

# **FLOODING & DRAINAGE ASSESSMENT FOR A PROPOSED RESIDENTIAL DEVELOPMENT SITE ADJACENT BUTT LANE, SNAITH**

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## **1.0 INTRODUCTION**

- 1.01 Following instructions from Midland Construction Services Ltd during August 2018, CoDA Structures have undertaken an initial assessment of flooding and drainage issues in relation to a potential residential development site adjacent Butt Lane, Snaith.
- 1.02 The site is undeveloped.
- 1.03 This report has been prepared to accompany a planning application on the site. The report examines any potential flooding and drainage issues in relation to the proposed development and outlines solutions where necessary, to deal with the identified issues.
- 1.04 The Local Authority and the Local Lead Flood Authority is East Riding of Yorkshire Council (ERYC).

## **2.0 POLICY CONSIDERATIONS AND OBJECTIVES**

### **2.01 National Planning Policy Framework:**

Section 10 of the National Planning Policy Framework (NPPF) published in July 2018 sets out Government policy on development and flood risk for England. It aims to ensure that flood risk is taken into account at all stages of the planning process, to avoid inappropriate developments in areas at risk of flooding, and to direct development away from areas of highest risk. Where new development is thought necessary in areas of flood risk, the NPPF aims to make it safe, without increasing flood risk elsewhere, and, where possible, reduce the overall flood risk.

The NPPF promotes a sequential risk-based approach to determine the suitability of land for development in flood risk areas. The broad aim of the NPPF is to reduce the number of people and properties within the natural and built environment at risk of flooding. To achieve this aim, planning authorities are required to ensure that flood risk is properly assessed during the initial planning stages of any development.

### **2.02 Consideration and Objectives:**

This Flooding and Drainage Assessment Report will consider the following:-

- whether the proposed development is likely to be affected by flooding.
- whether the proposed development will increase flood risk to adjacent properties.

The report will also demonstrate that any existing flood risk or flood risk associated with the proposed development can satisfactorily managed. This will include:-

- whether the proposed development is likely to be affected by flooding and whether it will increase flood risk elsewhere.

- specifying the measures proposed to deal with the identified risks, including, where appropriate, proposals to reduce existing and/or future flood risk levels.
- satisfy the Local Authority that any flood risk to the development or additional risk arising from the proposal will be successfully managed so the site can be developed and occupied safely with out risk to adjacent properties.

### 3.0 FLOODING ISSUES

#### 3.01 The Site:

The site is located to the west of Butt Lane and lies approximately 275m to the south of the centre of Snaith. A site location plan (Fig. 1) is attached in Appendix B.

The Ordnance Survey co-ordinates for the centre of the site are 464370mE, 421730mN.

The site is approximately 2.00 hectares in area.

The site can be accessed from Butt Lane.

The general fall of the site is to the southeast. Site levels range from:-

Location	Level m (AOD)
Northern boundary	7.81 – 10.45
Southern boundary	6.61 – 7.85
Eastern boundary	6.61 – 7.81
Western boundary	7.61 – 1.10

A site topographical survey (Fig. 2) is attached in Appendix C.

A site aerial photograph is attached in Appendix D.

No watercourses are believed to lie on or in the immediate vicinity of the site.

From the inspection of OS maps and the OS Water Network Map, there are watercourses in the vicinity of the site as follows:-

- drainage ditch approximately 100m to the southeast.
- drainage ditch approximately 375m to the southeast.
- drainage ditch approximately 400m to the south.
- 2 no. drainage ditches approximately 450m to the north.
- 2 no. drainage ditches approximately 500m to the south.

The River Aire lies approximately 900m to the north of the site.

There is a small pond approximately 375m to the southeast of the site.

The location of the river, drainage ditches and pond are indicated on the Site Location

Plan (Fig. 1) attached in Appendix B and OS Water Network Map attached in Appendix E.

### 3.02 Flood Zone Classification:

The site is located within Flood Zone 1 on the EA flood map. This zone comprises land assessed as having less than 1 in 1000 (<0.1%) annual probability of tidal or river flooding in any year.

A copy of the EA flood map is attached in Appendix F.

### 3.03 Sources of Flood Risk:

The following table shows a summary of the forms of flood and the potential issues in relation to the site that require further assessment.

<b>Flood Source</b>	<b>Applicable</b>	<b>Comment</b>
Fluvial	✓	There are drainage ditches in the vicinity of the site.
Tidal	X	Site inland.
Run Off	✓	Potential for run off from higher land to the northwest.
Groundwater	X	BGS Groundwater flooding susceptibility for the site is indicated as 'limited potential for groundwater flooding to occur'.
Sewers	✓	A 225mm diameter surface water sewer crosses the eastern sector of the site. A 150mm diameter foul sewer lies in Sycamore Close to the north of the site. A 100mm diameter combined sewer lies in Walnut Crescent to the west of the site. There is a 150mm diameter rising main in Butt Lane adjacent the site. There is a 150mm foul sewer in Butt Lane to the southeast of the site.
Reservoirs, Canals, etc.	X	No such features in the vicinity of the site.

### 3.04 Flood Risk Assessment:

The site is within Flood Zone 1. This zone comprises land assessed as having less than a 1 in 1000 (<0.1%) annual probability of tidal or river flooding in any one year.

The drainage ditches to the south of the site may be a source of localised fluvial flooding that has not been captured on the EA flood map.

The development may be at risk from potential overland flood waters from higher ground to the northwest. However, any such flood waters would flow through the site to the southeast.

The effect of groundwater as a flood source is not known to be an issue at this location. BGS Groundwater flooding susceptibility for the site is indicated as 'limited potential for groundwater flooding to occur'.



From inspection of the EA Risk of Flooding from Surface Water Maps, it would appear there is a very low risk (less than 1 in 1000 [0.1%]) of surface water flooding affecting the site. However, it should be noted that surface water flooding can be difficult to predict and occurs when rainwater does not drain away through the 'normal' drainage systems or soaks into the ground but lies on or flows over the ground instead.

The EA Risk of Flooding from Surface Water Map is attached in Appendix G.

The development may be at risk from overland flood waters from the potential overloading of the public surface water sewers that crosses the eastern sector of the site. However, any such flood waters would flow through the site to the southeast.

### **3.05 Sequential Test:**

The Sequential Test should be applied at all stages of planning. Its aim is to steer new development to areas at the lowest probability of flooding.

Table 2 of the Technical Guidance to the NPPF (which categorises the flood risk vulnerability of land uses) indicates the proposed development is categorised as a 'more vulnerable' land use.

From the EA flood map site is identified as being Flood Zone 1.

Table 3 of the Technical Guidance to the NPPF indicates where the proposed land use is 'more vulnerable' development is appropriate in Flood Zone 1. Therefore, the Sequential Test has been passed.

### **3.06 Exception Test:**

Table 3 of the Technical Guidance to the NPPF indicates where the proposed land use is 'more vulnerable' development is considered appropriate in Flood Zone 1 and the Exception Test is not required.

Notwithstanding the above the following sections of this report will demonstrate that the proposed development will be safe from flooding and will not increase flood risk elsewhere.

### **3.07 Effect of Development on the Wider Catchment:**

The proposed development on the site will result in an impermeable area on the site and unattenuated surface water flows from the development would potentially increase the flooding risk to the receiving watercourses or sewers in the wider catchment. This is assessed in detail in the drainage section of this report.

### **3.08 Flood Risk Mitigation:**

The proposed development is in Flood Zone 1.

The proposed finished floor level on the new build development should be set at least 0.15 and ideally 0.30m above the existing ground level.

The external levels around the development should be set to route any potential overland flood waters around the proposed building to the southeast as the existing situation.

#### **4.0 DRAINAGE**

##### **4.01 Public Sewers:**

A 225mm surface water sewer crosses the eastern sector of the site. A 150mm diameter foul sewer lies in Sycamore Close to the north of the site. A 100mm diameter combined sewer lies in Walnut Crescent to the west of the site. There is a 150mm diameter rising main in Butt Lane adjacent the site and a 150mm foul sewer in Butt Lane to the southeast of the site.

An extract from the public sewer record is attached in Appendix G.

##### **4.02 Existing Drainage:**

Land drains may be present on the site.

##### **Foul Water Drainage**

##### **4.03 Foul Drainage:**

A separate foul water system will be provided on the development.

It is proposed to discharge foul water from the development to the 150mm foul sewer in Butt Lane to the southeast of the site. The foul sewer in Butt Lane to the southeast of the site is 1.35m deep and it appears a gravity system can be adopted on the development.

##### **Surface Water Drainage**

##### **4.04 Geology:**

BGS Geological Sheet 79 Goole indicates the following:-

- The site is underlain by the Sherwood Sandstone Group of the Guadalupian Age.
- The Brighton Sand Formation is likely to be present at the surface.
- No faults or abnormal features are recorded on or in the vicinity of the site.
- No coal seams are recording as outcropping on or in the near vicinity of the

site.

- There are no areas of made or filled ground within 1000m of the site.

A borehole log (Ref: SE62SW197) viewed on the BGS website, undertaken approximately 250m to the southeast of the site, indicates the following sequence of strata:-

<b>Borehole (SE62SW197)</b>	
<b>Strata</b>	<b>Thickness (m)</b>
Made Ground	0.70
Clay	1.00
Sand	1.10
Clay	1.70
Sandstone	34.50

#### 4.05 Ground Conditions:

A trial pit ground investigation was undertaken on the site on 20 September 2018 and 27 November 2018. It should be noted TP11 wasn't excavated.

The following ground conditions were encountered in the trial pits excavated on the site:-

<b>Strata</b>	<b>Location</b>					
	<b>TP01</b>	<b>TP02</b>	<b>TP03</b>	<b>TP04</b>	<b>TP05</b>	<b>TP06</b>
Approx. Ground Level (m AOD)	9.81	8.50	9.40	9.45	8.40	7.45
Topsoil	0.00 – 0.35m	0.00 – 0.30m	0.00 – 0.30m	0.00 – 0.30m	0.00 – 0.35m	0.00 – 0.38m
Sands / Gravels	0.35 – 1.10m (sand & gravel)	0.30 – 0.90m (sand & gravel)	0.30 – 0.80m (sand & gravel)	-	0.35 – 1.40m (sand)	-
	1.10 – 1.60m (clayey sand)					
Clay	1.60 – 1.80m (soft, low strength)	0.90 – 1.40m (very stiff)	0.80 – 1.30m (very stiff)	0.30 – 1.10m (very desiccated)	1.40 – 2.00m (firm)	1.38 – 1.50m (stiff, desiccated)
	1.80 – 2.30m (with sand bands)			1.10 – 1.60m (soft, low strength)		1.50 – 1.80m (very soft, low strength)
						1.80 – 2.10m (very stiff, high strength)
Silt	-	-	1.30 – 1.80m (very soft, low strength)	-	-	-
Sands / Gravels	2.30 – 3.40m (sand)	1.40 – 2.60m (sand)	1.80 – 2.70m (sand)	1.60 – 3.00m (sand)	2.00 – 3.50m (sand)	2.10 – 3.60m (sand & gravel)
		2.60 – 3.80m (sand & gravel)				
Clay	3.40 – 3.70m (firm)	-	2.70 – 3.50m (soft, low strength)	3.00 – 3.70m (soft, low strength)	-	-
Sand	-	-	3.50 – 4.00m (sand & gravel)	3.70 – 4.00m (sand)	-	-

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Stability	Major collapse of pit walls below 2.30m	Continued collapse of pit walls below 3.40m	Slight collapse of pit walls from 1.80 – 2.70m and below 3.50m	Slight collapse of pit walls below 3.70m	Slight collapse of pit walls below 2.90m	Slight collapse of pit walls below 2.10m
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Strata	Location					
	TP07	TP08	TP09	TP10	TP12	TP13
Approx. Ground Level (m AOD)	8.75	7.60	7.75	8.20	7.60	7.30
Topsoil	0.00 – 0.35m	0.00 – 0.30m	0.00 – 0.30m	0.00 – 0.30m	0.00 – 0.35m	0.00 – 0.50m
Sands & Gravels	-	0.30 – 1.10m (sand)	-	-	-	-
Clay	0.35 – 1.40m (very stiff, desiccated)	1.10 – 1.50m (stiff, desiccated)	0.30 – 1.30m (very stiff, desiccated)	0.30 – 1.40m (very stiff, desiccated)	0.30 – 1.20m (desiccated)	0.50 – 1.35m (very stiff, high strength, desiccated)
	1.40 – 2.80m (very soft, low strength)		1.30 – 1.70m (firm, medium strength)	1.70 – 2.00m (soft, becoming firm, low strength)		
Silt	-	-	-	-	-	-
Sands & Gravels	2.80 – 3.80m (sand & gravel)	1.50 – 3.00m (sand & gravel)	1.70 – 3.50m (sand & gravel)	2.00 – 2.95m (sand & gravel)	1.20 – 2.00m (sand)	1.35 – 3.50m (sand & gravel)
		3.00 – 3.70m (sand)		2.95 – 3.50m (sand)	2.00 – 3.55m (sand & gravel)	3.50 – 3.95m (gravel)
Clay	-	-	-	-	-	-
Sand	-	-	-	-	-	-
Stability	Slight collapse of pit walls below 3.10m	Slight collapse of pit walls below 1.80m	Slight collapse of pit walls below 3.20m	Slight collapse of pit walls	Slight collapse of pit walls	Slight collapse of pit walls

Strata	Location			
	S1	S2	S3	S4
Approx. Ground Level (m AOD)	8.10	8.85	7.60	9.70
Topsoil	0.00 – 0.35m	0.00 – 0.30m	0.00 – 0.35m	0.00 – 0.50m
Sand and/or Gravel	-	0.30 – 0.60m (sand & gravel)	-	-
Clay	0.35 – 1.90m	0.60 – 0.70m	0.35 – 1.75m	0.50 – 1.00m
Sand and/or Gravel	1.90 – 3.00m (sand & gravel)	0.70 – 1.00m (sand)	1.75 – 3.00 (sand & gravel)	1.00 – 3.50m (sand)
Silt	-	1.80 – 2.20m	-	-
Sand and/or Gravel	-	2.20 – 3.40m (gravel)	-	-
Stability	Pit wall stable whilst open	Pit wall stable whilst open	Pit wall stable whilst open	Pit wall stable whilst open
Groundwater	Not encountered	Not encountered	Not encountered	Not encountered

For the detailed description of the strata encountered see the trial pit logs attached in

## Volume 2, Appendix I.

The following typical ground conditions were encountered in the window sampling boreholes sunk on the site:-

Strata	Location					
	M1	M2	M3	M4	M5	M6
Approx. Ground Level (m AOD)	9.20	9.85	7.75	9.25	9.30	7.10
Topsoil	0.00 – 0.40m	0.00 – 0.25m	0.00 – 0.45m	0.00 – 0.40m	0.00 – 0.30m	0.00 – 0.40m
Clay	0.40 – 0.80m (firm)	0.25 – 1.00m (stiff)	0.45 – 0.55m	0.40 – 1.00m (stiff)	0.30 – 1.80m (firm, medium strength)	0.40 – 0.80m (stiff)
		1.00 – 2.00m (firm, medium strength)	0.55 – 1.40m (stiff, high strength)			0.80 – 1.00m (firm)
Sand and/or Gravel	0.80 – 1.40m (medium dense, sand & gravel)	2.00 – 4.31m (medium dense, sand & gravel)	1.40 – 3.42m (medium dense, sand)	1.00 – 1.45m (medium dense, sand)	1.80 – 1.82m (sand)	1.00 – 1.50m (medium dense, sand & gravel)
Clay	1.40 – 2.40m (soft, low strength becoming stiff, high strength)	-	-	1.45 – 2.60m (soft, low strength)	1.82 – 2.00m (firm)	1.50 – 2.00m (firm)
Sand and/or Gravel	2.40 – 2.45m (sand)	-	-	2.60 – 2.70m (sand)	2.00 – 2.80m (medium dense, sand)	2.00 – 2.80m (medium dense, sand)
					2.80 – 4.38m (medium dense, sand & gravel)	2.80 – 3.04m (sand & gravel)
Clay	2.45 – 2.80m (firm)	-	-	2.70 – 2.80m (firm)	-	-
	2.80 – 3.45m (stiff, high strength)					
Sand	-	-	-	2.80 – 2.85m	-	-
Clay	-	-	-	2.85 – 3.00m (firm)	-	-
Sand	-	-	-	3.00 – 3.80m (medium dense)	-	-
Clay	-	-	-	3.80 – 4.40m (firm)	-	-
Groundwater	Seepage at 1.35m	Seepage at 2.10m	Not encountered	Soils wet at 1.90m	Not encountered	Not encountered

For the detailed description of the strata encountered see the window sampling borehole logs attached in Appendix J.

**4.06 Groundwater:**

Groundwater was encountered during the trial pit investigation as follows:-

Strata	Location					
	TP01	TP02	TP03	TP04	TP05	TP06
Approx. Ground Level	9.81	8.50	9.40	9.45	8.40	7.45

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(m AOD)						
Groundwater	Soils damp at 2.80m Seepage at 3.20m	Soils wet at 3.40m	Soils damp at 1.80m Soils damp at 3.50m	Soils damp at 1.60m	Soils damp at 3.00m	Soils damp at 3.40m

Strata	Location					
	TP07	TP08	TP09	TP10	TP12	TP13
Approx. Ground Level (m AOD)	8.75	7.60	7.75	8.20	7.60	7.30
Groundwater	Soils damp at 3.20m	Not encountered	Soils damp at 2.60m	Soils damp at 3.40m	Soils damp at 2.80m	Soils damp at 3.50m

Strata	Location			
	S1	S2	S3	S4
Approx. Ground Level (m AOD)	8.10	8.85	7.60	9.70
Groundwater	Not encountered	Not encountered	Not encountered	Not encountered

Groundwater was encountered during the window sampling borehole investigation as follows:-

Strata	Location					
	M1	M2	M3	M4	M5	M6
Approx. Ground Level (m AOD)	9.20	9.85	7.75	9.25	9.30	7.10
Groundwater	Seepage at 1.35m	Seepage at 2.10m	Not encountered	Soils wet at 1.90m	Not encountered	Not encountered

#### 4.07 Environmental Setting:

The site is underlain by a bedrock aquifer designated as a Principle Aquifer which is strata that has a high intergranular and/or fracture permeability and usually provides a high level of water storage that may support water supplies and/or river base flow on a strategic scale.

The superficial aquifer is designated as a Secondary Aquifer – A which is strata which contains permeable layers capable of supporting water supplies at a local rather than strategic scale and in some cases forming an important source of base flows to rivers.

The overlying soils are classified as having a high leaching potential.

There is 1 no. water abstraction license held within 1000m of the site and details are summarised as follows:-

- surface water abstraction for spray irrigation 766m to the west.

The site is within Zone III of a Source Protection Zone.

The use of infiltration drainage on the site has not yet been discussed with the EA



Groundwater Protection Team but it is envisaged it will be acceptable in principle. However, the scheme will need to include adequate treatment prior to infiltration and this should follow in the guidance given in the CIRIA 697 The SUDS Manual.

#### 4.08 **Falling Head Permeability Testing:**

The results of the falling head permeability testing in accordance with BRE 365: Soakaways are summarised in the following table:-

Location	Soil Infiltration Rate m/s		
	Test 1	Test 2	Test 3
S1	$5.82 \times 10^{-6}$	-	-
S2	$4.40 \times 10^{-6}$	-	-
S3	No result	-	-
S4	No result	-	-

The results of falling head permeability testing indicate the use of soakaway is not feasible in the north western and south eastern section of the site. The results obtained in the south western and north eastern indicate relatively low soil infiltration rates. Therefore, in view of the results and the variable nature of the near surface strata below the site including bands of clay, it is considered that the use of soakaways on the development is not appropriate.

The test results are attached in Appendix K

#### 4.09 **Surface Water Drainage:**

A separate surface water drainage system should be provided on the development.

In situ testing and ground conditions on the site indicate the use of soakaways for the disposal of water from the development is not feasible.

Therefore, subject to agreement from Yorkshire Water, it is proposed to discharge surface water from the development to the 225mm diameter surface water that crosses the site. The discharge would be limited to greenfield run-off which is generally accepted as 1.4 l/sec/ha for this area. This would result in a discharge of 2.8 l/sec for the site. However, in order to provide a flow control with an orifice size that would not be prone to blockage a discharge rate of 3.0 l/sec is proposed.

The storm water storage would be provided for storms up to a 1:100 year storm return period with a 30% increase in rainfall intensity for climate change.

The following estimation of stormwater storage requirements for the development has been based on the following parameters:-

Proposed discharge rate: 3.0 l/sec

Proposed Hardcover area: 9180 m<sup>2</sup>

Stormwater storage requirements: 651.1 m<sup>3</sup>

(Based on a 1:100 year storm return period and a 30% increase in rainfall intensity for climate change).

The stormwater storage estimate calculation is attached in Appendix L.

A schematic drainage layout (7848/020 & 021) for the development is attached in Appendix M.

#### 4.10 Maintenance Requirements of the Surface Water System

##### a) Private Areas – Roofs and Hardstandings

Regular inspection and maintenance is required to ensure the effective long-term operation of below ground drainage systems. Initially, the maintenance will be the responsibility of the developer. However, it will ultimately become the responsibility of the individual house holders.

Maintenance Schedule	Required Action	Recommended Frequency
Regular maintenance	Remove debris from any catchment surfaces (may cause risks to performance).	Monthly for first 3 months, then six monthly thereafter (and after large storm events).
	Visual inspection of manholes, to ensure no obvious build-up of silt or other blockages. De-silt as required. Check to ensure there is no standing water in the manholes.	Monthly for first 3 months, then six monthly thereafter (and after large storm events).
	Remove sediment from inspection chambers, rainwater gullies, channels and jet associated pipework.	Annually, or as required.
Ongoing monitoring	Inspect/check all drainage inlets to ensure that they are in good condition and operating as designed.	Annually and after large storm events.
Remedial actions	Repair/rehabilitation of drainage inlets. De-silt as required.	As required.

**5.0 SUMMARY**

<b>The Site</b>	<p>The site is located to the west of Butt Lane and lies approximately 275m to the south of the centre of Snaith.</p> <p>The Ordnance Survey co-ordinates for the centre of the site are 464370mE, 421730mN.</p> <p>The site is approximately 2.00 hectares in area.</p> <p>The site can be accessed from Butt Lane.</p> <p>The general fall of the site is to the southeast. Site levels vary as follows:-</p> <table border="1"> <thead> <tr> <th>Location</th><th>Level m (AOD)</th></tr> </thead> <tbody> <tr> <td>Northern boundary</td><td>7.81 – 10.45</td></tr> <tr> <td>Southern boundary</td><td>6.61 – 7.85</td></tr> <tr> <td>Eastern boundary</td><td>6.61 – 7.81</td></tr> <tr> <td>Western boundary</td><td>7.61 – 1.10</td></tr> </tbody> </table> <p>No watercourses are believed to lie on or in the immediate vicinity of the site.</p> <p>From the inspection of OS maps and the OS Water Network Map, there are watercourses in the vicinity of the site as follows:-</p> <ul style="list-style-type: none"> <li>- drainage ditch approximately 100m to the southeast.</li> <li>- drainage ditch approximately 375m to the southeast.</li> <li>- drainage ditch approximately 400m to the south.</li> <li>- 2 no. drainage ditches approximately 450m to the north.</li> <li>- 2 no. drainage ditches approximately 500m to the south.</li> </ul> <p>The River Aire lies approximately 900m to the north of the site.</p> <p>There is a small pond approximately 375m to the southeast of the site.</p>	Location	Level m (AOD)	Northern boundary	7.81 – 10.45	Southern boundary	6.61 – 7.85	Eastern boundary	6.61 – 7.81	Western boundary	7.61 – 1.10
Location	Level m (AOD)										
Northern boundary	7.81 – 10.45										
Southern boundary	6.61 – 7.85										
Eastern boundary	6.61 – 7.81										
Western boundary	7.61 – 1.10										
<b>Flood Risk Assessment</b>	<p>The site is within Flood Zone 1. This zone comprises land assessed as having less than a 1 in 1000 (&lt;0.1%) annual probability of tidal or river flooding in any one year.</p> <p>The drainage ditches to the south of the site may be a source of localised fluvial flooding that has not been captured on the EA flood map.</p> <p>The development may be at risk from potential overland flood waters from higher ground to the north. However, any such flood waters would flow through the site to the southeast.</p> <p>The effect of groundwater as a flood source is not known to be an issue at this location. BGS Groundwater flooding susceptibility for the site is indicated as 'limited potential for groundwater flooding to occur'.</p> <p>From inspection of the EA Risk of Flooding from Surface Water Maps, it would appear there is a very low risk (less than 1 in 1000 [0.1%]) of surface water flooding affecting the site.</p> <p>However, it should be noted that surface water flooding can be difficult to predict and occurs when rainwater does not drain away through the 'normal' drainage systems or soaks into the ground but lies on or flows over the ground instead.</p> <p>The development may be at risk from overland flood waters from the potential overloading of the public surface water sewers that crosses the eastern sector of the site. However, any such flood waters would flow through the site to the southeast.</p>										
<b>Sequential Test</b>	<p>The Sequential Test should be applied at all stages of planning. Its aim is to steer new development to areas at the lowest probability of flooding.</p> <p>Table 2 of the Technical Guidance to the NPPF (which categorises the flood risk vulnerability of land uses) indicates the proposed development is categorised as a 'more vulnerable' land use.</p> <p>From the EA flood zone map site is identified as being Flood Zone 1.</p> <p>Table 3 of the Technical Guidance to the NPPF indicates where the proposed land use is 'more vulnerable' development is appropriate in Flood Zone 1. Therefore, the Sequential Test has been passed.</p>										
<b>Exception Test</b>	<p>Table 3 of the Technical Guidance to the NPPF indicates where the proposed land use is 'more vulnerable' development is considered appropriate in Flood Zone 1 and the Exception Test is not required.</p> <p>Notwithstanding the above the following sections of this report will demonstrate that the proposed development will be safe from flooding and will not increase flood risk elsewhere.</p>										
<b>Flood Risk Mitigation</b>	<p>The proposed finished floor level on the new build development should be set at least 0.15 and ideally 0.30m above the existing ground level.</p> <p>The external levels around the development should be set to route any potential overland flood waters around the proposed buildings to the south as the existing situation.</p>										
<b>Foul Drainage</b>	A separate foul water system will be provided on the development.										

	It is proposed to discharge foul water from the development to the 150mm foul sewer in Butt Lane to the southeast of the site. The foul sewer in Butt Lane to the southeast of the site is 1.35m deep and it appears a gravity system can be adopted on the development.
<b>Environmental Setting</b>	<p>The site is underlain by a bedrock aquifer designated as a Principle Aquifer which is strata that has a high intergranular and/or fracture permeability and usually provides a high level of water storage that may support water supplies and/or river base flow on a strategic scale. The superficial aquifer is designated as a Secondary Aquifer – A which is strata which contains permeable layers capable of supporting water supplies at a local rather than strategic scale and in some cases forming an important source of base flows to rivers. The overlying soils are classified as having a high leaching potential.</p> <p>There is 1 no. water abstraction license held within 1000m of the site and details are summarised as follows:-</p> <ul style="list-style-type: none"> <li>- surface water abstraction for spray irrigation 766m to the west.</li> </ul> <p>The site is within Zone 111 of a Source Protection Zone.</p> <p>The use of infiltration drainage on the site has not yet been discussed with the EA Groundwater Protection Team but it is envisaged it will be acceptable in principle. However, the scheme will need to include adequate treatment prior to infiltration and this should follow in the guidance given in the CIRIA 697 The SUDS Manual.</p>
<b>Surface Water Drainage</b>	<p>A separate surface water drainage system should be provided on the development. Insitu testing and ground conditions on the site indicate the use of soakaways for the disposal of water from the development is not feasible. Therefore, subject to agreement from Yorkshire Water, it is proposed to discharge surface water from the development to the 225mm diameter surface water that crosses the site. The discharge would be limited to greenfield run-off which is generally accepted as 1.4 l/sec/ha for this area. This would result in a discharge of 2.8 l/sec for the site. However, in order to provide a flow control with an orifice size that would not be prone to blockage a discharge rate of 3.0 l/sec is proposed. The storm water storage would be provided for storms up to a 1:100 year storm return period with a 30% increase in rainfall intensity for climate change. In addition, hardcover areas would also be increased by 10% to cater for urban creep.</p> <p>The following estimation of stormwater storage requirements for the development has been based on the following parameters:-</p> <p>Proposed discharge rate: 3.0 l/sec</p> <p>Proposed Hardcover area: 9180 m<sup>2</sup></p> <p>(Including 10% increase for urban creep)</p> <p>Stormwater storage requirements: 651.1 m<sup>3</sup></p> <p>(Based on a 1:100 year storm return period and a 30% increase in rainfall intensity for climate change).</p>

## 6.0 CAVEATS

- 6.01 The comments given in this report and recommendations made are based on the information that could be obtained from reasonably accessible sources. Detailed discussions have not yet been held with statutory bodies and the local authority.
- 6.02 This report has been prepared for the sole use of Midlands Construction Services Ltd and their development funders, unless agreed otherwise in writing by CoDA Structures.

Signed:



J Lawrence B Eng C Eng M I Struct E



## **APPENDIX A**

### **PROPOSED DEVELOPMENT PLAN - FIG. 1**

## **APPENDIX B**

### **SITE LOCATION PLAN - FIG. 1**



# CoDa+ Structures

Consulting Civil & Structural Engineers  
No 2 Harewood Yard  
Harewood  
Leeds LS17 9LP  
Tel: 0113 288 6766  
Fax: 0113 288 6765

Project Butt Lane Snaith

Title Site Location Plan

Drawn JL

Date 10.18

Drg. No.

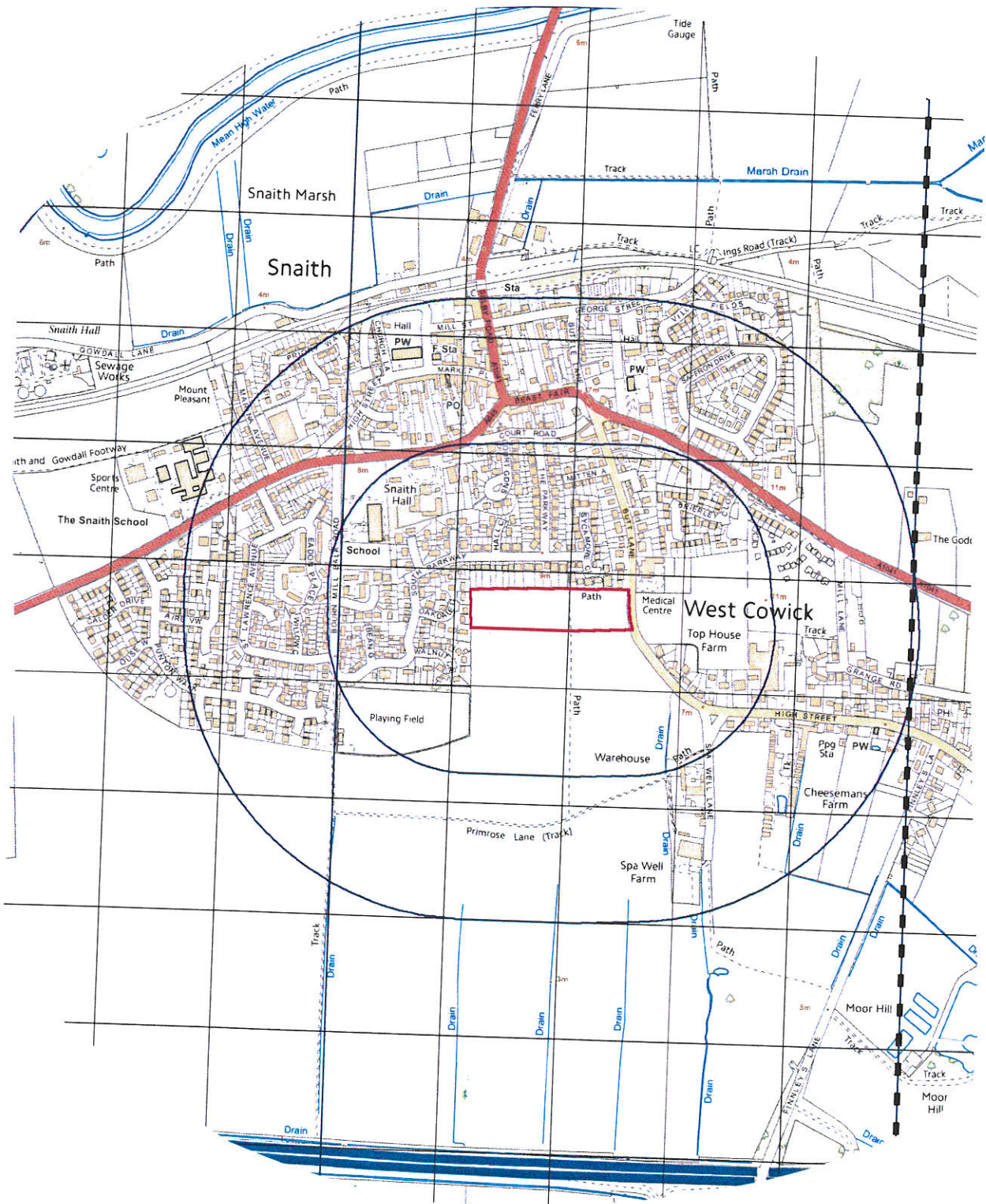
Rev.

Scale 1:10000

Checked JL

7549/Fig1

-



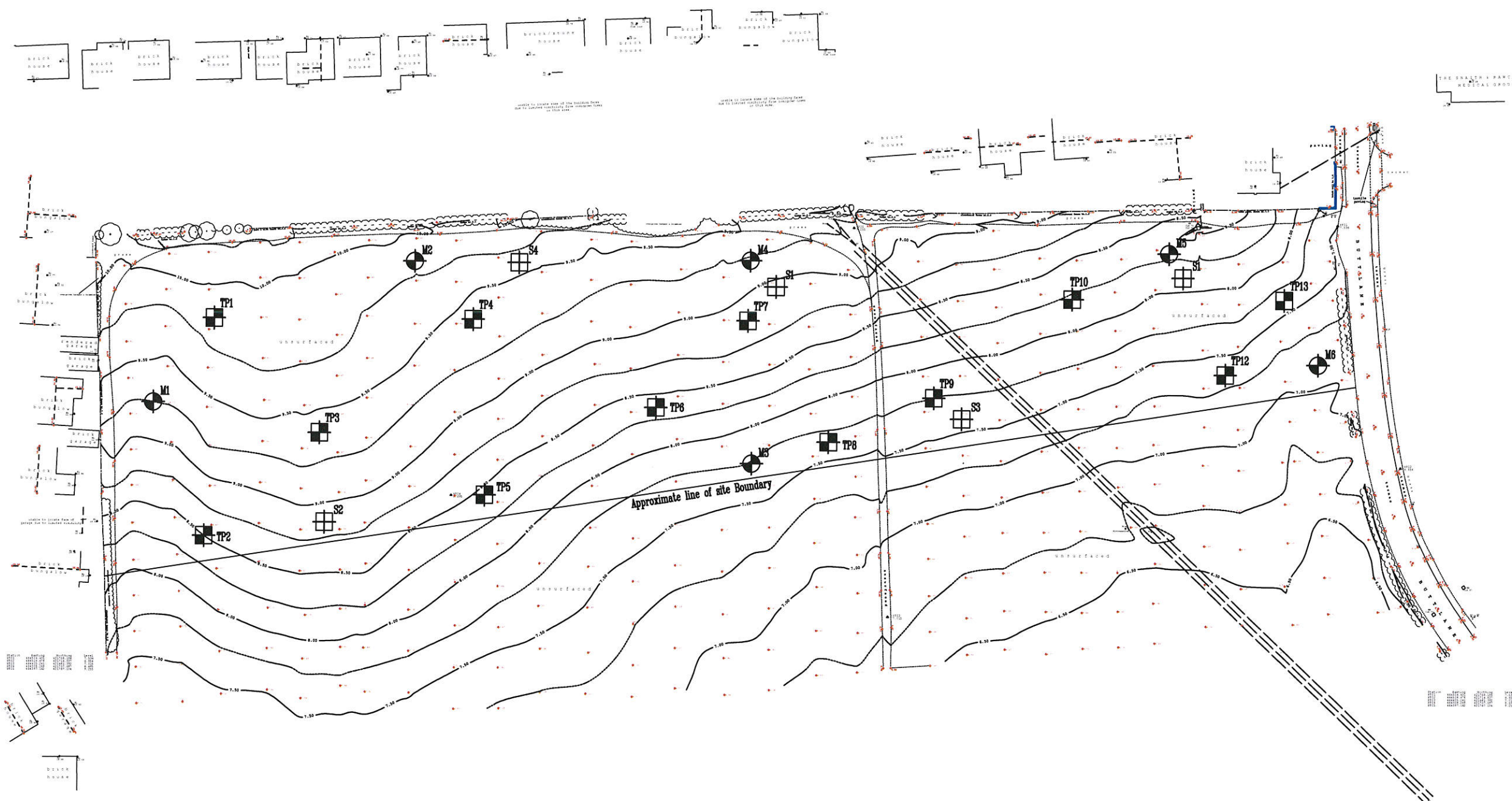
## **APPENDIX C**

### **SITE TOPOGRAPHICAL SURVEY - FIG. 2**



# Notes

- M1-M6  
Denotes window sampling borehole sunk on 27.11.19
- GM Denotes gas/ground water monitoring well
- S1-S4  
Denotes falling head permeability test locations undertaken on 27.04.19
- TP1-TP12  
Denotes trial pit excavated on 20.11.18



Rev.	A	SI locations added	23.04.19
		Content	Date

Client	Midland Construction Ltd				
Project	Butt Lane, Snaith				
Title	Site Topographical Survey				
Drawn	Date	Dwg. No.	Rev.		
RD	19.09.18	7849/Fig2	A		
Scale	Checked				
1:500:100@A1	JL				

**CoDa+ Structures**  
 Consulting Civil & Structural Engineers  
 14 Springfield Court  
 Guiseley  
 Leeds LS20 8PD  
 Tel: 01943 872567  
 Fax: 01943 870824

## **APPENDIX D**

### **SITE AERIAL PHOTOGRAPH**



untitled Map

Write a description for your map.

Leger

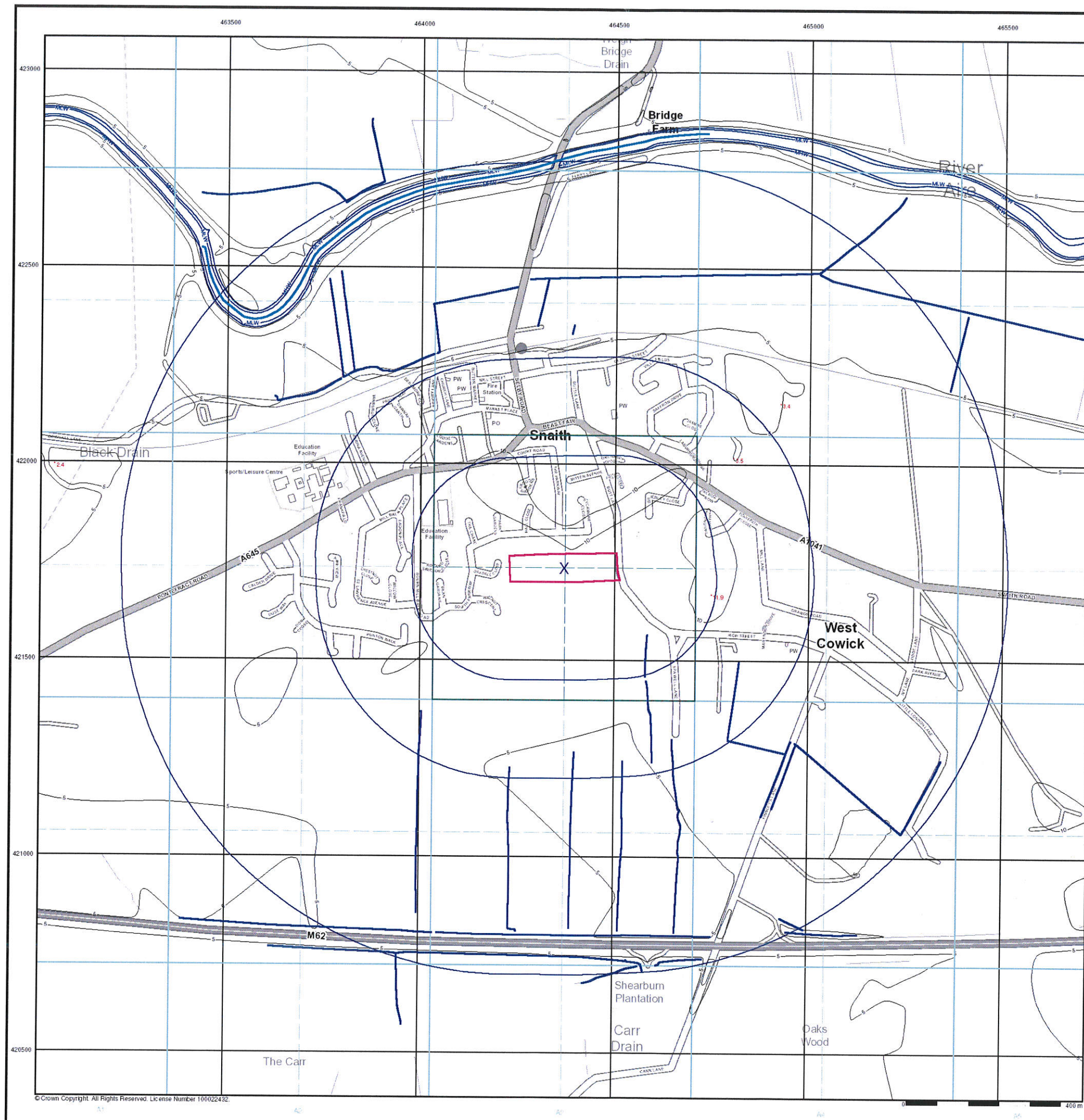




## **APPENDIX E**

### **OS WATER NETWORK MAP**





# Envirocheck®

LANDMARK INFORMATION GROUP®

## General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

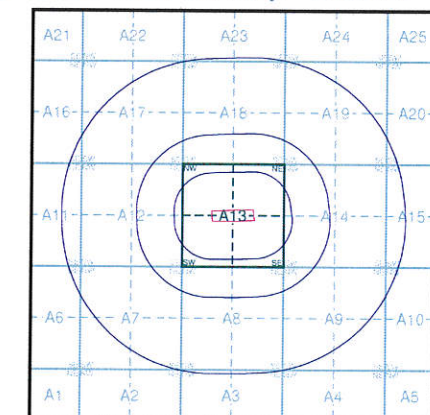
## OS Water Network Data

- |              |                         |
|--------------|-------------------------|
| Canal        | Drain                   |
| Reservoir    | Other                   |
| Foreshore    | Lake                    |
| Marsh        | Transfer                |
| Tidal River  | Lock Or Flight Of Locks |
| Inland River | Sea                     |

## Contours (height in meters)

- Standard Contour 105 100 95
- Master Contour
- Spot Height 167.3
- MLW Mean Low Water
- MHW Mean High Water

## OS Water Network Map - Slice A



## Order Details

Order Number: 178145577\_1\_1  
 Customer Ref: 7849  
 National Grid Reference: 464370, 421730  
 Slice: A  
 Site Area (Ha): 1.96  
 Search Buffer (m): 1000

## Site Details

10, Butt Lane, Snaith, GOOLE, DN14 9DP

**Landmark**  
 INFORMATION GROUP

Tel: 0844 844 9952  
 Fax: 0844 844 9951  
 Web: www.envirocheck.co.uk

## **APPENDIX F**

### **ENVIRONMENT AGENCY FLOOD MAP**



# Flood map for planning

Your reference  
**Snaith**

Location (easting/northing)  
**464327/421759**

Created  
**8 Aug 2018 12:18**

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

## **This means:**

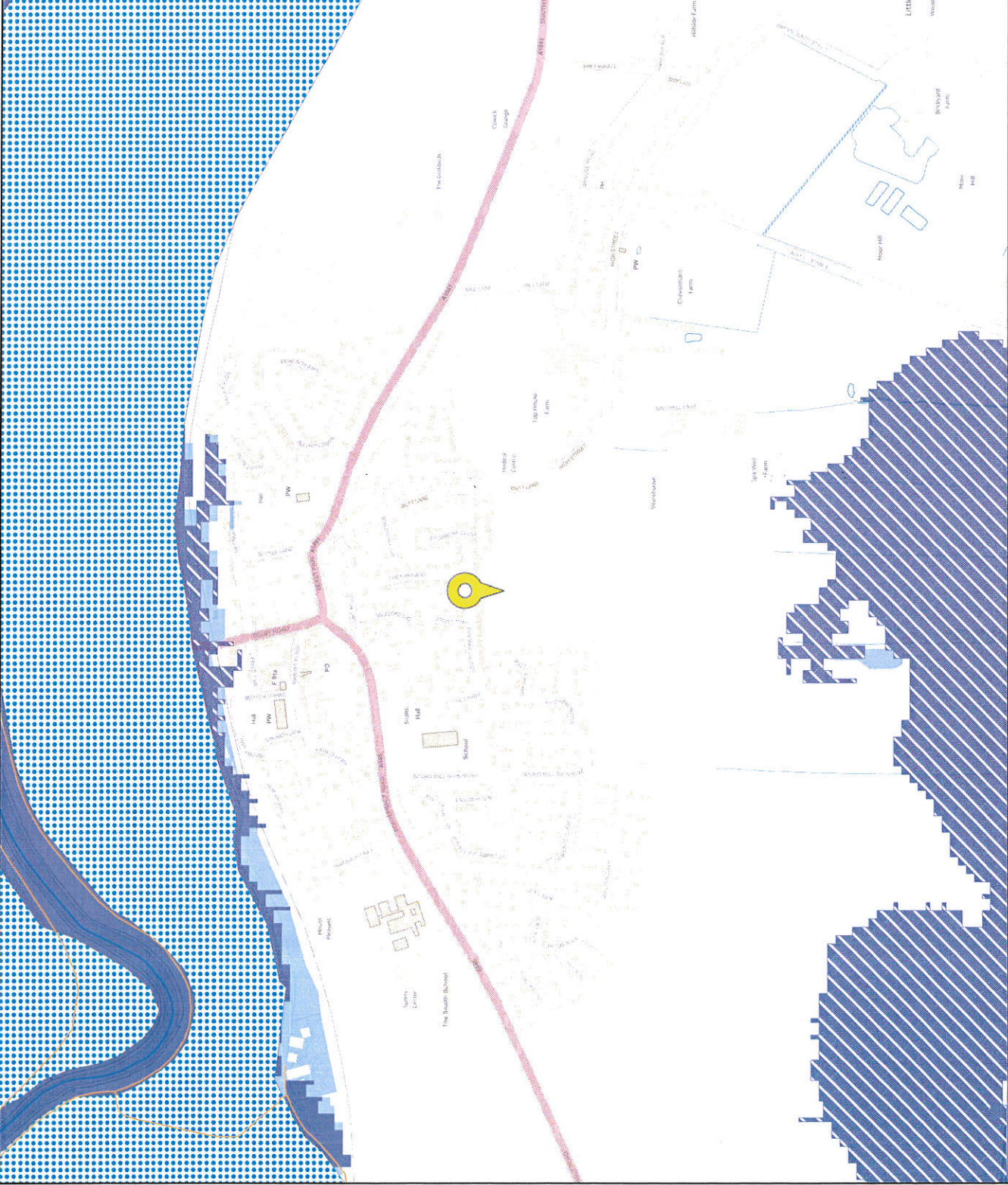
- you don't need to do a flood risk assessment if your development is smaller than 1 hectare and not affected by other sources of flooding
- you may need to do a flood risk assessment if your development is larger than 1 hectare or affected by other sources of flooding or in an area with critical drainage problems

## **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.

The Open Government Licence sets out the terms and conditions for using government data.  
<https://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/>



**Your reference**  
**Snaith**

Scale  
1:10000

 Selected point

 Flood zone 3: areas benefitting from flood defences

Flood zone 1

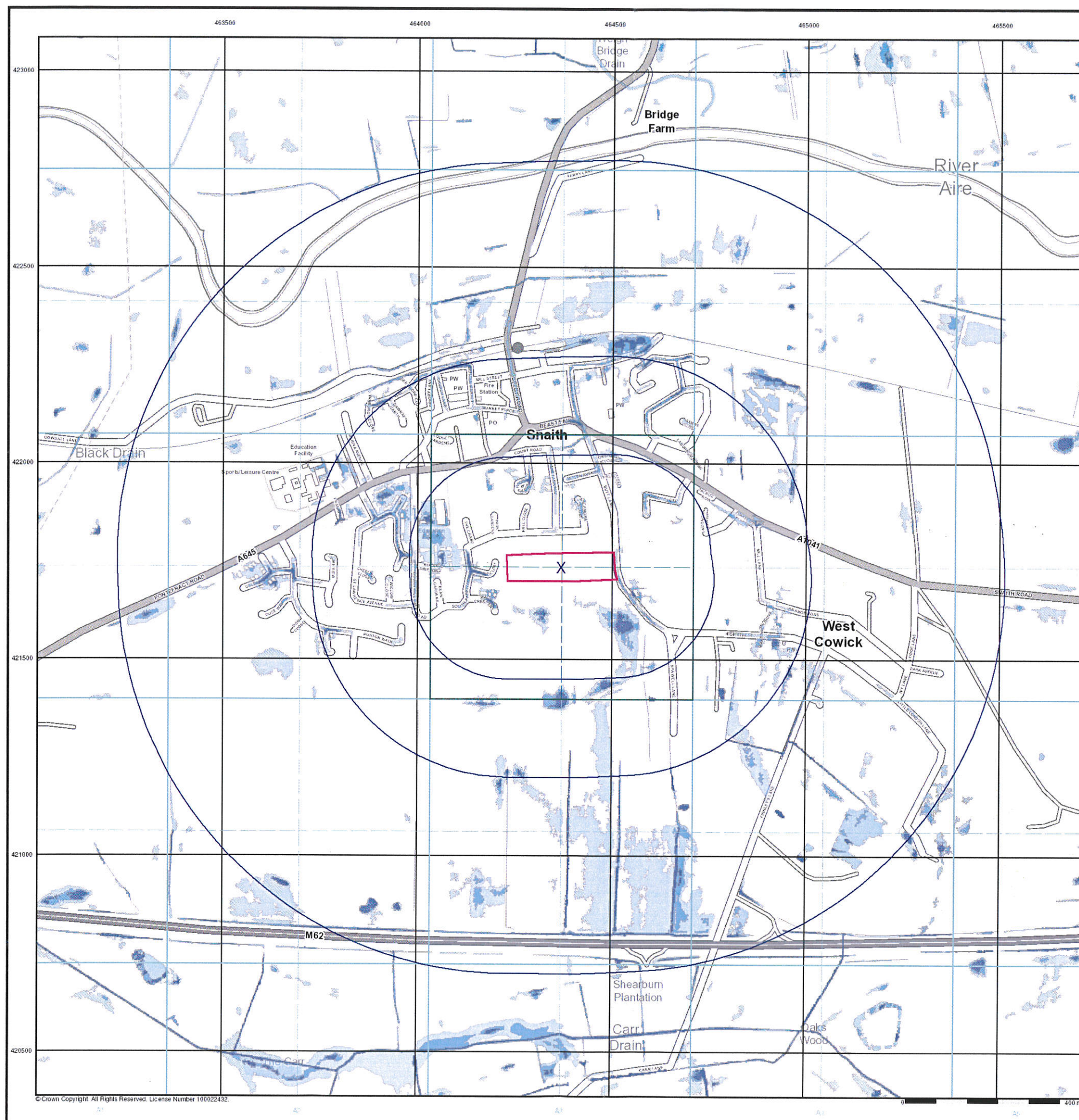
— Main river

Page 2 of 2

## **APPENDIX G**

### **ENVIRONMENT AGENCY RISK OF FLOODING FROM SURFACE WATER MAP**





## General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

## Risk of Flooding from Surface Water

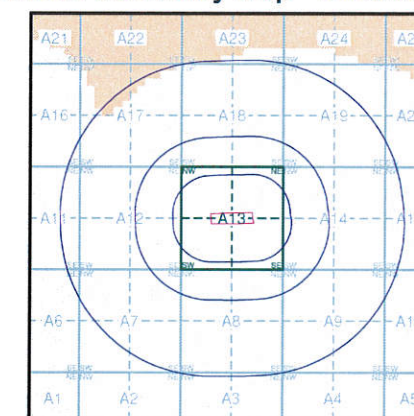
- High - 30 Year Return
- Medium - 100 Year Return
- Low - 1000 Year Return

## Suitability

See the suitability map below

- National to county
- County to town
- Town to street
- Street to parcels of land
- Property

## EA/NRW Suitability Map - Slice A



## Order Details

Order Number: 178145577\_1\_1  
 Customer Ref: 7849  
 National Grid Reference: 464370, 421730  
 Slice: A  
 Site Area (Ha): 1.96  
 Search Buffer (m): 1000

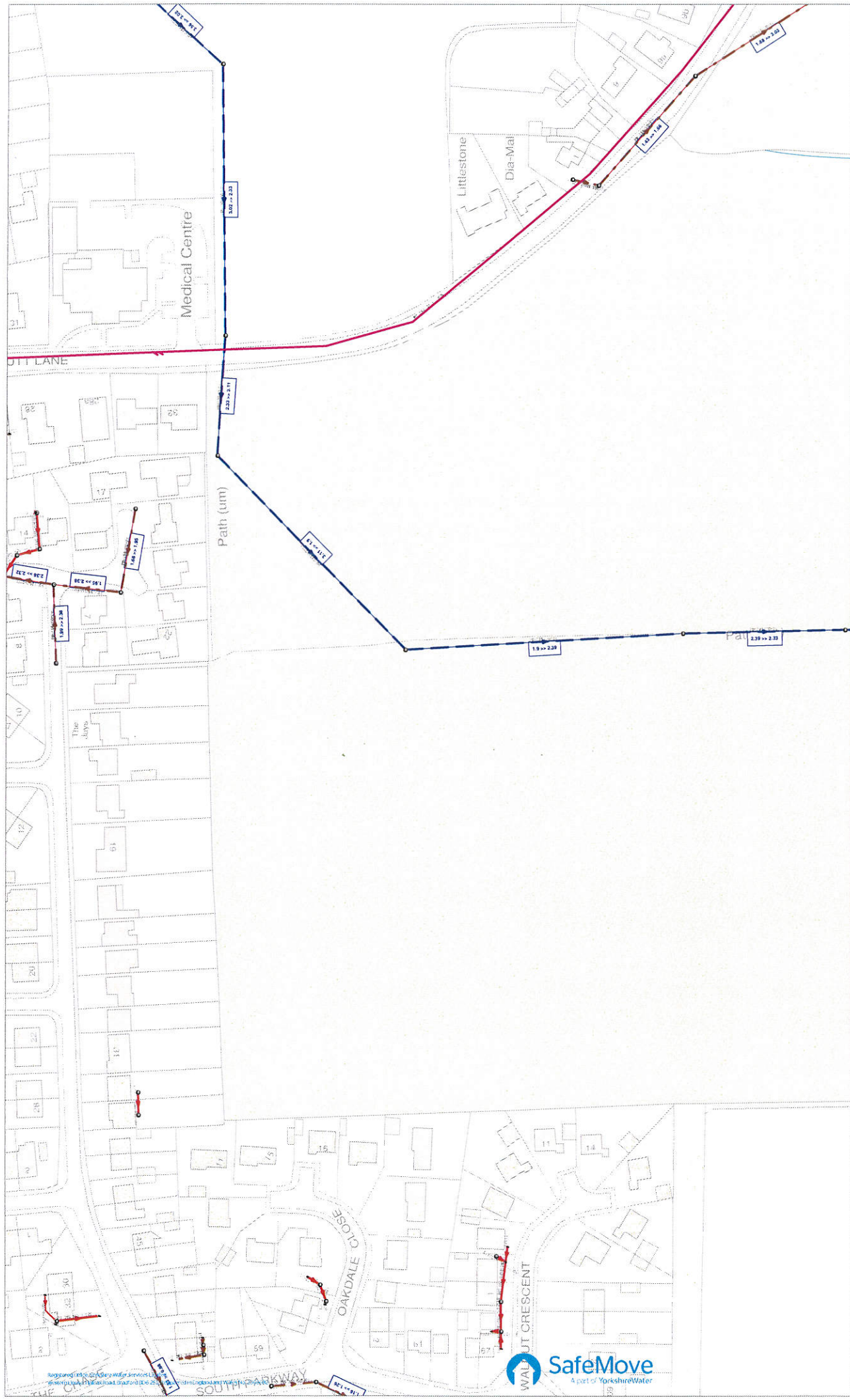
## Site Details


10, Butt Lane, Snaith, GOOLE, DN14 9DP



## **APPENDIX H**

### **EXTRACT FROM THE PUBLIC SEWER RECORD**



464169 : 421557		Map Name : SE6421NW Yorkshire Water, PO Box 500, Hallifax Road, Bradford BD6 3LZ Contact Name : A Hargreaves Contact Tel :	 <b>YorkshireWater</b>	Title Notes	Partial Key Foul Sewer = F Confined Sewer = C Surface Water Sewer = SW Trade Sewer = TC Partially Separated = PS	This plan is furnished as a general guide only and the user must not be held responsible for its use in connection with any project. The user must not be held responsible for its use in connection with any project. The user must not be held responsible for its use in connection with any project.

## **APPENDIX I**

### **TRIAL PIT LOGS**



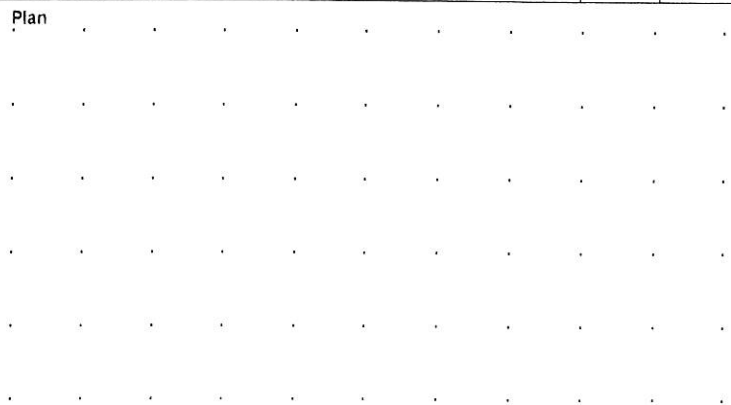
						<b>Site</b> BUTT LANE, SNAITH, GOOLE, EAST RIDING OF YORKSHIRE		<b>Trial Pit Number</b> <b>TP01</b>	
<b>Excavation Method</b> MECHANICAL EXCAVATOR		<b>Dimensions</b> 2.80m x 0.60m		<b>Ground Level (mOD)</b>		<b>Client</b> CODA STRUCTURES		<b>Job Number</b> NE3751	
		<b>Location</b> AS PLAN				<b>Dates</b> 20/09/2018		<b>Engineer</b>	
<b>Depth (m)</b>	<b>Sample / Tests</b>	<b>Water Depth (m)</b>	<b>Field Records</b>	<b>Level (mOD)</b>	<b>Depth (m) (Thickness)</b>	<b>Description</b>		<b>Legend</b>	<b>Water</b>
0.20	D				(0.35)	TOPSOIL			
0.40	D				0.35	Brown medium to coarse SAND and rounded GRAVEL.			
					(0.75)				
1.00	D				1.10	Brown gravelly slightly silty slightly clayey SAND/very sandy CLAY.			
1.30	D				(0.50)				
					1.60	Soft low strength brown silty CLAY with lenses of sand.			
					1.80	Brown silty CLAY and sand bands.			
2.00	D				(0.50)				
					2.30	Brown coarse SAND.			
2.70	D				(1.10)				Σ1
									Σ2
3.50	D				3.40	Firm brown slightly sandy silty CLAY.			
					(0.30)				
					3.70	Complete at 3.70m			
<b>Plan</b> .						<b>Remarks</b> Major collapse of pit sides from 2.30m to 3.40m Pit orientated East to West HV = Hand Shear Vane test On completion backfilled with arisings.			
						<b>Scale (approx)</b> 1:25		<b>Logged By</b> DS/SJ	



						<b>Site</b> BUTT LANE, SNAITH, GOOLE, EAST RIDING OF YORKSHIRE		<b>Trial Pit Number</b> TP02	
<b>Excavation Method</b> MECHANICAL EXCAVATOR		<b>Dimensions</b> 2.80m x 0.60m		<b>Ground Level (mOD)</b>		<b>Client</b> CODA STRUCTURES		<b>Job Number</b> NE3751	
		<b>Location</b> AS PLAN		<b>Dates</b> 20/09/2018		<b>Engineer</b>		<b>Sheet</b> 1/1	
<b>Depth (m)</b>	<b>Sample / Tests</b>	<b>Water Depth (m)</b>	<b>Field Records</b>	<b>Level (mOD)</b>	<b>Depth (m) (Thickness)</b>	<b>Description</b>		<b>Legend</b>	<b>Water</b>
0.20	D				(0.30)	TOPSOIL			
					0.30	Brown medium to coarse SAND and rounded GRAVEL.			
0.60	D				(0.60)				
					0.90	Very stiff desiccated brown gravelly silty CLAY.			
1.20	D				(0.50)				
					1.40	Brown slightly gravelly medium SAND with lenses of clay.			
1.60	D				(1.20)				
					2.60	Brown coarse SAND and rounded GRAVEL.			
2.70	D				(0.90)				
					3.50	Complete at 3.50m			
3.45	D		Wet(1) at 3.40m. 20/09/2018:						
<b>Plan</b>						<b>Remarks</b> Continual collapse of pit sides below 3.40m Pit orientated Northeast to South West On completion backfilled with arisings.			
						<b>Scale (approx)</b> 1:25		<b>Logged By</b> DS/SJ	
						<b>Figure No.</b> NE3751.TP02			

						<b>Site</b> BUTT LANE, SNAITH, GOOLE, EAST RIDING OF YORKSHIRE		<b>Trial Pit Number</b> TP03	
<b>Excavation Method</b> MECHANICAL EXCAVATOR		<b>Dimensions</b> 3.30m x 0.60m		<b>Ground Level (mOD)</b>		<b>Client</b> CODA STRUCTURES		<b>Job Number</b> NE3751	
		<b>Location</b> AS PLAN		<b>Dates</b> 20/09/2018		<b>Engineer</b>		<b>Sheet</b> 1/1	
<b>Depth (m)</b>	<b>Sample / Tests</b>	<b>Water Depth (m)</b>	<b>Field Records</b>	<b>Level (mOD)</b>	<b>Depth (m) (Thickness)</b>	<b>Description</b>	<b>Legend</b>	<b>Water</b>	
0.50	D				(0.30)	TOPSOIL			
					0.30	Brown medium to coarse SAND and GRAVEL.			
1.00	D				(0.50)				
					0.80	Very stiff desiccated brown and light brown mottled silty CLAY.			
1.40	D		HV@1.40m, c=12kPa		(0.50)				
					1.30	Very soft very low strength brown clayey SILT.			
1.90	D		Damp(1) at 1.80m.		(0.90)				
					1.80	Brown silty fine SAND.			
2.60	D				(0.90)				
					2.70	Soft low strength brown silty CLAY with low cobble content.			
2.90	D				(0.80)				
					3.50	Brown medium to coarse SAND and rounded GRAVEL.			
3.90	D		HV@3.50m, c=36kPa Damp(2) at 3.50m.		(0.50)				
					4.00				
<b>Plan</b>						<b>Remarks</b>  Slight collapse of pit sides from 1.80m to 2.70m and below 3.50m Pit orientated Northeast to Southwest HV = Hand Shear Vane test On completion backfilled with arisings.			
						<b>Scale (approx)</b>		<b>Logged By</b>	
						1:25		DS/SJ	
								<b>Figure No.</b>	
								NE3751.TP03	

						Site BUTT LANE, SNAITH, GOOLE, EAST RIDING OF YORKSHIRE		Trial Pit Number TP04	
Excavation Method MECHANICAL EXCAVATOR		Dimensions 3.40m x 0.60m		Ground Level (mOD)		Client CODA STRUCTURES		Job Number NE3751	
		Location AS PLAN		Dates 20/09/2018		Engineer		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	
0.10	D				(0.30)	TOPSOIL			
					0.30	Very stiff desiccated brown silty CLAY.			
0.60	D				(0.80)				
					1.10	Soft low strength grey and brown mottled silty CLAY with lenses of sand.			
1.30	D		HV@1.20m, c=34kPa		(0.50)				
					1.60	Brown and dark grey banded silty SAND.			
1.75	D		Damp(1) at 1.60m.						
					(1.40)				
2.40	D								
					3.00	Soft low strength brown silty CLAY.			
3.30	D		HV@3.20m, c=36kPa		(0.70)				
					3.70	Brown gravelly coarse SAND.			
3.90	D		20/09/2018		(0.30)				
					4.00				
Plan						Remarks			
						Slight collapse of pit sides below 3.70m Pit orientated East to West HV = Hand Shear Vane test On completion backfilled with arisings.			
						Scale (approx)	Logged By	Figure No.	
						1.25	DS/SJ	NE3751.TP04	

						<b>Site</b> BUTT LANE, SNAITH, GOOLE, EAST RIDING OF YORKSHIRE		<b>Trial Pit Number</b> <b>TP05</b>	
<b>Excavation Method</b> MECHANICAL EXCAVATOR		<b>Dimensions</b> 3.20m x 0.60m		<b>Ground Level (mOD)</b>		<b>Client</b> CODA STRUCTURES		<b>Job Number</b> NE3751	
		<b>Location</b> AS PLAN		<b>Dates</b> 20/09/2018		<b>Engineer</b>		<b>Sheet</b> 1/1	
<b>Depth (m)</b>	<b>Sample / Tests</b>	<b>Water Depth (m)</b>	<b>Field Records</b>	<b>Level (mOD)</b>	<b>Depth (m) (Thickness)</b>	<b>Description</b>		<b>Legend</b>	<b>Water</b>
0.20	D				(0.35)	TOPSOIL			
0.50	D				0.35	Brown slightly silty slightly clayey SAND.			
					(1.05)				
1.20	D				1.40	Firm grey and brown mottled silty CLAY with lenses of sand.			
1.60	D				(0.60)				
2.20	D				2.00	Brown gravelly coarse SAND. Gravel is rounded.			
					(1.50)				
3.10	D		Damp(1) at 3.00m.		3.50	Complete at 3.50m			
			20/09/2018:						
<b>Plan</b> 					<b>Remarks</b> Slight collapse of pit sides below 2.90m Pit orientated Northeast to Southwest On completion backfilled with arisings.				
					<b>Scale (approx)</b> 1:25		<b>Logged By</b> DS/SJ		<b>Figure No.</b> NE3751.TP05



						Site BUTT LANE, SNAITH, GOOLE, EAST RIDING OF YORKSHIRE		Trial Pit Number <b>TP06</b>	
Excavation Method MECHANICAL EXCAVATOR		Dimensions 3.20m x 0.60m		Ground Level (mOD)		Client CODA STRUCTURES		Job Number NE3751	
		Location AS PLAN		Dates 20/09/2018		Engineer		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	
0.10	D				(0.38)	TOPSOIL			
					0.38	Stiff desiccated brown slightly gravelly sandy silty CLAY.			
0.60	D				(1.12)				
1.10	D				1.50	Very soft very low strength laminated grey and and brown mottled silty CLAY.			
1.60	D		HV@1.60m, c=18kPa		(0.30)	Very stiff high strength brown silty CLAY.			
1.90	D		HV@1.90m, c=100kPa		(0.30)				
2.40	D				2.10	Brown coarse SAND and rounded GRAVEL.			
					(1.50)				
3.50	D		Damp(1) at 3.40m.		3.60	Complete at 3.60m			
			20/09/2018						
Plan						Remarks Slight collapse of pit sides below 2.10m Pit orientated Northeast to South West HV = Hand Shear Vane test On completion backfilled with arisings.			
						Scale (approx) 1:25		Logged By DS/SJ	







						Site BUTT LANE, SNAITH, GOOLE EAST RIDING OF YORKSHIRE		Trial Pit Number <b>TP07</b>			
Excavation Method MECHANICAL EXCAVATOR		Dimensions 2.80m x 0.60m		Ground Level (mOD)		Client CODA STRUCTURES		Job Number NE3751			
		Location AS PLAN		Dates 20/09/2018		Engineer		Sheet 1/1			
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water			
0.20	D				(0.35)	TOPSOIL					
					0.35	Very stiff desiccated light brown silty CLAY.					
0.55	D				(0.35)						
					0.70	Very stiff desiccated brown silty CLAY.					
1.10	D				(0.70)						
1.50	D				1.40	Very soft very low strength becoming soft low strength laminated brown silty CLAY with bands of sand.					
					(1.40)	.... from 2.20m : soft low strength		Σ1			
2.40	D		HV@2.10m, c=10kPa HV@2.20m, c=30kPa		2.80	Brown coarse SAND and rounded GRAVEL.					
3.20	D		Damp(1) at 3.20m.		(1.00)						
			20/09/2018		3.80	Complete at 3.80m					
Plan						Remarks Slight collapse of pit sides below 3.10m Pit orientated East to West HV = Hand Shear Vane test On completion backfilled with arisings.					
						Scale (approx) 1:25		Logged By DS/SJ		Figure No. NE3751.TP07	

						<b>Site</b> BUTT LANE, SNAITH, GOOLE, EAST RIDING OF YORKSHIRE		<b>Trial Pit Number</b> TP08	
<b>Excavation Method</b> MECHANICAL EXCAVATOR		<b>Dimensions</b> 2.80m x 0.60m		<b>Ground Level (mOD)</b>		<b>Client</b> CODA STRUCTURES		<b>Job Number</b> NE3751	
		<b>Location</b> AS PLAN		<b>Dates</b> 20/09/2018		<b>Engineer</b>		<b>Sheet</b> 1/1	
<b>Depth (m)</b>	<b>Sample / Tests</b>	<b>Water Depth (m)</b>	<b>Field Records</b>	<b>Level (mOD)</b>	<b>Depth (m) (Thickness)</b>	<b>Description</b>		<b>Legend</b>	<b>Water</b>
0.20	D				(0.30)	TOPSOIL			
					0.30	Brown slightly silty slightly clayey SAND/very sandy CLAY.			
0.60	D				(0.80)				
					1.10	Stiff desiccated grey and brown mottled silty CLAY with occasional thin lenses of sand.			
1.20	D				(0.40)				
					1.50	Brown medium to coarse SAND and rounded GRAVEL with low cobble content and occasional lenses of clay.			
1.70	D				(1.50)				
					3.00	Orangeish brown medium to coarse SAND.			
2.40	D				(0.70)				
					3.70	Complete at 3.70m			
3.60	D		20/09/2018: DRY						
<b>Plan</b>					<b>Remarks</b> Slight collapse of pit sides below 1.80m Pit orientated North to South On completion backfilled with arisings.				
					<b>Scale (approx)</b> 1:25				
					<b>Logged By</b> DS/SJ		<b>Figure No.</b> NE3751.TP08		

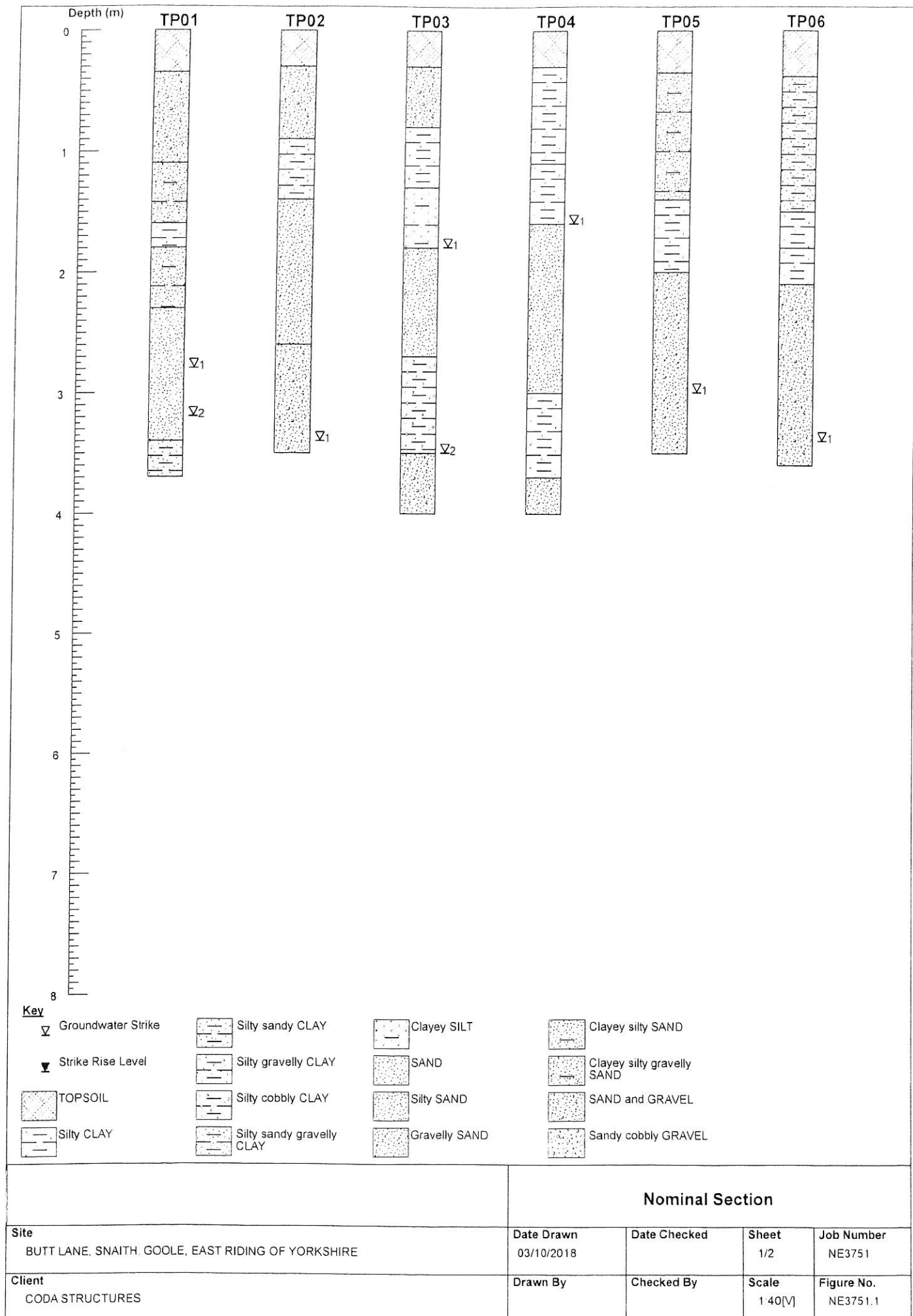




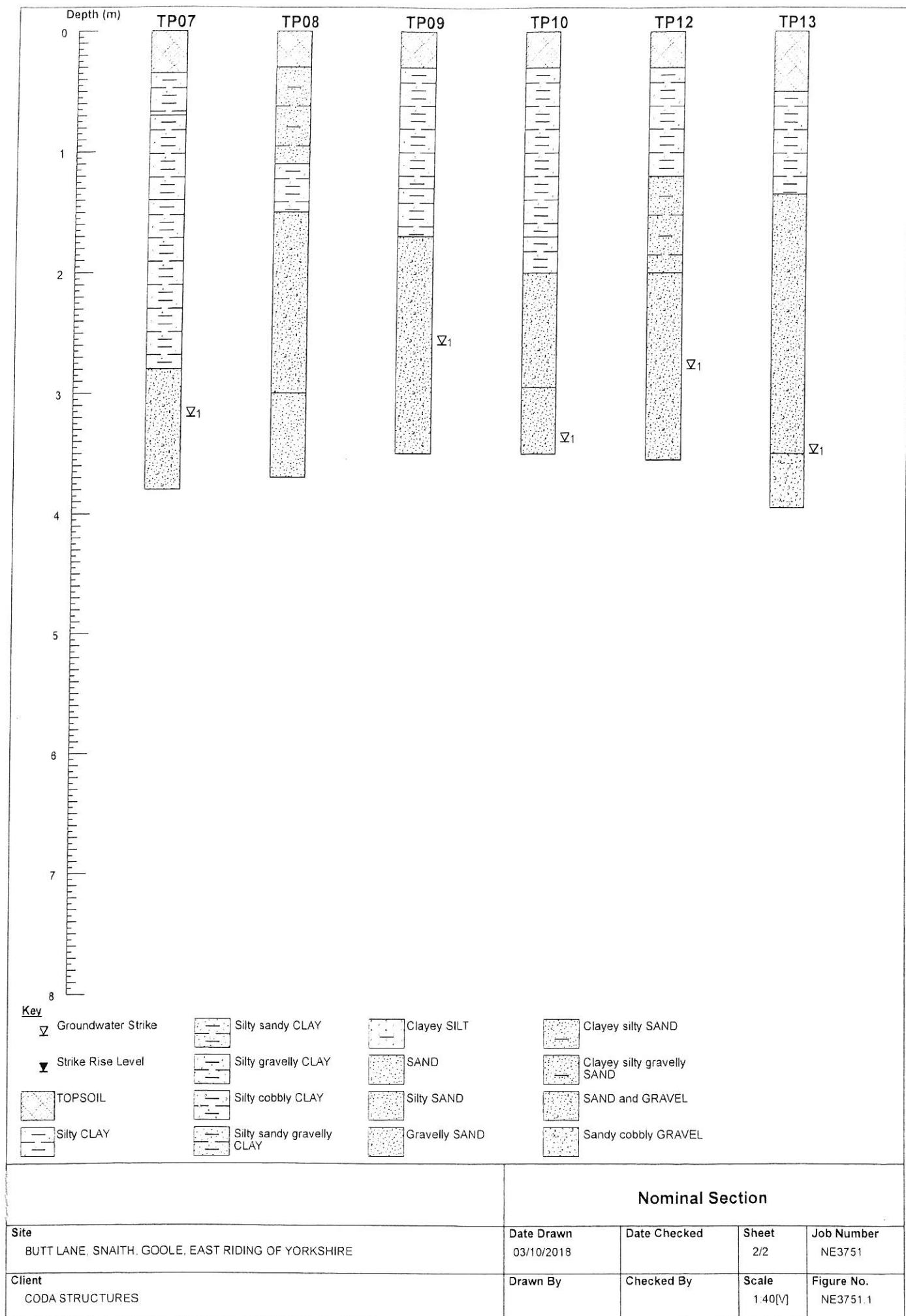
						Site BUTT LANE, SNAITH, GOOLE, EAST RIDING OF YORKSHIRE		Trial Pit Number <b>TP10</b>	
Excavation Method MECHANICAL EXCAVATOR		Dimensions 2.90m x 0.60m		Ground Level (mOD)		Client CODA STRUCTURES		Job Number NE3751	
		Location AS PLAN		Dates 20/09/2018		Engineer		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	
0.10	D				(0.30)	TOPSOIL			
					0.30	Very stiff initially desiccated brown and light brown mottled silty CLAY.			
0.50	D								
					(1.40)				
1.10	D								
					1.70	Soft becoming firm low strength laminated brown silty CLAY with lenses of sand.			
1.80	D		HV@1.70m, c=32kPa HV@1.90m, c=44kPa		(0.30)				
					2.00	Brown medium to coarse SAND and rounded medium GRAVEL.			
2.30	D				(0.95)				
					2.95	Brown slightly gravelly SAND.			
3.10	D				(0.55)				
			Damp(1) at 3.40m. 20/09/2018:		3.50	Complete at 3.50m			
Plan						Remarks  Slight collapse of pit sides. Pit orientated East to West HV = Hand Shear Vane test On completion backfilled with arisings.			
						Scale (approx) 1:25	Logged By DS/SJ	Figure No. NE3751.TP10	


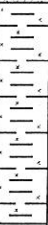
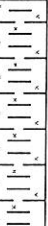

						Site BUTT LANE, SNAITH, GOOLE, EAST RIDING OF YORKSHIRE		Trial Pit Number <b>TP12</b>	
Excavation Method MECHANICAL EXCAVATOR		Dimensions 2.90m x 0.60m		Ground Level (mOD)		Client CODA STRUCTURES		Job Number NE3751	
		Location AS PLAN		Dates 20/09/2018		Engineer		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	
0.20	D				(0.30)	TOPSOIL			
					0.30	Desiccated brown silty CLAY.			
0.80	D				(0.90)				
1.30	D				1.20	Brown gravelly slightly silty slightly clayey SAND.			
					(0.80)				
2.10	D				2.00	Brown coarse SAND and rounded fine to medium GRAVEL.			
2.80	D		Damp(1) at 2.80m.		(1.55)			Σ1	
3.50	D		20/09/2018:		3.55	Complete at 3.55m			
Plan						Remarks  Slight collapse of pit sides. Pit orientated North to South On completion backfilled with arisings.			
						Scale (approx) 1:25		Logged By DS/SJ	





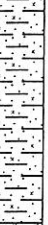


						Site BUTT LANE, SNAITH, GOOLE, EAST RIDING OF YORKSHIRE		Trial Pit Number TP13			
Excavation Method MECHANICAL EXCAVATOR		Dimensions 3.20m x 0.60m		Ground Level (mOD)		Client CODA STRUCTURES		Job Number NE3751			
		Location AS PLAN		Dates 20/09/2018		Engineer		Sheet 1/1			
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water			
0.20	D				(0.50)	TOPSOIL					
0.60	D		HV@0.60m, c=130kPa		0.50	Very stiff high strength desiccated brown silty CLAY.					
1.10	D		HV@1.00m, c=110kPa		(0.85)						
1.50	D				1.35	Brown gravelly SAND becoming brown coarse SAND and rounded medium GRAVEL with depth.					
2.10	D				(2.15)						
3.10	D				3.50	Brown sandy GRAVEL with low cobble content.					
			Damp(1) at 3.50m.		(0.45)						
3.90	D		20/09/2018:		3.95						
Plan						Remarks Slight collapse of pit sides. Pit orientated East to West HV = Hand Shear Vane test On completion backfilled with arisings.					
										Scale (approx)	
						1:25		DS/SJ		NE3751.TP13	



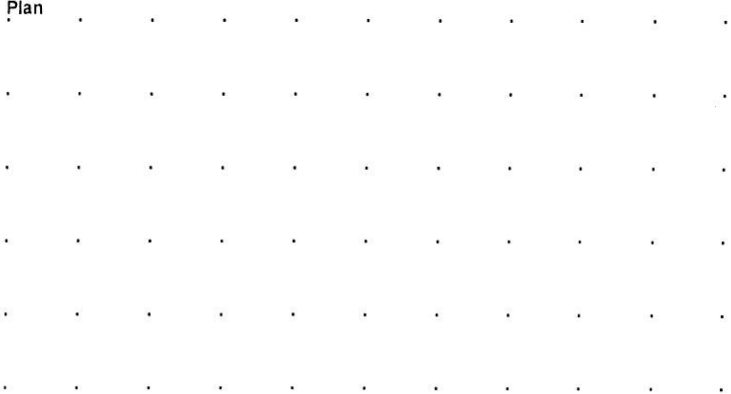






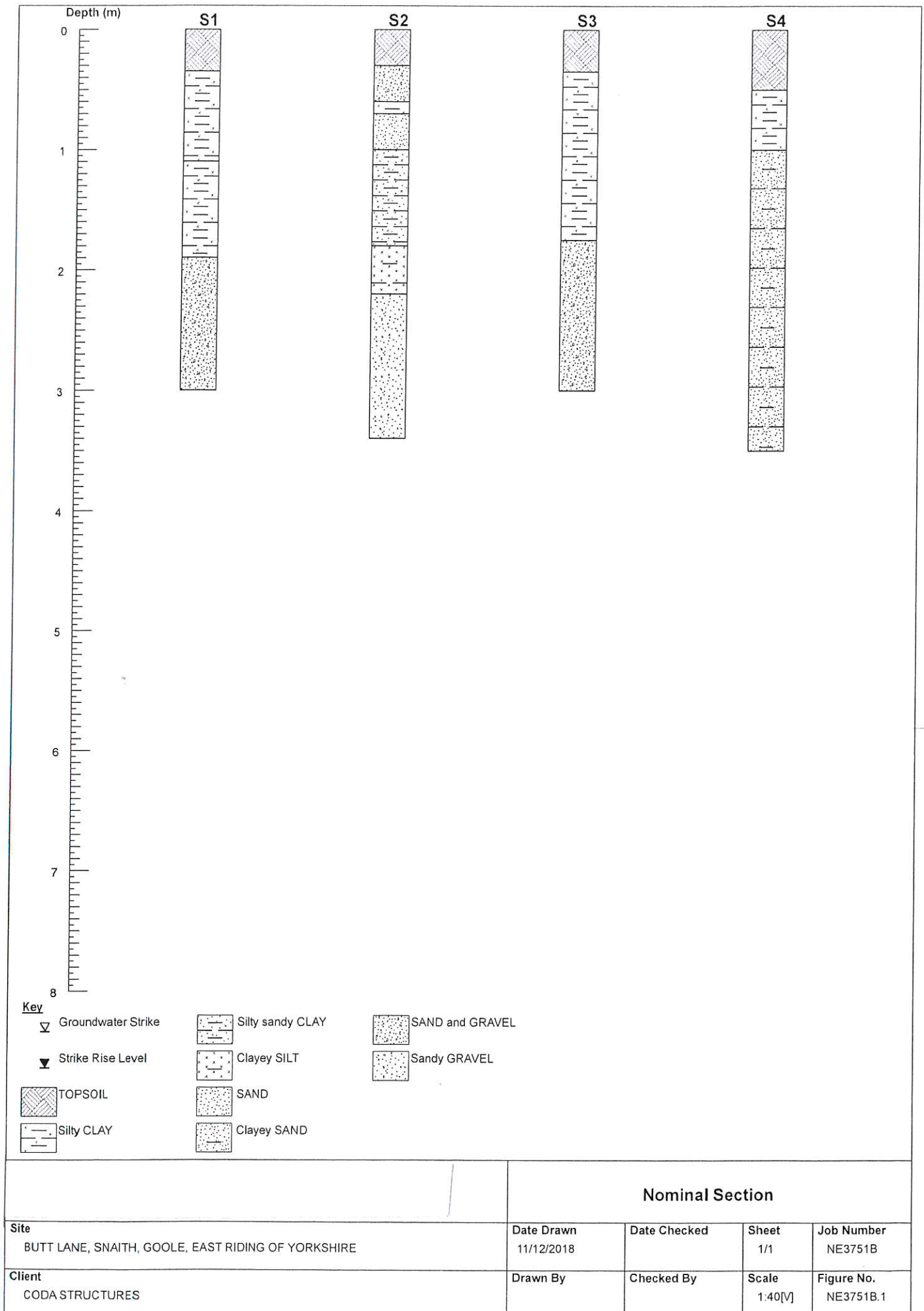
						<b>Site</b> BUTT LANE, SNAITH, GOOLE, EAST RIDING OF YORKSHIRE		<b>Trial Pit Number</b> <b>S1</b>	
<b>Excavation Method</b> MECHANICAL EXCAVATOR		<b>Dimensions</b> 1.60m x 0.60m		<b>Ground Level (mOD)</b>		<b>Client</b> CODA STRUCTURES		<b>Job Number</b> NE3751B	
		<b>Location</b> AS PLAN		<b>Dates</b> 27/11/2018		<b>Engineer</b>		<b>Sheet</b> 1/1	
<b>Depth (m)</b>	<b>Sample / Tests</b>	<b>Water Depth (m)</b>	<b>Field Records</b>	<b>Level (mOD)</b>	<b>Depth (m) (Thickness)</b>	<b>Description</b>	<b>Legend</b>	<b>Water</b>	
					(0.35) 0.35 (0.75) 1.10 (0.80) 1.90 (1.10) 3.00	TOPSOIL  Brown silty CLAY.  Brown and grey silty CLAY.  Brown medium SAND and rounded GRAVEL and occasional cobbles.  Complete at 3.00m	   		
			27/11/2018:						
<b>Plan</b>						<b>Remarks</b> Pit sides remained vertical and stable. No groundwater encountered. On completion backfilled with gravel for a soakaway test.			
						<b>Scale (approx)</b> 1:25		<b>Logged By</b> DS/SJ	
						<b>Figure No.</b> NE3751B.S1			

					<b>Site</b> BUTT LANE, SNAITH, GOOLE, EAST RIDING OF YORKSHIRE		<b>Trial Pit Number</b> <b>S2</b>	
<b>Excavation Method</b> MECHANICAL EXCAVATOR		<b>Dimensions</b> 1.50m x 0.60m		<b>Ground Level (mOD)</b>		<b>Client</b> CODA STRUCTURES		<b>Job Number</b> NE3751B
		<b>Location</b> AS PLAN		<b>Dates</b> 27/11/2018		<b>Engineer</b>		<b>Sheet</b> 1/1
<b>Depth (m)</b>	<b>Sample / Tests</b>	<b>Water Depth (m)</b>	<b>Field Records</b>	<b>Level (mOD)</b>	<b>Depth (m) (Thickness)</b>	<b>Description</b>	<b>Legend</b>	<b>Water</b>
					(0.30) 0.30 (0.30) 0.60 (0.10) 0.70 (0.30) 1.00 (0.80) 1.80 (0.40) 2.20 (1.20) 3.40	TOPSOIL  Brown coarse SAND and subrounded GRAVEL.  Brown silty CLAY. Brown fine SAND.  Brown sandy silty CLAY.          Brown clayey SILT.  Brown sandy GRAVEL and some cobbles.          Complete at 3.40m	      	
			27/11/2018:					
<b>Plan</b>					<b>Remarks</b>  Pit sides remained vertical and stable. No groundwater encountered. On completion backfilled with gravel for a soakaway test.			
					<b>Scale (approx)</b> 1:25		<b>Logged By</b> DS/SJ	
					<b>Figure No.</b> NE3751B.S2			

						<b>Site</b> BUTT LANE, SNAITH, GOOLE, EAST RIDING OF YORKSHIRE		<b>Trial Pit Number</b> <b>S3</b>	
<b>Excavation Method</b> MECHANICAL EXCAVATOR		<b>Dimensions</b> 1.70m x 0.60m		<b>Ground Level (mOD)</b>		<b>Client</b> CODA STRUCTURES		<b>Job Number</b> NE3751B	
		<b>Location</b> AS PLAN		<b>Dates</b> 27/11/2018		<b>Engineer</b>		<b>Sheet</b> 1/1	
<b>Depth (m)</b>	<b>Sample / Tests</b>	<b>Water Depth (m)</b>	<b>Field Records</b>	<b>Level (mOD)</b>	<b>Depth (m) (Thickness)</b>	<b>Description</b>		<b>Legend</b>	<b>Water</b>
			27/11/2018:			TOPSOIL			
					(0.35) 0.35	Brown becoming brown and grey silty CLAY.			
					(1.40) 1.75	Brown medium to coarse SAND and rounded GRAVEL and occasional cobbles.			
					(1.25) 3.00	Complete at 3.00m			
<b>Plan</b> 						<b>Remarks</b> Pit sides remained vertical and stable. No groundwater encountered. On completion backfilled with gravel for soakaway test.			
						<b>Scale (approx)</b> 1:25		<b>Logged By</b> DS/SJ	
						<b>Figure No.</b> NE3751B.S3			










## **APPENDIX J**

### **WINDOW SAMPLING BOREHOLE LOGS**


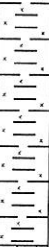


							Site BUTT LANE, SNAITH, GOOLE, EAST RIDING OF YORKSHIRE		Borehole Number M1	
Boring Method MINI PERCUSSIVE		Casing Diameter		Ground Level (mOD)		Client CODA STRUCTURES		Job Number NE3751B		
		Location AS PLAN		Dates 27/11/2018		Engineer		Sheet 1/1		
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
1.00-1.45	SPT(C) N=30			8,13/10,7,7,6		(0.40)	TOPSOIL			
						0.40	Firm brown slightly gravelly silty CLAY.			
						(0.40)				
						0.80	Medium dense brown slightly clayey slightly silty SAND and subrounded fine to coarse sandstone, quartz GRAVEL.			
2.00-2.45	SPT(C) N=26			Seepage(1) at 1.35m.  6,6/5,6,7,8		(0.60)				
						1.40	Soft low strength becoming stiff high strength brown slightly gravelly sandy silty CLAY.			
						(1.00)				
						2.40	Dark grey coarse SAND.			
3.00-3.45	SPT(C) N=60			10,13/18,21,11,10		2.45	Firm brown silty CLAY.			
						(0.35)				
						2.80	Stiff high strength brown gravelly silty CLAY.			
						(0.65)				
				27/11/2018:		3.45	Complete at 3.45m			
<b>Remarks</b> Hand dug inspection pit from GL to 1.20m to check for services. On completion backfilled with arisings and installed a 50mm dia slotted standpipe with a gas valve and a gravel surround to 3.00m, a Bentonite seal from 1.00m to 0.20m and a concreted in lockable steel protective cover from 0.20m to GL.								Scale (approx) 1:25	Logged By DS/SJ	Figure No. NE3751B.M1



						Site BUTT LANE, SNAITH, GOOLE, EAST RIDING OF YORKSHIRE		Borehole Number <b>M2</b>		
Boring Method MINI PERCUSSIVE		Casing Diameter		Ground Level (mOD)		Client CODA STRUCTURES		Job Number NE3751B		
		Location AS PLAN		Dates 27/11/2018		Engineer		Sheet 1/1		
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
1.00-1.45	SPT(C) N=16			2,3/4,3,4,5		(0.25)	TOPSOIL			
						0.25	Stiff brown silty CLAY.			
						(0.60)				
						0.85 (0.15)	Stiff brown sandy silty CLAY.			
2.00-2.45	SPT(C) N=14			2,3/3,4,4,3 Seepage(1) at 2.10m.		1.00	Firm medium strength brown sandy silty CLAY with sand lenses.			
						(1.00)				
3.00-3.45	SPT(C) N=15			2,2/2,4,5,4		2.00	Medium dense becoming very dense slightly clayey slightly silty medium to coarse SAND and rounded GRAVEL with low quartz cobble content.		Σ1	
						(2.31)				
4.00-4.31	SPT(C) 46/155			13,14/16,16,14  27/11/2018:		4.31	..... below 4.00m : becoming very dense (possibly affected by cobbles)			
							Complete at 4.31m			
<b>Remarks</b> Hand dug inspection pit from GL to 1.20m to check for services. On completion backfilled with arisings and installed a 50mm dia slotted standpipe with a gas valve and a gravel surround to 4.00m, a Bentonite seal from 1.00m to 0.20m and a concreted in lockable steel protective cover from 0.20m to GL.								Scale (approx) 1:25	Logged By DS/SJ	
								Figure No. NE3751B.M2		

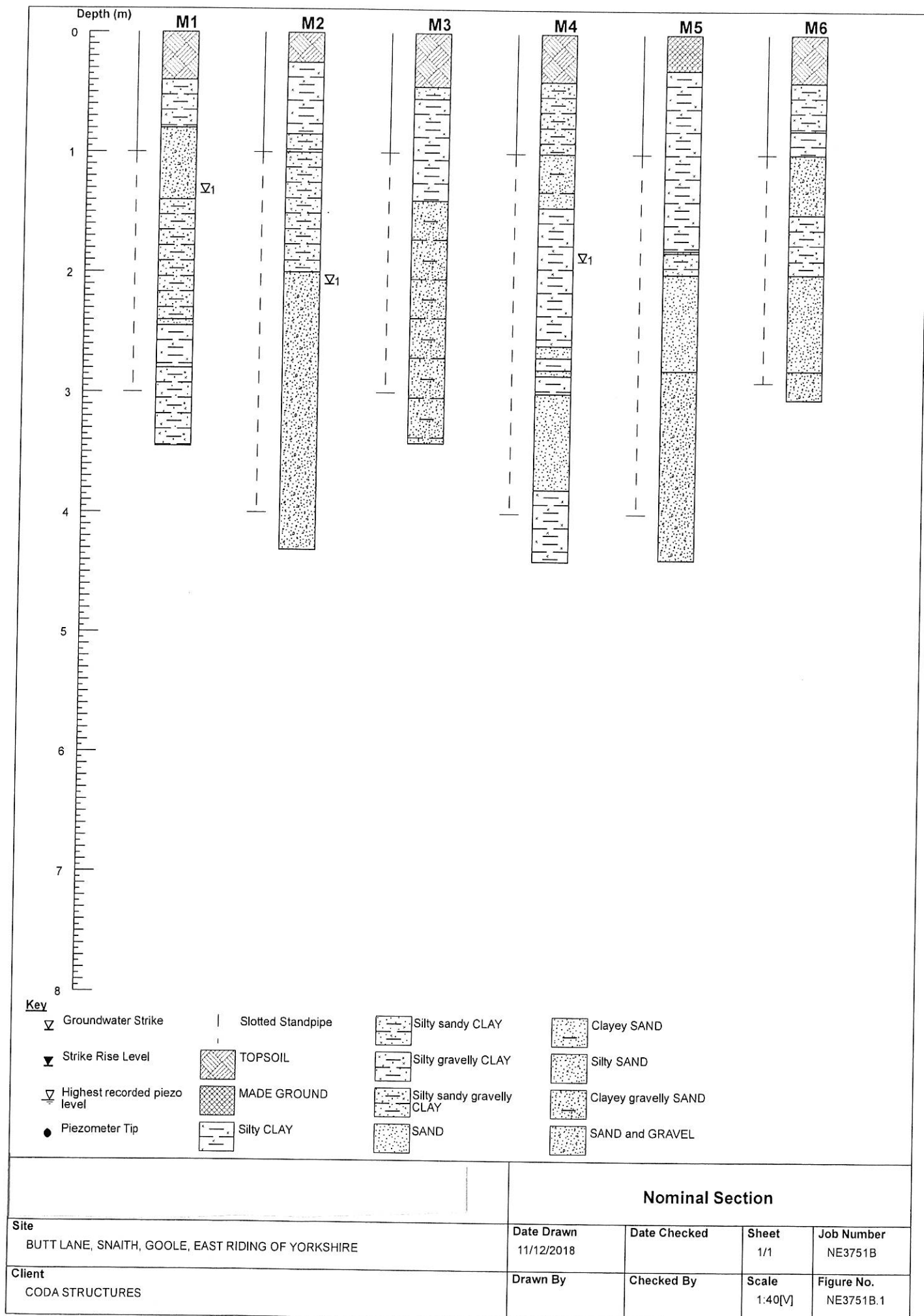
							<b>Site</b> BUTT LANE, SNAITH, GOOLE, EAST RIDING OF YORKSHIRE		<b>Borehole Number</b> <b>M3</b>	
<b>Boring Method</b> MINI PERCUSSIVE		<b>Casing Diameter</b>		<b>Ground Level (mOD)</b>		<b>Client</b> CODA STRUCTURES		<b>Job Number</b> NE3751B		
		<b>Location</b> AS PLAN		<b>Dates</b> 27/11/2018		<b>Engineer</b>		<b>Sheet</b> 1/1		
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
1.00-1.45	SPT(C) N=22			3,3/4,6,6,6		(0.45)	TOPSOIL			
						0.45 (0.10)	Dark brown sandy silty CLAY.			
						0.55	Stiff high strength brown and grey silty CLAY with occasional thin sand lenses.			
2.00-2.45	SPT(C) N=26			3,4/6,6,7,7		(0.85)				
						1.40	Medium dense brown clayey gravelly SAND/sandy CLAY.			
3.00-3.42	SPT(C) 50/265			9,9/11,12,16,11		(2.02)				
							.... below 3.00m : with occasional cobbles			
				27/11/2018: DRY		3.42	Complete at 3.42m			
<b>Remarks</b> Hand dug inspection pit from GL to 1.20m to check for services. On completion backfilled with arisings and installed a 50mm dia slotted standpipe with a gas valve and a gravel surround to 3.00m, a Bentonite seal from 1.00m to 0.20m and a concreted in lockable steel protective cover from 0.20m to GL.								<b>Scale (approx)</b> 1:25	<b>Logged By</b> DS/SJ	
								<b>Figure No.</b> NE3751B.M3		

							Site BUTT LANE, SNAITH, GOOLE, EAST RIDING OF YORKSHIRE		Borehole Number M4	
Boring Method MINI PERCUSSIVE		Casing Diameter		Ground Level (mOD)		Client CODA STRUCTURES		Job Number NE3751B		
		Location AS PLAN		Dates 27/11/2018		Engineer		Sheet 1/1		
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
1.00-1.45	SPT(C) N=13			1,2/2,3,4,4		(0.40)	TOPSOIL			
						0.40	Stiff brown slightly gravelly sandy silty CLAY.			
						(0.60)				
						1.00	Medium dense brown clayey SAND/sandy CLAY.			
2.00-2.45	SPT(C) N=5			Wet (1) at 1.90m. 1,0/0,1,2,2		(0.45)				
						1.45	Soft brown low strength brown silty CLAY.			
						(1.15)				
						2.60 (0.10)	Brown medium SAND.			
3.00-3.45	SPT(C) N=28			2,4/5,7,8,8		2.70 (0.10)	Firm brown silty CLAY.			
						2.80 (0.10)	Brown medium SAND.			
						2.85 (0.15)	Firm brown silty CLAY.			
						3.00	Medium dense brown medium to coarse SAND.			
4.00-4.40	SPT(C) 50/250			10,9/13,14,14,9		(0.80)				
						3.80	Firm brown sandy silty CLAY.			
						(0.60)				
						4.40	Complete at 4.40m			
Remarks Hand dug inspection pit from GL to 1.20m to check for services. On completion backfilled with arisings and installed a 50mm dia slotted standpipe with a gas valve and a gravel surround to 4.00m, a Bentonite seal from 1.00m to 0.20m and a concreted in lockable steel protective cover from 0.20m to GL.								Scale (approx) 1:25	Logged By DS/SJ	Figure No. NE3751B.M4

						Site BUTT LANE, SNAITH, GOOLE, EAST RIDING OF YORKSHIRE		Borehole Number <b>M5</b>		
Boring Method MINI PERCUSSIVE		Casing Diameter		Ground Level (mOD)		Client CODA STRUCTURES		Job Number NE3751B		
		Location AS PLAN		Dates 27/11/2018		Engineer		Sheet 1/1		
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
1.00-1.45	SPT(C) N=10			1,2/2,3,2,3		(0.30)	MADE GROUND: clayey topsoil.			
						0.30	Firm medium strength brown laminated silty CLAY.			
2.00-2.45	SPT(C) N=20			Damp(1) below 1.50m  4,5/5,5,5,5		(1.50)	..... below 1.50m : sand lenses			
						1.80	Brown medium SAND.			
						1.82 (0.18)	Firm brown sandy silty CLAY.			
						2.00	Medium dense brown fine to medium SAND.			
3.00-3.45	SPT(C) N=29			4,5/6,7,8,8		(0.80)				
						2.80	Medium dense becoming dense brown gravelly slightly clayey slightly silty medium to coarse SAND and rounded to subrounded GRAVEL with low quartz cobble content.			
4.00-4.38	SPT(C) 50/225			12,13/15,20,15		(1.58)				
						4.38	Complete at 4.38m			
<b>Remarks</b> Hand dug inspection pit from GL to 1.20m to check for services. On completion backfilled with arisings and installed a 50mm dia slotted standpipe with a gas valve and a gravel surround to 4.00m, a Bentonite seal from 1.00m to 0.20m and a concreted in lockable steel protective cover from 0.20m to GL.								Scale (approx)  1:25	Logged By  DS/SJ	
								Figure No. NE3751B.M5		



						Site BUTT LANE, SNAITH, GOOLE, EAST RIDING OF YORKSHIRE		Borehole Number <b>M6</b>		
Boring Method MINI PERCUSSIVE		Casing Diameter		Ground Level (mOD)		Client CODA STRUCTURES		Job Number NE3751B		
		Location AS PLAN		Dates 27/11/2018		Engineer		Sheet 1/1		
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
1.00-1.45	SPT(C) N=35			4,7/9,8,9,9			TOPSOIL			
						(0.40)				
						0.40	Stiff brown slightly gravelly silty CLAY.			
						(0.40)				
2.00-2.45	SPT(C) N=36			Damp(1) below 1.45m		0.80	Firm brown silty CLAY.			
						(0.20)				
						1.00	Medium dense light brown medium slightly clayey slightly silty fine to medium SAND and subrounded fine to coarse GRAVEL.			
						(0.50)				
2.90-3.04	SPT(C) 43*/130 36/5			8,9/9,9,9,9		1.50	Firm brown gravelly silty CLAY.			
						(0.50)				
						2.00	Medium dense brown silty fine to medium SAND.			
						(0.80)				
						2.80	Brown slightly clayey slightly silty fine to coarse SAND and subrounded fine to coarse GRAVEL with low quartz cobble content.			
						(0.24)				
				18,25/36		3.04	Complete at 3.04m			
				27/11/2018:						
<b>Remarks</b> Hand dug inspection pit from GL to 1.20m to check for services. On completion backfilled with arisings and installed a 50mm dia slotted standpipe with a gas valve and a gravel surround to 2.90m, a Bentonite seal from 1.00m to 0.20m and a concreted in lockable steel protective cover from 0.20m to GL.								Scale (approx) 1:25	Logged By DS/SJ	
								Figure No. NE3751B.M6		



## **APPENDIX K**

### **FALLING HEAD PERMEABILITY TESTING**

## Insitu Test Results

Site: Butt Lane, Snaith, Goole, East Riding Of Yorkshire

Job Number  
NE3751B

Client:

Sheet:

Engineer: CODA STRUCTURES

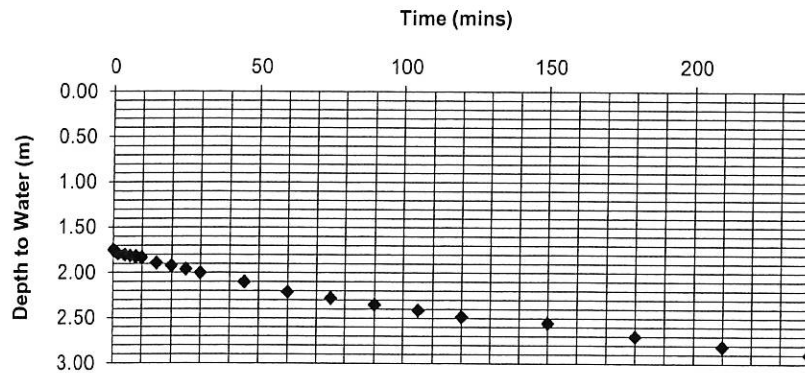
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## Soakaway Test (with gravel infill)

Trial Pit No: S1

TEST NO: 1

DATE: 27/11/18



Length of pit: L = 1.60 m  
 Width of pit: W = 0.60 m  
 Depth of pit: D = 3.00 m  
 Base area of pit: A = 0.96 m<sup>2</sup>

100% effective depth D100 = 1.75 m  
 75% effective depth D75 = 2.06 m  
 50% effective depth D50 = 2.38 m  
 25% effective depth D25 = 2.69 m

time to D75 T75 = 2340 sec  
 time to D25 T25 = 10680 sec

time from D75 to D25  $t_{p75-25}$  = 8340 sec  
 (T25 - T75)

volume between D75 & D25\*  $V_{p75-25}$  = 0.18 m<sup>3</sup>  
 (A x (D25 - D75)) x 30%

surface area to D50 inc. base  $a_{p50}$  = 3.71 m<sup>2</sup>  
 ((2x(D-D50)x(W+L)) + A)

## SOIL INFILTRATION RATE

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

$$f = 5.82E-06 \text{ m/sec}$$

Time (min)	Depth (m)
0.0	1.75
0.5	1.76
1.0	1.77
2.0	1.79
4.0	1.80
6.0	1.81
8.0	1.82
10.0	1.83
15.0	1.89
20.0	1.92
25.0	1.96
30.0	2.00
45.0	2.10
60.0	2.21
75.0	2.28
90.0	2.35
105.0	2.41
120.0	2.48
150.0	2.55
180.0	2.70
210.0	2.81
240.0	2.90

Test Strata: 0.00 to 0.35m MADE GROUND: topsoil.  
 (see Trial Pit) 0.35 to 1.20m Brown silty CLAY.  
 1.20 to 1.90m Brown grey mottled silty CLAY.  
 1.90 to 3.00m Brown gravelly clayey silty fine to coarse SAND with low quartz cobble content. Gravel is sub rounded fine to coarse quartz.

Remarks: \*30% correction applied to volume to allow for gravel infill



# Insitu Test Results

Site: Butt Lane, Snaith, Goole, East Riding Of Yorkshire

Job Number  
NE3751B

Client:

Sheet:

Engineer: CODA STRUCTURES

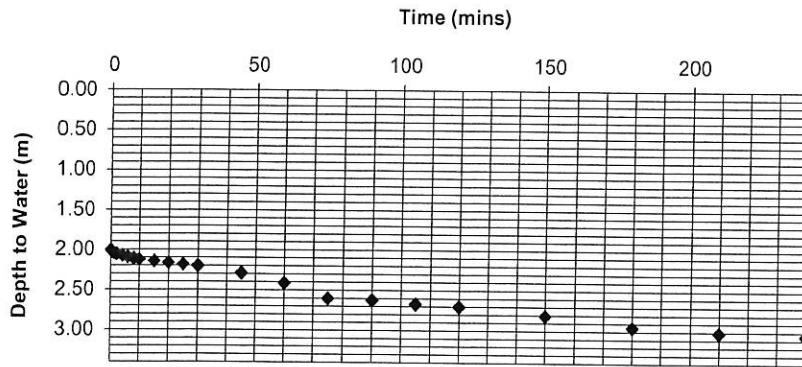
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## Soakaway Test (with gravel infill)

Trial Pit No: S2

TEST NO: 1

DATE: 27/11/18



Time (min)	Depth (m)
0.0	2.01
0.5	2.02
1.0	2.04
2.0	2.05
4.0	2.07
6.0	2.09
8.0	2.11
10.0	2.12
15.0	2.14
20.0	2.16
25.0	2.18
30.0	2.20
45.0	2.29
60.0	2.41
75.0	2.60
90.0	2.62
105.0	2.67
120.0	2.70
150.0	2.81
180.0	2.95
210.0	3.01
240.0	3.05

Length of pit: L = 1.50 m

Width of pit: W = 0.60 m

Depth of pit: D = 3.40 m

Base area of pit: A = 0.90 m<sup>2</sup>

100% effective depth D100 = 2.01 m

75% effective depth D75 = 2.36 m

50% effective depth D50 = 2.71 m

25% effective depth D25 = 3.05 m

time to D75 T75 = 3240 sec

time to D25 T25 = 14400 sec

time from D75 to D25  $t_{p75-25} = 11160$  sec  
(T25 - T75)

volume between D75 & D25\*  $V_{p75-25} = 0.19$  m<sup>3</sup>  
(A x (D25 - D75)) x 30%

surface area to D50 inc. base  $a_{p50} = 3.82$  m<sup>2</sup>  
((2x(D-D50)x(W+L)) + A)

### SOIL INFILTRATION RATE

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

$$f = 4.40E-06 \text{ m/sec}$$

Test Strata:	0.00 to 0.30m	MADE GROUND: topsoil.
(see Trial Pit)	0.30 to 0.60m	Brown gravelly slightly clayey slightly silty fine to coarse SAND. Gravel is sub rounded fine to coarse quartz.
	0.60 to 0.70m	Brown silty CLAY.
	0.70 to 1.00m	Brown slightly clayey slightly silty fine SAND.
	1.00 to 1.80m	Brown sandy silty CLAY.
	1.80 to 2.20m	Brown clayey SILT.
	2.20 to 3.40m	Brown sandy sub rounded fine to coarse quartz GRAVEL. With cobbles.

Remarks: \*30% correction applied to volume to allow for gravel infill

## Insitu Test Results

Site: Butt Lane, Snaith, Goole, East Riding Of Yorkshire

Job Number  
NE3751B

Client:

Sheet:

Engineer: CODA STRUCTURES

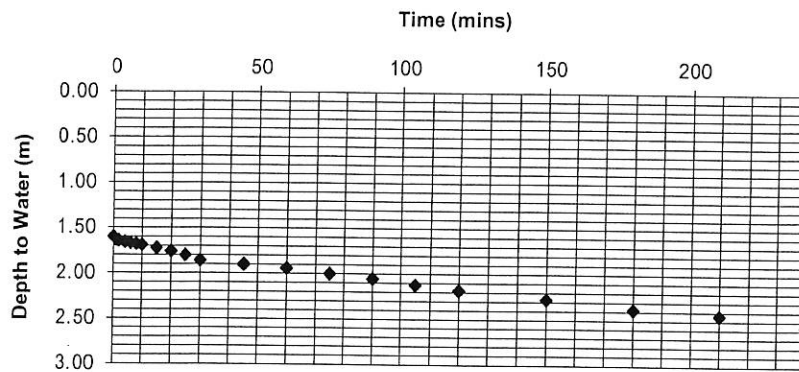
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## Soakaway Test (with gravel infill)

Trial Pit No: S3

TEST NO: 1

DATE: 27/11/18



Time (min)	Depth (m)
0.0	1.60
0.5	1.61
1.0	1.63
2.0	1.64
4.0	1.66
6.0	1.67
8.0	1.68
10.0	1.69
15.0	1.72
20.0	1.76
25.0	1.80
30.0	1.86
45.0	1.90
60.0	1.94
75.0	2.00
90.0	2.05
105.0	2.12
120.0	2.18
150.0	2.27
180.0	2.38
210.0	2.44
240.0	2.56

Length of pit: L = 1.70 m

Width of pit: W = 0.60 m

Depth of pit: D = 3.00 m

Base area of pit: A = 1.02 m<sup>2</sup>

100% effective depth D100 = 1.60 m

75% effective depth D75 = 1.95 m

50% effective depth D50 = 2.30 m

25% effective depth D25 = 2.65 m

time to D75 T75 = 3893 sec

time to D25 T25 = - sec

time from D75 to D25  $t_{p75-25}$  = - sec  
(T25 - T75)volume between D75 & D25\*  $V_{p75-25}$  = 0.21 m<sup>3</sup>  
(A x (D25 - D75)) x 30%surface area to D50 inc. base  $a_{p50}$  = 4.24 m<sup>2</sup>  
((2x(D-D50)x(W+L)) + A)

## SOIL INFILTRATION RATE

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

$$f = - \quad \text{m/sec}$$

Test Strata: 0.00 to 0.35m MADE GROUND: topsoil.  
 (see Trial Pit) 0.35 to 1.75m Brown occasional grey mottled silty CLAY.  
 1.75 to 3.00m Brown gravelly slightly clayey slightly silty fine to coarse SAND with low quartz cobble content. Gravel is sub rounded fine to coarse quartz.

Remarks: \*30% correction applied to volume to allow for gravel infill  
 Soil infiltration rate not able to be calculated, strata of very low permeability and unsuitable for soakaways.

## Insitu Test Results

Site: Butt Lane, Snaith, Goole, East Riding Of Yorkshire

Job Number  
NE3751B

Client:

Sheet:

Engineer: CODA STRUCTURES

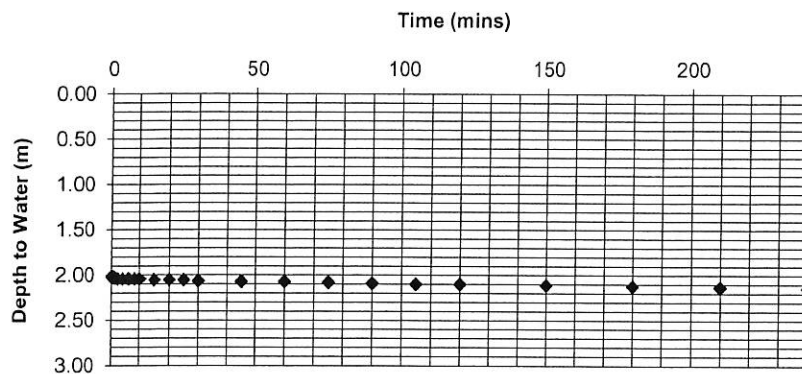
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## Soakaway Test (with gravel infill)

Trial Pit No: S4

TEST NO: 1

DATE: 27/11/18



Time (min)	Depth (m)
0.0	2.02
0.5	2.02
1.0	2.03
2.0	2.04
4.0	2.04
6.0	2.04
8.0	2.04
10.0	2.04
15.0	2.05
20.0	2.05
25.0	2.05
30.0	2.06
45.0	2.07
60.0	2.07
75.0	2.08
90.0	2.09
105.0	2.10
120.0	2.10
150.0	2.11
180.0	2.12
210.0	2.13
240.0	2.14

Length of pit: L = 1.70 m  
 Width of pit: W = 0.60 m  
 Depth of pit: D = 3.00 m  
 Base area of pit: A = 1.02 m<sup>2</sup>

100% effective depth D100 = 2.02 m  
 75% effective depth D75 = 2.27 m  
 50% effective depth D50 = 2.51 m  
 25% effective depth D25 = 2.76 m

time to D75 T75 = - sec  
 time to D25 T25 = - sec

time from D75 to D25  $t_{p75-25}$  = - sec  
 (T25 - T75)

volume between D75 & D25\*  $V_{p75-25}$  = 0.15 m<sup>3</sup>  
 (A x (D25 - D75)) x 30%  
 surface area to D50 inc. base  $a_{p50}$  = 3.27 m<sup>2</sup>  
 ((2x(D-D50)x(W+L)) + A)

## SOIL INFILTRATION RATE

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

$$f = - \text{ m/sec}$$


Test Strata: 0.00 to 0.50m MADE GROUND: topsoil.  
 (see Trial Pit) 0.50 to 1.00m Brown silty CLAY.  
 1.00 to 3.50m Brown gravelly clayey silty fine to coarse SAND with low quartz cobble content. Gravel is sub rounded fine to coarse quartz.

Remarks: \*30% correction applied to volume to allow for gravel infill  
 Soil infiltration rate not able to be calculated, strata of very low permeability and unsuitable for soakaways.

## **APPENDIX L**

### **STORMWATER STORAGE ESTIMATE**




CODA Structures Ltd		Page 1
14 Springfield Court Guiseley Leeds LS20 8FD	Butt Lane Snaith Storage Estimate 1:100 yr + 30%cc	
Date 28/08/2019 11:08 File storage estimate 2.srcx	Designed by JL Checked by	
Causeway	Source Control 2017.1.2	

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m <sup>3</sup> )	Status
15 min Summer	7.995	0.395	2.9	222.8	O K
30 min Summer	8.117	0.517	2.9	291.4	O K
60 min Summer	8.241	0.641	2.9	361.7	O K
120 min Summer	8.366	0.766	2.9	432.0	O K
180 min Summer	8.434	0.834	2.9	470.6	O K
240 min Summer	8.479	0.879	2.9	495.5	O K
360 min Summer	8.531	0.931	2.9	525.3	O K
480 min Summer	8.565	0.965	2.9	544.4	O K
600 min Summer	8.587	0.987	2.9	556.4	O K
720 min Summer	8.600	1.000	2.9	563.9	O K
960 min Summer	8.611	1.011	2.9	570.3	O K
1440 min Summer	8.600	1.000	2.9	563.7	O K
2160 min Summer	8.559	0.959	2.9	540.8	O K
2880 min Summer	8.519	0.919	2.9	518.3	O K
4320 min Summer	8.443	0.843	2.9	475.6	O K
5760 min Summer	8.370	0.770	2.9	434.5	O K
7200 min Summer	8.293	0.693	2.9	390.7	O K
8640 min Summer	8.214	0.614	2.9	346.2	O K
10080 min Summer	8.146	0.546	2.9	307.8	O K
15 min Winter	8.043	0.443	2.9	249.9	O K
30 min Winter	8.180	0.580	2.9	326.9	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
15 min Summer	131.279	0.0	203.7	27
30 min Summer	86.055	0.0	240.1	41
60 min Summer	53.779	0.0	359.7	72
120 min Summer	32.513	0.0	426.6	130
180 min Summer	23.921	0.0	452.7	190
240 min Summer	19.137	0.0	456.8	250
360 min Summer	13.872	0.0	453.6	368
480 min Summer	11.049	0.0	448.4	488
600 min Summer	9.255	0.0	443.2	606
720 min Summer	8.004	0.0	438.4	726
960 min Summer	6.361	0.0	429.7	964
1440 min Summer	4.594	0.0	414.7	1440
2160 min Summer	3.313	0.0	805.4	1796
2880 min Summer	2.624	0.0	830.6	2168
4320 min Summer	1.887	0.0	769.6	2984
5760 min Summer	1.492	0.0	983.9	3816
7200 min Summer	1.243	0.0	1024.2	4616
8640 min Summer	1.070	0.0	1057.7	5360
10080 min Summer	0.943	0.0	1085.0	6064
15 min Winter	131.279	0.0	222.8	26
30 min Winter	86.055	0.0	244.1	41

CODA Structures Ltd		Page 2
14 Springfield Court Guiseley Leeds LS20 8FD	Butt Lane Snaith Storage Estimate 1:100 yr + 30%cc	
Date 28/08/2019 11:08 File storage estimate 2.srcx	Designed by JL Checked by	
Causeway	Source Control 2017.1.2	

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m <sup>3</sup> )	Status
60 min Winter	8.320	0.720	2.9	406.4	O K
120 min Winter	8.461	0.861	2.9	485.4	O K
180 min Winter	8.538	0.938	2.9	529.3	O K
240 min Winter	8.589	0.989	2.9	558.0	O K
360 min Winter	8.651	1.051	2.9	592.9	O K
480 min Winter	8.692	1.092	2.9	615.8	O K
600 min Winter	8.719	1.119	2.9	630.8	O K
720 min Winter	8.736	1.136	2.9	640.8	O K
960 min Winter	8.754	1.154	2.9	651.1	O K
1440 min Winter	8.753	1.153	2.9	650.3	O K
2160 min Winter	8.709	1.109	2.9	625.6	O K
2880 min Winter	8.658	1.058	2.9	596.8	O K
4320 min Winter	8.559	0.959	2.9	540.8	O K
5760 min Winter	8.457	0.857	2.9	483.3	O K
7200 min Winter	8.352	0.752	2.9	424.2	O K
8640 min Winter	8.227	0.627	2.9	353.5	O K
10080 min Winter	8.122	0.522	2.9	294.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
60 min Winter	53.779	0.0	399.9	70
120 min Winter	32.513	0.0	456.2	128
180 min Winter	23.921	0.0	459.7	186
240 min Winter	19.137	0.0	457.5	246
360 min Winter	13.872	0.0	452.2	362
480 min Winter	11.049	0.0	447.9	478
600 min Winter	9.255	0.0	444.4	596
720 min Winter	8.004	0.0	441.6	712
960 min Winter	6.361	0.0	437.4	940
1440 min Winter	4.594	0.0	434.0	1388
2160 min Winter	3.313	0.0	879.5	2012
2880 min Winter	2.624	0.0	864.6	2280
4320 min Winter	1.887	0.0	796.2	3204
5760 min Winter	1.492	0.0	1101.9	4144
7200 min Winter	1.243	0.0	1146.9	5048
8640 min Winter	1.070	0.0	1184.6	5800
10080 min Winter	0.943	0.0	1216.1	6464

CODA Structures Ltd		Page 3
14 Springfield Court Guiseley Leeds LS20 8FD	Butt Lane Snaith Storage Estimate 1:100 yr + 30%cc	
Date 28/08/2019 11:08 File storage estimate 2.srcx	Designed by JL Checked by	
Causeway	Source Control 2017.1.2	


#### Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.406	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

#### Time Area Diagram

Total Area (ha) 0.918

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From:	To: (ha)	From:	To: (ha)	From:	To: (ha)
0	4 0.306	4	8 0.306	8	12 0.306

CODA Structures Ltd		Page 4
14 Springfield Court Guiselley Leeds LS20 8FD	Butt Lane Snaith Storage Estimate 1:100 yr + 30%cc	
Date 28/08/2019 11:08 File storage estimate 2.srcx	Designed by JL Checked by	
Causeway	Source Control 2017.1.2	

### Model Details

Storage is Online Cover Level (m) 10.000

### Tank or Pond Structure

Invert Level (m) 7.600

Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )
0.000	564.0	1.000	564.0	1.210	0.0
0.500	564.0	1.200	564.0		

### Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0079-3000-1200-3000
Design Head (m)	1.200
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	79
Invert Level (m)	7.600
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	3.0
Flush-Flo™	0.348	2.9
Kick-Flo®	0.707	2.4
Mean Flow over Head Range	-	2.6

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.3	1.200	3.0	3.000	4.6	7.000	6.8
0.200	2.8	1.400	3.2	3.500	4.9	7.500	7.0
0.300	2.9	1.600	3.4	4.000	5.2	8.000	7.3
0.400	2.9	1.800	3.6	4.500	5.5	8.500	7.5
0.500	2.8	2.000	3.8	5.000	5.8	9.000	7.7
0.600	2.7	2.200	4.0	5.500	6.1	9.500	7.9
0.800	2.5	2.400	4.1	6.000	6.3		
1.000	2.8	2.600	4.3	6.500	6.6		

## **APPENDIX M**

### **DRAINAGE SCHEME – DRAWING 7849/020 & 021**