4	1560
6	1590
8	1600
10	1620
12	1640
15	1670
53	1870
93	1950
130	2100

**Depth (m)**

0-0.2
0.2-0.3
0.3-2.1

Description

TOPSOIL: Dark brown slightly clayey sand with occasional gravel of sandstone.
Brown slightly clayey SAND with occasional gravel of sandstone.
Yellow slightly clayey gravelly SAND with medium cobble content.

PROJECT:	New Smithy Avenue, Thurlstone	Job No. 40630	Date 9.12.16
SUBJECT:	Infiltration Test Results and Calculation of Infiltration Rates	Prepared DN	Checked AJK

Test No. SA4 - Test 1

Soil Infiltration Rate in Accordance with BR365

$$f = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$$

Where: V_{p75-25} is the effective storage volume of water in the trial pit between 75% and 25% effective depth;

a_{p50} is the internal surface area of the trial pit up to 50% effective depth and including the base area

t_{p75-25} is the time for the water level to fall from 75% to 25% effective depth

Initial parameters

Depth to water = **1400 mm** Average water depth: **350 mm**

Start time = **0 min**

Change in water depth: **700 mm**

Final parameters

Depth to water = **2100 mm**

Time interval: **130 min**

End time = **130 min**

Effective Storage Volume of Water in the Trial Pit = **0.728 m³**
 75% Effective Depth = **1575 mm** from ground level
 25% Effective Depth = **1925 mm** from ground level
 Time at 75% Effective Depth = **5 minutes**
 Time at 25% Effective Depth = **80 minutes**

V_{p75-25} = **0.36 m³**

a_{p50} = **2.62 m²**

t_{p75-25} = **4500 sec**

f = **3.1E-05 m/sec**

Average Soakaway Rate = **9.3E-05 m³/sec**

Average soakaway area = **2.62 m² (sides + base)**

BR365 Soil Infiltration Rate = 3.1E-05 m/sec

Average Infiltration Rate = 3.6E-05 m/sec

(Consulting Engineers) Ltd

PROJECT:	New Smithy Avenue, Thurlstone	Job No. 40630	Date 09.12.16
SUBJECT:	Infiltration Test Results and Calculation of Infiltration Rates	Prepared DN	Checked AJK

Test No. SA5 - Test 1**Test Pit Dimensions**Length = **1300 mm**Plan area = **0.845 m²**Width = **650 mm**Depth = **1880 mm (Total depth)**

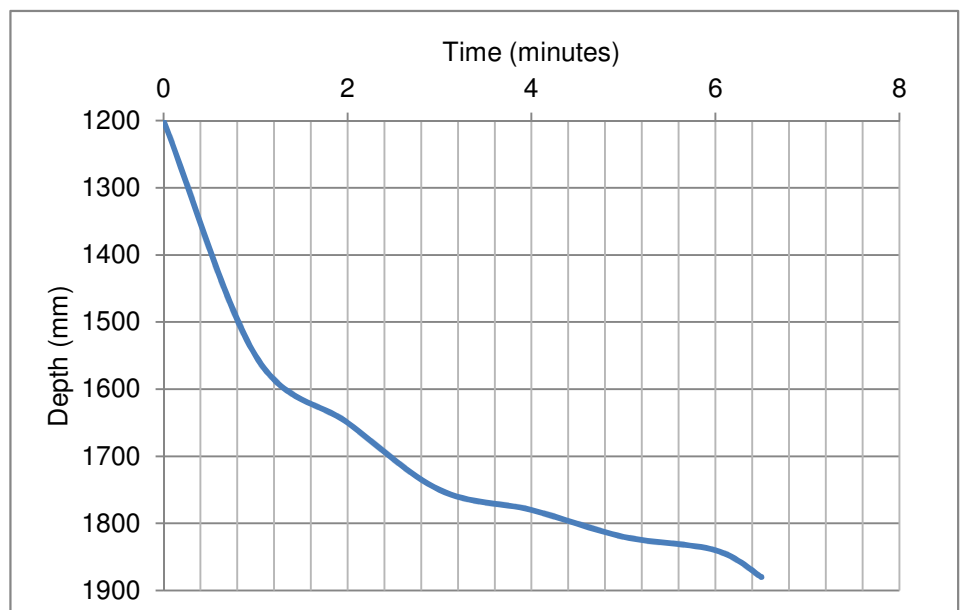
Approximate time to discharge water into the hole:

27 Seconds

Depth to water after completion of pumping:

1200 mm**Time (min) Depth (mm)**

0	1200
1	1550
2	1650
3	1750
4	1780
5	1820
6	1840
6.5	1880

**Depth (m)**

0-0.25

0.25-0.7

0.7-1.8

Description

TOPSOIL: Dark brown slightly clayey SAND with occasional sandstone gravel.

MADE GROUND: Brown gravelly SAND with medium cobble content. Gravel and cobbles of subangular-subrounded sandstone.

Yellow gravelly SAND becoming yellow sandy gravel and cobbles of sandstone.

PROJECT:	New Smithy Avenue, Thurlstone	Job No. 40630	Date 09.12.16
SUBJECT:	Infiltration Test Results and Calculation of Infiltration Rates	Prepared DN	Checked AJK

Test No. SA5 - Test 1

Soil Infiltration Rate in Accordance with BR365

$$f = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$$

Where: V_{p75-25} is the effective storage volume of water in the trial pit between 75% and 25% effective depth;

a_{p50} is the internal surface area of the trial pit up to 50% effective depth and including the base area

t_{p75-25} is the time for the water level to fall from 75% to 25% effective depth

Initial parameters

Depth to water = **1200 mm** Average water depth: **340 mm**

Start time = **0 min**

Change in water depth: **680 mm**

Final parameters

Depth to water = **1880 mm**

Time interval: **6.5 min**

End time = **6.5 min**

Effective Storage Volume of Water in the Trial Pit = **0.5746 m³**
 75% Effective Depth = **1370 mm** from ground level
 25% Effective Depth = **1710 mm** from ground level
 Time at 75% Effective Depth = **0.4 minutes**
 Time at 25% Effective Depth = **2.8 minutes**

V_{p75-25} = **0.29 m³**

a_{p50} = **2.17 m²**

t_{p75-25} = **144 sec**

f = **9.2E-04 m/sec**

Average Soakaway Rate = **1.5E-03 m³/sec**

Average soakaway area = **2.17 m² (sides + base)**

BR365 Soil Infiltration Rate = 9.2E-04 m/sec

Average Infiltration Rate = 6.8E-04 m/sec

(Consulting Engineers) Ltd

PROJECT:	New Smithy Avenue, Thurlstone	Job No. 40630	Date 09.12.16
SUBJECT:	Infiltration Test Results and Calculation of Infiltration Rates	Prepared DN	Checked AJK

Test No. SA5 - Test 2**Test Pit Dimensions**Length = **1300 mm**Plan area = **0.845 m²**Width = **650 mm**Depth = **1880 mm (Total depth)**

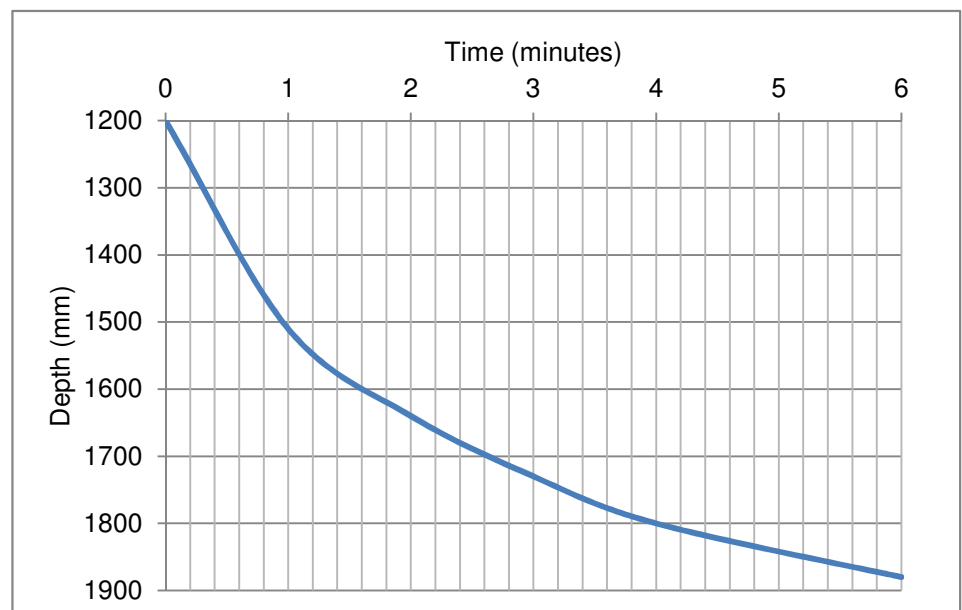
Approximate time to discharge water into the hole:

20 Seconds

Depth to water after completion of pumping:

1200 mm

Time (min)	Depth (mm)
0	1200
1	1510
2	1640
3	1730
4	1800
6	1880

**Depth (m)**

0-0.25

0.25-0.7

0.7-1.8

Description

TOPSOIL: Dark brown slightly clayey SAND with occasional sandstone gravel.

MADE GROUND: Brown gravelly SAND with medium cobble content. Gravel and cobbles of subangular-subrounded sandstone.

Yellow gravelly SAND becoming yellow sandy gravel and cobbles of sandstone.

PROJECT:	New Smithy Avenue, Thurlstone	Job No. 40630	Date 09.12.16
SUBJECT:	Infiltration Test Results and Calculation of Infiltration Rates	Prepared DN	Checked AJK

Test No. SA5 - Test 2

Soil Infiltration Rate in Accordance with BR365

$$f = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$$

Where: V_{p75-25} is the effective storage volume of water in the trial pit between 75% and 25% effective depth;

a_{p50} is the internal surface area of the trial pit up to 50% effective depth and including the base area

t_{p75-25} is the time for the water level to fall from 75% to 25% effective depth

Initial parameters

Depth to water = **1200 mm** Average water depth: **340 mm**

Start time = **0 min**

Change in water depth: **680 mm**

Final parameters

Depth to water = **1880 mm**

Time interval: **6 min**

End time = **6 min**

Effective Storage Volume of Water in the Trial Pit = **0.5746 m³**
 75% Effective Depth = **1370 mm** from ground level
 25% Effective Depth = **1710 mm** from ground level
 Time at 75% Effective Depth = **0.5 minutes**
 Time at 25% Effective Depth = **2.8 minutes**

V_{p75-25} = **0.29 m³**

a_{p50} = **2.17 m²**

t_{p75-25} = **138 sec**

f = **9.6E-04 m/sec**

Average Soakaway Rate = **1.6E-03 m³/sec**

Average soakaway area = **2.17 m² (sides + base)**

BR365 Soil Infiltration Rate = 9.6E-04 m/sec

Average Infiltration Rate = 7.4E-04 m/sec

Appendix 4

Chemical Test Results – Chemtest Report No. 16-30166
Assessment Values



Final Report

Report No.: 16-30166-1

Initial Date of Issue: 19-Dec-2016

Client Eastwood & Partners

Client Address: St. Andrews House
23 Kingfield Road
Sheffield
South Yorkshire
S11 9AS

Contact(s): Geo
Sarah Illingworth

Project 40630 New Smithy Avenue, Thurlstone

Quotation No.: **Date Received:** 08-Dec-2016

Order No.: 40630/AJK/SRI **Date Instructed:** 09-Dec-2016

No. of Samples: 10

Turnaround (Wkdays): 5 **Results Due:** 15-Dec-2016

Date Approved: 19-Dec-2016

Approved By:

Details: Martin Dyer, Laboratory Manager

Results - Soil

Client: Eastwood & Partners	Chemtest Job No.:				16-30166	16-30166	16-30166	16-30166	16-30166	16-30166	16-30166	16-30166
Quotation No.:	Chemtest Sample ID.:				388615	388616	388617	388618	388619	388620	388621	388622
	Client Sample ID.:				TP2	TP3	TP4	TP4	TP5	TP6	TP6	TP8
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.1	0.4	0.2	0.8	0.1	0.1	0.4	0.1
	Date Sampled:				06-Dec-2016	06-Dec-2016	06-Dec-2016	06-Dec-2016	06-Dec-2016	06-Dec-2016	06-Dec-2016	06-Dec-2016
	Asbestos Lab:				COVENTRY		COVENTRY		COVENTRY	COVENTRY		COVENTRY
Determinand	Accred.	SOP	Units	LOD								
ACM Type	U	2192		N/A	-		-		-	-		-
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected		No Asbestos Detected		No Asbestos Detected	No Asbestos Detected		No Asbestos Detected
Moisture	N	2030	%	0.020	21	17	20	12	22	23	22	18
Soil Colour	N	2040		N/A	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown
Other Material	N	2040		N/A	Stones, Roots	Stones, Roots	Stones, Roots	Stones	Stones, Roots	Stones, Roots	Stones	Stones
Soil Texture	N	2040		N/A	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand
pH	M	2010		N/A	6.0	7.3	5.9	7.2	5.1	4.5	4.0	5.6
Sulphate (2:1 Water Soluble) as SO ₄	M	2120	g/l	0.010		< 0.010		< 0.010			0.014	
Total Sulphur	M	2175	%	0.010		0.020		0.010			0.040	
Sulphate (Acid Soluble)	M	2430	%	0.010		0.020		< 0.010			0.091	
Arsenic	M	2450	mg/kg	1.0	25	5.8	20	4.6	13	21	5.6	13
Cadmium	M	2450	mg/kg	0.10	0.31	< 0.10	0.22	< 0.10	0.16	0.16	< 0.10	0.17
Chromium	M	2450	mg/kg	1.0	15	7.7	14	12	13	15	13	12
Copper	M	2450	mg/kg	0.50	38	11	27	9.2	18	25	12	19
Mercury	M	2450	mg/kg	0.10	0.21	< 0.10	0.14	< 0.10	0.15	0.13	< 0.10	0.10
Nickel	M	2450	mg/kg	0.50	14	5.8	12	14	10	12	6.8	10
Lead	M	2450	mg/kg	0.50	170	22	73	6.6	72	95	43	52
Selenium	M	2450	mg/kg	0.20	0.68	0.20	0.57	< 0.20	0.48	0.50	0.35	0.41
Zinc	M	2450	mg/kg	0.50	66	23	42	30	34	38	23	37
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Naphthalene	M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.10	< 0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.16	< 0.10	< 0.10
Acenaphthene	M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.11	< 0.10	< 0.10
Phenanthrene	M	2800	mg/kg	0.10	0.46	< 0.10	< 0.10	< 0.10	0.18	2.9	< 0.10	< 0.10
Anthracene	M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	M	2800	mg/kg	0.10	0.74	< 0.10	< 0.10	< 0.10	0.23	3.0	< 0.10	< 0.10
Pyrene	M	2800	mg/kg	0.10	0.67	< 0.10	< 0.10	< 0.10	0.17	2.3	< 0.10	< 0.10
Benzo[a]anthracene	M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.20	< 0.10	< 0.10
Chrysene	M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.72	< 0.10	< 0.10
Benzo[b]fluoranthene	M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.60	< 0.10	< 0.10
Benzo[k]fluoranthene	M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.31	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Of 16 PAH's	N	2800	mg/kg	2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	10	< 2.0	< 2.0

Project: 40630 New Smithy Avenue, Thurlstone

Client: Eastwood & Partners	Chemtest Job No.:				16-30166	16-30166
Quotation No.:	Chemtest Sample ID.:				388623	388624
	Client Sample ID.:				TP8	TP9
	Sample Type:				SOIL	SOIL
	Top Depth (m):				0.5	0.1
	Date Sampled:				06-Dec-2016	06-Dec-2016
	Asbestos Lab:					COVENTRY
Determinand	Accred.	SOP	Units	LOD		
ACM Type	U	2192		N/A		-
Asbestos Identification	U	2192	%	0.001		No Asbestos Detected
Moisture	N	2030	%	0.020	13	22
Soil Colour	N	2040		N/A	Brown	Brown
Other Material	N	2040		N/A	Stones	Stones, Roots
Soil Texture	N	2040		N/A	Sand	Sand
pH	M	2010		N/A	7.4	5.8
Sulphate (2:1 Water Soluble) as SO ₄	M	2120	g/l	0.010	< 0.010	
Total Sulphur	M	2175	%	0.010	0.020	
Sulphate (Acid Soluble)	M	2430	%	0.010	0.018	
Arsenic	M	2450	mg/kg	1.0	5.0	16
Cadmium	M	2450	mg/kg	0.10	< 0.10	0.23
Chromium	M	2450	mg/kg	1.0	12	14
Copper	M	2450	mg/kg	0.50	8.7	29
Mercury	M	2450	mg/kg	0.10	< 0.10	0.10
Nickel	M	2450	mg/kg	0.50	14	13
Lead	M	2450	mg/kg	0.50	12	87
Selenium	M	2450	mg/kg	0.20	0.23	0.45
Zinc	M	2450	mg/kg	0.50	32	42
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50
Naphthalene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10	< 0.10
Acenaphthene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Fluorene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Phenanthrene	M	2800	mg/kg	0.10	< 0.10	0.88
Anthracene	M	2800	mg/kg	0.10	< 0.10	0.14
Fluoranthene	M	2800	mg/kg	0.10	< 0.10	1.2
Pyrene	M	2800	mg/kg	0.10	< 0.10	0.85
Benzo[a]anthracene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Chrysene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Benzo[a]pyrene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Total Of 16 PAH's	N	2800	mg/kg	2.0	< 2.0	3.1

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2175	Total Sulphur in Soils	Total Sulphur	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenzo[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS

Report Information

Key

- U UKAS accredited
- M MCERTS and UKAS accredited
- N Unaccredited
- S This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
- SN This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
- T This analysis has been subcontracted to an unaccredited laboratory
- I/S Insufficient Sample
- U/S Unsuitable Sample
- N/E not evaluated
- < "less than"
- > "greater than"

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

All Asbestos testing is performed at the indicated laboratory

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

- A - Date of sampling not supplied
- B - Sample age exceeds stability time (sampling to extraction)
- C - Sample not received in appropriate containers
- D - Broken Container

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:

customerservices@chemtest.co.uk

Inorganic Compounds	Human Health - Residential with Homegrown Produce (mg/kg)
Arsenic	37
Cadmium	11
Chromium (III)	910
Chromium (VI)	6
Lead	200
Mercury	1.2
Nickel	180
Selenium	250
Copper	2400
Zinc	3700

Organic Compounds	Human Health - Residential with Homegrown Produce (mg/kg)		
	1% SOM	2.5% SOM	6% SOM
Naphthalene	2.3	5.6	13
Acenaphthene	210	510	1100
Acenaphthylene	170	420	920
Fluorene	170	400	860
Phenanthrene	95	220	440
Anthracene	2400	5400	11000
Fluoranthene	280	560	890
Pyrene	620	1200	2000
Benzo(a)anthracene	7.2	11	13
Chrysene	15	22	27
Benzo(b)fluoranthene	2.6	3.3	3.7
Benzo(k)fluoranthene	77	93	100
Benzo(a)pyrene	2.2	2.7	3.0
Dibenz(a,h)anthracene	0.24	0.28	0.3
Indeno(1,2,3-cd)pyrene	27	36	41
Benzo(g,h,i)perylene	320	340	350
Benzene	0.087	0.17	0.37
Toluene	130	290	660
Ethylbenzene	47	110	260
o-Xylene	60	140	330
m-Xylene	59	140	320
p-Xylene	56	130	310

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Prepared	KDL	Checked	CAT	Date	05.01.17	Job No	40630
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 Eastwood & Partners CONSULTING ENGINEERS St Andrew's House 23 Kingfield Road Sheffield S11 9AS Tel: (0114) 255 4554 Fax: (0114) 255 4330	MR P. MULLINS LAND SOUTH OF NEW SMITHY AVENUE, THURLSTONE ASSESSMENT CRITERIA – RESIDENTIAL WITH HOMEGROWN PRODUCE
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Contaminant	Phytotoxicity			
	pH 5.0 to 5.5	pH 5.5 to 6.0	pH 6.0 to 6.5	pH >7.0
Arsenic	50			
Cadmium	3			
Chromium	400			
Lead	300			
Mercury	1			
Nickel	50	60	75	110
Copper	80	100	135	200
Zinc	200	200	200	300

The assessment concentration for lead is the Category 4 Screening Level produced by Contaminated Land: Applications in Real Environments (CL:AIRE) and outlined in Appendix H of their report SP1010. The others have been taken from Nathanail, C. P., McCaffrey, C., Gillett, A., Ogden, R., and Nathanail, J., 2015, *'The LQM/CIEH S4ULs for Human Health Risk Assessment'*, Land Quality Press, Nottingham. The metals/metalloids are based on a sandy loam soil and 6% soil organic matter. The assessment values are not intended to be applied to individual sample results where materials are similar, as the levels of contaminants will have a natural variability across the site. Instead, the modified mean value should be compared with the assessment concentration.

The assessment values for phytotoxicity are the levels at which plant growth is thought to be affected. They are taken from the maximum permissible and advisable concentrations in soil after application of soil sludge given in the *'The Code of Good Agricultural Practice for the Protection of Soil'*, MAFF, 1998.

The assessment of sulphate, water soluble sulphate, elemental sulphur and sulphide is to determine the aggressive nature of the ground with respect to concrete and consequently the results are compared with BRE Special Digest 1:2005 *'Concrete in Aggressive Ground'*.

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